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INTERNATIONAL MEETING FOR AUTISM RESEARCH

Annual Meeting of the International Society for Autism Research (INSAR)

May 13-16, 2015

Grand America Hotel | Salt Lake City, Utah, USA
International Meeting for Autism Research

www.autism-insar.org

ABSTRACT BOOK

Keynote Address
100 - Who Owns Autism? Exceptionalism, Stigma, and Stakeholders
9:00 AM - 10:00 AM - Grand Ballroom

Speaker: R. R. Grinker, George Washington University, Washington, DC

This presentation focuses on critical themes and challenges in the cultural study of autism spectrum disorder (ASD). First, in clinical, research, and advocacy settings ASD has emerged as a singular and powerful construct that encompasses an increasing number of heterogeneous phenomena. What forces made this category possible? How did it become both a valid and unstable construct? Second, the growth of genetic and other biomedical perspectives on ASD risks reducing ASD to biology alone, and, as a consequence, masking the fact that scientific representations express cultural values about diversity and disability. Difference constructed on the molecular level is still difference, no less stigmatizing and socially consequential because of its biological source (and perhaps even more so). How can we integrate both the biological and sociocultural aspects of ASD into research? Third, ASD is now, in some respects, a commodity that circulates in an industry of "stakeholders," such as therapists, producers of high-cost diagnostic tools, and advocacy organizations. Indeed, as health professionals are discovering in low- and middle-income countries, few diagnostic categories cost as much as ASD. How does the economy of ASD influence the science of ASD?

9:00   **100.001**   Who Owns Autism? Exceptionalism, Stigma, and Stakeholders
        R. R. Grinker, *George Washington University, Washington, DC*

> This presentation focuses on critical themes and challenges in the cultural study of autism spectrum disorder (ASD). First, in clinical, research, and advocacy settings ASD has emerged as a singular and powerful construct that encompasses an increasing number of heterogeneous phenomena. What forces made this category possible? How did it become both a valid and unstable construct? Second, the growth of genetic and other biomedical perspectives on ASD risks reducing ASD to biology alone, and, as a consequence, masking the fact that scientific representations express cultural values about diversity and disability. Difference constructed on the molecular level is still difference, no less stigmatizing and socially consequential because of its biological source (and perhaps even more so). How can we integrate both the biological and sociocultural aspects of ASD into research? Third, ASD is now, in some respects, a commodity that circulates in an industry of "stakeholders," such as therapists, producers of high-cost diagnostic tools, and advocacy organizations. Indeed, as health professionals are discovering in low- and middle-income countries, few diagnostic categories cost as much as ASD. How does the economy of ASD influence the science of ASD?

Panel Session
101 - Autism and Society: Taking Stock of the History and Meaning of Autism Research
10:30 AM - 12:30 PM - Grand Ballroom B

Panel Chair: Roy Grinker, *George Washington University, Washington, DC*

Current debates about the present and future of autism research generally focus on scientific discovery and are fitted into the framework of the scientific method. This panel departs from convention to "take stock" of the field, and explore autism research as a system of knowledge and practices in social, historical, and economic context. The questions at the core of this panel concern the various and sometimes contradictory aspects of the field of autism research: How has the definition of autism changed over time for a range of individuals, communities, and audiences, and what factors led to those changes? What kinds of authority (e.g., institutional, bureaucratic, academic, legislative, familial) have structured, and been structured by, scientific representations of autism? Is autism a disease, a disability, or an aspect of a 'normal' range of human variation? Is autism singular, or do the boundaries and definitions of the category constrain the ability of researchers and clinicians to address the dimensions of autism as outcomes of a common set of developmental pathways shared by all humans? Speakers from the fields of anthropology, disability rights, linguistics, and epidemiology will employ historical, ethnographic, philosophical, and public health perspectives to explain the dramatic changes in the field of autism research over the past several decades and outline possibilities for the future.

10:30   **101.001**   Trends in the Prevalence of Intellectual Disability and Autism Spectrum Disorder
        M. S. Durkin, *Population Health Sciences, University of Wisconsin-Madison, Madison, WI*

> Background: Changes in the diagnosis and treatment of just one psychiatric condition can have an important effect on the diagnosis and treatment of others. This presentation provides a historical review of the epidemiology of intellectual disability (ID) and autism (ASD) in relation to each other. Objectives: We discuss possible explanations for declines in ID prevalence include the expansion of

proven interventions for the prevention of ID, such as newborn screening, early interventions to boost intellectual functioning, and numerous other public health interventions. Declines in the prevalence of ID could also be related to gradual, population-level improvements in intellectual functioning over time.

Methods: Evidence from around the globe, primarily from developed countries, suggests that the recent rises in the prevalence of autism spectrum disorder (ASD) have corresponded with declines in the prevalence of intellectual disability (ID), and with declines in the proportion of ASD cases with co-occurring ID.

Results: Possible explanations for declines in ID prevalence include the expansion of proven interventions for the prevention of ID, such as newborn screening, early interventions to boost intellectual functioning, and numerous other public health interventions. Declines in the prevalence of ID could also be related to gradual, population-level improvements in intellectual functioning over time. Other developments that could contribute to both the decline in ID and rise in ASD prevalence include: improvements in the precision of diagnostic assessment tools, training of professionals and general awareness of ASD; the expansion of diagnostic criteria for ASD; less stigma and better access to services associated with ASD relative to ID; the effectiveness of early autism interventions in raising IQ, but without necessarily eliminating ASD; and possible selective effects of the information age and technology on brain development and behavior. In sum, it is difficult to understand either one of these conditions without understanding the other. An evaluation of trends in the prevalence of ID and ASD challenges the exceptionality of ASD as a condition isolated from the broader history of childhood onset disabilities and suggests a number of important implications for future research and policies related to intellectual development and ASD across the lifespan and the globe.

Conclusions: An evaluation of trends in the prevalence of ID and ASD challenges the exceptionality of ASD as a condition isolated from the broader history of childhood onset disabilities and suggests a number of important implications for future research and policies related to intellectual development and ASD across the lifespan and the globe.

11:00 **101.002** The Lived Experience of Autism

J. E. Robison, The College of William and Mary, Springfield, MA

Background: In the past few years we have begun to speak of "autisms" as we describe a range of conditions that include symptoms clinicians deem autistic. At the same time, the interpretative latitude for the words used to describe autism has broadened enormously.

Objectives: One result of broadening is an increase in the identified autistic population. As this has unfolded, biological studies show that we have identifiable differences, and more of us are loosely bound together by a group of shared biomarkers. Some possible biomarkers are de novo – and those tend to accompany the gravest disability. That leaves a large number of us – me included – whose impairments are less severe. We are the ones who inherit our difference from our parents, and pass it on to our children.

Methods: Hans Asperger recognized this family clustering when he described our population in 1938. Perhaps we are a lost tribe of history, now being identified and brought together by genetics and brain imaging studies. Behavioral observations were the first clue, and biomarker tests prove the case. What does this mean for science and society today?

Results: If autism touches 1% of our population there are more than three million autistic Americans. That's a big population, one that until recently has had no voice. But that is changing, and it's important for scientists to work with us as we begin to speak out and assert ourselves. While it's true that autism delivers crushing disability to many, it also delivers extraordinary gifts to others. Many of us live with both gifts and disability. However, the medical and educational communities – indeed, most of society – tend to see us as broken. We are evaluated by the ways in which we are less than typical people. What about seeing the ways in which we are more? As functional as I seem to you now, I have lived my whole life with this double-edged sword of autism – gift and disability – with the disability largely invisible to everyone but me. I isolated myself through my blindness, society rejected me for the inappropriate behaviors they didn't understand, and I felt like a failure. Yet today I see I am a success.

Conclusions: Cancer is a disease to be cured. Smallpox is a scourge to be eradicated. Autism is neither. We must embrace a more balanced view. We need to find a balance between the extreme views of cause, accommodation, and cure that divide our community. The nature of our population is emerging and the goal of autism science should be to maximize our success and remediate our disability. There is a great risk that the young people who are emerging as spokespersons for the autistic identity and neurodiversity movements will reject autism science if we do not recognize and embrace the complexity and range of the experience of being autistic. Scientists must understand and appreciate our gifts, and relieve our suffering. We have a great challenge and a great opportunity, together.

11:30 **101.003** Emic and Etic Perspectives in the Construction of Authoritative Knowledge on Autism

O. Solomon, University of Southern California, Los Angeles, CA

Background: The distinction made in medical anthropology between an etic term 'disease' and an emic term 'illness', signifying the duality of the biomedical and the experiential phenomena (Good, 1977; Good & Delvecchio Good, 1980, 1985; Kleinman, 1989; Kleinman et el., 1978) is especially

relevant to understanding how authoritative knowledge of autism has evolved since the demise of psychogenic theories. Temporarily putting aside the question whether autism is or should be defined as a 'disease', the value of the emic and etic distinction lies in explicating how the dialogue between the biomedical and the social science perspectives has engendered a system of knowledge and practices that is called 'autism research' today.

Objectives: In recent years, autism has been the subject matter of psychiatry, psychology, epidemiology, genetics, neuroscience and occupational science, but also of anthropology, sociology, disability studies, education, linguistics and philosophy. Although these disciplines employ diverse theories and methods, and interdisciplinary approaches and mixed methods are common, research on autism tends to cluster around the etic view of autism as a neurodevelopmental disorder (e.g. Amaral et al., 2008; Courchesne et al., 2007; Dapretto et al., 2006; Geschwind & Levitt, 2007; Hirstein et al., 2001; Kasari et al., 2008; Levitt & Cambell, 2009; Moldin & Rubenstein, 2006; Sigman & Capps, 1997; Striano & Reed, 2009; Volkmar, 2005) and the emic view of autism as a personal, family, and community experience (Angell & Solomon, 2014; Bagatell 2007, 2010; Grinker 2007, 2010; Grinker & Cho, 2013; Prince 2010; Kaufman 2010; Lawlor 2010; Maynard 2005, 2006; Ochs et al., 2001, 2004, 2005; Ochs & Solomon, 2004; Park, 2008; Solomon, 2008, 2010, 2013; Solomon & Lawlor, 2013; Sterponi 2004; Sterponi & Fasulo 2010).

Methods: As Grinker and Cho (2013) have agued, although psychiatric diagnoses are social constructions that are situated in social, historical, and economic contexts, the constellations of symptoms that these diagnoses signify are experienced as real and disabling by the affected individuals and their families independently of what diagnostic categories or clinical terms are assigned to these symptoms.

Results: Based upon almost two decades of ethnographic research that spans linguistic and medical anthropology and occupational science, this presentation explores the tensions between the particularities and uniqueness of individual and family experiences of autism, and the experience-distant notions (e.g. "heterogeneity", "elopement and wandering") that frame these particularities as part of a larger, generalized pattern.

Conclusions: The presentation will argue that this tension resides not only between the research arena and personal or family experiences, but as a 'double vision' (Mattingly 1994) in individual stakeholders' perspectives on autism as both a biomedical condition/ syndrome/ disorder, and a lived experience and a way of being in the world.

12:00 **101.004** ASD vs. ASC: Is One Small Letter Important?

S. Baron-Cohen, Autism Research Centre, University of Cambridge, Cambridge, United Kingdom

Background: The term "disorder" is defined as a "lack of order or intelligible pattern" or "randomness" whereas the term "condition" is simply "a state of being. Those who prefer the term ASD (autism spectrum disorder) argue that "disorder" implies severity and suffering, and thus is necessary to trigger medical services.

Objectives: The term "disorder" may be appropriate for comorbid symptoms such as epilepsy, self-injury, mutism, gastro-intestinal pain, and perhaps general learning difficulties. However, it can be also be argued that most individuals on the autism spectrum do not have these comorbid features, and that a term denoting something broken is harsh, stigmatizing, and inaccurate.

Methods: Scientific evidence from both neurobiology and psychology shows difference, not dysfunction.

Results: Those who argue in favour of the term ASC (autism spectrum conditions) propose that the term "condition" still succeeds in signaling that autism is biomedical, entails disability and vulnerability, and thus can serve as a trigger for services. But "condition" is a less hard-hitting and more respectful concept that can comprise a range of levels of severity, whilst acknowledging both cognitive deficits and assets – in short, a different 'cognitive style.' The more neutral term ASC carries fewer value judgments.

Conclusions: The DSM (editions I through to 5) uses the term "disorder" (not just for autism but for any atypical behaviour), but that word may be a legacy from an earlier period in the history of psychiatry. It may be time to consider the emotional and social impact of the conventional language used to describe autism, and rethink our categories. Certainly, whether we opt for ASD vs. ASC, it should not affect insurance cover.

Panel Session
102 - An Update on Vocal Complexity in Infants and Children with ASD
10:30 AM - 12:30 PM - Grand Ballroom A

Panel Chair: Tiffany Woynaroski, *Hearing and Speech Sciences, Vanderbilt University, Thompsons Stn, TN*

Research spanning several decades has demonstrated that vocalizations differentiate young children with ASD from their typically developing peers and predict spoken language and other developmental outcomes in ASD. This panel presents recent findings from several different research groups on vocalization in infants and children with ASD. We open with a presentation that: a) highlights several ways in which the vocalizations of

children with ASD differ from their typically developing peers, b) examines associations between these aspects of vocal development and other key domains of deficit in ASD, and c) explores how these differences in vocal development and other domains relate to later cognitive and communication outcomes in ASD. The subsequent series of talks draws on a large database from the LENA Research Foundation, as well as an independent sample of children with ASD who are in early stages of language development, to test the stability and/or validity of several current options for automated analysis of child vocalizations. Implications of the findings for research and clinical practice will be discussed.

10:30 **102.001** Relations Among Canonical Babbling and Volubility in Infants Later Diagnosed with ASD and Other Markers Predictive of Outcome

E. Patten[1], G. T. Baranek[2], L. R. Watson[3], K. Belardi[4], E. R. Crais[5], K. Poon[6] and D. K. Oller[7], (1)Department of Audiology and Speech Pathology, University of Tennessee Health Science Center, Knoxville, TN, (2)Division of Occupational Science and Occupational Therapy, The University of North Carolina at Chapel Hill, Chapel Hill, NC, (3)Division of Speech and Hearing Sciences, University of North Carolina, Chapel Hill, NC, (4)Speech & Hearing Sciences, University of Noth Carolina, Chapel Hill, Chapel Hill, NC, (5)Division of Speech and Hearing Sciences, The University of North Carolina at Chapel Hill, Chapel Hill, NC, (6)National Institute of Education, Nanyang Technological University, Singapore, Singapore, (7)Konrad Lorenz Institute for Evolution and Cognition Research, Klosterneuburg, Austria

Background:

Onset of canonical babbling is a key milestone for speech development in typically developing infants. Delays in canonical babbling and decreased volubility (density of vocalizations) are often indicative of poor communication outcomes (Oller, 2000).
A retrospective study of audio-video samples of 9-12 and 15-18 month old infants later diagnosed with ASD has suggested early potential diagnostic markers. Watson et al. (2013) found that children with autism were less likely to use communicative gestures during both age ranges than typically developing children, and Colgan et al. (2006) found that variety of type of gesture was significantly associated with ASD status. Poon et al. (2012) evaluated imitation, play and gesture, finding these predicted communication and intellectual functioning at 3-7 years. A subsequent study by Patten et al. (2013) of overlapping samples showed that vocalization variables (canonical babbling and volubility) also differed in the ASD group. The associations among these variables has not yet been evaluated.

Objectives:
We will present data exploring associations between vocal development and these other key features of development and examine later cognitive outcomes in the ASD children, comparing predictions based on multiple regression models.

Methods:
This series of studies is derived from an extant data set that includes home movies recorded during infancy and developmental measures acquired during early childhood. Vocal behaviors of 37 infants, 23 who were later diagnosed with ASD and 14 who were typically developing were analyzed using a total of 20 minutes of video randomly extracted from home movies at 2 time points (10 minutes at each age-range). Gesture, imitation, and play behaviors were previously coded for each of the age ranges. For the vocalization study, a naturalistic real-time listening technique with coding of vocalizations on a single pass for canonical and non-canonical syllables was used. These data will be analyzed using multiple regression to evaluate associations between independent variables (at least one vocal variable along with at least one other potentially aggregated developmental skills variable) and outcome variables (communication and intellectual functioning).

Results:

1. Infants later diagnosed with ASD were less likely than typically developing infants to engage in key gestural, imitative, and play behaviors at both age ranges.
2. Infants later diagnosed with ASD were less likely to have reached the canonical babbling stage, produced significantly lower canonical babbling ratios, and produced significantly lower volubility at both age ranges.
3. The gestural, imitative and play behaviors significantly predicted later cognitive development in the ASD group.
4. Associations between the vocal development and other features of development are currently being analyzed along with prediction of cognitive outcomes as determined by multiple regression.

Conclusions:
Assessment of vocal patterns and other key developmental features in infants as young as 9-12 months may well provide useful components in diagnosing ASD in infancy. The current effort will illuminate potential relations among these markers.

11:00 **102.002** Stability and Validity of Automated Vocal Analysis As a Measure of Vocalization Complexity in Preschoolers with ASD in Early Stages of Language Development

T. Woynaroski[1], D. K. Oller[2] and P. J. Yoder[3], (1)Hearing and Speech Sciences, Vanderbilt University, Thompsons Stn, TN, (2)Konrad Lorenz Institute for Evolution and Cognition Research, Klosterneuburg, Austria, (3)Special Education, Vanderbilt University, Nashville, TN

Background:

Explaining individual differences in spoken word use of preschoolers with ASD increases our understanding of variability in this population and helps us predict the extent to which children with ASD will use spoken words to communicate. Theory and research suggest that vocalization complexity explains individual differences in spoken word use in ASD.

Objectives:

This longitudinal correlational study examines the relative validity and reliability of three estimates of vocalization complexity in preschoolers with ASD who are preverbal or just beginning to use words to communicate. Two estimates were derived via automated vocal analysis of day-long samples of child vocalizations collected in natural settings, and another was derived from human coded, brief conventional communication samples collected in the lab.

Methods:

Participants were 33, 24-48 month old children with Autistic Disorder who were reported by their parents to use <200 words at entry to the study (Time 1). Our index of vocalization complexity from conventional communication samples was the proportion of communication acts including canonical syllables aggregated with the number of different consonants used communicatively across samples. The first automated index of child vocalization complexity, the infraphonological vocal complexity score, was derived using software developed for research by Oller et al. (2010) that can be applied after standard utterance labeling by LENA software. The additional automated index of vocalization complexity, the Automated Vocal Analysis (AVA) developmental age equivalency score, was provided directly by the standard LENA software. Parents reported children's spoken vocabulary use on the MacArthur-Bates Communicative Development Inventories: Words and Gestures (MBCDI) checklist at Time 1 and four months later at Time 2.

Results:

The infraphonological vocal complexity score reached our criterion for acceptable stability with one day-long audio recording (g = .82) and covaried with Time 1 (r = .46) and Time 2 (r = .51) spoken vocabulary. Associations for the infraphonological vocal complexity score with concurrent and future spoken vocabulary were non-significantly different from the analogous associations for the variable from conventional communication samples (Z = -1.12, p = .26; Z = -1.02, p = .31, respectively). The AVA developmental age equivalency score was similarly stable, but was not significantly correlated with concurrent or future spoken vocabulary in our sample. Results were similar for the subset of our sample reported to use <20 words on the MBCDI at Time 1.

Conclusions:

Results suggest the infraphonological vocal complexity score from automated vocal analysis is a valid and reliable alternative to the more expensive vocal complexity measures from conventional communication samples and may thus provide a cost-effective method for measurement of vocal complexity in clinical practice. However, at present the infraphonological vocal complexity score is not publicly available in the standard LENA software package.

11:30 **102.003** Looking Under the Hood of the Infraphonological Vocal Complexity Score

P. J. Yoder[1], T. Woynaroski[2], D. Xu[3], J. A. Richards[4], S. Hannon[5], S. S. Gray[6] and D. K. Oller[7], (1)Special Education, Vanderbilt University, Nashville, TN, (2)Hearing and Speech Sciences, Vanderbilt University, Thompsons Stn, TN, (3)Department of Speech, Language and Hearing Sciences, University of Colorado, Boulder, CO, (4)LENA Research Foundation, Boulder, CO, (5)LENA Research Foundation, Denver, CO, (6)Mobility Core Research, Nuance Communications, Dracut, MA, (7)Konrad Lorenz Institute for Evolution and Cognition Research, Klosterneuburg, Austria

Background:
The infraphonological vocal complexity (IVC) score is derived from computer-automated analysis of day-long samples of children's vocalizations according to 12 acoustic properties intended to describe the degree to which vocalizations are speech-like (Oller et al., 2010). The original IVC is the sum of these 12 properties weighted by regression coefficients from a multiple regression model that predicted concurrent chronological age of children who were typically developing (TD). Because we wish to derive a measure of the degree to which vocalizations are speech-like, IVCs with regression weights based on predicting productive language might be more valid than the original IVC. Because a valid measure of speech-likeness of vocalizations might have clinical value in minimally-verbal children with ASD, we need to test the validity of such measures in minimally-verbal children with ASD.

Objectives:
We sought to identify (a) the set of acoustic properties of child vocalizations with zero-order correlations with productive language at or above a moderate effect size (i.e., *language-related*

properties), (b) the participant sample providing the most useful weights (i.e., typically developing, TD, or autism spectrum disorder, ASD), and (c) the relative predictive validity for later productive language in a separate sample of initially minimally-verbal children with ASD.

Methods:
The model building samples were from the LENA Research Foundation (LENA TD, n = 30; LENA ASD, n = 43) and had mean expressive language ages of 28 months (*SD* = 6) and 22 months (*SD* = 9), respectively. The productive language measure in the LENA samples was an aggregate of the Language Development Survey raw score and the Child Development Inventory Expressive age equivalent. The test sample of preschoolers with ASD (n = 20) had a median of 4 and mode of 0 words said according to parents when day-long vocal samples were recorded. In the test sample, the interval between vocal samples and the productive vocabulary measure (i.e., MacArthur-Bates Words and Gestures checklist) was 4 months.

Results:
Results indicate that 8/12 and 9/12 properties had at least medium-sized associations with concurrent measures of productive language in the LENA ASD and LENA TD samples, respectively. Different properties predicted productive language in the two groups (e.g., Squeals in the ASD, Growls in the TD). In the test sample, the IVC variant based only on the language-related acoustic properties in the LENA ASD sample was the best predictor of later productive vocabulary (r = .54), relative to that based on language-related properties in LENA TD sample (r = .37).

Conclusions:
In the minimally-verbal sample of children with ASD, the size of the association between the selected variant of IVC and later productive vocabulary was similar in magnitude relative to that for the original IVC (r = .51) (Woynaroski, 2014). Future research with a larger ASD sample to derive more precise regression weights is needed to determine whether the selected variant on the IVC improves the association with productive language over the original IVC.

12:00 **102.004** Toward Improved Clinically Useful Automated Vocal Assessments for the Prediction of ASD

D. K. Oller[1], P. J. Yoder[2], D. Xu[3], J. A. Richards[4], J. Gilkerson[3] and S. S. Gray[5], (1)Konrad Lorenz Institute for Evolution and Cognition Research, Klosterneuburg, Austria, (2)Special Education, Vanderbilt University, Nashville, TN, (3)Department of Speech, Language and Hearing Sciences, University of Colorado, Boulder, CO, (4)LENA Research Foundation, Boulder, CO, (5)Mobility Core Research, Nuance Communications, Dracut, MA

Background:

Oller et al. (2010) , Xu et al. (2014), and Richards et al. (2008) have provided three alternatives for automated analysis of child vocalizations measured in day-long home recordings. The three methods vary by theoretical orientation, method of derivation, and number of vocal characteristics considered, but all three used the massive quantities of data available from the LENA Research Foundation and have been shown to predict age and to differentiate groups that differ on presence and type of disability (including ASD). Clinical utility of the measures would be enhanced by testing which of the three measures is most strongly associated with variables more directly relevant to language level.

Objectives:

We test which of the three methods of automated vocal analysis is most strongly associated with communication and language in three groups of preschoolers who differ on presence and type of disability.

Methods:
The dataset is based on multiple day-long recordings from 106 typically developing (TD) children, 77 children diagnosed with ASD, and 49 children diagnosed with language delay (LD) but not ASD (a total of 1486 day-long recordings). Children's ages ranged from 20-48 months. Communication and language measures were collected via parent report at approximately the same time as the day-long recordings. The communication measure, the LENA Developmental Snapshot (LDS) developmental age, correlates highly with age and other measures of early cognitive, social, and language development (Gilkerson, et al., 2008). Ninety-five percent of parents also completed the Child Development Inventory (CDI; Ireton & Glascoe, 1995). We used the developmental age scores from expressive language (CDI-Exp) and language comprehension (CDI-Comp) subscales as our language measures. The three models of vocal analysis are: (a) the linear combination of 12 vocal characteristics (here called *parameters*), mostly based on infraphonological theory (12P; Oller, et al., 2010), (b) the linear combination of 4 variables derived from the Sphynx automated speech recognition system (SASRS; Xu, et al., 2014), and (c) a single variable derived from SASRS with mathematical adjustments based on the relation of the earlier scores with age and language measures (AVA developmental age score; Richards et al., 2008).

Preliminary Results:

All three models are significantly associated with age and the communication/language variables. The 12P model is more strongly associated with the communication and language variables than with age. In the TD group, the 12P and the AVA models are most strongly associated with the CDI language variables, adjusted R^2 values ≥ 0.74. In the LD group, 12P and AVA yield lower, but still excellent

adjusted, R^2 values > .5. In the ASD group, the 12P model is most strongly associated with the CDI-Exp and CDI–Comp, adjusted R^2 = 0.61 and 0.54, respectively.
Conclusions:

Combined models using 12P and SASRS have as yet not been thoroughly evaluated, but may yield a much improved score that can be made available publicly for clinical work. The potential for improved clinically relevant automated tools of vocal analysis is clear. A new generation of vocal assessment with no human intervention seems just around the corner.

Panel Session
103 - Approaches to Examining and Identifying Neural Biomarkers for Autism: Progress and Challenges
10:30 AM - 12:30 PM - Grand Ballroom C

Panel Chair: Joseph McCleery, *Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA*

Discussant: Timothy Roberts, *Children's Hospital of Philadelphia, Philadelphia, PA*

Clinicians involved in treating heart disease, diabetes, and cancer, are all able to utilize a number of scientifically validated biomarkers to better understand the origin and nature of their patients' diseases, and to initiate tailored interventions. One of the greatest current challenges to understanding and treating autism and other psychiatric conditions is the relative absence of such biomarkers. The current panel presents four research programs involving differing approaches to the search for brain-based biomarkers for autism spectrum disorders. Bartley and colleagues present data utilizing arterial spin labelling to establish voxel-based reliability of activity across 10 weeks in a brief biomarker assessment; Stefanidou and colleagues present evidence that event-related potentials biomarkers for core social processing atypicalities may differ across development and/or intellectual ability levels in autism; Hudac and colleagues describe evidence for a significant role of genetic variability in defining an electroencephalography-based biomarker for social processing within individuals diagnosed with autism; finally, Roberts and colleagues describe a robust, multi-modal set of biomarkers for variability in language-related functioning in individuals with autism. Together, these presentations describe both challenges and successes in the field's application of cutting edge neuroimaging procedures and approaches to the identification of meaningful, clinically-relevant biomarkers for individuals with autism.

10:30 **103.001** Cerebral Blood Flow Biomarkers of Autism during a Passive Viewing Task

G. K. Bartley[1], *H. S. Liu*[2], *J. D. Herrington*[3], *B. E. Yerys*[4], *J. A. Detre*[5] *and R. T. Schultz*[3], *(1)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)University of Pennsylvania, Philadelphia, PA, (3)Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (4)Psychiatry, University of Pennsylvania, Philadelphia, PA, (5)Neurology, University of Pennsylvania, Philadelphia, PA*

Background: Changes in the cerebral blood flow (CBF) reflect underlying neural activation (Sokoloff, 1981). One MRI based-method for characterizing CBF, Arterial Spin Labeling (ASL), relies on the magnetic tagging of cerebral blood water for weighted measures of relative CBF across the entire brain. Compared to the fMRI based BOLD signal, ASL is more sensitive to small changes in CBF over the course of several minutes (Aguirre et al., 2002; Wang et al., 2003). Despite this advantage, there are no published brain imaging studies of autism using ASL.
Objectives: Evaluate brain perfusion in ASD compared to matched typically developing controls (TDC) during passive watching of a nature video.
Methods: Thirty-three males with ASD and 26 TDC males, matched on age (ASD=14.9 ± 1.7, TDC=14.9 ± 1.64, p=0.97) were scanned with pseudo-continuous ASL (pCASL) at 3T, while watching without sound the Discovery Channel video ("Planet Earth: Pole-to-Pole") on a projection screen. All participants were re-scanned while watching this video about 10 weeks later (ASD= 9.68 ± 2.64, TDC=11.08 ± 4.28) in order to assess per-voxel regional CBF (rCBF) reliability via intra-class correlation (ICC). rCBF (mL/100g/min) was measured using pCASL with 2D gradient-echo echo-planar imaging (GE EPI). The labeling and control RF duration was 1.5 sec with post-labeling delay of 1.2 sec. Multi-slice perfusion maps with 40 label/control pairs were acquired with: TR/TE = 4000/17 ms, flip angle=90^0, bandwidth = 3005 Hz/pixel, slice thickness = 5mm, matrix size = 64×64, FOV = 220×220 mm^2 and slice number = 20).
Results: Gray matter signal was moderate-to-highly reliable (ICCs: 0.5 to > 0.9), with no significant group differences in ICC values. Per-voxel group comparisons of rCBF averaged across both time points revealed robust ventral pathway deficits in ASD (p < 0.05 corrected) extending posteriorly from the temporal pole to the fusiform and middle temporal gyri in both hemispheres (Fig 1). Left hemisphere reductions in rCBF were particularly robust, especially the left temporal pole (p<0.006 corrected). No evidence of ASD hyper-perfusion (ASD > TDC; p < 0.05 corrected) was observed. Group differences were found for several phenotypic measures of behavior (e.g. SRS, Vineland), and these metrics strongly correlated (r's > .68) with left temporal pole rCBF.

Conclusions: To our knowledge this is the first demonstration of rCBF perfusion deficits in ASD. This method is very promising for characterizing biomarkers, as it is reliable across the duration of a typical drug trial, takes only ~ 8 minutes to collect, does not require compliance with an active task, and yields robust group differences. Findings were concentrated in the temporal lobes, and include hypoperfusion of the fusiform face and word form areas (with the former being localized individually via fMRI for each participant). These results also highlight the role of the temporal pole in socially relevant integrative processes (See Olsen et al., 2007 review).

10:55 **103.002** Evaluation of Atypical Human Action Sound Processing As an Early Biomarker for Autism

C. Stefanidou[1], *R. Ceponiene*[2] *and J. McCleery*[3], *(1)School of Psychology, University of Birmingham, Birmingham, United Kingdom, (2)UCSD Medical Center, California, CA, (3)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA*

Background: Previous behavioural and neuroimaging studies have revealed reduced attention to social orienting cues, such as eye-gaze and pointing gestures, as well as atypical visual perceptual processing of biological motion and human actions in children with autism spectrum disorders.
Objectives: Examine human versus non-human action sound processing as a putative biomarker for autism in young children diagnosed with autism without intellectual disability, high-risk toddler siblings of children with autism, and toddlers diagnosed with autism with intellectual disability.
Methods: Human and non-human action sounds were presented using a Rapid Auditory Mismatch event-related potentials (ERPs) procedure. The autism without intellectual disability group and high-risk toddler group were each matched with a group of typically developing children/toddlers who were matched for gender, chronological age, and verbal ability. The autism with intellectual disability group was matched with a typically developing toddler control group matched for gender and chronological age.
Results: Children with autism without intellectual disability exhibited atypical processing of non-human action sounds at an early cognitive stage of processing, as well as reduced habituation to human action sounds at a later stage of processing, both over posterior parietal cortex. High-risk toddlers also exhibited atypical processing of non-human action sounds at an early cognitive stage over posterior parietal cortex. However, toddlers with autism with intellectual disability exhibited reduced right frontal activity specifically in response to human action sounds, with no apparent atypicalities in either human or non-human action sound processing over posterior parietal cortex.
Conclusions: The current findings indicate that atypicalities in human action sound processing are present in individuals with autism both with and without intellectual disability. However, these atypicalities were differentially expressed as reduced habituation over parietal cortex in individuals without intellectual disability versus reduced activation over right frontal cortex in the individuals with intellectual disability. These findings suggest that the nature of neurobiological markers for core impairments in social processing may differ across levels of intellectual disability in this population.

11:20 **103.003** Biomarkers of Social Perception in Children with ASD and Loss of Function Gene Mutations

C. Hudac[1], *A. Kresse*[2], *T. DesChamps*[2], *S. J. Webb*[3] *and R. Bernier*[2], *(1)University of Washington, Seattle, Seattle, WA, (2)University of Washington, Seattle, WA, (3)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA*

Background: Recurrent disruptive mutations in genes such as *CHD8* and *DYRK1A* have been implicated as contributing to approximately 1% of autism spectrum disorders, (ASD; O'Roak et al., 2012; Devlin & Scherer, 2012). Work has begun to identify ASD subtypes associated with specific loss-of-function genetic mutations (e.g., Bernier et al., 2014). Despite the hallmark social impairments of ASD, to date, no one has characterized the impact of genetic mutations associated with ASD on social cognition. Social perception biomarkers are ideal for assessing social cognition in children with widespread behavioral capacities, given the robust nature of passive viewing tasks (e.g., Kaiser et al., 2010). Reduction of mu attenuation in response to viewing social versus nonsocial motion is one such biomarker of social perception. However, discrepant results of mu rhythm in ASD are reported (e.g., Bernier et al., 2007; 2013; Oberman et al., 2005; 2013), potentially highlighting existing heterogeneity that may be driven by etiological differences.
Objectives: We aimed to compare the biomarkers of social perception in children with ASD with recurrent, ASD associated, loss of function mutations (e.g., *CHD8*, *DYRK1A*) to children with idiopathic ASD and typically developing children.
Methods: Children completed an EEG session during which they watched videos of social and nonsocial motion. Mu attenuation was computed across electrodes surrounding C3 and C4 as Fast Fourier transformed power (8-13 Hz), relative to resting. We targeted children with ASD and loss-of-function gene mutations falling into an interactive protein network (ASD-LOF). Comparison groups included age- and gender-matched children with idiopathic ASD (ASD-NON) and typical development (TYP). See participant characterization in Table 1. Single-trial analysis conducted in SAS 9.3 used REML multilevel models and Bonferroni correction for pair-wise comparisons.
Results: Observed mu attenuation for each group is presented in Figure 1 across trial and on average for social (green) and nonsocial stimuli (orange). First, a model comparing both ASD groups to TYP indicated no group differences of condition, $F(1,7023)=.94$, $p=.33$. Second, a model comparing all

three groups indicated a group effect of condition, $F(1,7031)=30.93$, $p<.0001$, such that ASD-NON group did not exhibit mu attenuation condition differences, $t=2.49$, $p=.19$. The ASD-LOF and TYP groups exhibited more mu attenuation for social than nonsocial stimuli, respectively, $t=5.39$ and $t=6.09$, p's$<.0001$. *Post-hoc* ANOVAs indicated that the children with *CHD8* and the *DSCAM* genetic events exhibited equivalent mu attenuation to both social and nonsocial stimuli, $F(1,58)$'s<3.4, p's$>.068$. The other ASD-LOF children exhibited greater mu attenuation to social compared to nonsocial stimuli, similar to the TYP group. There were no significant effects of IQ, age, or gender. Conclusions: Traditional analysis of TYP versus ASD suggested no difference in mu attenuation (e.g., Bernier et al., 2013). Implementation of a "genetics-first" approach specified that ASD-LOF children exhibit patterns of mu attenuation similar to TYP. However, children with specific genetic mutations (*CHD8*, *DSCAM*) exhibit mu attenuation more similar to ASD-NON. These results indicate the necessity of careful consideration for genetic mutations contributing to phenotypic social cognition profiles of ASD.

11:45 **103.004** Electrophysiological Signatures for ASD: Putting the "Bio" into Biomarker

T. P. Roberts[1], W. C. Gaetz[2], J. I. Berman[1], L. Blaskey[1] and J. C. Edgar[1], (1)Children's Hospital of Philadelphia, Philadelphia, PA, (2)The Children's Hospital of Philadelphia, Bala Cynwyd, PA

Background: Electrophysiological signatures recorded by EEG and MEG are increasingly recognized as distinctive features of ASD, offering neurobiologic insight as well as potential diagnostic/prognostic utility. As such they increasingly attract the label "biomarker". However, the mechanistic basis implied in this moniker is often left unspecified. Furthermore, by establishing a biological component to the signature, and justifying the term "biomarker", an additional potential axis is offered for stratification of the heterogeneous autism spectrum.

Objectives: To evaluate the interpretation of auditory evoked electrophysiologic responses as biomarkers for ASD, using converging evidence form multimodal imaging/spectroscopy studies to provide a biological basis for defining sub-populations for future use as inclusion/enrichment criteria for targeted pharmaceutical trials.

Methods: Approximately 200 school-aged (6-15yrs) children on the autism spectrum, and typically-developing control subjects have been recruited for multimodal imaging studies including magnetoencephalography (MEG) during auditory stimulation, as well as diffusion-magnetic resonance imaging (both DTI and HARDI) and , in a subset, spectrally-edited magnetic resonance spectroscopy (MRS). While MEG measures auditory evoked cortical response component latency (M50 and M100), diffusion measures focus on the microstructure of thalamocortical projections to superior temporal gyrus, and MRS measures address levels of neurotransmitters GABA and glutamate in superior temporal lobe. Clinical assessments include ADOS and ADI-R, as well as dimension scales such as the social responsiveness scale (SRS) and domain-specific measures such as the clinical evaluation of language fundamentals (CELF-4).

Results: Auditory evoked response components M50 and M100 are characterized by significantly delayed latencies in ASD of magnitude ~5ms and ~10ms respectively (p's <0.05). While the developmental trajectory of these response components shows a maturational slope similar to that observed in typical development, the absolute delay persists. This pattern of atypical maturation is reflected in quantitative diffusion imaging of the thalamocortical white matter in which the mean diffusivity shows a developmental slope similar to neurotypical, but of differing underlying (eigenvalue) basis. As such strong associations between properties of the white matter (such as fractional anisotropy) and cortical response latencies that are significant in typical development (p<0.05) are lost in ASD. Similarly evidence for atypical neurochemistry in ASD is revealed in an approximately 15-20% decrease in levels of inhibitory neurotransmitter GABA in the superior temporal lobe of children with ASD compared to TD (p<0.05). Nonetheless, both diffusion and spectroscopy findings are associated with significant inter-individual variability, perhaps representing a brain level embodiment of autism spectrum heterogeneity, and suggesting their combined use in definition of sub-populations.

Conclusions: Delays in the latency of auditory cortical responses such as the ~100ms M100 component have been consistently observed in ASD (although to varying degrees) and speculatively attributed to both white matter conduction anomalies as well as deficits in synaptic transmission. Support for both of these explanatory neurobiological hypotheses can be found in diffusion imaging of thalamocortical white matter and MRS assays of temporal lobe neurotransmitter balance. Since the potential therapeutic management of these etiologies differs, we propose that such biological measures form the basis of stratification biomarkers, appropriate for tailoring clinical trial inclusion, and subsequently directing patient management.

Panel Session
104 - Attending to Attention Among Persons with Autism Spectrum Disorder: Perspectives on Strengths, Weaknesses, and Goodness-of-Fit
10:30 AM - 12:30 PM - Grand Ballroom D

Panel Chair: Oriane Landry, *La Trobe University, Bendigo, Australia*

Throughout the lifespan, where and how visual attention is allocated affects what we learn about the world, how we interact with others, and how we plan goal-directed behaviors. Several "atypicalities" in visual attention are cited among persons with ASD. Under some circumstances, such as visual search, this atypicality takes the form of enhanced performance. In other circumstances, such as attentional disengagement, the abnormality is characterized as impairment. But in many other aspects of visual attention, the differences that emerge between individuals with autism can simply be identified as superior or inferior. For example, the processes involved in the modulation of attentional focus, such as needed under varying conditions of perceptual load or when the task necessitates efficient attending to target information in dynamic complex environments, can involve diminished performance in one circumstance and enhanced performance on another. Across all these permutations of strengths and weaknesses, the understanding of the subtle nuances of attentional processing provides considerable insight into context-specific cognitive and social styles and level of performance of persons with ASD. In this panel, we will explore the nuances of visual attention of persons with ASD within the frameworks of both strength and weakness within the demands of the environment.

10:30 **104.001** Attentional Priority for Special Interests in Autism Spectrum Disorder (ASD) and Neurotypical Passions

A. Remington[1], O. E. Parsons[2] and A. P. Bayliss[3], (1)Institute of Education, London, United Kingdom, (2)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (3)School of Psychology, University of East Anglia, Norwich, United Kingdom

Background: Autism Spectrum Disorder (ASD) is characterized by impairments in social interaction. A component of this deficit is lack of expertise for face processing (Grelotti et al., 2002). For typical individuals, faces are prioritized for processing over non-social items however our research previously demonstrated that this is not the case in ASD – where equal preference for social and non-social images is seen (Remington et al., 2012).
Why is that the case? It has been suggested that the specialized face processing system is not innately assigned in typical infants but becomes specific due to strong interest and experience of faces, and therefore has the potential to become specialized for any category (Gauthier et al., 2000). It is therefore striking that autistic individuals often hold an obsessive interest in a specific category.
Objectives: We aimed to establish whether in autistic people, their category of choice has adopted the expertise system and is afforded prioritized processing resources.
Methods: A selective-attention paradigm was used with autistic adolescents who hold obsessional interests, and neurotypical controls with similar passions/interests. Participants classified a target word based on category (e.g. for trains: 'Steam or Electric'?). The target (e.g. 'Bullet Train') was presented alone or in a list of 1 or 5 non-words, thereby varying the 'perceptual load' (amount of potentially task relevant information) of the task. A distractor (photograph of special interest item) was presented next to the words and participants were explicitly told to ignore it. The distractor was either congruent or incongruent (same or alternative sub-category to target). Each participant performed the task with personalized stimuli related to their special interest. All pictures were non-social (i.e. did not contain faces).
By comparing RTs we can establish to what extent distractors are processed under various levels of load, allowing us to index the degree to which a particular stimulus category is prioritized in the information processing system. Load Theory (Lavie, 1995) suggests that distractor processing of non-social items only occurs if perceptual load does not exhaust processing capacity. Conversely social stimuli are afforded a 'special saliency' and are processed at all levels of load. Our study examined whether stimuli related to each participant's area of interest would be processed in a similar manner to other non-social stimuli, or would show a 'special saliency' in ASD.
Results: Preliminary results indicate that, as with other non-social items (Lavie et al., 2003; Remington et al., 2012), neurotypical controls showed a congruency effect that was eliminated at high levels of load: greater distractor-impact under lower load levels. Conversely, for ASD, the congruency effect did not differ across load levels. This indicates that the autistic participants processed the pictures of their special interest to the same degree under all load levels, despite the fact that this slowed their performance on the central task.
Conclusions: This research begins to elucidate a potential link between social and non-social symptoms in ASD. Moreover, the findings will have crucial practical implications for intervention programs that aim to improve social skills of individuals with ASD.

11:00 **104.002** Visual Search in Time Among Persons with an Autism Spectrum Disorder

N. Russo[1], W. R. Kates[2] and B. Wyble[3], (1)Syracuse University, Syracuse, NY, (2)SUNY Upstate Medical University, Syracuse, NY, (3)The Pennsylvania State University, University Park, PA

Background: Individuals with an Autism Spectrum Disorder (ASD) demonstrate specific strengths in attention that includes the ability to detect visual stimuli among distractors. This visual search strength has generally been studied using static conjunctive search tasks, in which participants search for a target (e.g. orange squares) among distractors that share features with it (e.g. orange circles and blue squares). Here we look at the integrity of *temporal* visual search through single and dual target search tasks, and focus on the attentional blink (AB) in dual target searches. The AB is a phenomenon whereby the second of two targets is often missed when it follows the first target by 200-500ms.

Objectives: To extend findings on enhanced visual search from the spatial domain to the temporal domain in both single and dual target search experiments and to assess the integrity of the AB, and it's associated characteristics.

Methods: 15 participants with an ASD (ADOS and ADI-R confirmed) and 15 typically developing (TD) children and adolescents matched on the basis of age and IQ completed 4 experimental tasks in counterbalanced order. On the multispeed tasks (current N = 7, analysis underway for the remaining participants), participants were asked to detect 1 target (either a purple letter among white letters: featural task (exp 1.), or a letter among numbers: category task, exp.2). 29 distractors, and 1 target were presented at slow (135ms/stimulus), medium (102.5ms/stimulus) and fast (83ms/stimulus) speeds and participants had to report the correct target at the end of the stream. In the AB tasks (exp 3 and 4, N = 15 participants anlayzed), participants reported two targets (the T1 and T2), which consisted of either 2 purple letters among white letters (featural AB task) or 2 letters among numbers (categorical AB task).

Results: Performance on experiments 1 and 2 was more accurate among individuals with an ASD compared to TD participants, and this was especially evident at the fastest speed. On the AB tasks, participants' ability to detect the first of 2 targets did not differ between the groups for either experimental task. For T2|T1 (conditional accuracy: the accuracy with which participants correctly identified the T2 given correct T1 identification), task and group differences emerged. The AB was more pronounced overall in the category task compared to the feature task for both groups, and was less pronounced in ASD on the feature task and more pronounced on the category task relative to the TD participants. Additional characteristics of the AB, including swaps (in which participants identify both targets correctly but reverse their order) appeared over longer lags among persons with ASD, whereas binding errors, in which participants falsely report the target as the distractor preceding or following the target (by 1 or 2 lags) did not differ between the groups.

Conclusions: Strengths in visual search were noted for the multispeed tasks however more subtle group differences were noted on AB tasks. These findings will be discussed with respect to current theories of the AB and ASD.

11:30 **104.003** Challenging the Myth of Attentional Overfocus Among Persons with Autism Sprectrum Disorder

J. A. Burack[1], *D. A. Brodeur*[2], *J. Stewart*[3], *J. Querengesser*[4] and *O. Landry*[5], (1)Educational & Counselling Psychology, McGill University, Montreal, QC, Canada, (2)Department of Psychology, Acadia University, Wolfville, NS, Canada, (3)McGill University, Montreal, QC, Canada, (4)Educational and Counselling Psychology, McGill University, Montreal, QC, Canada, (5)La Trobe University, Bendigo, Australia

Background: Overfocused attention is often considered, at least implicitly and often explicitly, as central to essential theories of cognitive style of persons with ASD. The idea of an excessive focus on one piece, part of a piece, or group of pieces of information in the environment at the expense of processing others is consistent with various theories about the ways that persons with ASD process and respond to information. For example, the theory of mind deficit might be seen as an overfocus on objects and events from an egocentric view rather than on those from others' viewpoints; the theory of executive function deficit as an overfocus on ideas in the here and now rather than on those for the future; and the theories of weak central coherence and enhanced perceptual functioning as an overfocus on details rather than on global objects. These conceptual extrapolations from theory and behavior are consistent with historical depictions of attentional processing among persons with ASD as overfocused (Rincover & Ducharme, 1987; Wainwright-Sharp & Bryson, 1993) and overselective (Townsend & Courchesne, 1994; Townsend et al., 1996), but not as distractibile (Burack, 1994; Burack et al., 1997).

Objectives: To provide a more precise understanding of attentional functioning and modulation, specifically in relation to the notion of focus and its relevance to understanding cognitive styles among persons with ASD.

Methods: A critical analysis of the studies of attentional focus and filtering among persons with ASD based on the premise that two aspects of functioning should be especially heightened if attention were really overfocused – one, "zooming-in" the focus of attention to a meaningfully restricted spatial area, and two, maintaining that focus despite the occurrence of events or appearance of objects in the environment.

Results: Proponents for the overfocused approach cite evidence that individuals with ASD experience difficulty in broadening the focus of attention (Mann & Walker, 2003), deploy a narrower than typical attentional spotlight suggesting a prolonged zoom-in lens but a sluggish zoom-out one (Ranconi et al., 2013), and display "tunnel vision" (Robertson et al., 2013). However, in a study with a dynamic version of the Erikson flanker task, children with ASD, as compared to MA-matched TD children, met neither of the essential criteria of over-focus but rather displayed behavior indicative of under-focus – they were distracted by targets quite distant from the target and by distractors that appeared considerably after the presentation of the target stimulus (Stewart et al., submitted). Although detrimental to performance on a flanker task, this type of underfocus might better be interpreted with regard to the hypothesis that increased distractor processing among persons with ASD results from enhanced perceptual capacity rather than an attentional deficit in filtering or focus (Remington et al., 2012).

Conclusions: A model that involves underfocus and increased perceptual capacity, rather than the

common characterization of overfocus, might better represent the attentional and cognitive styles of persons with ASD. We offer new evidence to support this assertion and an alternative explanation for the findings typically cited to support the overfocus hypothesis.

12:00 **104.004** The Curious History of the Gap/Overlap Procedure
J. T. Elison, Institute of Child Development, University of Minnesota, Minneapolis, MN

Background: Impaired attentional disengagement is widely considered a key cognitive mechanism in the pathogenesis of autism (Elison & Reznick, 2012; Keehn, 2013). Disengagement is often examined with the gap/overlap procedure (also referred to as a shift/disengagement procedure or competition/non-competition procedure). The translational potential of this construct holds much promise, and as such, requires careful scrutiny.
Objectives: To trace the use of this procedure since its inception (Saslow, 1967) to identify interpretational pivot points within and between separable bodies of literature (i.e., an infant cognition line and an adult cognition line). More specifically, I will attempt to identify papers that offered interpretations that subsequently altered researchers conceptualization of performance in this procedure within a given line of research. I will also identify convergence/divergence between disparate bodies of literature that have employed this task.
Methods: As of November 1, 2014, Web of Science identified 382 papers that cited the original report of the gap/overlap paradigm (Saslow, 1967). Each abstract was examined and dichotomously classified according the age of the sample studied. Those papers that examined infants and/or children were tagged for further examination in order to characterize citation patterns in the developmental line of research, which I suspected to be the line of research adopted by the autism field.
Results: Two, essentially non-overlapping bodies of work (with very few exceptions, e.g., Farroni et al., 1999; Masuzawa & Shimojo, 1997; Ross & Ross, 1980; Senju & Hasegawa, 2005) with different emphases stemmed from the original Saslow (1967) report, one in the adult cognition literature (encapsulating cognitive/systems neuroscience) and one in the infant cognition literature. In the adult literature, effort was primarily focused on understanding/characterizing the mechanism(s) responsible for reduced latencies in the gap condition (e.g., disengagement of attention facilitating express saccades, the premotor theory, etc.). On the other hand, with very few exceptions (c.f. Aslin & Salapatek, 1975), the infancy literature focused on the overlap condition and its service to understanding 1) the extent of the visual field during infancy, and 2) the phenomenon of obligatory attention observed in very young infants. The emergence of cognitive neuroscience and its merger with developmental science in the late '80's and early '90's yielded new interpretations of performance in the gap/overlap paradigm that were adopted by the autism field (with few exceptions, see Goldberg et al., 2002) at the expense of including emerging data from the adult line of research.
Conclusions: Building a cumulative developmental science requires conceptual and methodological precision coupled with innovation. This inquiry into the history of the gap/overlap procedure yields evidence that important findings from adults (and non-human primates) have been neglected in current interpretations of gap/overlap performance. Whether performance in the overlap condition (or difference between overlap condition and baseline condition) reflects "attentional disengagement" as originally conceived remains open for debate and requires further examination.

Panel Session
105 - Pivotal Response Treatment: Novel Intervention Models to Optimize Outcome
10:30 AM - 12:30 PM - Grand Salon

Panel Chair: Antonio Hardan, *Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, CA*

Discussant: Laura Schreibman, *University of California, San Diego, La Jolla, CA*

This panel will review new research into state-of-the-art models for disseminating evidence-based Pivotal Response Treatment (PRT) for ASD across key contexts and stakeholders. The first presentation examines results of a large randomized controlled trial of PRT Group (PRTG) and reviews data on the effects of group parent education on child language and parenting stress and empowerment. The second talk introduces the novel Classroom PRT (CPRT) approach for training teachers and will present preliminary teacher outcomes and child characteristics from large-scale application of CPRT in school settings. The third presentation reviews preliminary data on the effects of brief individually-administered PRT on child language use, as well as neurophysiological function measured with EEG for a small subsample. Finally, our fourth panelist will discuss a package treatment model which combines both parent training and clinician-delivered intervention in home settings to maximize treatment effects and data supporting this model will be shared. Overall, this panel offers a review of innovative research in intervention models of PRT to optimize outcome across multiple universities, documenting novel approaches for community implementation of evidence-based motivational treatment practices. We seek to stimulate further research interest in the development of high-quality autism interventions and in effective strategies for wide-spread dissemination.

10:30 105.001 Pivotal Response Treatment Parent Training Group: Effects on Parent Factors and Child Outcomes from a Randomized Controlled Trial

K. L. Berquist[1], *G. W. Gengoux*[2], *M. B. Minjarez*[3], *J. M. Phillips*[2], *T. W. Frazier*[4] and *A. Y. Hardan*[2], (1)Stanford University, Stanford, CA, (2)Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, CA, (3)Psychiatry and Behavioral Sciences, Seattle Children's Hospital, Seattle, WA, (4)Cleveland Clinic, Center for Autism, Cleveland Clinic Children's, Cleveland, OH

Background: As rates of autism spectrum disorder have increased in recent years, the need for effective and efficient service delivery models continues to expand. In previous studies of Pivotal Response Treatment (PRT), research has documented that parents can learn this evidence-based treatment and that their children show associated benefits in language. Recent research has also provided preliminary evidence that group parent training in PRT may reduce parenting stress and improve parent empowerment. However, this hypothesis has not yet been evaluated in a controlled trial.

Objectives: This presentation will review research on the effects of parent training on levels of parenting stress and family empowerment, as well as children's language outcomes. Evidence will be presented from a recently completed randomized controlled trial of group parent training in PRT (PRTG) compared to a parent psychoeducational group (PEG).

Methods: Participants included 53 children (2-6.11 years) with autism and significant language delay. Children were randomized into either the PRTG (N=27) or PEG (N=26). The PRTG taught parents PRT to facilitate language development. The PEG addressed general topics related to the assessment and treatment of autism. Measures of parental empowerment and stress and children's language outcomes were obtained at baseline and at the end of the 12-week trial.

Results: Results suggest that group parent education is an effective method for teaching parents to implement PRT with their children and that a majority of parents (84%) in the PRTG met PRT fidelity of implementation criteria after 12 weeks of treatment. Analysis of parents who participated in PRTG and PEG indicated that they endorsed strong empowerment on the Family and Service System subscales of the Family Empowerment Scale (FES). Results also showed that parents who participated in the PEG showed a trend toward greater improvement on the Community/Political subscale (t=3.942; df 43; p=0.054). Consistent with the literature reporting high levels of parenting stress in this population, 75% of parents across groups showed clinically significant levels of stress on the Parenting Stress Index, Short Form (PSI-SF). Furthermore, changes in child communication for families who completed the trial (PRTG N=26; PEG N=20) revealed that children whose parents participated in the PRTG exhibited a significant increase in the number of utterances compared to those whose parents participated in the PEG (F= 3.53; df 44; p= 0.038; d=0.42). Changes on a standardized measure of adaptive communication were also observed following PRTG: Receptive Communication V-Scale score (F= 4.27; df 40; p= 0.028; d=0.23) and overall Communication Standard Score (F=3.80; df 40; p=0.041; d=0.34).

Conclusions: These findings suggest that specific instruction in PRT results in strong skill acquisition for both parents and children and may also have a positive impact on feelings of empowerment related to direct teaching interactions. Parents participating in a general psychoeducation group benefited more in terms of their empowerment related to community and political advocacy. These findings will be discussed in the context of programs which combine parent education in specific intervention strategies with education related to community advocacy, and recommendations for future research in this area will be reviewed.

10:55 105.002 Examining Outcomes and Satisfaction in a Randomized Trial of Classroom Pivotal Response Training (CPRT)

A. C. Stahmer[1], *J. Suhrheinrich*[1] and *S. R. Rieth*[2], (1)Psychiatry, University of California, San Diego, San Diego, CA, (2)Child and Family Development, San Diego State University, San Diego, CA

Background:
Autism interventions that are shown to be efficacious in controlled research settings are often not well integrated into school settings, demonstrating the need for translation or adaptation for classroom use. Classroom Pivotal Response Teaching (CPRT) is a behavioral intervention for children with ASD adapted from Pivotal Response Training through an iterative process in collaboration with researchers, teachers, and school administrators. Although the effectiveness of the original PRT protocol is well established and pilot study data suggest that CPRT may be effective in classroom settings, it has not been rigorously tested in a controlled trial.
Objectives:
This presentation will describe an overview of a large-scale community effectiveness trail of the CPRT intervention and preliminary teacher, paraprofessional, and student outcomes.
Methods:
The current study uses a randomized waitlist-control design with 108 classrooms (including the lead teacher and paraprofessional educators) over three years. Preliminary data will be presented for the completed first year. Participant measures were collected in the beginning and end of the school year, across training and control conditions. Teacher measures included the Professional Development Assessment (PDA) for all teachers and fidelity of implementation of CPRT and satisfaction surveys for teachers participating in the training year. Child measures included the ADOS,

cognitive battery, Vineland Adaptive Behavior Scales (VABS) and Pervasive Developmental Disability Behavioral Index (PDDBI).

Results:

Thus far data representing 64 teachers, 43 paraprofessionals and 114 students have been analyzed. Teachers were 95% female, 54% with Masters' degrees and 60% with 5-15 years of experience teaching special education. Paraprofessionals were 98% female, 63% with high school degrees, and 65% with 5-15 years of experience in special education. Students were 83% male, with an average age of 5.8 yrs. All classrooms had generally high quality ratings on the PDA. Preliminary outcome data for teachers participating in training (n = 64) indicates 75% met fidelity of implementation mastery criteria for CPRT, 100% of teachers were satisfied or very satisfied with the overall quality of training they received and 89% of teachers report CPRT is a successful or very successful strategy for children in their class. On average, teachers reported using of CPRT for 50 min/day. Time to acquisition of CPRT varied by teacher/program. Student testing data demonstrate that 99% of students met criteria for autism spectrum on the ADOS. A total of 18% of students scored within one standard deviation of the mean on cognitive assessments (80% below; 2% above). A comprehensive description of teacher, paraprofessional and child characteristics including autism severity and adaptive functioning will be provided.

Conclusions:

Results indicate that CPRT is feasible to implement in classroom settings and is well received by participating teachers. Teachers learned to implement the strategies in the context of training. Collaborative adaptation of evidence-based practices may facilitate community fidelity of implementation. Variability in fidelity of implementation and use of CPRT will be discussed.

11:20 **105.003** Efficacy of Brief Pivotal Response Training on Language Outcomes and Neurophysiological Indices in Children with ASD

M. B. Minjarez[1], *T. DesChamps*[2], *A. Kresse*[3], *G. W. Gengoux*[4], *A. Y. Hardan*[4], *K. L. Berquist*[5], *S. J. Webb*[2] *and R. Bernier*[6], (1)Psychiatry and Behavioral Sciences, Seattle Children's Hospital, Seattle, WA, (2)University of Washington, Seattle, WA, (3)Seattle Children's Research Institute, Seattle, WA, (4)Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, CA, (5)Stanford University, Stanford, CA, (6)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA*

Background: Behavioral interventions are robustly supported in the treatment of ASD, including those that are parent-administered. Few studies have explored the efficacy of brief parent training models and the effects on child functioning. Further, little is understood regarding the impact of behavioral treatments on neurophysiological functioning. Pivotal Response Training (PRT) is an empirically supported, naturalistic behavioral approach, typically delivered via 25 or more parent training hours. Few studies have examined more brief models of PRT. Additionally, while evidence suggests behavioral interventions alter brain functioning in animal models, recent work suggests behavioral interventions for ASD (e.g., Early Start Denver Model) may also change neurological functioning; however, studies examining the effects of PRT on brain function are just emerging.

Objectives: This study examined the effect of brief (12-week) PRT on child language functioning. As an exploratory objective, correlated brain activity was examined in an additional group of participants by assessing neurophysiological indices of language skills.

Methods: In this uncontrolled trial, efficacy of parent-delivered PRT was examined to address language impairment in children with ASD, ages 3 to 7 years. Thirteen families have completed the protocol across two sites to date. Data collection is ongoing. Parent-child dyads participated in 12 weekly, 60-minute PRT parent training sessions, with a focus on child language gains. Data were obtained at baseline and post-treatment, using systematic scoring by independent raters of target behaviors observed during 10-minute video-taped structured lab observations (SLO). The primary dependent variable was child functional utterances during the SLO. These data were analyzed using paired t-tests to examine changes from pre- to post-treatment. For a small number of additional participants, high density EEG was collected during observation of social and nonsocial videos. Cortical activation, as reflected in spectral power in alpha and theta bands during the observation of social and nonsocial stimuli, was assessed to examine changes over treatment. For these children, a multiple baseline design across participants was used to examine child functional utterances and EEG data.

Results: Preliminary findings suggest parent training in PRT was associated with child language improvements (N=9), 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). Adequate, artifact free EEG was obtained from three of four additional participants. A multiple baseline design across participants indicated similar improvements in functional utterances and preliminary EEG findings indicate more normalized cortical activation (decreased alpha power and increased theta power) when viewing faces relative to objects following intervention.

Conclusions: Findings from this pilot study suggest brief parent training in PRT is associated with improvement in child language skills. Further, EEG findings support that these behavioral changes, following short-term PRT, are mirrored in changes in neurophysiological functioning to more normalized neural activity. These findings are analyzed in light of the need for more cost-effective and efficient treatment models and better understanding the impact of behavioral interventions on neurophysiological functioning in children with ASD.

11:45 **105.004** Pivotal Response Treatment Package: Combined Parent Training with Clinician-Delivered in-Home Treatment

G. W. Gengoux[1], J. M. Phillips[1], C. M. Ardel[1], M. E. Millan[1], R. Schuck[1], T. W. Frazier[2] and A. Y. Hardan[1], (1)Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, CA, (2)Cleveland Clinic, Center for Autism, Cleveland Clinic Children's, Cleveland, OH

Background: Pivotal Response Treatment (PRT) is an evidence-based naturalistic behavioral intervention which is traditionally delivered via a parent training model. While there is some evidence in support of brief treatment models, some children and parents may need longer duration of treatment or greater intensity in order to make clinically meaningful progress. For instance, while parents are still learning to implement the treatment themselves, clinician-delivered intervention may help boost child language development.
Objectives: This presentation will review initial outcomes from a randomized controlled trial of a PRT package treatment (PRT-P) which combines parent training with clinician-delivered in-home treatment.
Methods: This study is a randomized controlled trial of PRT-P compared to a Delayed Treatment Group (DTG). The active treatment involves weekly parent training and 10 hours per week of in-home therapist-delivered treatment for 3 months, followed by a less-intensive phase with 5 hours per week of in-home treatment and monthly parent training sessions. Participants include children with ASD and significant language delay, ages 2-5 years. Dependent measures include Clinical Global Impression Improvement (CGI-I) ratings by trained raters blinded to treatment condition, as well as standardized parent questionnaires and structured behavioral observations.
Results: To date, 18 subjects have been randomized. The trial is ongoing and preliminary data are currently available from 14 participants. CGI-I ratings focused specifically on communication indicate 3 children rated as very much improved (0 in DTG), 4 children rated as much improved (2 in DTG), 1 child rated as minimally improved (3 in DTG) and no children rated "no change" (1 in DTG). Preliminary examination of changes with PRT-P revealed that children in the active group are acquiring language skills as evidenced by increased performance on the Vineland Adaptive Behavior Scales, Second Edition (Vineland-II) Expressive Language raw scores (Baseline: 28.55 ± 9.63 ; Post-treatment: 37.13 ± 14.93) and an average gain of over 100 words between baseline (M=70.67 ± 23.46) and post treatment (M=187.67 ± 46.97) on the MacArthur-Bates Communicative Development Inventories.
Conclusions: These preliminary data suggest that the PRT package approach shows promise for addressing communication deficits associated with ASD. Potential benefits and challenges of a combined parent training and clinician-delivered intervention approach will be discussed and areas in need of future research will be explored.

Poster Session
106 - Medical and Psychiatric Comorbidity
11:30 AM - 1:30 PM - Imperial Ballroom

1   **106.001** A Delphi-Procedure Study of Standards of Clinical Assessment and Treatment of Individuals with Co-Occurring Gender Dysphoria and Autism Spectrum Disorders

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Background: An overrepresentation of autism spectrum disorders (ASD) among individuals with gender dysphoria (GD) has been reported, with rates of almost 1 in 10 gender referrals meeting full diagnostic criteria for ASD, and many others with the broader ASD phenotype (de Vries et al., 2010). There is also evidence that gender identity issues are more common among referrals for ASD (Strang et al., 2014). Nine published case studies highlight the diagnostic and clinical complexity of these individuals, but there are no clinical guidelines for their treatment/management. A gold-standard method for developing initial clinical practice standards in an emerging field is the Delphi research procedure, which facilitates the development of clinical consensus statements, as well as identifies where current experts differ (Linstore & Turoff, 2002).
Objectives: To obtain a set of clinical consensus statements from those clinicians and researchers experienced in working with individuals with co-occurring ASD and GD.
Methods: Experts in comorbid ASD and GD were identified through a four-step procedure: 1. comprehensive internet search for individuals involved in publications and clinical services related to the comorbidity, 2. comprehensive search for clinics serving individuals with gender dysphoria, 3. a "snowball" sampling procedure to allow identified expert participants to refer other experts in the field, and 4. an assessment for inclusion in the study that evaluated publication history related to the comorbidity, clinical experience with the comorbidity, and training. Twenty-eight experts in comorbid ASD and GD were identified internationally, and 22 completed the multi-step Delphi procedure. Participants each completed an initial round of questions about the clinical management of the comorbidity. Results were then coded for themes using the NVivo qualitative data analysis computer

software (QSR International, 2012). 36 clinical statements emerged, which were then evaluated and shaped using a rating system by the 22 participants.

Results: Participants were 45% medical doctors (37% psychiatrist, 9% endocrinologist, 5% pediatrician), 45% clinical psychologists, and 10% other clinical specialty. 42% of participants had previously published on the comorbidity. The Delphi procedure produced 28 consensus statements; for 6 items the expert panel was unable to come to consensus. The resulting Delphi statements include general principles for assessment of individuals with the comorbidity, a three-step assessment protocol, a checklist for treatment approaches (including approaches for both psychotherapy and, when appropriate, sex reassignment treatment), and identified primary risk areas. Principal themes include the need for and nature of the multidisciplinary team for working with these individuals, the need for a more extended diagnostic period in which clinical decisions unfold more slowly, and the importance of autism treatment adapted to include concrete psycho-education about gender identity and gender outcomes.

Conclusions: The expert international panel was able to achieve consensus for preliminary guidelines in the assessment and treatment of individuals with comorbid ASD and GD. The full guidelines will be presented at the meeting with opportunities for the INSAR membership to provide their input. Next steps for the project will include the perspective of individuals with ASD and GD.

2   **106.002** ASD in Sibling Pairs Discordant for ADHD

A. M. Reiersen and M. B. McGrath, Psychiatry, Washington University in St. Louis School of Medicine, St. Louis, MO

Background:
Symptoms of Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD) frequently co-occur in clinical and population-based samples, and there is evidence that this co-occurrence is largely due to overlap of genetic influences that contribute to the two disorders. The diagnosis of both disorders in one person is now allowed according to DSM-5 diagnostic criteria, so it is important to identify appropriate methods for determining which individuals should receive just one versus both diagnoses. Many existing reports of ASD symptoms in ADHD have been based on parent-rated questionnaires, but few studies have used the Autism Diagnostic Observation Schedule (ADOS) to investigate the presence of likely ASD among individuals with ADHD.

Objectives:
To examine evidence for ASD among individuals showing parent-reported lifetime symptoms of combined type ADHD and their "unaffected" siblings.

Methods:
The ADOS was administered to individuals classified as having a severe combined form of ADHD (n=96) and their siblings (n=91) with few if any lifetime ADHD symptoms. Subjects were selected from a population-based sample of large sibships (n=169) or recruited through study advertisements (n=18). In each case, ADOS module 3 (N=43) or module 4 (N=144) was administered and scored according to the original ADOS algorithm to determine the ADOS classification. The ADOS-2 module 3 algorithm was then also applied to all ADOS assessments (regardless of module administered) to determine an ADOS-2 (module 3) classification.

Results:
Subjects were 8-31 years old, 96% Caucasian (includes 4 Hispanic subjects), 4% African-American, and 59% male. Using the original ADOS algorithm, 17% of ADHD probands and 8% of siblings had a classification of either "autism" or "autism spectrum". Using the ADOS-2 module 3 algorithm, 19% of ADHD probands and 12% of siblings had a classification of either "autism" or "autism spectrum". When ADHD probands qualified for an ADOS-2 diagnosis, they were more likely to be classified as "autism" (n=13) rather than "autism spectrum" (n=5). This was not true of siblings, who were more likely to be classified in the less severe "autism spectrum" category (n=8) than the "autism" category (n=3).

Conclusions:
We estimate that approximately 17-19% percent of individuals with lifetime combined type ADHD may be classified as having a co-occurring ASD based on the ADOS or ADOS-2. Consistent with previous findings of genetic overlap between ADHD and ASD, a substantial proportion (8-12%) of "unaffected" siblings of ADHD probands may also be classified as having ASD by the ADOS or ADOS-2.

3   **106.003** Alexithymia As a Predictor of Dimensional Scales of Autism Symptoms

K. Stephenson[1], M. E. Maisel[1], J. C. Cox[2] and M. South[3], (1)Department of Psychology, Brigham Young University, Provo, UT, (2)Counseling and Psychological Services, Brigham Young University, Provo, UT, (3)Psychology and Neuroscience, Brigham Young University, Provo, UT

Background: Alexithymia is characterized by difficulties identifying, expressing, and feeling emotional states. In addition to core clinical symptoms of autism spectrum disorders (ASD), researchers have found high rates of comorbid anxiety, depression, and alexithymia symptoms. However, there is little research investigating the association between these constructs and how they relate to dimensional measures of ASD symptoms.

Objectives: The goal of this study was to explore the relationship between ASD symptoms and the related constructs of alexithymia, anxiety, and depression. Specifically, we hypothesized that alexithymia would remain a significant predictor of ASD symptoms even after controlling for anxiety

and depression.

Methods: Participants were 23 adults diagnosed with ASD as well as 20 neurotypical controls. All participants completed a battery of questionnaires including the Toronto Alexithymia Scale (TAS-20), the Autism Spectrum Quotient (AQ), the Social Responsiveness Scale (SRS-2), the State-Trait Anxiety Inventory (STAI), and the Beck Depression Inventory (BDI). We used multiple regression analyses to predict autism symptoms (i.e., AQ and SRS-2 scores) using alexithymia, anxiety, depression, and categorical diagnosis as predictors.

Results: Multiple regression analyses indicated that both alexithymia and diagnosis were significant predictors of both AQ and SRS-2 scores when controlling for anxiety and depression. Furthermore, alexithymia emerged as a better predictor of dimensional ASD symptoms than categorical diagnosis. Additional Pearson correlations showed differing patterns between the study variables among the two diagnostic groups. In particular there appears to be different relationships between subscales of the TAS-20 and the SRS-2 in individuals with ASD.

Conclusions: Alexithymia appears to be a robust predictor of dimensional measures of autism symptoms, even when controlling for related anxiety and depression symptoms. This evidence emphasizes the connection between autism and alexithymia and suggests the importance of the assessment of alexithymia in both clinical and research settings.

4 **106.004** Antipsychotic Medication Use and Metabolic Monitoring in an Integrated Outpatient Clinic for Individuals with Autism and Other Neurodevelopmental Disabilities

L. M. Ruiz[1], M. Damron[2], K. B. Jones[3], D. Weedon[2], P. S. Carbone[2], A. V. Bakian[1] and D. A. Bilder[1], (1)Psychiatry, University of Utah, Salt Lake City, UT, (2)University of Utah, Salt Lake City, UT, (3)Family and Preventive Medicine, University of Utah, Salt Lake City, UT

Background: Antipsychotic medications are frequently taken by individuals with neurodevelopmental disabilities to address co-occurring psychiatric conditions. These medications increase metabolic syndrome risk and subsequent cardiovascular complications. The American Diabetes Association and American Psychiatric Association have established metabolic monitoring guidelines, but low reported rates of monitoring for medical complications of antipsychotic medications demonstrate a substantial gap between recommendations and clinical practice. The Neurobehavior HOME program (HOME) is an outpatient clinic with integrated primary and psychiatric care, funded by Medicaid, for individuals across the lifespan with neurodevelopmental disabilities and co-occurring psychiatric disorders. The majority of HOME enrollees have autism spectrum disorder (ASD) with or without intellectual disability (ID). HOME provides a unique setting to study prescribing and monitoring practices for antipsychotic medications in this high risk population.

Objectives: This study aims (1) to describe antipsychotic use among children and adults with neurodevelopmental disabilities served in an outpatient clinic, and (2) identify subsequent metabolic monitoring rates.

Methods: Participants included all patients enrolled in HOME from January through June 2013. Participant characteristics (i.e., antipsychotic use, demographics, insurance coverage, and disability type, see Table 1) and metabolic monitoring were obtained from billing records, Medicaid pharmacy data, and electronic medical records. Multiple and single variable logistic regression models were fit to investigate the association between antipsychotic medication use, medication monitoring, and participant characteristics. The models that included HOME program enrollment duration, insurance category, and co-occurring metabolic conditions as independent variables were adjusted for age.

Results: HOME program enrollees totaled 832 participants (67% males; mean age: 29.1 years, range: 4-82). Disability types were as follows: 9.3% ASD only, 30.2% ID only, and 54.8% ASD and ID. Sixty-one percent (n=508) of participants were taking antipsychotic medication. Compared with those not taking antipsychotics, participants taking antipsychotics did not experience significantly higher rates of prediabetes/diabetes, dyslipidemia, or hypertension. Antipsychotic use was significantly associated with male gender (p<0.01) and having both ASD and ID (p=0.02). Participants with triple insurance coverage (Medicaid, Medicare, and private) were less likely to take an antipsychotic medication (p=0.01) than those with Medicaid alone. Metabolic monitoring rates among participants taking antipsychotics were as follows: lipids, 75%; glucose/Hemoglobin A1c (BG/HbA1c), 85%; weight, 91%; and blood pressure, 93%. Advanced age was associated with BG/HbA1c (p<0.001) and lipids (p<0.01), whereas younger age was associated with monitoring weight (p=0.01).

Conclusions: Our findings demonstrate high antipsychotic medication use among participants with neurodevelopmental disabilities in this outpatient setting. A greater likelihood of antipsychotic use was associated with male gender and the co-occurrence of ASD and ID, but not with ASD only. Overall, most participants were monitored for weight and blood pressure and the majority, for BG/HbA1c and lipids. Notably, advanced age was associated with BG/HbA1c and lipid monitoring and inversely associated with weight monitoring. Metabolic monitoring rates for participants taking antipsychotics were high in HOME, suggesting the importance of an integrated care model for patients at risk for medical complications from psychiatric medication. Further study is needed to identify factors that facilitate medical monitoring of medication in individuals with neurodevelopmental disabilities.

5 **106.005** Anxious Imagery in Children with Autism Spectrum Disorder

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United Kingdom, (2)Denmark Hill, King's College London, London, United Kingdom, (3)Children's Neurosciences Centre, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom, (4)Children's Neurosciences Centre, Guy's and St Thomas' NHS foundation trust, London, United Kingdom, (5)Cognition and Brain Sciences Unit, Cambridge University, Cambridge, United Kingdom

Background:
Anxiety disorders occur in ~40% of children with ASD (van Steensel et al, 2011), compared to 2-3% in the general population. Reasons for this increased rate are currently speculative although a small body of research is emerging investigating cognitive and physiological pathways to anxiety in ASD (Hollocks et al, 2013). In the typically developing (TD) adult population, research has suggested mental imagery may play a role in the aetiology and maintenance of anxiety disorders. Images can be extremely vivid, intrusive and more emotionally-laden than verbal thoughts; despite this, the latter have tended to be the focus of most cognitive behavioural research. Given that individuals with ASD are often thought of as being 'visual thinkers' (Kunda and Goel, 2011), we sought to examine the role anxious imagery might play in the development and maintenance of anxiety in this population.
Objectives:
This is an exploratory cross sectional cohort study investigating anxious imagery in children with ASD with both high and low anxiety, compared to TD children with both high and low anxiety.
Methods:
78 participants (29 ASD high anxiety; 14 ASD low anxiety; 17 TD high anxiety; 18 TD low anxiety) aged 8-16 (69% male) matched for IQ took part in a semi-structured interview that provided both quantitative and qualitative data on the features of images experienced, and the meaning attached to them. Participants completed four questionnaires examining anxiety, depression, spontaneous use of imagery in daily life, and emotional regulation. Parents completed anxiety, depression, and the Social Communication Questionnaire. Nominal data were compared using χ^2 or Fisher's exact tests. Parametric or nonparametric tests were used for continuous measurements as appropriate given normality. For the binary logistic regression a backward elimination approach was used using predictor variables with presence of anxiety as the dependent variable.
Results:
Children with ASD and anxiety reported the highest number of anxious images, followed by children with ASD and low anxiety, TD children with anxiety, and finally TD children with low anxiety ($\chi2=22.7$; p<0.001). Children with anxiety regardless of ASD diagnosis had images that were more frequent ($\chi2=9.1$; p=0.028); more vivid (t=-2.7; p=0.012), and had more emotional valence (t=-2.8; p=0.007). Examples of anxious intrusive imagery included 'the eyes emanating from the television'; 'the nothing thing – a shadowy creature'; 'the sound of the teacher shouting at my classmate' 'standing alone at the school gates with no one to pick me up'; 'the smell of blood from my arteries popping'. Logistic regression revealed that anxiety in all groups was predicted by vividness of images(OR=3.6, p=0.011).
Conclusions:
Children with ASD and anxiety experience anxious imagery that causes them distress. These images may play a significant role in the high rates of anxiety seen in ASD. This finding also has treatment implications for the delivery of CBT in anxiety disorders in this group, which may be more effective if imagery modification/restructuring as well as verbal cognitions are addressed in therapy.

6 **106.006** Assessing ASD Symptoms and Comorbid Psychopathology in Adults with ASD: Who Should You Ask?

A. N. Heintzelman, A. M. Pearl, M. Murray and K. C. Durica, Department of Psychiatry, Penn State Hershey, Hershey, PA

Background: ASD symptoms and psychiatric comorbidities in adults with ASD are notoriously difficult to assess. Recently, self- and other-report versions of the Social Responsiveness Scale, Second Edition (SRS 2) have been normed on adults. In regards to psychopathology, there are several well-established measures to assess psychiatric symptoms in typically developing adults. To the authors' knowledge, the few assessment tools specifically designed to assess for comorbid psychiatric symptoms in individuals with ASD are still in their infancy. However, little is known about the agreement between self- and other-reports of these symptoms in adults with ASD on available assessment tools.
Objectives: To explore agreement between self- and caregiver-report of ASD symptoms and comorbid psychopathology.
Methods: Twenty-one adults diagnosed with ASD ages 18- to 35-years-old (M = 22.57, SD = 4.03) enrolled in a 16-week social skills intervention. 91% were male and 95% were Caucasian. Prior to beginning the intervention, ASD diagnosis was confirmed via the Checklist for Autism Spectrum Disorders (CASD; M = 22.67, SD = 3.17) and verbal IQ was estimated using the Kaufman Brief Intelligence Scale, Second Edition (KBIT 2; M = 93.40, SD = 18.84). Exclusionary criteria included verbal IQ below 70. Additionally, the participants and a primary caregiver completed the Adult Self-Report (ASR) or Adult Behavior Checklist (ABCL), as well as the SRS 2.
Results: Intraclass (ICCs) and Pearson correlations between raters for ASD symptoms on the SRS 2 were significant only for the Social Cognition (ICC & r = .54, p < .01) and Social Motivation (ICC & r = .51, p < .01) subscales. Inter-rater differences were examined using paired-samples t-tests. There were significant differences between self- and caregiver-report on all subscales of the SRS 2. Effect

sizes for these differences ranged from medium to large (Cohen's *d* range = .42 to .72). There were no significant differences between self- and caregiver-report on any of the subscales on the Adult Self-Report/Adult Behavior Checklist. When intraclass (ICCs) and Pearson correlations between raters for these subscales were examined the all subscales were significant correlated except for the Withdrawn Problems, Thought Problems, Rule-breaking Problems, and Avoidant Problems subscales. The Aggression and Externalizing subscales had the highest correlations suggesting that these variables are observed more consistently between young adults with ASD and their caregivers as compared to the other subscales.

Conclusions: The SRS 2 demonstrated poor inter-rater reliability between reporters. Caregivers of young adults with ASD consistently rated their children higher on the SRS 2 than individuals rated their own behavior. This suggests that importance of acquiring other-reports of ASD symptoms when assessing young adults' symptoms of ASD. The ABCL and ASR demonstrated high inter-rater reliability between reporters. These results suggest that these broadband measures of psychopathology are valuable tools for researchers and/or clinicians to screen for the presence of symptoms of internalizing and externalizing disorders in adults with ASD. The high inter-rater reliability provides more confidence for the utility of these instrument when obtaining a self-report rating.

7   **106.007** Association Between Age at Menarche and Autistic Traits in Turkish University Students

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Background: The androgen theory of autism suggests that masculinizing effect of fetal androgens may play a role in the expression of autism. Recent evidence also showed that prenatal androgen exposure might delay age at menarche (AAM).

Objectives: There is a limited number of studies examining the relation between autism and AAM. In a cross-sectional survey, relied on retrospective self-reports, AAM was delayed by 8 months in women with ASD when compared with age-matched controls (13 years 4 months vs. 12 years 7 months, respectively). Recently, an association between higher autistic-like symptoms and relatively later AAM was reported in a sample of typically developing girls. The aim of this study was to examine the association between AAM and autistic traits in a nonclinical sample of female university students. As prenatal androgen exposure is implied in the etiologies of both AAM and autism, we predicted that there would be a positive relation between autistic traits and menarche age.

Methods: The participants of the study were female university students, recruited from a public university in the middle part of Turkey, Konya. Because timing of menarche differs among ethnic groups, only White-Caucasian participants were included in the study. AAM was assessed using the following question: 'How old were you when you experienced your first menstrual bleeding?' Participants were asked to respond in years and months. Retrospective self reports of AAM are generally accepted as reliable and accurate in young women. Autistic traits were measured using the Autism Spectrum Quotient (AQ).

Results: A total of 436 female university students participated in the study. The mean age of the sample was 19.6 ± 1.3 years (range = 17.1 – 24.8) and the mean AAM was 13.3 ± 1.1 years (range = 9.6 – 16.5). The mean AQ Total Score was 18.6 ± 4.7 (range = 6 - 32). Spearman's correlation analysis revealed a positive relation between AQ Total score and AAM (r = .100, p = .037), indicating individuals with higher AQ Total scores had later AAM. We examined the correlations between AAM and each subscale of the AQ. Social Skills, Communication and Imagination subscales were significantly and positively correlated with AAM. We also compared the AAM between participants who scored 26 or higher on the AQ (n = 25, % 5.7) versus those who scored less than 26 (n = 411, %94.3), as 26 had been proposed as a cut-off score. Subjects with above average autistic traits (AQ ≥ 26) reported later AAM than subjects with below average autistic traits (AQ < 26) (13.8 ± 0.9 years vs. 13.3 ± 1.0 years; Z = -1.943, p = .052).

Conclusions: We found a positive relation between autistic traits and AAM in nonclinical university students. These findings are consistent with the androgen theory of autism suggesting that delayed menarche and autistic traits may share a common developmental mechanism, exposure to high levels of prenatal androgens.

8   **106.008** Association Between Pubertal Stage and Behavioral Profile Across Neurodevelopmental Disorders

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Background: Puberty is a time period associated with tremendous biological, social and behavioral change. Youth with neurodevelopmental disorders (NDDs), including autism spectrum disorder (ASD), are not immune to these changes, and small case series have reported they may be at additional risk for behavioral deterioration at the time of puberty. To date, no research has evaluated the behavioral response to puberty across NDDs.

Objectives: The objective of this study was to determine the association between Tanner stage of

puberty and behavioral profile across NDDs.

Methods: This was a cross-sectional study using data collected through the Ontario Brain Institute Province of Ontario Neurodevelopmental Disorders (OBI-POND) network. OBI-POND enrolls children with NDDs, including ASD, attention deficit hyperactivity disorder (ADHD), obsessive compulsive disorder (OCD), and intellectual disability (ID). All participants had caregivers complete the Child Behaviour Checklist (CBCL). Participants aged 6 years or older (or their caregivers) completed a Tanner Staging Form, where penile/breast growth and pubic hair development are both reported compared to reference pictures. Spearman correlation coefficients were used to determine the bivariate association between Tanner stages of growth and pubic hair development and between Tanner stages and CBCL T-scores. We then assessed the influence of Tanner stage on CBCL scores using multivariate linear regression controlling for age, gender, and diagnosis.

Results: Three-hundred twenty participants were included in the analysis. Seventy-four percent of the sample was male (n=237). The mean age at enrollment was eleven years (standard error = 2.9 years). The distribution of NDDs was: ASD: 152 participants (48%); ADHD: 99 participants (31%); OCD 64 participants (20%); and ID 5 participants (2%). Participants were distributed through all Tanner stages (growth/pubic hair, respectively): Stage 1: 114/145; Stage 2: 67/55; Stage 3: 55/27; Stage 4: 52/51; and Stage 5: 28/39. The correlation coefficient between self-reported Tanner stages of growth and pubic hair was 0.88 (p<0.0001). There were no significant associations between CBCL internalizing behaviour scores with Tanner stage or any independent variable. Spearman correlations were significant between Tanner stage of puberty and externalizing behavior (r= -0.19, p=0.0006; and r= -0.24, p<0.0001 for growth and pubic hair, respectively) and in univariate regression models, diagnosis and age were also significantly associated with CBCL externalizing scores (p<0.0001). After controlling for diagnosis or age, the association between Tanner stage and externalizing behaviour scores was no longer significant.

Conclusions: Unadjusted associations between Tanner stage and externalizing behavior showed a trend toward decreasing externalizing behavior with increasing Tanner stage; however, this relationship was not significant when controlling for diagnosis and particularly, age. Future longitudinal studies of the effects of puberty in NDDs should focus on consecutive behavioral measures at successive Tanner stages.

9   **106.009** Associations Between ASD Symptoms, Internalizing Symptoms, Empathy, and Social Loneliness in Young Adults with ASD

A. M. Pearl, K. C. Durica, M. Murray and A. N. Heintzelman, *Department of Psychiatry, Penn State Hershey, Hershey, PA*

Background: Autism Spectrum Disorder (ASD) is a persistent and debilitating condition which is frequently accompanied by comorbid psychopathology. Problems with comorbid psychopathology are well-documented in children and adolescents with ASD, specifically in regards to anxiety and social loneliness (Mazurek & Kanne, 2009; White & Roberson-Nay, 2009), as well as impaired empathy in adults with ASD (Baron-Cohen & Wheelwright, 2004). More specifically, researchers have found high-functioning individuals with ASD report higher levels of anxiety, more loneliness than typically developing individuals (White & Roberson-Nay, 2009). However, little is known about these specific associations in young adults with ASD.

Objectives: The authors sought to examine associations between self- and caregiver-report of ASD impairment and internalizing symptoms, as well as self-reported empathy and social loneliness in young adults with ASD.

Methods: Twenty-one adults diagnosed with ASD ages 18- to 35-years-old (M = 22.57, SD = 4.03) were enrolled in a 16-week social skills intervention. 91% were male and 95% were Caucasian. Prior to beginning the intervention, ASD diagnosis was confirmed via the Checklist for Autism Spectrum Disorders (CASD, M = 22.67, SD = 3.17) and verbal intelligence was estimated through administration of the Kaufman Brief Intelligence Scale, Second Edition (KBIT 2; M = 93.40, SD = 18.84). Additionally, the participants and a primary caregiver completed the Achenbach Adult Self-Report (ASR) or Adult Behavior Checklist (ABCL), as well as the Social Responsiveness Scale, Second Edition (SRS 2). Participants completed the Social and Emotional Loneliness Scale for Adults (SELSA), Empathy Quotient (EQ), and the Social Phobia Inventory (SPIN).

Results: Bivariate correlations were completed to identify significant associations between the variables of interest. Higher self- and other-reported ASD symptoms were associated with higher self-reported internalizing symptoms [r = .62 (self), .64 (other), $p < .01$] and higher self-reported social anxiety symptoms [r = .67 (self), .41 (other), $p < .01$]. Additionally, higher other-reported internalizing symptoms were associated with higher empathy (r = .45, $p < .05$). Finally, in regards to social loneliness, higher social loneliness was associated with older age (r = .56, $p < .01$), ASD symptoms (r = .57, $p < .01$) and lower empathy (r = .57, $p < .01$). Higher family emotional loneliness was associated with higher impairment in ASD symptoms (r = .47, $p < .01$).

Conclusions: Findings contribute to the ASD literature supporting a significant association between level of ASD impairment and internalizing symptoms, including social anxiety in young adults. However, it was found that higher internalizing symptoms are also associated with more empathy in young adults with ASD. In regards to social loneliness, it was found that this was associated with older age, more ASD impairment, and less empathy. More specifically, young adults with more impairing ASD reported higher family emotional loneliness.

10   **106.010**   Autism Spectrum and Psychosis Risk in the 22q11.2 Deletion Syndrome; Findings from a Prospective Longitudinal Study

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Background: Individuals with the 22q11.2 deletion syndrome (22q11DS) have a 25-fold increased risk for developing psychotic disorders, in particular schizophrenia. Interestingly, several studies in children with 22q11DS have reported that the rate of Autism Spectrum Disorders (ASDs) is also increased in this population. However, it has been postulated that the social and communicative deficits observed in a subgroup of children with 22q11DS are in fact the prodromal signs of schizophrenia, rather than symptoms of another disorder (i.e. ASD). If this proposition is true, one would expect that the diagnosis of ASD in childhood predicts the emergence of psychosis later in life in individuals with 22q11DS.
Objectives: To test the hypothesis that children with 22q11DS with a diagnosis of ASD are more likely to develop a psychosis compared to children with 22q11DS without ASD.
Methods: 66 children with 22q11DS were assessed twice in a prospective longitudinal study; the average age ($\pm$SD) at first measurement was 14.3 ± 2.0 yrs, and at the second measurement 19.2 ± 2.9 yrs. Both measurements were performed by the same research team using standardized clinical interviews including the Autism Diagnostic Interview (ADI-R) and the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (Kiddie-SADS). Diagnosis of ASD and/or psychotic disorders were made in accordance to the DSM-IV criteria. The rate of individuals with psychotic disorders (including Schizophrenia and psychotic disorder NOS) and the rate of individuals who reported persistent positive psychotic symptoms (hallucinations and or delusional thoughts) were compared with those who had and those who had not been diagnosed with of ASD at first measurement.
Results: A total of 30.8% of children developed psychotic symptoms while 24.2% fulfilled criteria of a psychotic disorder during follow-up. The proportion of children with ASD who were diagnosed with a psychotic disorder at a follow-up assessment was 14,6 % versus 40.0% of children without ASD ($p=0.020$). The proportion of children who developed psychotic symptoms during follow-up followed a similar pattern (psychotic symptoms were observed in 25.0% of those with ASD versus in 40.0% of those without ASD ($p=0.20$)).
Conclusions: The findings of this study indicate that a diagnosis of ASD early in life is not associated with an increased risk for the subsequent development of psychotic disorders. If any, our data suggest that those with ASD may be less likely to develop psychotic disorders later in life. These results replicate a previously reported retrospective study in an independent cohort of adult individuals with 22q11DS. Our results indicate that early developmental deficits in social and communicative abilities in a subgroup of patients with 22q11DS can not be considered as prodromal symptoms of schizophrenia.

11   **106.011**   Body Mass Index (BMI) Is Negatively Correlated with Adaptive Functioning in a Population of Children with Neurodevelopmental Disorders

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Background: Childhood obesity is a global epidemic that leads to both significant physical health problems, such as, diabetes and cardiovascular disease, as well as mental health and behavioral problems. Both young children and adults with obesity have increased rates of internalizing and externalizing behaviors, and in children, the association seems to increase with age. Children with neurodevelopmental conditions have at least a similar if not greater risk of obesity compared to the normal pediatric population. Maladaptive behavior is a key feature of most neurodevelopmental disorders. Identifying alternative factors external to the disorder itself that may compound this problem is worthwhile, especially given the limited management options. Such behaviors greatly impact overall functioning, independence and quality of life.
Objectives: To determine if body mass index (BMI) is associated with internalizing behavior, externalizing behavior, or adaptive skills.
Methods: Data was drawn from the Province of Ontario Neurodevelopmental Disabilities (POND) Network, a large cohort of children with neurodevelopmental disabilities including autism spectrum disorder (ASD), attention deficit/hyperactivity disorder (ADHD), intellectual disability and obsessive compulsive disorder. Internalizing and externalizing behavior was measured using the Child Behavior Checklist (CBCL). Adaptive skills were measured using the Vineland Adaptive Behavior Scales (VABS). The Pearson correlation was used to determine the correlation between BMI, internalizing behavior, externalizing behavior and adaptive functioning.
Results: Complete data was available for 405 children with BMI values and externalizing and internalizing behavior scores. Children with BMI and VABS data were 263. The Pearson correlation demonstrated a significant negative correlation with the VABS Sum of Scores score (-0.381, $p < 0.01$) and total score (-0.244, $p < 0.01$). There was no significant correlation between BMI and internalizing or externalizing behavior.
Conclusions: Elevated BMI is a risk factor for physical and mental health issues, and is already an

important target in child health. Our data demonstrate an association of increasing BMI with worse adaptive skills. Further research is needed to more carefully explore this relationship. However, adaptive skills may represent an important target to help reduce BMI, and subsequently obesity in this population. Alternatively, reducing BMI may improve adaptive skills and overall independence.

12   **106.012** Burden of Psychiatric Symptoms in ASD: Understanding the Full Range from Inpatients to Outpatients and Across IQ

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Background: Children with autism spectrum disorder (ASD) have high rates of impairing comorbid psychiatric symptoms (Kaat, Gadow, & Lecavalier, 2013). However, there is a gap in our understanding of the symptom profiles of children with ASD who require psychiatric hospitalization as well as those with the most limited verbal and intellectual abilities.
Objectives: The overall project goal is to further elucidate the phenomenology of psychiatric symptoms in ASD. This is the initial comparison of two large cohorts of children with ASD with the full spectrum of intellectual and verbal ability levels who were treated at either a psychiatric inpatient unit or outpatient developmental disorders clinic.
Methods: Participants were children with an ADOS-2-confirmed ASD who were either inpatients on specialized psychiatric units (Autism Inpatient Collection, AIC; n = 78) or seen in an outpatient clinic (Cody Center for Autism and Developmental Disabilities; n = 283). Parent report of child psychiatric symptoms using the Child and Adolescent Symptom Inventory (CASI-4R and -5) was collected. The IQ range was similar in both samples (standard scores ~30 - ~140), but the AIC had a significantly lower ($p < .0001$) mean IQ (M = 68.51, SD = 29.39) than the Cody sample (M = 85.81, SD = 23.50), and more AIC participants (57%) were minimally-verbal than Cody participants (21%). Analyses focused on symptom count cut-off scores that reflect whether the required number of symptoms for a DSM-5 diagnosis are present and continuous symptom severity scores in five common ASD comorbidity domains (attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), generalized anxiety disorder (GAD), depression, mania).
Results: Parents endorsed a high rate of symptoms across both samples, with 99% of the AIC sample and 82% of the Cody sample exceeding at least one CASI cut-off (see Figure 1 for cut-offs by disorder). The AIC sample had significantly higher symptom severity scores ($p < .0001$) with large effect sizes across domains (Cohen's d's from .65-.90), except for depression. Higher IQ was related to more severe symptoms of ODD, GAD, and depression in the AIC sample, but was not related to either ADHD or mania symptoms (Figure 2). Magnitude of correlations between IQ and psychiatric symptom severity between the AIC and Cody samples only significantly differed for MDD (p=.005).
Conclusions: Psychiatric inpatients with ASD generally had more severe symptoms across common psychiatric domains than outpatients with ASD. These findings highlight the importance of psychiatric symptom severity as a key correlate of the most severe ASD presentations. Depression patterns were notably unique, with similar severity ratings across samples and a strong association with higher IQ only in the AIC. IQ was related to psychiatric symptom severity in several domains, which highlights the need to study comorbidity in fully representative samples. Future item-level analyses will help clarify whether IQ effects stem from reporting differences for symptoms that are more difficult to detect among those with less verbal ability. This work will help identify indicators of psychiatric hospitalization risk and inform our understanding of the structure of psychiatric symptoms in ASD.

13   **106.013** Chronic Sleep Reduction and Psychopathology Symptoms in Adults with High-Functioning Autism Spectrum Disorder

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Background: Insomnias are common co-morbidities reported by individuals with ASD, with resultant reduced total sleep time. Individuals with ASD are also reported to have a higher prevalence of anxiety and depressive disorders. However, the relationship between sleep, chronic sleep reduction, and psychopathology in adults with ASD has not yet been investigated.
Objectives: To investigate the relationships between sleep, chronic sleep reduction and psychopathology symptoms in adults with a diagnosis of autism spectrum disorder (ASD) and no comorbid intellectual impairment compared to age-, sex-, and IQ-matched neuro-typical (NT) adults.
Methods: Participants completed a questionnaire battery including the Chronic Sleep Reduction Questionnaire (CSRQ), the Patient Health Questionnaire, the State Trait Anxiety Inventory, and the Sleep Anticipatory Anxiety Questionnaire. Participants also completed a 14 day sleep/wake diary and 14-day actigraphy.
Results: Thirty-six adults with ASD and no comorbid intellectual impairment and 57 NT adults

completed the study. Currently data from 28 ASD and 28 NT participants has been analysed. These preliminary results showed that adults with ASD had significantly higher scores on all psychopathology measures; effect sizes were moderate to large. Adults with ASD also had significantly higher total scores on the CSRQ as well as on the shortness of sleep, irritability, and loss of energy sub-scales; effect sizes were also moderate to large. CSRQ scores were significantly and strongly correlated with all psychopathology variables in both groups. In assessing, psychopathology variables with sleep diary and actigraphy variables in the NT group, state anxiety was significantly correlated with total sleep time (TST; r = -.397) measured by both the diary and actigraphy. In addition, wake after sleep onset (WASO) duration measured by the diary was significantly associated with physiological sleep anxiety (r = .327), cognitive sleep anxiety (r = .363), and depression (r = .372). While in the ASD group only actigraphy variables were correlated with psychopathology measures. Specifically, state anxiety was significantly correlated with sleep onset latency (SoL; r = .356), WASO duration (r = .396), and sleep efficiency (r = -.433). Physiological sleep anxiety was associated with SoL (r = .340), and sleep efficiency (r = -.345), and depression was associated with WASO duration (r = .382), and sleep efficiency (r = -.346).

Conclusions: The CSRQ measures symptoms of chronic sleep reduction and thus the impact of sleep debt. The strong correlations between chronic sleep reduction and psychopathology variables confirms the impact poor sleep can have on general wellbeing in both groups; however the relationship between psychopathology symptoms and sleep appears to differ between the two groups. Subjective feelings of poor sleep are associated with increased symptoms of psychopathology in NT adults; however objective poor sleep is related to increased symptoms of psychopathology in ASD adults. It may be that NT adults are more inclined to under-report their sleep while ASD adults with increased psychopathology symptoms may not perceive their sleep to be as problematic. Data for the full sample of participants will be available at the time of presentation.

14   **106.014** Close but No Cigar: Factor Structure of the ADHD Rating Scale in Children with Autism Spectrum Disorder

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Background: DSM-5 allows comorbid diagnosis of autism spectrum disorder (ASD) and attention deficit/hyperactivity disorder (ADHD). This comorbidity was not allowed under DSM-IV, thus there is a paucity of research that examines whether parent and teacher rating scales used to identify significant ADHD symptoms are appropriate for use in youth with ASD. Many core symptoms of ADHD occur in a social context (e.g., talks excessively, doesn't listen when spoken to directly, interrupts or intrudes others, difficulty awaiting turn), and it is possible that elevated scores in children with ASD may be capturing social impairments rather than inattention and hyperactivity/impulsivity impairments. The ADHD Rating Scale is a commonly used measure in clinics and research as a screen for ADHD, because it maps directly to DSM symptoms. In a normative sample, the original factor analysis of the ADHD-IV rating scale found the best fit to be a two-factor solution (inattention and hyperactivity/impulsivity) consistent with the DSM-IV and DSM-5 ADHD subtypes. There are no published studies that examine the ADHD Rating Scale's factor structure in school-age youths with ASD.

Objectives: To characterize the factor structure of parent and teacher ratings ADHD rating scale in a large sample of youth with ASD and to probe commonly observed relationships between ADHD symptoms and youth characteristics.

Methods: Parents and teachers of 208 youths with an ASD diagnosis (192 males; Age M=10.45 (Range: 6-18 years)); General Conceptual Ability M=100 (Range: 67-158), completed this study. ASD was diagnosed using DSM-IV criteria and confirmed with ADI-R/ADOS. Confirmatory factor analysis (CFA) was used with polychoric correlations using one-, two- (Inattention, Hyperactivity/Impulsivity), and three-factor (Inattention, Hyperactivity, Impulsivity) models, with a robust weighted least squares estimation. We also conducted Pearson correlations with age, executive function, and adaptive behaviors.

Results: According to parents, 57% did not meet clinical cut-off; 16% were Predominantly Inattentive, 6% Predominantly Hyperactivity/Impulsivity, and 21% Combined type. According to teachers, 73% did not meet clinical cut-off; 14% Predominantly Inattentive, 4% Predominantly Hyperactivity/Impulsivity, and 9% Combined type. Correlations revealed significant, but modest, negative relationships for age with parent and teacher ratings of hyperactivity/impulsivity (rs=-.26 and -.29), and teacher ratings of inattention (r=-.22). Partial correlations between parent ADHD symptoms and parent BRIEF scales while controlling for age revealed moderate-to-large effects (r's>.46). Correlations between parent ADHD symptoms and parent adaptive behavior ratings revealed significant but modest negative correlations (Socialization r=-.23 and Communication r=-.29).

The CFA did not meet Goodness-of-Fit criteria for the 1-factor (Parent: CFI=.907, TLI=.894, RMSEA=.127; Teacher: CFI=.873, TLI=.857, RMSEA=.144) or 2-factor models (Parent: CFI=.946, TLI=.938, RMSEA=.097; Teacher: CFI=.946, TLI=.938, RMSEA=.095), but the 3-factor met partially (Parent: CFI=.952*, TLI=.944, RMSEA=.093; Teacher: CFI=.958*, TLI=.951*, RMSEA=.084). Modification indices suggest items 5, 10, and 15 reduced the 3-factor model fit.

Conclusions: Prevalence rates and relationships with youth characteristics converge with prior studies, but the factor structure observed in community youth did not fit for youth with ASD. Three items require modification to distinguish ADHD from social interaction deficits or more general ASD deficits. This study has significant clinical and research implications for screening/diagnosing ADHD in ASD.

15 **106.015** Correlates of Cross-Sectional and Longitudinal Health-Related Quality of Life Among Children with Autism Spectrum Disorders

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Background:
Studies of the health-related quality of life (HRQoL) of children with Autism spectrum disorders (ASD) have not examined the association of health conditions with HRQoL.
Objectives:
We examine the associations of ASD-related characteristics, behavioral characteristics, and health conditions with baseline and longitudinal change in HRQoL.
Methods:
We examined HRQoL using the Pediatric Quality of Life Inventory (PedsQL) total scores for children enrolled in the Autism Speaks – Autism Treatment Network (AS-ATN) Registry. Children in the AS-ATN Registry were enrolled from 2008 through 2013 from 19 sites with a confirmed ASD diagnosis. We used linear regression to identify associations between baseline behavioral and health characteristics and baseline HRQoL and longitudinal structural mean models to test for baseline characteristics predictive of change in HRQoL over time. We examined the following characteristics: Age, race, gender, insurance status, household income, caregiver education, IQ, ASD diagnosis characteristics including the DSM-IV and the calibrated ADOS severity score, Child Behavior Checklist (CBCL) internalizing and externalizing scores, Children's Sleep Habits Questionnaire (CSHQ) total scores, parent reported gastrointestinal (GI) symptoms (by type), and history of seizures and specific mental health problems. Longitudinal models were adjusted for potentially informative loss to follow-up using inverse-probability weights estimated from the same predictors.
Results:
Our sample of 5,624 children was 6.3±3.5 years old at baseline (range 2 to 18 years), 84% male, 77% Caucasian, 53% covered by private insurance, and 59% with an income of $50,000 or higher. Baseline analyses omitted 843 children who lacked PedsQL assessments completed within 60 days of their baseline visit. Children were followed for an average of 0.8 years (range 0 to 4 years).
Mean PedsQL score at baseline was 65.1 (range of 11.8 to 100). All but ADOS and caregiver education independently predicted baseline PedsQL in bivariate analyses. In a multivariate model using stepwise selection considering all baseline characteristics, older age (beta=-1.40, p<.01), having any insurance (beta=-8.17, p<.01), higher CBCL externalizing and internalizing scores (beta=-.23, p<.01; beta=-.53, p<.01), higher CSHQ scores (beta=-.27, p<.01), caregiver education of at least some college (beta=-2.53, p<.01), having seizures (beta=-3.45, p<.05), having stomach pain (beta=-2.87, p<.01), and having stomach reflux (p=-2.01, p<.05) were associated with lower baseline PedsQL total scores.
Baseline mean PedsQL total scores did not significantly improve or decline over time. Age, DSM-IV diagnosis, IQ, CBCL internalizing and externalizing scores, having anxiety, having depression, and having OCD were significant unadjusted predictors of PedsQL trajectory. In a multivariate longitudinal model, using stepwise selection considering all baseline characteristics, older age predicted slower decline in PedsQL (interaction beta=.49, p<.01) while having public insurance and history of seizures predicted faster decline (beta =-2.04, p<.05; beta=-4.13, p<.01, respectively).
Conclusions:
Similar to previous work, both behavioral issues and sleep problems are associated with lower baseline HRQoL. This study additionally found that physical characteristics including GI symptoms and seizures were associated with HRQoL. These results strongly suggest that paying attention to physical health is important for children with ASD.

16 **106.016** Dietary Influences on BMI in Children with Autism Spectrum Disorders

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Background: The prevalence of childhood obesity has increased over the past two decades in the United States. Children with autism spectrum disorders (ASD) may have a similar or greater prevalence of obesity due to selective eating and mealtime behaviors which may alter risk factors
Objectives: Known dietary risk factors (points of intervention) for overweight/obesity in the general population will be analyzed for children with ASD. Children with ASD with and without

overweight/obesity will be compared on the following factors: 1) food categories contributing the most calorie per day 2) caloric intake from sugar sweetened beverages (SSB); 3) servings of fruits and vegetables consumed 4) number of eating occasions/day; and 5) breakfast consumption.

Methods: Children (n=292) with ASD (2-11 years) from five Autism Speaks Autism Treatment Network (AS ATN) sites (Rochester, Pittsburgh, Cincinnati, Little Rock, Denver) participated in an AIRP study of dietary intake (2010-11). They were characterized per the AS ATN registry protocol for diagnosis and demographics. Prospective three day diet diaries were collected and analyzed using Nutrition Database Research Studies software. BMI (Body Mass Index) was calculated. In addition to the above, data analysis includes food category comparison to the National Health and Nutrition Examination Survey (NHANES 2005-06 for ages 2-13 years), descriptive statistics, t-test and chi square.

Results: The mean age of respondents was 5.2 years, 84% were male. Only the 4-8 year old age group in both the ASD and NHANES groups were similar in the top ten food categories relative to calorie intake: grain based desserts, yeast breads, pizza, pasta and pasta dishes and reduced fat milk. The top foods that contributed to caloric intake were different in children (2-3, 8-11 years) with ASD compared to the NHANES sample. SSB contributed fewer calories (% kcal/day) for children with ASD compared to the NHANES sample (2-3 years: 0.7% v.s. 1.5%; 4-8 years: 1.8% v.s 2.8%, 9-11 ASD: 1.8% v.s 9-13 NHANES: 2.8%). Within the top ten calorie contributing food categories, 100% fruit juice (not orange or grapefruit) (2-3 years 5.3%; 4-8years 3.2%) and fried white potatoes (3.0%) were the only fruit or vegetable that were ranked. Children with ASD had eating occasions on average of 18/3 days (5.9 SD). More than 95% of children with ASD consumed breakfast on all three days across BMI groups. Relationships of these feeding behaviors with BMI will be further examined.

Conclusions: As in the general population, addressing eating behaviors is an important behavioral target for overweight/obesity prevention and management in children with ASD. Targeting SSB and breakfast consumption may have less impact on obesity management. Additional modifications to the current approach of promoting healthy weight may be necessary for children with ASD.

17   **106.017** Dispositional Mindfulness Predicts Anxiety in Adults Diagnosed with Autism Spectrum Disorder

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Background: Converging findings show that individuals diagnosed with autism spectrum disorders (ASD) often experience severe comorbid anxiety. Other research suggests that mindfulness skills (paying attention to the present moment in a non-judgmental way), are associated in neurotypical people with less anxiety and stress. A few recent studies have shown benefits of mindfulness-based interventions on anxiety in ASD. However, no studies to date have examined how trait mindfulness and trait anxiety are associated in everyday function in ASD.

Objectives: This study aimed to examine the role that dispositional mindfulness plays in predicting anxiety in adults diagnosed with ASD, compared to age- and IQ matched typical controls. We hypothesized that ASD adults would report decreased mindfulness overall compared to controls but that mindfulness would significantly predict anxiety levels in both ASD and control groups. Finally, we explored whether the separate factors of mindfulness captured by the Five Facet Mindfulness Questionnaire (FFMQ) might vary across groups in their predictive value for anxiety.

Methods: Participants included 21 young adults (ages 18-30) who have been diagnosed with ASD and a control group (CON group) consisting of 20 college students who reported no history of psychological diagnoses. Participants completed a brief intelligence test (WASI-II) and several self-report measures including the Five Facet Mindfulness Questionnaire, the State Trait Anxiety Inventory (a measure of everyday anxiety symptoms), and the Social Responsiveness Scale-2nd Edition (as a measure of dimensional autism symptoms).

Results: As expected, the ASD group reported significantly less mindfulness than controls. However, mindfulness was shown to affect the two groups differently. Multiple regression demonstrated that increased anxiety for ASD group is predicted by decreased levels of the mindfulness facets of *observe*—which measures attention to sensations and emotions; and *non-reactivity*—the ability to let emotions come and go without getting stuck on them. In contrast, anxiety in the CON group was significantly predicted by the facet of *non-judging*, meaning the ability to experience negatively-valenced feelings without condemning them.

Conclusions: These findings support other recent research in our lab that anxiety in ASD may arise from limited awareness of internal emotional states. We hypothesize that this limited awareness leads to feelings of uncertainty about how to respond to any given situation, and subsequent worry about whether one is responding appropriately. This may underlie a tendency to get "stuck" on particular feelings and situations. These findings also confirm that incorporating mindfulness in psychological interventions can be helpful for ASD populations. However, because mindfulness may moderate anxiety differently in ASD than neurotypical adults, interventions should be tailored specifically for the types of comorbidity seen in ASD populations.

18   **106.018** EEG Endophenotypes in Autism Spectrum Disorder

ABSTRACT WITHDRAWN

Background: The association between autism and epilepsy has been consistently reported.   EEG abnormalities have been reported in patients with autism spectrum disorder (ASD) without a history of seizures. However, little is known about the relationship between EEG abnormalities and the core features of autism, particularly relating to deficits in communication, cognition and behavior.
Objectives: The purpose of the study was to identify the presence of epilepsy and EEG abnormalities among youth with well-characterized ASD in order to determine the relationship between epileptiform discharges and specific disease-associated impairments in ASD.
Methods: Data was collected from medical records of patients at Cincinnati Children's Hospital Medical Center, ages 2 years to 6 years, with well-characterized ASD. These patients were sub-divided into four groups: ASD/abnormal EEG, ASD/normal EEG, ASD/no EEG, and ASD/epilepsy. Phenotypic data was collected, including cognitive and behavioral measures (Mullen Scales of Infant Development, Stanford-Binet, Vineland Adaptive Behavior Scales, Child Behavior Checklist), language testing (Preschool Language Scales), ADOS scores, birth and developmental history, medications, and medical comorbidities. EEG data was abstracted from reports and included presence, characterization, and localization of abnormalities.
Results: We now report on data from an initial group of 534 consecutively treated patients with ASD drawn from a larger 3,800 subject data set. From this initial group, analysis was carried out on 168 patients with ASD who had an EEG. Thirty-seven (24.5%) had an abnormal EEG and no history of seizures. Of these, 17 (46%) were epileptiform. Patients with epilepsy exhibited higher scores on the Anxious/Depressed subscale of the CBCL compared to the other patient groups, which reached statistical significance when compared to patients with abnormal EEGs (p=0.01). Patients with abnormal EEGs exhibited NVIQ scores 14 points lower than patients with normal EEGs on the Stanford-Binet. Although differences were not statistically significant, significance may be attained with larger sample size. For these two groups, a sample size of 45 in each group will have 80% power to detect a difference in means of 15.0 in NVIQ with a standard deviation of 25.0 using a two group t-test with a 0.050 two-sided significance level, yielding an effect size of 0.4. Patients with epilepsy performed worse on all IQ measures on the Stanford-Binet compared to the abnormal EEG group. Though the differences were not statistically significant, significance may be attained with larger sample size. For these two groups, a sample size of 26 in each group will have 80% power to detect a difference in means of 19.3 with a standard deviation of 24.0 using a two group t-test with a 0.05 two-sided significance level, yielding an effect size of 0.8. Based on our identified sample size, we are confident that we will have the power to detect a significant difference between groups.
Conclusions: Preliminary analysis suggests that the presence of an abnormal EEG or epilepsy in the setting of ASD confers worse cognitive and behavioral outcomes. Further analysis will further help to clarify these associations and may offer insight into treatment for this sub-population.

19 **106.019** Eating Problems Are Associated with Autism Severity in Toddlers with Autism Spectrum Disorder

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Background:
The prevalence of feeding problems in typical toddlers is estimated to be 25% and 46-89% for children with autism spectrum disorder (ASD). Most of the problems in feeding toddlers with ASD are behavioral in nature and includes food selectivity or picky eating. The selective diet which in some cases doesn't meet the nutrition needs for optimal growth may lead to adverse long term medical and developmental outcomes. There are only few studies on the relationship between eating problems and severity of the ASD core symptoms.
Objectives: The aim of the current study was to explore the frequency and type of eating disorder in toddlers with ASD and to examine the association between selective eating disorder and the severity of autism symptoms.
Methods:
The study included 117 toddlers aged 19-39 months (M=29.2; SD=4.3), 93 boys and 24 girls diagnosed with ASD that were enrolled in 8 center-based early intervention programs (EIP) for toddlers with ASD. The assessment included evaluation of autism severity using the Social Communication Questionnaires (SCQ), filled by the caretakers and the EIP professional team at the entrance to EIP. Information on eating profile was obtained by a questionnaire developed by the researchers. The questionnaire included information on the variety of foods accepted by the participant, the eating habits, dietary intake and selectivity based on colors, textures and shapes.
Results:
Based on the results of the eating profile questionnaire 5 subgroups were defined: 38% had no eating problems, (adequate variety and appropriate for age eating habits); 30% had extreme selectivity in food intake (eating < 16 types of food, not meeting the food pyramid requirements); 16% had mild selectivity in food intake (accept at least 16 types of food including at least 4 types of fruit and vegetables, 3 different types of protein rich food and 3 different types of carbohydrates); not meeting the food pyramid requirements); 4% ate only ground food or formula; 1% refused food (eating small amount of food, 1-2 times a day, fulfilled the criteria for failure to thrive). To assess the

association between selective eaters and autism severity, the group without eating problems (n=40) was compared in autism severity to a group with selective eating consisted of participants from the subgroups 2, 3 and 5 (n=51). The professional team SCQ scores revealed that the group with selective eating had significantly more severe autism symptoms than the group without eating disorder (p<0.001). Specifically, higher reciprocal-social interaction and communication domains scores were noted for the selective eating group (p<0.05).

Conclusions:
Toddlers with ASD present high prevalence of eating problems specifically extreme selective eating. The selective eating profile is associated with higher severity of ASD symptoms, specifically in social and communication domains. These findings emphasize the importance of evaluating the eating problems of young children with ASD. Specific intervention for the eating abnormalities to ensure an adequate diet for proper growth and development should be part of the treatment plan. It is suggested that improving core ASD symptoms might reduce the selective eating problems.

20 **106.020** Eating Problems in Men and Women with ASD and Average Intelligence

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Background:
Research shows that eating problems are common in children with ASD. However, we know little about eating problems and eating disorders in adults with ASD with normal or high intelligence. Furthermore, information is lacking about differences in eating problems between men and women with ASD.

Objectives:
To examine eating problems in men and women with ASD and average or high intelligence.

Methods:
19 men and 21 women with ASD and full scale IQ > 85 were examined using the Dutch translation of the SWEA (SWeadish Eating Assessment for Autism). Results were compared with 30 neurotypical men and 32 neurotypical women. The ASD and non-ASD groups were matched on level of education and age. Diagnoses of the participants with ASD were based on the ADI-R and an interview based on the DSM-5 criteria of ASD.

Results:
Results showed that the men with ASD reported significantly more preferences for certain foods, more sensitivity for food surrounding and less sensitivity for signals of hunger and thirst than the neurotypical men. The women with ASD reported similar problems as the men with ASD. The women with ASD also reported significantly more sensory sensitivity regarding foods, problems in motor control, difficulty with social aspects of eating situations and symptoms of formal eating disorders than neurotypical women.

Conclusions:
Our results seem to indicate that men and especially women with ASD experience various eating problems. In women, there was also evidence for symptoms of eating disorders. Further research is necessary, especially regarding the diagnostics and treatment of eating problems and eating disorders in men and women with ASD.

21 **106.021** Elevated Prevalence of Overweight and Obesity Among Children with Autism Spectrum Disorders

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Background:
Pediatric overweight and obesity are a significant public health concern. Although many of the risk factors for unhealthy weight are likely the same among children with ASD as in the general population, children with ASD may be vulnerable to additional risk factors including atypical eating patterns, food selectivity, and limited opportunities for social/physical activity. The presence of these additional risk factors raises the question of whether children with ASD are more likely to be overweight or obese compared to children without ASD.

Objectives:
To determine if the prevalence of unhealthy weight overall and obesity specifically is significantly higher in individuals with ASD (available through the Autism Speaks Autism Treatment Network [ATN]) versus those from a general population sample (available through the National Health and Nutrition Examination Survey [NHANES]).

Methods:
Children with ASD (n = 5053; ages 2-17) enrolled in the ATN were compared to children in an age-matched sample available through NHANES (n = 8844). In both samples, weight and height were measured during a standardized physical exam and were used to calculate BMI percentiles; classifications of overweight (OWT; 85th percentile ≤ BMI < 95th percentile) and obesity (OBY; BMI ≥ 95th percentile) were according to CDC guidelines for BMI for sex and age. Children in the ATN sample had confirmed ASD diagnoses according to DSM-IV-TR (American Psychiatric Association, 2000) criteria and supported by administration of the ADOS (Lord et al., 2000). Following NHANES analysis guidelines, prevalence estimates were calculated after applying the mobile examination center 6-year

sample weights to take into account the complex sampling design. Estimates were compared using two-proportion z-tests across all ages (2-17) as well as by age group (2-5, 6-11, 12-17) for unhealthy weight status (OWT or OBY) as well as only obese weight status (OBY). Further analyses were conducted for boys and girls separately, as well as by the following racial/ethnic groups: Non-Hispanic white, Non-Hispanic black, Hispanic.

Results:
In this study, 33.6% of children with ASD (2-17 years) were an unhealthy weight and 18% were obese. Compared to the NHANES general population sample, prevalence estimates for unhealthy weight overall and for obesity only were significantly higher among children with ASD than in the general population for those ages 2-5 and 12-17, regardless of gender.

Conclusions:
Our results indicate that the prevalence of unhealthy weight status is significantly greater among children with ASD compared to the general population, which is consistent with several recent reports based on measured height and weight values in individuals with confirmed ASD diagnoses (Broder-Fingert, Brazauskas, Lindgren, Iannuzzi, & Van Cleave, 2014; Egan, Dreyer, Odar, & Beckwith, 2013). We also found that these differences are present as early as ages 2-5. Since obesity is more prevalent among older children in the general population (Ogden, Carroll, Kit, & Flegal, 2014), these findings raise the question of whether there are different trajectories of weight gain among children with ASD, possibly beginning at a very early age.

22   **106.022**   Ethnic Differences in Comorbid Impairments in Attention and Hyperactivity Among Youth with Autism Spectrum Disorder

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Background: Under the DSM-5, a diagnosis of autism spectrum disorder (ASD) no longer excludes a diagnosis of Attention-Deficit/Hyperactivity Disorder (ADHD). Given the high rates of problems with attention and impulse control in ASD, it is likely that many children with ASD will qualify for a comorbid diagnosis of ADHD (Leyfer et al., 2006). Prior research has found that in the general population, African American (AA) children tend to have higher rates of problems with attention, hyperactivity, and impulsivity than White children, but are less likely to be diagnosed with ADHD (Miller, Nigg, & Miller, 2009). AA children are also less likely to be diagnosed with ASD (CDC, 2014). Thus, AA children with ASD may be at particular risk for under-diagnosis of comorbid ADHD.

Objectives: The aim of the present study was to investigate rates of comorbid symptoms of ADHD and ADHD diagnoses in AA versus White children with ASD. Based on prior research, it was hypothesized that rates of ADHD diagnosis would be lower in AA children than White children, but that symptom rates would be higher.

Methods: Participants included treatment-seeking youth with a confirmed diagnosis of ASD, ages 5-19 years with an IQ>70, recruited as part of a larger research study and through clinical evaluation. From the initial sample of 966 participants, a final sample of 35 White and 35 AA participants was generated, matched on gender and full-scale IQ (within 5 points). Groups did not differ significantly based on age or highest level of parental education. Parent report on the ADHD Rating Scale (DuPaul, Power, Anastopoulos, & Reid, 1998), and select subscales of the Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) and the Child Behavior Checklist (CBCL; Achenbach, 2001), was compared across the AA and White groups. Rates of clinical ADHD diagnosis and use of stimulant and non-stimulant medication for ADHD symptom treatment, obtained by medical record review, were also compared.

Results: Independent samples t-tests were used to assess differences in ADHD symptoms across ethnic groups. Chi-square analysis was used to assess differences in diagnostic rates. Significant differences were found on both the Inhibit (t=3.04, p<.003) and the Working Memory (t=2.95 p<.004) subscales of the BRIEF, with White children rated as having significantly more problems than AA children. White children were also rated as having significantly more problems on the Attention Problems subscale of the CBCL (t=3.04, p<.003) and the Inattention subscale of the ADHD Rating scales (t=2.66, p<.01). Results of a chi-square analysis indicated that White children were significantly more likely to be diagnosed with ADHD (χ^2=5.57, p<.02). However, rates of medication use did not differ significantly by ethnicity.

Conclusions: Contrary to findings in the general population, AA children with ASD were rated as having fewer symptoms of ADHD than their White peers. AA children with ASD may have lower rates of comorbid ADHD. Differences in parent perceptions may also have affected the present findings.

23   **106.023**   Features of Pathological Demand Avoidance Identified Using the Diagnostic Interview for Social and Communication Disorders ('DISCO')

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Background:

Pathological demand avoidance (PDA) is a term coined by Elizabeth Newson to describe children within the autism spectrum who exhibited an unusual pattern of behaviour. The key characteristics of this group included (1) an obsessive resistance to complying with everyday demands; (2) an apparent ability to use behaviour strategically to subvert requests, such as distracting or using 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 towards targeted at particular people, who may be loved or hated (or both). Intriguingly, Newson reported an equal gender ratio, and also noted that those with PDA responded to different educational and management approaches than most individuals with autism – in particular surprise, humour and flexibility. Identifying PDA features in individuals with ASD may have an important clinical function in providing more tailored educational and support strategies.

Objectives:

Whilst interest in PDA is increasing apace in the UK, as yet, no validated clinician-rated instrument has been used to systematically quantify PDA features. The primary objective was to identify items that tap PDA features from within the Diagnostic Interview for Social and Communication Disorders (DISCO) (Wing & Gould, 2002). In particular, we were looking for items that are relatively low frequency across an autism spectrum sample per se, but commonly endorsed in PDA. The second objective was to examine the behavioural profile across a high scoring subset on PDA indicators in a sample assessed using the DISCO (N=153).

Methods:

We identified items relevant to PDA from the DISCO on the basis of previous data on a sample reported to have been identified as having PDA (O'Nions et al., 2014), and by examining which items were endorsed as 'marked' in less than 30% of the sample for whom DISCO data was available (N=153). We then identified cut-offs for the purposes of these analyses, and compared our high scoring subset to the rest of the sample on other DISCO indicators.

Results:

The behavioural profile of the high scoring group resembled Newson's descriptions. The group was characterised by high levels of lack of cooperation, use of socially manipulative behaviour, socially shocking behaviour with deliberate intent, difficulties with others, and sudden changes from loving to aggressive behaviour in particular. Anxiety was reported at very high rates in the high scoring subset. Additional features, including physical aggression, laughing at others' distress, lack of awareness of psychological barriers, difficult or objectionable personal habits, needing constant supervision and demanding attention from caregivers were also seen more frequently in the high scoring PDA subset than the rest of the sample. All but one of the high scoring PDA group met criteria for ASD.

Conclusions:

This study provides an important step towards deriving a clinician rated measure to tap PDA features. Differences in the behavioural profile highlight the need for further investigations of the neurocognitive and etiological basis of this profile.

24 **106.024** Fractal Analysis of Autonomic Nervous System Function in ASD

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Background: Emerging evidence suggests that autism spectrum disorder (ASD) may be associated with dysfunction of the autonomic nervous system (ANS). However, it remains unclear how the observed atypicalities are related to atypicalities in individual branches of the ANS (sympathetic versus parasympathetic). The interplay between these two branches is particularly challenging to investigate as the nonlinear relationship between the activity of the two branches of the autonomic nervous system challenges the reliability of commonly used linear tools (e.g., HRV spectrum analysis). In this paper, we employ fractal analysis of cardiac interbeat intervals to investigate this issue. In typical populations, fractal analysis have revealed the presence of long-range, power-law correlations in this time series which are altered with disease and aging. Fractal analysis of cardiac signals in ASD have not been reported to date. This new approach to analysis ANS function may provide further insight on the nature of these atypicalities.

Objectives: To investigate ASD-related alterations in the fractal structure of interbeat intervals during baseline and response to an anxiogenic stimulus.

Methods: A sample of typically-developing children (n=33, age: 12.5 +/-2.9 years, full-scale IQ: 112.9 +/- 14.1, 19 male), and those with a diagnosis of ASD (n=40, age: 12.0 +/- 2.9 years, full-scale IQ: 92.9 +/- 20.6, 33 male) completed an anxiogenic task (Stroop test), preceded and followed by a 15-minute and 5-minute baseline task (movie watching), respectively. Throughout the experimental session, electrocardiogram (ECG) was measured and used to extract inter-beat interval time-series. Deterended fluctuation analysis (DFA) was used to obtain the scaling exponent, an index of complexity in the signal. Repeated measures multiple regression analysis was performed to examine

the effect of group and group x time interaction on the scaling exponent while controlling for age, gender, and full-scale IQ.

Results: Multiple regression analysis revealed a significant group x time interaction for the scaling exponent (p=0.04) (Figure 1), suggesting atypical fractal dynamics in the ASD group.

Conclusions: Our results suggest that ASD may be associated with atypical fractal structure in the cardiac interbeat sequences. Specifically, the results point to altered, and possibility decreased, flexibility and adaptability of the autonomic response in ASD. This study adds to the body of evidence supporting atypical ANS function in ASD. Future studies with longer time-series are needed to further characterize the nature of nonlinear atypicalities in this domain.

25   **106.025** Gastrointestinal Issues in Children with Autism Spectrum Disorders Compared to Children with Developmental Delays and a Population Based Sample in the Study to Explore Early Development (SEED)

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Background: Gastrointestinal (GI) problems are commonly reported in children with autism spectrum disorders (ASD), with prevalence ranging from 9 to 70%. However, many studies do not include comparison groups; thus, it has been difficult to assess whether GI problems in children with ASD differ in frequency from children with developmental delays (DD) or children with typical development.

Objectives: Determine the prevalence of parent-reported GI problems and the use of treatments for constipation in children with ASD compared to children with DD recruited from community sources serving children with developmental concerns and children recruited from the general population (POP) in the Study to Explore Early Development (SEED).

Methods: SEED is a multi-site, case-control study designed to thoroughly characterize phenotypes of ASD in children ages 2 to 5 years and to examine potential genetic and environmental risk factors for ASD. The cohort includes children born between the years 2003 and 2006. Children classified as ASD (n=672), DD (n=994), and POP (n=911), whose parent completed a GI questionnaire were included in this analysis (80.5% of the total sample). These analyses are limited to questions related to current GI issues (occurring greater than 2 times per month) such as vomiting, diarrhea, constipation, abdominal pain and gas; treatment for constipation in the previous 30 days with stool softeners, laxatives, or fiber supplements; and GI problems that were present in the past but were not present at the time of the survey. Chi-square tests were used to assess overall group differences. Between group differences were explored through univariable logistic regression.

Results: Parents reported current GI problems in 35% of children with ASD, 22% of children with DD, and 12% of POP children (p<0.0001). Children with ASD were more likely to have current GI problems than POP children (OR= 4.01, 95% CI= 3.10, 5.21) or children with DD (OR=1.96, 95% CI= 1.56, 2.44). Parents reported past GI problems in 28% of children with ASD, 19% of children with DD, and 14% of POP children (p<0.0001). Children with ASD were more likely to have past GI problems than POP children (OR= 4.51, 95%CI= 1.95, 3.26) or children with DD (OR=1.68, 95% CI 1.32, 2.12). Parents reported use of treatment for constipation in 16% of children with ASD, 13% of children with DD, and 8% of children in the POP group (p<0.0001). Children with ASD were more likely to use treatments for constipation than POP children (OR=2.24; 95% CI 1.63, 3.09). However, the use of treatments for constipation was not significantly different between the ASD and the DD groups (OR= 1.27; 0.96, 1.68).

Conclusions: Based on parent report, children with ASD had a higher frequency of current and past GI problems than children with DD and children from the POP group. Children with ASD and DD had greater use of treatments for constipation compared with the POP group. These findings have implications for clinical management. The findings are also informative for understanding phenotypic subtypes in future genetic analyses of risk for ASD.

26   **106.026** Gastrointestinal Symptoms and Associated Clinical Features in Preschoolers with Autism Spectrum Disorders

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Background:
Parents of children with autism spectrum disorder (ASD) frequently report gastrointestinal (GI) symptoms in their child with a higher prevalence than in typically developing peers (TD). Moreover, literature suggests that children with ASD and GI disorder(s) (ASD/GI+) may be at high risk for problem behaviors.
Objectives:
To investigate the clinical features of ASD/GI+ preschoolers compared to ASD children without GI symptoms (ASD/GI-) and to TD using the Child Behavior Checklist for ages 1.5 to 5 years (CBCL 1.5-5), a parent-report questionnaire for evaluating the child's functioning during the last two months.
Methods:
A total of 230 preschoolers were included in this study. The ASD group consisted of 115 subjects (95 male and 20 female; mean [SD] age =3.8 [1.1] years; age range =1,8-5,9 years) with a clinical diagnosis of Pervasive Developmental Disorders (PDD) based on the DSM-IV-TR criteria. The control group consisted of 115 TD children (95 male and 20 female; mean [SD] age =3.9 [1.0] years; age range =1,8-5,9 years) with a CBCL 1.5- 5 Total Problems T score below the clinical range and without a CBCL profile suggestive of ASD (Muratori et al., 2011). Parents of children filled out the CBCL 1.5 -5. Items responses are recorded on a Likert scale: 0 = Not True, 1 = Somewhat/Sometimes True, 2 = Very True/Often True. A Total Problem Score, the Internalizing and Externalizing Problems scores, six different syndromes scores (Emotionally Reactive, Anxious/Depressed, Withdrawn, Sleep Problems, Attention Problems, and Aggressive Behavior) and five DSM-oriented Problems scales scores (Affective, Anxiety, Pervasive Developmental, Attention Deficit/Hyperactivity, Oppositional) were evaluated. GI symptoms were identified in seven CBCL items (Costipated, Diarrea, Nausea, Noteat, PainfulBM, Stomachaches, Vomiting).
Results:
At least one GI symptom was reported by parents of 69,6% of ASD children versus 53,9% of TD peers (p<0.05). When more stringent criteria to define subjects suffering GI symptoms (at least one GI symptoms scored as "2") were used, the prevalence of GI problems were still significantly higher in ASD (37,4%) than in TD individuals (15,7%) (p =0.0003). Specifically, "Not eat" and "Costipated" were the items more frequently reported both in ASD/GI+ and in TD with GI symptoms (TD/GI+) children, but with a significantly higher prevalence in ASD than in TD (respectively p<0.01; p<0.01).
Within the ASD group, ASD/GI+ showed a higher percentage of borderline/clinical scores in Aggressive (p<0.01), Internalizing (p<0.01) and Total Problems than ASD/GI-(p<0.001) scores whereas within the TD group, TD/GI+ exhibited a higher percentage of borderline/clinical scores in Internalizing (p <0.01) and Affective Problems (p<0.05) scores than TD/GI-.
Conclusions:
Preschoolers with ASD had higher prevalence of at least one GI symptom than TD peers. GI symptoms were related to behavioral problems both in ASD and in TD subjects, but aggressive behaviors appeared specific to ASD/GI+ children. The observed association suggests that GI symptomatology should be systematically checked and treated in ASD patients, in order to potentially reduce not only GI symptoms, but also the emotional and behavioral associated features.

27 **106.027** Gastrointestinal Symptoms, Whole Blood Serotonin Levels, and Behavioral Symptoms in Children and Adolescents with Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is characterized by social communication deficits and repetitive behavior, but several co-occurring medical disorders are also increased in ASD. Constipation appears to be particularly common, occurring in 32% of children in the Autism Speaks Autism Treatment Network (Peters et al., 2014). In parallel, elevated whole blood serotonin, or hyperserotonemia, is a well-replicated, heritable biomarker occurring in a subgroup of approximately 28% of children with ASD (Gabriele et al., 2014). In the periphery, serotonin (5-hydroxytryptamine, 5-HT) is synthesized in gut enterochromaffin cells that release it into the blood, where >99% of whole blood 5-HT is found stored in platelets. Within the gastrointestinal (GI) system, 5-HT regulates multiple processes, including motility and inflammation (Gershon, 2014). To our knowledge, no previous study has examined the relationship between gastrointestinal symptoms and whole blood 5-HT levels in ASD. Previous studies have separately examined behavioral correlates in these ASD subgroups, with some but not all studies finding elevated rates of self-injury, repetitive behavior, sensory processing difficulties, and heightened stress reactivity associated with either GI symptoms or elevated blood 5-HT levels.
Objectives: Our primary aim was to investigate the relationship between gut symptoms, particularly functional constipation, and whole blood 5-HT levels in children and adolescents with ASD. We also aimed to assess the relationship between functional constipation, whole blood 5-HT levels, and previously reported behavioral correlates.
Methods: This multicenter study involved a sample of 81 children with ASD, ages 6-18, with and without GI symptoms. The Questionnaire on Pediatric Gastrointestinal Symptoms—Rome III Version

(QPGS-RIII) was used to assess GI disorders. Whole blood serotonin was measured by high-performance liquid chromatography. Sensory symptoms, repetitive behavior, and anxiety were assessed using caregiver reported measures. Stress reactivity was assessed by heart rate variability during two stress-inducing tasks.

Results: Functional constipation (FC) was the most common Rome III diagnosis, occurring in 42% (34/81) of the sample. Participants with functional constipation did not differ from those with no GI diagnosis on age, sex, race, ethnicity, or IQ. Comparing to previous norms (McBride et al., 1998), 23% (19/81) of the participants had 5-HT levels two standard deviations above the mean for their age, sex, and race. Whole blood 5-HT levels, corrected for age and sex, were not significantly different in the functional constipation group in comparison to those with no GI diagnosis ($p = 0.18$). Behavioral measures and stress reactivity were not different in the hyperserotonemic or in the functional constipation subgroups in comparison to the rest of the sample.

Conclusions: No association between functional constipation and whole blood serotonin was observed in this population of children with ASD. These are preliminary analyses, with further analysis ongoing to include measurement of inflammatory markers.

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28   **106.028** History of Tympanosotomy Tube Placement in Children Referred to a Tertiary Autism Diagnostic Center

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Background: Tympanostomy tube placement (TTP) is the most common outpatient pediatric surgery performed in the United States, with nearly 1 in 15 children having tubes by the age of 3 years. Despite a lack of evidence to support TTP in improving developmental outcomes in previous studies that have excluded children with neurodevelopmental disorders, clinical guidelines have been published recommending tubes be offered to children with neurodevelopmental disorders, including speech/language disorders, global developmental delay, and autism spectrum disorder (ASD). However, the prevalence of TTP in children prior to receipt of a formal ASD diagnosis has not been previously reported.

Objectives: To determine the prevalence of prior TTP in children referred for d

Methods: The electronic medical records of all children ≤ 5 years of age evaluated at a single regional ASD diagnostic center between September 2012 and June 2014 were reviewed. History of TTP, clinical diagnoses, and demographic information was abstracted for each patient.

Results: 561 children (80% [N=450] male; 20% [N=111] female) with mean age of 44 months (SD 10 months) completed a diagnostic autism evaluation. Of those evaluated, 95 (17%) had a history of TTP. Of those patients with tubes, 61% (N=58) received an ASD diagnosis and 33% (N=31) were diagnosed with another neurodevelopmental disorder (speech/language disorder [N=11]; global developmental delay [N=20]).

Conclusions: Our data indicate that 1 in 6 children presenting for diagnostic evaluation at a regional autism center have a history of prior TTP. Despite recently published guidelines advocating for TTP in children with neurodevelopmental disorders, given concerns about the potential negative neurodevelopmental impact of exposure to anesthesia/surgery further investigation into whether neurodevelopmental outcomes are improved in children with neurodevelopmental disorders who undergo TTP is needed, as previous studies on the impact of TTP have excluded this population of children.

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29   **106.029** Impact of Feeding Disorders in Parental Stress in Children with Autism Spectrum Disorder and with Other Developmental Disabilities

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Background: Feeding difficulties, in particular food selectivity, have been reported in children with autism spectrum disorder (ASD) and eating problems are typically part of the repertoire of symptoms for a child with ASD. There are few comparisons with children with other developmental disabilities (DD) and the impact of such problems in the family dynamics.

Objectives: To compare feeding disorders in children with ASD vs. those with other DD, and to assess the relationship of feeding problems to parental stress.

Methods: Cross sectional study with structured interview for 50 children with ASD and 50 children with other DD, matched by age/gender. DDs included intellectual disability/global delay and cerebral palsy. Interview included: Feeding Questionnaire, Aberrant Behavior Checklist (ABC) and Parental Stress Index, Short Form. Statistical analysis included McNemar, chi-square, t test and logistic regression.

Results: Mean age 8±3 yr; 15% White, 44% Hispanic and 24% African/American. Food selectivity was

reported in 74% of the ASD group and 62% of the DD group (p=1). Both groups reported selectivity to textures (ASD=36% vs. DD=32% p=.8) and to color (ASD=20% vs. DD=10% p=.2) but children with ASD were more likely to present smell selectivity (36% vs. 14% p=.02), brand selectivity (30% vs. 6% p=.008), inability to mix the food (36% vs. 8% p=.003) and pica (24% vs. 2% p=.003). Both groups reported food allergies (14% vs. 14% p=1). Children with ASD were more irritable (54% vs. 20% p=.001) and parents reported more stress (46% vs. 22% p=.05). There was no association between irritability or parental stress with overall food selectivity in either group, but in the ASD group children with selectivity to textures were more irritable (83% vs. 35% p=.03) and parents reported more stress (77% vs. 26% p=.001). The association between food selectivity (textures) and parental stress persisted after adjusting for demographics, developmental diagnosis and irritability (OR 2.7 95% CI 1.01-7.5).

Conclusions: Both children with ASD and other DD presented with different types of food selectivity. In families of children with ASD, selectivity to textures was associated with parental stress. Feeding programs that ameliorate food selectivity in children with ASD may decrease parental stress.

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30   **106.030** Internalizing Symptoms in Adults with ASD: Relation to ASD Symptomatology

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Background: Studies of internalizing symptoms in autism spectrum disorder (ASD) estimate that approximately 40-45% of individuals with ASD have significant levels of anxiety and depression (Sterling et al., 2007; White et al., 2009). To assess internalizing symptoms, measures used in the general population or those being used with individuals with intellectual disability (ID) are being adapted or considered for use in ASD. However, given overlap of symptoms, it can be difficult to differentiate ASD and internalizing symptoms, raising the possibility of diagnostic overshadowing and challenging differential diagnosis. The wide range of functioning in ASD complicates measurement and screening of internalizing symptoms.

Objectives: The purpose of this study was to examine caregiver reported internalizing symptoms and how these symptoms relate to severity of ASD. This study assessed a variety of internalizing problems in adults with ASD across a wide range of intellectual functioning and ASD symptom severity.

Methods: Caregivers completed surveys about adults with ASD as part of a study on the long-term outcome and needs of individuals with ASD in mid-adulthood served as children by the University of North Carolina TEACCH Autism Program. Thus far, 81 caregivers have completed surveys. Adults with ASD had an average age of 33 years (range 20-64 years). The Social Responsiveness Scale, Second Edition (SRS-2; Constantino & Gruber, 2012) Adult (Relative/Other Report) and Waisman Activities of Daily Living Scale (W-ADL; Maenner et al., 2013) were completed in addition to a screening instrument for internalizing symptoms developed for use among individuals with ID, the Anxiety, Depression, and Mood Scale (ADAMS; Esbensen et al., 2003).

Results: The SRS-2 total score was significantly positively correlated with all factors of the ADAMS although the strength of the correlation varied across factors. General Anxiety was significantly positively correlated with SRS-2 total, $r = .35$, $p = .002$, as was Depressed Mood, $r = .23$, $p < .04$, Social Avoidance, $r = .62$, $p < .001$, Compulsive Behavior, $r = .49$, $p < .001$, and Hyper/Manic Behavior, $r = .51$, $p < .001$. Better adaptive skills were significantly related to fewer internalizing symptoms and fewer ASD symptoms. When adaptive skills were controlled for, SRS-2 total and ADAMS factors of Social Avoidance, Compulsive Behavior, and Hyper/Manic Behavior remained significant; Generalized Anxiety and Depression were no longer related to SRS-2 total.

Conclusions: Generally, internalizing symptoms on the ADAMS were related to increased ASD symptoms and fewer adaptive skills. However, these results do not necessarily suggest that those with more ASD symptomatology are at higher risk for comorbidity. Instead, some internalizing factors may be measuring symptoms of ASD. For instance, ASD symptoms were most highly correlated with Social Avoidance and Compulsive Behavior, which overlap with symptoms of ASD. However, Generalized Anxiety and Depression scores were weakly correlated with ASD symptoms and may be more indicative of comorbidity on this screener. These results suggest that increased focus on appropriate screening and measurement of comorbidity in adults with ASD deserves significant attention as it has important implications for treatment, community service needs, and quality of life.

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31   **106.031** Investigating Sympathetic over-Arousal in ASD

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Background: There is emerging evidence to suggest that ASD is associated with atypicalities in the autonomic nervous system (ANS), the branch of the peripheral nervous system responsible for regulating visceral body functions. The findings to date, however, have been disparate with regards

to which branch of the ANS is affected in ASD, and point to large heterogeneity in individual responses. Characterizing autonomic functioning and variables contributing to heterogeneity in this domain are important steps towards understanding the neurobiology in ASD.

Objectives: The objectives of this study were to 1) characterize the functional profile of the sympathetic branch of the ANS in a sample of children with ASD using electrodermal activity measurement, and 2) examine the effect of anxiety symptoms on ANS profiles in this population as a potential variable contributing to response heterogeneity in this domain.
Methods: A sample of typically developing (TD) children (n=29, age:12.7+2.8, FSIQ: 112.2+ 13.6, 16 male) and children with ASD (n=36, age: 12.4+ 2.8, FSIQ: 94.6+20.7, 30 male) were recruited for this study. Participants performed tasks eliciting anxiety, attention, working memory, response inhibition, and social cognition. During the performance of these tasks, electrodermal activity (EDA) signals were recorded for each participant using a wearable sensor from Shimmer Research. Mean tonic EDA and number of electrodermal responses produced during each task were computed for each participant. Anxiety symptoms were characterized using the Child Behaviour Checklist (CBCL). Participants in the ASD group were divided into high and low anxiety groups using a cut-off of 65 on the CBCL Anxiety/Depressed domain.
Results: The ASD group had significantly lower tonic EDA than the TD group (p=0.03). There was a significant effect of anxiety group on the electrodermal response, with the high anxiety ASD group having significantly decreased tonic electrodermal activity compared to the TD group (p=0.03). The difference between the low anxiety group and the TD and high anxiety group did not reach significance, although this may be due to insufficient statistical power.
Conclusions: The results of this study suggest hyperarousal of the sympathetic branch of the ANS in children with ASD, and suggest anxiety as a potential variable for stratification of participants in studies of ANS in ASD.

32   **106.032** Longitudinal Changes in the Presence and Severity of Self-Injurious Behaviors, and Predictors of Change, in Children with Autism Spectrum Disorders

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Background: Self-injurious behaviors (SIB) are common in children with autism spectrum disorders (ASD). Understanding the natural history of SIB in ASD can inform studies examining the efficacy of interventions. Furthermore, identification of characteristics that predict changes in SIB over time may help target interventions.
Objectives: To assess parent-reported changes in the presence and severity of SIB in children with ASD over one year and explore baseline characteristics that predict changes.
Methods: Parent-reported current presence (yes/no) and current severity (mild, moderate, severe) of SIB at both baseline and follow-up visit were examined among children with ASD aged 2-17 years enrolled in the Autism Treatment Network registry. Participants were categorized into: SIB present at both visits, SIB absent at both visits, SIB present at baseline but not follow-up (improvement), and SIB absent at baseline but present at follow-up (new occurrence). Subjects who improved were compared to those with SIB at both visits. Subjects with new occurrence were compared to those without SIB at both visits. The four severity groups were: mild at both visits, moderate-severe at both visits, moderate-severe at baseline and mild at follow-up (improvement), and mild at baseline and moderate-severe at follow-up (deterioration). Subjects who improved were compared to those who remained moderate-severe, and subjects who deteriorated were compared to those who remained mild. McNemar's test was used to evaluate all differences in proportions and logistic regression was used to assess effects of baseline demographic, developmental, behavioral, and somatic characteristics on all changes.
Results: Among 1575 participants with data on presence of SIB at both visits, SIB was present in 34.2% at baseline and 28.0% at follow-up. SIB improvement was more common at follow-up (14.7%) than was new occurrence (8.5%, p<0.0001). Improvement was associated with higher baseline adaptive behaviors scores (adjusted OR=1.02; 95% CI: 1.00, 1.04). Improvement was less likely in children with developmental regression (aOR=0.64; 0.43, 0.95) and low maternal education (aOR=0.66; 0.44, 0.98) at baseline. New SIB occurrence was associated with aggression (aOR=2.09; 1.43, 3.06) and low maternal education (aOR= 1.81; 1.18, 2.78). New occurrence was less likely with higher baseline adaptive behaviors scores (aOR=0.97; 0.95, 0.99). Only 277 participants had severity data at both visits due to changes in data collection, but had similar characteristics to those without follow-up data. Among these 277 children, 54.3% had mild SIB and 45.7% had moderate-severe SIB at baseline, while 60.1% had mild SIB and 39.9% had moderate-severe SIB at follow-up. More parents reported change from moderate-severe to mild (19.5%), compared to the reverse (11.5%; p=0.02). Higher IQ at baseline predicted improvement (aOR=1.02; 1.00, 1.04), while having public insurance (aOR=3.02; 1.16, 7.90) and low maternal education (aOR=3.46; 1.28, 9.40) at baseline predicted deterioration.
Conclusions: At baseline, parents reported SIB in 34.2% of children. More parents reported resolution than development of new SIB. Further, SIB severity was more likely to improve over time than to

worsen. Maternal education, public insurance, IQ scores, developmental regression, and adaptive behaviors scores at baseline predicted changes in SIB and may be useful for targeting SIB prevention and interventions.

33 **106.033** Loxapine Substitution for Reversal of Antipsychotic-Induced Metabolic Disturbances: A Retrospective Chart Review

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Background:
Atypical antipsychotics are widely used to treat irritability and aggression in Autism Spectrum Disorders (ASD), despite side effects of significant weight gain and associated metabolic disturbances. Our findings regarding low-dose loxapine, a typical antipsychotic with atypical properties, warrant further study in reversal of metabolic illness associated with atypical antipsychotic treatment in ASD.
Objectives:
To examine a naturalistic outpatient clinic sample of adolescents and adults with ASD who received loxapine for weight and metabolic indicator outcomes. We hypothesized that substitution of loxapine for atypical antipsychotics or chlorpromazine would have beneficial effects on weight and metabolic indicators as well as behavioral outcomes.
Methods:
We performed a retrospective chart review of consecutive adolescents and adults with DSM-IV-TR ASD presenting on an atypical antipsychotic (n=14) or chlorpromazine (n=1), together with at least one form of metabolic disturbance before low dose loxapine substitution.
Results:
Subjects were 12 males and 3 females. Mean age was 31.7 years (range 16-61 years). Mean loxapine treatment duration at the time of chart review was 11.5 months (range 3-20 months). Final loxapine dose for 12 subjects was 5 mg/day and 10 mg/day for 3 subjects. 14 of 15 subjects tolerated addition of loxapine and tapering or discontinuation of their presenting antipsychotic. At the time of chart review, 14 of 15 subjects had a Clinical Global Impressions Scale- Improvement (CGI-I) of 2 (Much Improved) or 1 (Very Much Improved). In addition, 13 of 15 subjects had a CGI-I of 2 or 1 at $\geq$ 50% of their visits during loxapine treatment. Mean weight loss was significant at -6.65 kg (SD 10.07; median -3.22 kg). Mean BMI reduction was significant at -2.47 (SD 3.3; median -1.67). Mild extrapyramidal symptoms were noted in 3 subjects. No significant change in blood pressure or pulse was noted. Detailed metabolic indicator data, including fasting lipids, fasting glucose, and HbA1c, will be elaborated on.
Conclusions:
Our findings suggest that loxapine may safely enable tapering of an atypical antipsychotic in order to reverse drug-induced weight gain in patients with ASD.

34 **106.034** Medical and Psychiatric Comorbidities in a Cohort of Adults with Autism Spectrum Disorder

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Background: it is well known that children with autism spectrum disorder (ASD) usually present a wide range of medical comorbidities. Some of these medical conditions, such as epilepsy, gastrointestinal disorders, asthma, autoimmune diseases or sleep disorders, are usually more frequent in this patient group compared to the general population. Unfortunately, to date there is a paucity of data regarding medical and psychiatric co-occurring symptoms in adults with ASD.
Objectives: the aim of the present study is to investigate the presence of medical and psychiatric comorbidities in a cohort of adults with ASD.
Methods: one hundred and fifty subjects were recruited. All participants were screened by a senior psychiatrist who diagnosed ASD and evaluate the current presence of other psychiatric or neurological symptoms. Medical status was evaluated by a physician specialized in internal medicine. Medical charts were thoroughly reviewed in order to obtain information about previous medical problems.
Results: in the entire sample, we observed numerous medical comorbidities such as epilepsy, tuberous sclerosis, celiac disease or gluten sensitivity, systemic lupus erythematosus, etc. We observed a discrepancy according to QI value: ASD patients with intellectual disabilities present more medical comorbidities then patients with higher QI values (p<0.05). The more frequent psychiatric diagnoses were major depression and anxiety disorder.
Conclusions: These preliminary results support the hypothesis of a specific medical risk associated with ASD, with a different pattern according to the presence of intellectual disability. These data will possibly enable physicians to carry on appropriate examinations and to provide prompt care and treatment.

106.035 Medical and Psychiatric Comorbidity Among US Adolescents with Autism Spectrum Disorder from the NCSA

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Background: Autism spectrum disorder (ASD) is a heterogeneous disorder with high prevalence of comorbid learning disability (LD), another neurodevelopmental disorder. ASD is associated with increased risk for a wide range of medical and psychiatric conditions affecting multiple bodily systems, including gastrointestinal (GI), autoimmune/inflammatory, and neurological disorders as well as anxiety and conduct disorders. These comorbid conditions have been shown to cluster differentially within ASD samples.

Objectives: This study evaluates parent-reported ASD and other comorbid disorders in a nationally representative sample of U.S. adolescents to estimate and compare the prevalence and risk of medical and psychiatric comorbidity among ASD youth with and without comorbid LD compared to their typically developing peers.

Methods: The sample included adolescents aged 13-18 who participated in the National Comorbidity Survey – Adolescent supplement (NCS-A) whose parents answered a self-administered questionnaire concerning their child's lifetime health and development, including ASD and LD status (N=6,295). The NCS-A is a nationally representative household survey of adolescent mental health in the US. Participants were recruited between 2001 and 2004. ASD, LD, and status of 9 medical conditions were evaluated by parent report. Psychiatric disorder status was derived from both adolescent interview and parent report and grouped into six categories. Adjusted odds ratios (aOR) were estimated using multivariate logistic regression adjusted for age, sex, race/ethnicity, and household income. All estimates were weighted to represent the national population of adolescents at the time of recruitment and were evaluated at a 95% confidence level.

Results: The overall prevalence of ASD and LD was 0.7% (SE: 0.1) and 14.3%, (SE: 0.7) respectively. Approximately 70% (SE: 8.0) of ASD adolescents also had LD, while 3.6% (SE: 0.9) of adolescents with LD had ASD. There was increased risk for GI (ASD without LD: aOR= 8.83, p= 0.04; ASD with LD: aOR=4.52, p=0.003; LD without ASD: aOR= 1.70, p=0.03) and epilepsy/seizures (ASD without LD: aOR= 16.30, p= 0.005; ASD with LD: aOR=7.60, p=0.003; LD without ASD: aOR= 2.82, p=0.001) across all neurodevelopmentally-affected subgroups compared to typically developing peers. Only ASD without LD adolescents had higher odds of having heart problems (aOR=8.03, p=0.04). ASD with LD was significantly associated with allergy (aOR= 3.41, p=0.02), while ASD without LD approached significance (aOR=3.44, p=0.06).

Conclusions: Overall prevalence and comorbidity between ASD and LD in the NCS-A is similar to other population-based estimates, with a majority of ASD adolescents also having LD. ASD subgroups with and without LD reveal distinct patterns of comorbidity, possibly indicating different biological underpinnings as well as health and social service needs. Increased risk for allergy was specific to ASD. However, increased risk for GI and seizures, two medical conditions thought to be etiologically related to ASD, spanned all affected subgroups, suggesting an overarching neurodevelopmental component to this risk not specific to ASD. These findings highlight the importance of comprehensive multidisciplinary evaluation of youth with ASD.

36 **106.036** Methodological and Reporting Issues in Child Weight Research in ASD

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Background: Researchers have been increasingly interested in studying weight in particular groups, such as those with autism spectrum disorder (ASD). They are specifically attempting to identify risk factors and correlates of abnormal weight, possibly for use in prevention or intervention programs, as well as to increase understanding of how prescribing medications could have long-term effects on body mass. While there is literature available that can offer insight, often times the methodology or reporting practices are inconsistent, which can lead to confusion and prevent future results from being compared to existing data. Part of this confusion in weight reporting may stem from authors choosing to report p values and specific results (e.g., odds rations or F tests) in the absence of reporting the amount of variance for which these risk factors were able to account.

Objectives: Identify the amount of variances different studies are able to account for and compare that to the results that are reported in their publications. Evaluate whether the way current data are presented is useful for general consumption, and if not, construct recommendations that will further understanding and allow comparisons to be drawn between studies.

Methods: Search for weight literature using keyterms such as "child," "children," "weight," "overweight," "obese," and "obesity" that were published no earlier than the year 2000. All abstracts were evaluated to see if the paper included (a) original research, (b) identification of a risk factor or correlate of weight, and (c) included statistical outcomes that could be manipulated into amount of variance accounted if it was not explicated stated. If a paper appeared to include these criteria, it was evaluated further. Special attention was given to papers directly including children with ASD.

Results: Preliminary results at the time of abstract submission identified 23 articles that met the criteria mentioned above. Four of the articles related to children with ASD and an additional four related to children with intellectual or developmental disabilities. Although it was expected that

multiple statistical techniques would be used to evaluate weight (multiple regression, logistic regression, etc.), the results produced highly variable outcomes, with amount of variance ranging from .01%-41%.

Conclusions: Most studies where investigators reported statistic that were able to be converted into amount of variance accounted for produced relatively small amounts of variance (less than 8%). If studies accounted for substantially greater amounts of variance, they normally used BMI that was unadjusted for age, which is not recommended for children. Eleven studies out of the 23 preliminarily included were not able to be converted, as they did not include all needed necessary output (e.g., explicit degrees of freedom). Future researchers should be mindful that accounting for considerable variance is difficult, and possibly unlikely in weight studies, and that small numbers should be reported so it is common knowledge. The ASD field is investigating abnormal weight issues with increasing frequency, and as such, it is in our interest to quantify specific results (especially variance) for increased clarity by reporting more than significant p values.

37   **106.037**   New Directions and Research Opportunities for Investigators: Longitudinal Outcomes in the Autism Speaks Autism Treatment Network (AS ATN)

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Background:
The Autism Speaks Autism Treatment Network (AS ATN) Registry, which began enrollment in December 2007, is a multi-center clinical registry that includes both retrospective and prospective data on children ages 2-17 years with ASD. The ATN Registry is unique in containing data on medical co-morbidity, as well as diagnostic, behavioral, and functional assessments. As of December 2013, there were 6854 children enrolled in the AS ATN Registry. While cross-sectional data are valuable, there is a critical need to track children over time in order to better examine the trajectory of medical co-morbidities in ASD and their impact on neurodevelopmental outcomes. A subset of children in the current registry have longitudinal data (medical follow-up visits in year 1, 2, and 3). The AS ATN has made a focused effort over the last 12 months to increase the longitudinal data in the registry to provide researchers with more opportunities to examine medical and clinical changes in children with ASD over time. One of the goals of the AS ATN is to provide opportunities to develop collaborations and partnerships with clinicians and researchers who are external to its current ATN centers.
Objectives:
To make IMFAR attendees aware of the type of longitudinal data available in the AS ATN Registry.
Methods:
Baseline measures including autism assessment, cognitive, behavioral, quality of life, and medications were described. Frequencies for categorical variables were tabulated, and descriptive statistics (number of observations, mean, and standard deviation) were generated for continuous variables. Counts were provided for the number of children with longitudinal data available for each measure.
Results:
The majority of the children in the registry are male (83.9%), Caucasian (80.0%), non-Hispanic (89.8%), have an ASD diagnosis of autism (72.3%), have primary caregiver education level of at least some college (78.8%), and have a mean age at enrollment of 6 years (6.2 ± 3.4). Medication use had the most longitudinal data available. Information on medication use, including ADHD meds, alpha agonists, anticonvulsants, SSRIs, atypical antipsychotics, and melatonin, is available for 2770 children at baseline and first follow-up, for 1242 children at baseline, first, and second follow-up, and for 583 children at baseline, first, second, and third follow-up. Similar counts are provided for the ABC irritability subscale, PedsQL total scale, CGS-severity of autism, CGI-level of autism, Stanford-Binet abbreviated IQ standard score, Vineland adaptive behavior composite standard scores, and several parent form questions.
Conclusions:
Over 6800 children with ASD have been enrolled in the AS ATN Registry, and the ATN continues to enroll and collect longitudinal data on measures such as autism assessment, cognitive, behavioral, quality of life, and medications. Investigators may explore the registry data using the online query tool (*ASATN.org/asatn-query*) and may propose research analyses by submitting a Request for Data (RFD) to the AS ATN. For more information on the RFD please visit *ASATN.org/request/data*.

38   **106.038**   Parental Co-Regulation and Expressed Emotion As Predictors of Psychopathology in Children with ASD

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Background: Individuals with an Autism Spectrum Disorder (ASD) often have comorbid mental health problems (Ooi, Tan, Lim, Goh, & Sung, 2011; Totsika, Hastings, Emerson, Lancaster, & Berridge, 2011). Parental co-regulation (i.e. motivational or emotional scaffolding, and using strategies to help their child regulate emotions) has been associated with fewer internalizing and externalizing problems in typically-developing children and those with ASD, 3 to 6 years of age (Hooven, Gottman, & Katz, 1995; Wilson et al., 2013). Indications of low parental negative expressed emotion have also been linked with fewer mental health problems in adolescents and adults with ASD (Smith, Greenberg,

Seltzer, & Hong, 2008). However, expressed emotion and co-regulation have not been studied together, or examined in relation to psychopathology in older children with ASD.

Objectives: To investigate whether parental co-regulation and expressed emotion were related to externalizing and internalizing problems in children with ASD, 8 to 12 years of age.

Methods: Twenty-nine children with ASD (86.2% male) and their caregivers (75.9% female) have participated in a larger ongoing treatment trial to improve emotion regulation, which is expected to increase to 40 participants by April 2015. Children were 8 to 12 years of age ($M = 9.79$, $SD = 1.26$), with average IQ ($M = 102.90$, $SD = 11.91$, Range: 80-125). Parental co-regulation skills (i.e. scaffolding) were measured using a behavioural coding scheme (Gulsrud, Jahromi, & Kasari, 1995), applied to parent behaviours during a standardized *Emotion Discussion Task*. Expressed emotion was measured using the *Autism-Specific Five-Minute Speech Sample* (Benson, Daley, Karlof, & Robinson, 2011). Externalizing and internalizing problems were measured via parent report on the *Behavior Assessment System for Children, Second Edition – Parent Rating Scales* (Reynolds & Kamphaus, 2004). Clinically significant mental health problems were measured by the *Anxiety Disorders Interview Schedule for DSM-IV* (ADIS; Silverman & Albano, 1996).

Results: The following results are based on 20 participants with coded expressed emotion and co-regulation data, and data collection and analysis is ongoing. Pearson correlations were conducted to identify relationships among child characteristics (i.e. age, IQ), parent scaffolding and expressed emotion, and child internalizing and externalizing problems. Level of internalizing symptoms was negatively correlated with parent scaffolding ($r = -.45$, $p = .046$) and positively correlated with overall ADIS severity score ($r = .52$, $p = .006$) and child age ($r = .46$, $p = .016$). Level of externalizing symptoms was negatively correlated with parent scaffolding ($r = -.45$, $p = .047$) and positively correlated with overall expressed emotion ($r = .47$, $p = .037$) and ratio of critical to positive comments ($r = .57$, $p = .009$). With the increased power expected with the larger sample of 40 participants, the poster will also report on multiple regressions to further predict child psychopathology.

Conclusions: Findings will be discussed in relation to supporting parents of children with ASD who are experiencing emotional problems, such as anxiety or aggression. Findings can help inform clinicians on how to best include parents in treatment.

39 **106.039** Parental Eating Disorders and Broad Autism Phenotype Traits: Is There a Link?

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Background: Family members of individuals with ASD demonstrate increased social-communicative problems and multiple neuropsychiatric impairments. One class of neuropsychiatric disorders, eating disorders (ED), has not been well-studied in ASD relatives. However, several studies have shown that women with ED, especially anorexia nervosa, display clinically significant scores on measures of ASD symptoms. This study is the first to systematically evaluate the relationship between ED and the broad autism phenotype (BAP) in first-degree relatives.

Objectives: This study will: (1) compare autism trait measures for parents of individuals with ASD who have ED to those without ED; and (2) compare clinical outcomes for the offspring of these two groups.

Methods: Our dataset consisted of 2623 families from the Simons Simplex Collection (SSC), a collection of families containing one individual with ASD and no other first-third degree relatives with an ASD diagnosis.

As part of SSC ascertainment procedures, family histories and multiple measures of ASD traits were collected. Family history interviews included questions about the presence of ED in parents and their relatives. The Broad Autism Phenotype Questionnaire (BAP-Q) and Social Responsiveness Scale: Adult Research Version (SRS:ARV) measured ASD traits.

Descriptive analyses compared ED and non-ED groups on BAP-Q total and subscale scores (Aloof, Pragmatic Language, and Rigidity), and SRS total and subscale scores (Awareness, Motivations, Mannerisms, Cognition, and Communication). The proportion of individuals with clinically significant BAP-Q scores in both groups was also compared. Finally, clinical outcomes in offspring as a function of parental ED were examined.

Results: In total (N=2623), no fathers and 57 (2.2%) mothers had a positive history of ED. Comparison of BAP-Q scores showed that mothers with ED had significantly higher BAP-Q Total ($p=6.6^{10-5}$) and subdomain (Aloof p=0.003; Pragmatic p=1.4^{10-4}; Rigid p=0.013) scores. In contrast, mean SRS total and subdomain scores did not differ between the ED and non-ED mothers.

Among mothers with an ED, there was a significantly higher proportion with an elevated BAP-Q Total score (and elevated subdomain scores). The most significant differences were noted for the BAP-Q Total score [22.8% of those with an ED were positive for the BAP versus only 8.8% without an ED (p=0.0003)] and the BAP-Q Rigid subdomain score [21.1% of those with an ED were positive for this trait vs. 5.6% without an ED (p=1^{10-6})]. Comparisons of offspring of mothers with ED vs. those without ED showed no significant differences in sex, adaptive functioning, or behavior problems.

Conclusions: Our results show that ED were restricted to mothers and lower than population estimates. For mothers with an ED, BAP-Q scores were significantly higher than mothers without an ED and were more likely to meet criteria for the presence of the BAP trait. By contrast, the groups did not differ on any SRS variables.

These results converge with findings of increased ASD features among women with ED. The overlap of ED and elevated BAP-Q scores merits further study to determine if there is also biologic overlap (i.e., common genes or pathways) and which BAP features may heighten risk for ED in select individuals.

40   **106.040** Physiological Arousal Is Related to Parent-and Self-Report of Anxiety in Youth with ASD: Preliminary Evidence for the Concurrent Validity of Anxiety Symptoms

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Background: High rates of anxiety have been reported among youth with autism spectrum disorders (ASD). Coexisting symptoms of anxiety have the potential to cause substantial clinical impairment for youth with ASD. However, the diagnostic interview schedules used to assess anxiety in youth with ASD have not been validated in the autism spectrum population, and it is unclear whether the high rates of comorbid anxiety disorders generated by these assessment instruments actually reflect clinical anxiety, or if they reflect a false positive result. Physiological measurement has the potential to serve as an 'objective' index of anxiety given the robust relationship between physiological arousal and manifest anxiety in non-ASD populations.
Objectives: The current study aimed to investigate the concurrent validity of anxiety in ASD by examining the correspondence between physiological response and parent- and self-report of anxiety symptoms. If youth with ASD are actually experiencing clinical anxiety, physiological arousal should theoretically correspond with reported symptoms of anxiety.
Methods: Thirty-two youth with ASD (ages 7-14 years) participated in a startle response paradigm to measure physiological indices of fear conditioning. Skin conductance response (SCR) was collected during the first 3 minutes of baseline, prior to presentation of the first stimulus. The final minute of baseline was used for the current analyses. Youth and their parents also completed the Multidimensional Anxiety Scale for Children (MASC; parent and child versions) and the Child and Adolescent Symptom Inventory-4R (CASI). Results from questionnaires were compared to SCR to investigate whether physiological response paralleled patterns of parent- and child-report of anxiety symptoms.
Results: Correlational analyses revealed strong relationships between baseline SCR and the following subscales of the MASC: Parent Somatic/Autonomic ($r = .356$, $p = .05$), Child Anxious Coping ($r = .644$, $p < .01$), Child Harm Avoidance ($r = .545$, $p < .01$), Child Separation/Panic ($r = .459$, $p < .05$), and Child Total score ($r = .423$, $p < .035$). Additionally, SCR baseline scores were related to the CASI Separation Anxiety Disorder subscale ($r = .439$, $p < .05$).
Conclusions: Results indicate that there is a correspondence between child- and parent-report of anxiety symptoms and physiological measurement of arousal. This provides preliminary evidence for the validation of anxiety symptoms in youth with ASD. Additional physiological data, including heart rate measurements, will be added to the model to further investigate the concurrent validity of anxiety symptoms in this sample. Results from this study have the potential to provide objective evidence that a proportion of youth with ASD actually experience clinical anxiety, which will in turn aid in proper identification of comorbid symptoms and provision of appropriate treatment for youth on the autism spectrum.

41   **106.041** Precision Grip Control with and without Visual Feedback in Autism Spectrum Disorder

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Background: Sensorimotor abnormalities are common in individuals with autism spectrum disorder (ASD). The ability to grasp objects has been shown to be disrupted in ASD and likely interferes with many activities of daily living such as writing and feeding. During grasping, precise control of force output is regulated by visual, somatosensory and proprioceptive feedback mechanisms as well as motor memory systems. The mechanisms contributing to grasping abnormalities in ASD remain unclear.
Objectives: To examine precision grip in ASD with and without visual feedback.
Methods: Seventeen individuals with ASD and 20 healthy control subjects matched on age, nonverbal IQ and handedness completed a test of precision grip. Participants pressed on opposing load cells with their thumb and index finger (Figure 1A). They viewed a horizontal white *force* bar that moved upwards with increased force and downwards with decreased force and a static *target* bar (Figures 1B & C). They were instructed to press on the load cells so that the *force* bar reached the same vertical level as the *target* bar, and then to maintain that level of force for the duration of 20 sec trials. During *vision* trials, the *force* bar remained visible for the whole trial. During *no-vision* trials, the *force*bar was removed for the last 12 seconds of the trial and participants were instructed to continue producing force at the target level until the trial ended. The target force level was set to 50% of each individual's maximum force for each of six trials (two vision and four no-vision trials). The accuracy (mean force: target force) and slope of the mean force were calculated for the last 12

seconds of each trial.

Results: During the vision condition, there was no difference in force accuracy between individuals with ASD and healthy controls ($p > 0.05$). During the no-vision condition, force accuracy was reduced across participants relative to the vision condition ($p < .001$). Reductions in force accuracy following removal of visual feedback were more severe in ASD compared to controls (group x condition interaction: $p= 0.03$). Participants' force showed a negative slope during the no-vision condition (Figure 2; main effect of condition: $p < .001$), and this slope was more negative for individuals with ASD compared to controls (group x condition interaction: $p=.04$).

Conclusions: Our findings indicate that individuals with ASD and controls show similar levels of precision grip force accuracy when visual feedback is provided, but force accuracy deteriorates more rapidly in ASD when visual feedback is not available. Vision plays a dominant role in guiding motor output. However, other sensory feedback mechanisms including somatosensory and proprioceptive control processes as well as motor memory systems play important roles in regulating precision grip forces. Thus, deficits in somatosensory and proprioceptive feedback control processes and motor memory mechanisms appear to contribute to impairments in precision grasping in ASD and may underlie the commonly seen abnormalities in handwriting and feeding behaviors in this disorder.

42   **106.042** Psychiatric Follow up of Children and Adolescent with Past History of Autism

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Background: Autism spectrum disorders (ASDs) were once considered lifelong disorders, but recent studies show that some children with diagnosis of ASD no longer meet the criteria for ASD. These children are considered to have achieved optimal outcome (OO)(Fein 2013 ,Orienstein 2014,Mukaddes 2014). Despite the presence of a few studies reporting optimal outcome in this group, there is lack of follow up studies in this group.

Objectives: The present study aims to assess the psychiatric disorders in individuals who lost the diagnosis of autism.

Methods: Twenty six individuals (21 male, 5 female) were included in this study with the age range: 6-16 years old (mean age: 9,1923 +/- 2,87081). They all lost the diagnosis of autism at least two years before follow up examination.The participants were recruited from a group of individuals with past history of autism who were diagnosed and assessed previously by the first author. The characteristics of this group has been described in another study from the same group (Mukaddes et al 2014). From 39 individuals who lost the diagnosis of autism and were reported earlier, individuals who achieved optimal outcome at least two years before were included.All individuals were assessed by a team of child psychiatrists and a clinical psychologist.The follow up clinical assessment was done 2 to 8 years   after losing the diagnosis of autism. Assessment and Measurements included:a)Systematic psychiatric interview with both children and parents based on Schedule for Affective Disorders and Schizophrenia for School-Age Children Present and Lifetime Version (K-SADS -PL) ,b) Intelligence quotient (IQ.) assessed using the Wechsler Intelligence Scale for Children—revised version(WISC-R) ,c) Autistic features were assessed using Social Comunication questionnaire (SCQ)(current).All data were organized in Microsoft Excel 2010, and all statistical tests were conducted in Excel. Relationships between parametric values were assessed using the Pearson correlation coefficient in the Statistical Package for Social Sciences (SPSS) 18.0, SPSS Inc., Chicago, Illinois, USA.

Results: According to K-SADS -Lifetime, 92.3 % of individuals (n:24) had at least one psychiatric disorder. ADHD (% 69.2 , n:18), specific phobia (% 46.2 , n:12) and OCD (% 38.5 ,n:10) were the most common life time disorders in this group.K-SADS -P revealed the presence of psychiatric disorders in 76.9 % of the group (n:20) . ADHD (% 53.8 , n:14), Specific Phobia (% 46.2 , n:12) and OCD (%19.2 , n:5) were the most common psychiatric disorders in K-SADS -P.Based on WISC-R test, all the participants showed performance in non- retarded range. Their Full IQs were between 73-148.Their SCQ revealed the total score between 1 -13 (cutoff score>15 is necessary for ASD).

Conclusions: The present study shows that although some children lose the diagnosis of autism, they are prone to develop other psychiatric disorders later in life. Therefore, long term psychiatric follow up of this group seems necessary even after achieving optimal outcome.

43   **106.043** Psychophysiological Predictors of Gastrointestinal Symptomatology in Autism Spectrum Disorder

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Background: Research suggests that individuals with Autism Spectrum Disorder (ASD) tend to suffer from a high rate of gastrointestinal (GI) disorders, but the underlying biology and etiology of GI disorders in ASD is not clearly understood. In the general population, there is a strong relationship between stress and GI symptomatology, and evidence suggests an augmented stress response in ASD. Taken together, it is possible that GI symptoms in those with ASD may vary as a function of stress reactivity. Determining the cause of GI disorders in ASD is important given their associations with sensory over-responsivity and stress, which can exacerbate problem behaviors. Understanding of the relationships among GI symptoms, stress, and behavior will be critical in planning future studies and better individualizing treatment.

Objectives: The present investigation examined the relationship between GI symptomatology and heart rate variability (HRV), a measure of stress reactivity, in those with ASD. Given the relationship between stress and GI symptoms, we hypothesized that a negative relationship would exist between HRV and GI symptomatology.

Methods: Children and adolescents from Missouri and Vanderbilt ATN sites (n = 101, Mean Age =12.2, SD =3.8, Range = 6-18) with an ASD diagnosis were outfitted with a 2-lead ECG apparatus. Initial baseline reactivity to the testing environment was taken for a period of 3 minutes. Next, to examine stress reactivity, participants engaged in independent trials of unilateral cold pressor and vibrotactile stimulation to the hands for 30 seconds in a counterbalanced fashion. After artifacts in the data were removed, the R-R interval data (average pulse interval) were processed, and the percentage of normal R-R intervals during each trial were calculated for each stimulus condition, and for each hand. Baseline and cold pressor stress reactivity are reported here. To assess GI symptomatology over the past 2 months, the participant's caretaker completed the QPGS Rome-III, and a continuous severity score was calculated with higher scores indicating greater GI severity.

Results: Results indicate that a significant positive correlation was found between lower GI symptomatology and baseline heart rate variability (Pearson correlation r = 0.23, p=0.024). Furthermore, a significant negative correlation was found between lower GI symptomatology and the change in heart rate variability from baseline under cold pressor stimulation (Pearson correlation r = -0.32, p=0.002). Similar but slightly weaker associations were observed with upper GI symptomatology (baseline: r = 0.18, p=0.08; cold pressor change: r = -0.26, p=0.01).

Conclusions: These findings suggest that altered autonomic function and reactivity may co-occur with lower GI symptoms in ASD. From these correlational data, it is unclear whether stress and stress reactivity may trigger GI symptoms, whether GI symptoms could exacerbate stress or stress reactivity, or whether abnormalities in both domains might reflect a common underlying pathophysiology that spans these systems in ASD. Future treatment work may be necessary to understand the directionality of this association.

44 **106.044** Relationships Between ASD/ADHD Symptoms and Abnormal Eating Behaviors in Children

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Background: Some people with autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) symptoms also have eating disorders. An increasing number of studies have dealt with comorbidity of eating and developmental disorders. Anorexia nervosa overlaps with ASD (Iwasaki et al., 2014; Oldershaw et al., 2011), while binge eating behaviors are associated with ADHD (Nazar et al., 2014). It is important to recognize people with ASD and ADHD symptoms who have abnormal eating behaviors. Despite the correlation between ASD and ADHD, little previous research has investigated their connection to eating disorders at the same time. Therefore, it is necessary to consider ADHD symptoms as covariant. Furthermore, most previous studies investigated clinical groups. Thus, there is little research examining the relationship of ASD and ADHD symptoms with eating behaviors in the general population in Japan.

Objectives: The present study investigated whether ASD and ADHD symptoms are related to abnormal eating behaviors in elementary and junior high school students in Japan.

Methods: Participants were 4584 children from 4th to 9th grade students enrolled in all elementary and junior high schools of a single city. 2314 were boys and 2270 were girls. The children completed an eating behavior inventory that measured propensity of anorexia and bulimia (Ito et al., submitted). Their parents or caregivers completed two questionnaires: the Autism Spectrum Screening Questionnaire (ASSQ; Ehlers, Gillberg, & Wing, 1999) for ASD symptoms and the ADHD Rating Scale (ADHD-RS; Dupaul, Power, Anastopoulos, & Reid, 1998) for inattention/hyperactivity. To investigate the effect of ASD and ADHD symptoms on the propensity of anorexia and bulimia, polynominal regression analysis was conducted.

Results: The analysis found that the linear effect of ASSQ (β=.062, p=.011) and ADHD-RS (β=.086, p<.001) were significant regarding propensity of anorexia. In terms of propensity of bulimia, the liner and nonlinear (quadratic) effect of ASSQ (liner; β=.062, p=.017, nonlinear; β=-.057, p=.018) and the

liner effect of ADHD-RS (β=.140, p<.001) were significant. (Fig.1) The other was not significant. Conclusions: First, both propensity of anorexia and bulimia are affected by ASD and ADHD symptoms. This relationship is supported by previous research, which refers to similar results in clinical cases. Second, propensity of bulimia is affected more by ADHD symptoms than by ASD symptoms. It is thought that aspects of ASD symptoms associated with poor social skills and those of ADHD symptoms associated with impulsivity may be associated with abnormal eating behaviors. These findings suggest that investigation of ASD and ADHD symptoms may lead to more appropriate treatment for people exhibiting abnormal eating behavior.

45 **106.045** Sensory Feedback Mechanisms Underlying Postural Control Abnormalities in Individuals with Autism Spectrum Disorder (ASD): A Preliminary Study

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Background: Postural control abnormalities have been demonstrated in some but not all studies of autism spectrum disorder (ASD). These prior studies have quantified the amount of sway during standing, but stability also depends on each individual's postural limitation boundary, or the maximum extent to which they may sway in each direction without losing their balance. In the present study, we examined postural sway relative to each individual's postural limitation boundary (virtual time to contact; VTC) in individuals with ASD and healthy controls (Fig.1A).
Objectives: To examine the range of center of pressure (COP) fluctuations as well as spatial and temporal VTC complexity for individuals with ASD and healthy controls during both static and dynamic standing postures.
Methods: Six children with ASD (ages 11-16 yrs) and 6 healthy controls matched on age, sex and non-verbal IQ completed tests of static and dynamic stances. Prior to testing, participants were instructed to stand side-by-side 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 leaning their body in each of four different directions (anterior, posterior, left and right) as far as they could without fallingand then fitting an ellipse to the COP maxima for each direction (Fig. 1B). COP measurements were derived from the force platform output.
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 anterior-posteriorly (AP) or medial-laterally (ML) at a comfortable speed. Participants completed three 30-sec trials for each stance. Each participant's VTC was derived by comparing the spatial and temporal relation between their postural limitation boundary and their COP collected during each trial. To examine participants' ability to dynamically adjust their postural sway over time in response to sensory feedback, the spatial and temporal complexity of each participant's VTC also were compared.
Results: During static stance, individuals with ASD showed **increased** COP range of motion in both AP and ML directions (p <0.05) and decreased spatial and temporal VTC complexity (p<0.05). During dynamic stances, patients showed **reduced** COP range of motion in each postural sway condition (p<0.05), but again they showed decreased VTC complexity in both spatial and temporal domains (p<0.05).
Conclusions: Our findings suggest that individuals with ASD show reduced postural stability relative to controls, but the quality of this deficit varies across different types of postural conditions. While traditional measures of postural stability highlight both increases and decreases in sway during static and dynamic stances, respectively, we find that the spatial and temporal complexity of patients' sway is reduced in ASD across stances. Thus, patients demonstrate deficits in their ability to dynamically adjust their balance across different postural conditions reflecting a reduced ability to integrate sensory feedback to maintain postural stability.

46 **106.046** Sleep Disturbance and Aggression in Children with Autism Spectrum Disorder : An Autism Speaks Autism Treatment Network Analysis

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Background: Autism Spectrum Disorders are defined by impairments in behavior, communication, and social skills that initially appear in childhood. Children and Youth with Autism Spectrum Disorders (CYASD) frequently experience sleep disturbances, with bedtime resistance being especially problematic. Recent studies show that children with autism and sleep disturbances have worse adaptive skill development and greater behavior difficulties than children with autism without sleep difficulties. In addition, children with autism with more severe core symptoms were more likely to have increased sleep problems.
Objectives: **1)** Examine the prevalence of sleep problems and aggression in CYASD. **2)** Examine

relationship link between sleep disturbances and behavior problems in CYASD.

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 mood lability, sleep quality, aggression, communication skills and IQ. Behavioral and mood items were measured via parent/legal guardian reporting.

Results: Sleep disturbances were reported in 56% of patients; of these, 64.3% experienced symptoms of aggression, and 98.2% experienced mood lability. Of the 44% of patients who did not experience sleep disturbances, only 31.8% of patients had aggression and 90.9% experienced mood lability. The mean difference in IQ between those with and without sleep disturbances was only 4.3 points.

Conclusions: CYASD have a high prevalence of sleep disturbance, yet the behavioral manifestations of sleep disturbance are not well elucidated. This study supports previous findings of mood lability in CYASD and further delineates marked aggression in this subset of CYASD. Currently, sleep disturbances are an underrecognized co-occurring condition in CYASD. Care for CYASD is multifaceted and complex including social, emotional, behavioral and medical treatments. Findings from this study support the need for increased awareness and assessment of sleep concerns in CYASD to maximize understanding of behaviors and inform treatment planning. Larger studies looking at the correlation between sleep and aggressive behaviors will be an important next step.

47 **106.047** Sleep Problems in Autism Spectrum Disorders: The Influence of Anxiety, Restricted and Repetitive Behaviours and Intolerance of Uncertainty

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Background: Sleep problems are one of the most common comorbidities experienced by individuals with ASD. While sleep problems have been well characterized in children with ASD less is known about the types of sleep disturbances experienced by adults with ASD. Further, the aetiology of the sleep disturbances is relatively unknown. It has been suggested that the inherent anxiety experienced by those with ASD may predispose them to experience sleep problems. In addition, core behaviours associated with ASD such as restricted and repetitive behaviours and an intolerance for uncertainty may also lead to delayed sleep onset and reduced total sleep time.

Objectives: The aim of this study was to investigate the relationships between sleep disturbance and symptoms of anxiety, restricted and repetitive behaviours (RRBs), and intolerance of uncertainty in adults with ASD and no intellectual impairment compared to age-, sex-, and IQ-matched NT adults.

Methods: Thirty adults with ASD and 30 NT adults participated in the study. Participants completed an online questionnaire battery that contained the Autism Quotient, the Pittsburgh Sleep Quality Index (PSQI), the State Trait Anxiety Inventory (STAI), the Restricted Behaviour Questionnaire-2 Adult (RBQ-2A), and the Intolerance of Uncertainty Scale (IUS).

Results: Adults with ASD had higher total PSQI scores as well as higher scores on the sleep quality, sleep latency, sleep disturbance, and daytime dysfunction due to sleepiness subscales of the PSQI; effect sizes were moderate to large. Adults with ASD had significantly higher total and subscale scores on the STAI, RRB-2A, and IUS; all effect sizes were large. In assessing the relationship between sleep and the other variables, PSQI total scores were significantly correlated with both state ($r = .63$) and trait ($r = .52$) anxiety and the rigidity/adherence to routine subscale of the RBQ-2A and the uncertainty paralysis ($r = .46$) of the IUS. There were no significant correlations between PSQI scores and any of the other variables in the NT group. Hierarchical regression was used to determine predictors of PSQI scores in the ASD group; state anxiety, rigidity/adherence to routine and uncertainty paralysis were entered into the regression. The model accounted for 37.5% of the variance in PSQI scores, with only state anxiety being a unique predictor.

Conclusions: This is one of the first studies to assess the relationship between sleep, anxiety, RRBs, and intolerance of uncertainty in adults with ASD. As expected adults with ASD had higher scores on all questionnaire measures and subscales, confirming that atypical sleep persists from childhood into adulthood in ASD. While RRBs and intolerance of uncertainty were related to sleep problems in the ASD group, only state anxiety was a unique predictor of PSQI scores. Treatments that aim to target anxiety, particularly around the onset of sleep, may improve sleep. Further, this may have a direct effect on RRBs and the experience of intolerance of uncertainty.

48 **106.048** Sleep Problems in Children with Autism Spectrum Disorder: Examining the Role of Anxiety and Sensory over-Responsivity

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Background:

Sleep problems are common among children with autism spectrum disorder (ASD), and can have significant detrimental effects on daytime functioning. Hyperarousal is often associated with insomnia in the general population and may also underlie sleep difficulties for children with ASD, particularly

given their increased risk for arousal-related symptoms. Emerging evidence from previous studies suggests that specific arousal-related symptoms, sensory problems and anxiety, may be related to the development and maintenance of sleep problems in children with ASD. However, research has yet to explore the associations between these symptoms.

Objectives:

The goal of the current study was to examine the bivariate and multivariate relationships among anxiety, sensory over-responsivity, and specific sleep problems in a large well-characterized sample of children and adolescents with ASD.

Methods:

Participants included 1348 children and adolescents (ages 2-18) enrolled in the Autism Speaks Autism Treatment Network (AS ATN) registry database. Primary measures included the Children's Sleep Habits Questionnaire (CSHQ), Child Behavior Checklist (CBCL), and Short Sensory Profile (SSP).

Results:

In bivariate correlations and multivariate path analyses, anxiety was associated with each type of sleep problem examined (i.e., bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, and night awakenings; ranging from $p < .01$ to $p < .001$; small to medium effect sizes). Sensory over-responsivity (SOR) was correlated with all sleep problems in bivariate analyses (ranging from $p < .01$ to $p < .001$; small effect sizes). In the multivariate path model for older children (ages 6-18), SOR was significantly associated with all sleep problems except night awakenings. In contrast, in the path model for younger children (ages 2-5), SOR was significantly associated with sleep onset delay, night awakenings, and sleep duration, but not bedtime resistance or sleep anxiety.

Conclusions:

The purpose of this study was to examine the relationships among three common co-occurring problems for children with ASD: sleep problems, sensory problems, and anxiety. Despite evidence to suggest that these three conditions may be highly related, this was the first study to examine their interrelations in children with ASD. Consistent with our predictions, the results indicate that children with ASD who have anxiety and SOR may be particularly predisposed to sleep problems. These data provide support for the idea that sleep problems in many children with ASD may be due to arousal dysregulation, and that hyperarousal may represent a shared underlying mechanism. Future research using physiological measures of arousal and objective measures of sleep are needed. Longitudinal studies would also be helpful to identify patterns of sleep, anxiety, and sensory problems over time.

49   **106.049** Suicidal Ideation in Korean Children at-Risk for Autistic Spectrum Disorder (ASD)

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Background: High rates of suicidal behaviors have been reported in individuals with ASD (e.g., Cassidy et al., 2014). Reported risk factors for suicidal behavior in ASD are male gender, comorbid psychiatric diagnosis and peer victimization (see Segers & Rawana, 2014). Studies have been in clinic- or community-based samples of ASD participants; no studies of prevalence or risk factors have drawn from representative, population-based samples.

Objectives: 1) Examine prevalence of current suicidal ideation (SI) in population-based samples of 7-12 year olds diagnosed with ASD or classified as high- or low-risk for ASD. 2) Determine whether having ASD is a risk factor for SI in addition to previously reported risk factors for SI. 3) Within the ASD group, explore differences between children with and without SI.

Methods: A retrospective cohort design was used in three population-based samples (Korean Prevalence=13,561, Sooncheon=4,837, CHEER=3,702). In the Korean Prevalence sample, 94 children had ASD diagnoses confirmed by comprehensive diagnostic assessment and were compared to 13,467 children with ASSQ scores <14 (low-risk). In the Sooncheon and CHEER cohorts, children were classified as high-risk for ASD based upon a score of >14 on the Autism Spectrum Symptom Questionnaire (ASSQ). Current SI was determined by items from the parent-rated Behavior Assessment for Children, 2nd Edition (BASC).

Differences in proportions (prevalence) were tested with Chi Square. Logistic regressions were used to determine whether ASD diagnosis/ASD risk status was a significant predictor of SI in addition to previously reported risk factors (gender, BASC scales reflecting emotional/behavior problems and items suggesting negative social experiences). Analyses were repeated for each of the samples. Independent Sample T-tests were used to compare ASD+SI vs. ASD+NoSI on age and BASC scales to inform understanding of factors that may relate to increased risk for SI within individuals with ASD.

Results: For the Korean prevalence study, SI was significantly more common in children with confirmed ASD (14.9%) than children at low-risk for ASD (5.4%; OR=3.09, CI95% 1.75-5.49). Logistic regression models showed that ASD diagnosis was a significant predictor of SI (OR=2.13, CI95% 1.15-3.92). Being teased (OR=1.96, CI95% 1.66-2.33) and chosen last for games (OR=1.84, CI95%=1.56-2.17), and scores from BASC scales of depression, hyperactivity, aggression, conduct problems, anxiety, and attention problems were also significant predictors of SI. Gender was not associated with SI. Children

with ASD+SI had more anxiety symptoms than children with ASD+NoSI (p<.01); groups did not differ on age or other BASC scales.

Children at high-risk for ASD had greater prevalence of SI than children with low ASD risk in the Sooncheon (16.6% vs. 3.4%; OR=5.59) and CHEER cohorts (27.4% vs. 6.9%; OR=5.08). Patterns of predictors of SI were similar to the Korean Prevalence sample.

Conclusions: Children with ASD or suspected high-risk for ASD had increased prevalence of current SI in all three Korean samples. Clinical implications for assessment and monitoring of SI in children with ASD will be discussed. Interventions in ASD aimed at reducing exposure to modifiable risk factors should focus on emotional and behavior problems, as well as negative social experiences.

50 **106.050** Suicidality in Children with Autism Spectrum Disorders

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Background: Studies indicate that children with Autism Spectrum Disorders (ASD) have increased rates of suicide ideation and attempts (SI/SA). The available literature indicates demographic characteristics (age 10+, male, African American, Hispanic, low SES) and psychological characteristics (depression, teasing/bullying, aggression, impulsivity and anxiety) as risk factors for SI/SA.

Objectives: Based on studies of SI/SA, as well as depression in ASD, we hypothesize that AD/HD diagnosis, impulsivity, executive dysfunction (especially inflexibility), and weak adaptive skills are related to increased SI/SA , while lower IQ and greater autism symptoms (poorer insight/self-awareness) are related to reduced SI/SA.

Methods: Parents of 199 youth with ASD (female=32), age 7-13.83 (M=10.15, SD=1.72), who met CPEA criteria for 'broad ASD' on the ADI-R and/or ADOS, completed clinical reports on their children. SI/SA were measured with item-level data from the Child Behavior Checklist and the Child and Adolescent Symptom Inventory parent-report measures of emotional and behavioral functioning. Independent samples t-tests and chi-square analyses were used to compare youth with and without SI/SA with ADHD diagnosis, Behavior Rating Inventory of Executive Function (BRIEF) scores, Vineland Adaptive Behavior Scales, and ADOS ratings.

Results: 16.1% of youth with ASD had parent reported SI/SA. SI/SA and non-SI/SA groups did not differ in their sex or age. Problems with inhibition (p<.01), shifting (p<.01), and emotional control (p<.01) were greater in those with SI/SA (see Figure 1). The comparison of those with SI/SA and greater ADHD symptoms approached significance, as did adaptive behavior weaknesses. There were no significant differences between the groups in IQ or ASD symptoms.

Conclusions: Youth with ASD who consider or attempt suicide had poorer inhibition and flexibility skills. Greater ADHD symptoms and poor adaptive behavior approached significance. Findings indicate the importance of considering ADHD, executive function (i.e., flexibility), and adaptive behavior as risk factors when assessing for SI/SA.

51 **106.051** The Relationship of ASD Symptoms with the Occurrence of Self-Injury Behaviors Among Middle School Students

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder involving significant phenotypic variability, and is characterized by social and communication deficits in addition to restricted and repetitive behaviors (American Psychiatric Association, 2000). Children with ASD often exhibit comorbidity with behavioral problems as well as psychiatric symptoms (e.g. Lecavalier, 2006). One of the most serious problems is self-injury behavior (SIB). It has been reported that up to 52% of ASD children show more than one type of SIB (Poustka & Lisch, 1993). Because SIB is a risk factor for increased suicidal ideation and probability of suicidal attempts (Glenn & Klonsky, 2009), it is crucial to provide appropriate, sufficient supports with children and adolescents with ASD. It is not specific to children and adolescents with ASD, but it is common among school-aged children (Camelot Foundation & Mental Health Foundation, 2006). However, there are few studies to investigate the relationship between ASD symptoms and SIB among school aged children. We have little known about whether ASD symptoms have any effects on the occurrence of SIB.

Objectives: The present study examined the effects of ASD symptoms on the occurrence of SIB among students from seventh through ninth grades in Japan.

Methods: The participants were students (N =2,181) attending all junior high schools in a city, along with their parents. The students completed a questionnaire to assess the occurrence of two types of SIB, hitting and cutting. Their parents answered the Autism Spectrum Screening Questionnaire (Ehlers, Gillberg, & Wing, 1999) and the Attention Deficit Hyperactivity Disorder (ADHD) Rating Scale-IV (Du Paul et al., 1998), to assess the ASD and ADHD symptoms that the students exhibited. Multivariate logistic regression analysis was performed to study the effect of ASD symptoms on SIB

over and above the effects of age, grades, and ADHD symptoms
Results: Multivariate logistic regression analysis indicated that after controlling for age, grade, and ADHD symptoms, ASD symptoms had an effect on the occurrence of both types of SIB that we assessed. Specifically, students with more severe ASD symptoms were more likely to engage in both hitting and cutting SBI (hitting SIB: $OR = 1.404$, $p < .001$; cutting SIB: $OR = 1.371$, $p = .001$). Age and ADHD symptoms also had a significant influence on the occurrence of SIB. Female students were more likely to engage in both types of SIB, and students with severe ADHD symptoms had a higher probability of the hitting SBI.
Conclusions: The current study indicated that even after controlling for sex, grade, and the severity of ADHD symptoms, ASD symptoms had a significantly influence on the occurrence of SIB, which suggests that ASD symptoms are a risk factor for SBI. In addition to the result of the current study, previous studies have reported that children and adolescents with ASD show higher levels of depression, which increases the probability of SIB (e.g., Kim et al., 2000). Therefore, we should provide children and adolescents with ASD, even those who have not official diagnosis, with sufficient psychosocial support to prevent them from engaging in SIB.

52   **106.052** The Role of Verbal Ability in the Co-Occurrence of Problem Behaviours and Gastrointestinal Symptoms in Autism Spectrum Disorders

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Background: Autism Spectrum Disorders (ASD) is frequently associated with behavioural, neurological, and medical comorbidities. Maladaptive and problem behaviors are often observed in individuals with ASD and largely considered to be part of its constellation of neurological abnormalities (Horvath, Papadimitriou, Rabsztyn, Drachenberg, & Tildon, 1999). However recent studies have linked problem behaviors, anxiety and irritability with gastrointestinal (GI) symptoms, another common comorbidity for children with ASD.
The co-occurrence of maladaptive problem behaviors and GI symptoms in individuals with ASD has been examined within the literature (Gorrindo et al., 2012; Maenner et al., 2012; Mazefsky, Schreiber, Olino, & Minshew, 2013; Mazurek et al., 2013; Nikolov et al., 2009). However, although the potential contributory role of expressive language deficits has been mentioned (Gorrindo et al., 2012), it is yet to be formerly examined. In a group of disorders characterized by socio-communicative and language difficulties, it is possible that gastrointestinal pain or discomfort improperly expressed emerge as irritability, aggression, or atypical physical or self-injurious behavior (Bauman, 2010; Buie et al., 2010; Horvath et al., 1999)
Objectives: To examine the relationship between the presence of GI symptoms in children with ASD and manifest behavioral and affective problems, and investigate the possible mediating role of expressive language ability.
Methods: Children and adolescents with ASD were examined in regards to expressive language ability, GI symptomatology and maladaptive behaviors.
Results: Children with concurrent GI symptoms exhibited significantly more problem behaviors on the CBCL compared to children without GI symptoms. No significant relationship was found between problem behaviors and expressive language and as such the mediational hypothesis was not supported. Contrary to expectations, children with GI symptoms exhibited significantly higher expressive language.
Conclusions: In accordance with previous literature, children with ASD and comorbid GI symptoms were reported to exhibit more problem behaviours. In this instance, impairments in expressive language were not found to contribute to the relationship between the presence of GI symptoms and behavioral and affective problems.

53   **106.053** Variability in Autism Symptom Severity: The Role of Diurnal Cortisol and Daily Stress in Youth with Autism Spectrum Disorder

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Background: The literature indicates increased rates of anxiety disorders in children with autism spectrum disorder (ASD); however, little research has investigated the determinants and consequences, physiologic and functional, of anxiety in ASD. Wood and Gadow (2010) have proposed a model in which daily stressors contribute to increased mood dysregulation and anxiety, which then exacerbates clinically impairing ASD symptoms.
Objectives: The current study aimed to investigate the relation between diurnal cortisol levels and parent-report of ASD-related stressors in youth with ASD. Secondly, it aimed to examine the relations among daily stressors, anxiety, and ASD symptom severity by testing Wood and Gadow's (2010) hypothetical mediational model.

Methods: Participants were 43 youth, aged 7-14, with ASD. Cortisol levels were collected at four time points throughout the day for three days. Parent, child and diagnostician reports of daily stressors (e.g., Stress Schedule Survey), anxiety symptoms (e.g., Pediatric Anxiety Rating Scale), and ASD symptom severity (e.g., Social Responsiveness Scale) were collected.

Results: Results from multilevel modeling suggest diurnal cortisol samples in youth with ASD follow a similar daily pattern established in the typically developing population, and that increased daily cortisol is related to greater ASD-related daily stressors ($t = 2.34$, $p < .05$). Additionally, results from path analysis suggest anxiety partially mediates the relation between ASD-related stressors and ASD-symptom severity.

Conclusions: Findings from this study establish a relation between physiological response and subjective reports of stressors and anxiety in youth with ASD and suggest that increased stressors contribute to greater anxiety and ASD symptom severity. These results suggest that treatments aimed at reducing anxiety and stressors in youth with ASD may also affect core ASD symptom severity and impairment. Future research should continue to investigate these potential relations, other related factors, and response to treatments for increased anxiety and ASD symptom severity in youth with ASD.

54 **106.054** Who Are You Afraid of?: Stress Response to Performance Evaluation in Young Adults Diagnosed with ASD

C. Nielson[1], M. E. Maisel[2], C. Kindt[1], S. Shahan[2], T. Homewood[1], A. Grow[2], A. Ashton[2] and M. South[3], (1)Neuroscience Center, Brigham Young University, Provo, UT, (2)Department of Psychology, Brigham Young University, Provo, UT, (3)Psychology and Neuroscience, Brigham Young University, Provo, UT

Background: Epidemiological studies have found high co-morbidity of ASD and social anxiety disorder (SAD) (White, Oswald, Ollendick and Scahill; 2009). Some theories propose that the social anxiety exhibited in ASD has a similar biopsychological basis as SAD, and that individuals with ASD have a difficulty with social interaction because they are hyperaware of their lack of social skills (Monk et al., 2010). Others claim that the social ineptitude of individuals with ASD stems from a lack of awareness and motivation to act in socially acceptable ways (Dawson, 2005). In this study, we used psychophysiological measures of arousal to characterize reactivity in ASD during socially stressful (i.e. explicit performance evaluation) task trials compared to unevaluated trials.

Objectives: We aimed to understand how anxiety in people with ASD is mediated by fear of negative social evaluation. In light of previous work in our lab on non-social stress, we hypothesized that ASD group would show elevated stress to both types of threat while the control group (CON) would be more affected by social evaluation than non-social (evaluative) contexts.

Methods: Twenty adults aged 18-29 diagnosed with ASD were compared to age- and IQ-matched healthy controls on modified Stroop and Multi-Sensory Integration tasks developed by Gianaros and colleagues (Sheu, Jennings and Gianaros, 2012). We measured stress response with impedance cardiography and skin conductance response. Participants completed the computerized task in one room, while research assistants in another room communicated via speakers. Participants were instructed at the beginning of each alternating block, whether they would or would not be evaluated for that block, by the research assistant watching through cameras and by the computer recording their responses. We examined within subjects differences over evaluated and unevaluated trials, as well as between subjects with ASD and CON groups.

Results: We found that adults with ASD had higher overall autonomic physiological responses, relative to controls, during stress conditions. Parasympathetic activity during recovery periods was likewise reduced in the ASD group. There were significant group x evaluation condition interactions, with the evaluated trials adding substantially more to the stress response in the CON but not the ASD group, which was already near ceiling. Response to social evaluation was significantly correlated with scores on the Fear of Negative Evaluation and the Social Anxiety Questionnaire in both groups.

Conclusions: This is the first study we know of to use measures of impedance cardiography in an autism sample. Findings of increased sympathetic activity during stress and decreased parasympathetic activity during rest confirm suggestions from other recent studies that ASD adults are out-of-sync with fear versus safety contexts, which may underlie a great deal of everyday anxiety. This elevated overall stress level may mitigate any extra stress that performance evaluation brings. Interventions for anxiety in ASD should focus on helping individuals to recognize physiological responses to stress and develop specific coping skills for such situations.

55 **106.055** "Typical Teen" or "Typical ASD"?: Changes in Self- and Parent-Report of Co-Occurring Conditions for Adolescents with ASD Following a Social Skills Intervention

S. M. Minnick, A. M. Pearl, K. C. Durica, A. N. Heintzelman and M. Murray, Department of Psychiatry, Penn State Hershey, Hershey, PA

Background: Discrepancies between adolescent and caregiver reports of symptoms and impact in a wide range of behavioral and physical health concerns is well documented. It is not well understood whether discrepancies also exist for adolescent and caregiver report of co-occurring conditions associated with Autism Spectrum Disorder (ASD). Observed discrepancies could illuminate challenges faced by families and adolescents with ASD during a developmental stage marked by shifting roles.

Objectives: This study examined agreement between self and caregiver assessment of co-occurring

conditions for adolescents with ASD participating in a social skills intervention. Additionally, changes in agreement patterns over time were examined to determine the impact of active intervention on self and caregiver assessment of needs.

Methods: Thirty-six adolescents with a confirmed diagnosis of ASD between the ages of 13- and 18-years-old (M = 14.61, SD = 1.36) completed a 12-week social skills intervention. 81% were male and 97% were Caucasian. Verbal IQ was estimated using the Kaufman Brief Intelligence Scale, Second Edition (KBIT 2; M = 104.33, SD = 18.85). Exclusionary criteria included verbal IQ below 70. Participants and caregivers completed the Strengths and Difficulties Questionnaire (SDQ) to assess for comorbidities at pre- and post-intervention, as well as at three-month follow-up.

Results: Paired-sample t-tests were completed to compare self- and parent-report of comorbidities at the three assessment points. Self- and caregiver-report of the adolescent's level of anxiety was not significantly different at pre-, post-intervention, or at three-month follow-up. At pre- and post-intervention, self- and caregiver-report of the adolescent's behavioral difficulties also did not differ. However, at the three-month follow up, caregivers reported significantly less behavioral difficulties (t = -2.81, p < .01). In regards to symptoms of hyperactivity/impulsivity, caregivers rated the adolescent's symptoms as significantly higher at pre-intervention (t = 3.58, p < .01); at post-intervention and at three-month follow-up, ratings did not significantly differ. In terms of peer difficulties, at every time point caregiver report rated the adolescents' behavior as significant higher than self-report (t = 4.78, p < .001; t = 2.65, p < .05; t = 5.20, p < .001). Finally, in the area of total difficulties, adolescents and their caregivers did not differ in their report of symptoms at pre-intervention and post-intervention; at three-month follow-up adolescents reported having significantly less total difficulties as compared to caregivers (t = 2.89, p < .01).

Conclusions: Consistency between self and caregiver report was noted at post intervention and follow-up for anxiety and hyperactivity/impulsivity reflecting good agreement between assessment of internal and external symptoms. The most significant and consistent discrepancies between self- and caregiver-report were observed for relationship and social interaction challenges, most notably with peer difficulties. Adolescents and their caregivers also had significant discrepancies on assessment of behavior and total problems at the three-month follow-up. Further investigation is warranted to determine whether these discrepancies are reflective of self-assessment challenges faced by adolescents with ASD or are more indicative of perceptual differences in the adolescent-caregiver relationship.

Poster Session
107 - Service Delivery/Systems of Care
11:30 AM - 1:30 PM - Imperial Ballroom

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56   **107.056** A Pilot Study of a Screening Model to Triage Toddlers Referred for Autism Spectrum Disorder (ASD) to a Tertiary Care Center (TRC) Using a New Level 2 ASD Screening Test

R. Choueiri[1], J. F. Lemay[2] and S. Wagner[3], (1)Pediatrics, University of Massachusetts Memorial Children's Medical Center, Worcester, MA, (2)Developmental and Behavioral Pediatrics, Alberta Children's HOspital, Calgary, AB, Canada, (3)Behavioral, Developmental and Educational Services (BDES), New Bedford, MA

Background:
Toddlers referred for concerns of ASD to be evaluated by ASD experts, wait an average of 6 months before being evaluated delaying diagnosis in those with true ASD and treatment.

Objectives:
To evaluate a screening model to expedite autism evaluations in toddlers in a TRC by trained speech pathologists and a developmental pediatrician (SP-DP)

Methods:
The *Rapid Interactive screening Test for Autism in Toddlers* (RITA-T) is a new Level 2 ASD screening test in toddlers. It includes 9 activities that evaluate social communication skills in toddlers in less than 10 minutes. We have established its scoring algorithm, manual, developed a training protocol and demonstrated its discriminative properties in specifically identifying toddlers with ASD. Over five weeks, toddlers under 39 months of age waiting to be evaluated, were administered first the MCHAT and the RITA-T by the SP-DP. They were then assigned to 3 different risk groups based on their respective scores. Another team of clinicians administered the following tests and provided diagnoses of ASD or Non-ASD accordingly: Low Risk: DSM 5 checklist and the Vineland Adaptive Behavior Scales (VABS); Medium Risk: DSM 5, VABS and the ADOS; High Risk: DSM 5 and a developmental evaluation.

Results:
Twenty-two toddlers (82% boys) were evaluated. Mean age was 29.8 months (17-39 months). 18% were low risk, 41% were in each medium and high risk groups. ASD diagnoses were 0%, 67% and 100% in the 3 groups respectively. In total, 15 (68%) had a diagnosis of ASD. The RITA-T total score, DSM-5 criteria checked, and the MCHAT critical items failed were significantly different between the ASD and Non-ASD groups (ANOVA, p<0.01) and between the 3 risk groups (ANOVA, p<0.01). There were no significant differences on the VABS. The RITA-T was significantly correlated with the DSM & MCHAT measures (Pearson corr=0.49, p<0.01).

Conclusions:
The RITA-T is useful in a screening protocol in expediting autism evaluations of toddlers in a TRC. Testing of the RITA-T and of this paradigm continues.

57   **107.057** ASD Database Development within the Uk's National Health Service, for Service Evaluation/Research Purposes

D. Wimpory[1] and B. Nicholas[2], (1)Penrallt Road, Bangor University & BCU Health Board, Bangor, United Kingdom, (2)Gwynedd LL57 2AS, Bangor University, Bangor, Wales, United Kingdom

Background:
We report on the development and use of an ASD database module as an enhancement to the UK National Health Service's (NHS) Community Child Health database (CCH). The ASD database module was established at the end of 2011 specifically for adults and children who have received NHS diagnoses in childhood in North Wales (total child population 145,000). Previous NHS analysis of data such as numbers of ASD diagnoses, age at diagnosis, diagnostic instruments employed, waiting times and types of professions contributing to diagnoses was only available via time-consuming inter-departmental audits requiring dedicated staffing. Parental consent to electronic record keeping is given as part of each child's birth record on the CCH and the database maintains an ongoing record of children's developmental milestones, routine vaccinations and significant conditions. The purpose of the ASD module and its supporting administrative process is to improve efficiency in reporting ASD in North Wales; the quality of data collected; and, appropriate access for ASD practitioners to derive improved delivery of assessment/care. University research ethical permission is granted for this project so that prevalence of fragile X syndrome and other ASD co-morbidities can be determined.
Objectives:
Evaluate and research the data to quantify changes in diagnostic practice and depth of data collection by monitoring the contents of the ASD records and their annual rate of addition to the CCH.
Methods:
A count, cross check and collation of CCH ASD database module records were made for the years 2012 and 2013 (2014 in progress). The data was compared with standards for ASD prevalence and the prevalence of ASD genetic comorbidities.
Results:
The original electronic database (without enhancements) recorded an ASD diagnosis rate of ~1/month. For 2012 the recorded rate rose to ~15/month and this rate was maintained in 2013. ASD prevalence increased from 0.4% immediately before the implementation of the ASD Database Module, to over 0.6% by the end of 2013. For 2012/13: The average age at diagnosis was ~8 years. ADOS was the most frequently employed instrument, and children waited 11 months, on average, between ASD referral and diagnosis. Clinical Psychologists were the most frequent contributors to the diagnoses. ASD genetic comorbidity records were lower than expected due partly to an unexpectedly low number of counts for ASD genetic comorbidities in the CCH compared to the standard prevalence for these disorders.
Conclusions:
The ASD database module initiative has prompted an increase in the rates of diagnosis that is closing the gap between the CCH reported prevalence of ASD and the generally accepted ~1% prevalence for the disorder. The rather high average age at diagnosis (~8 years) for 2012 and 2013 reflects a catch-up on previously undiagnosed ASD in the system. This status is anticipated to remain until the current improved rate of recording overwhelms the historical under-recording. The lower than expected number of reports of genetic disorders that carry increased risk of ASD as a comorbidity indicates there is scope for improvements in the availability of genetic testing in North Wales.

58   **107.058** Adults on the Spectrum Sharing Success: A Model

E. Francis[1], B. V. Parsons[2], R. J. Wuebker[3], K. J. Cottle[4], A. R. Asman[5], J. Viskochil[4] and W. M. McMahon[4], (1)University of Utah, Salt Lake City, UT, (2)Psychiatry Adjunct, University of Utah, Salt Lake City, UT, (3)Management, University of Utah, Salt Lake City, UT, (4)Psychiatry, University of Utah, Salt Lake City, UT, (5)Department of Psychiatry, University of Utah, Salt Lake City, UT

Background: Currently, online networks, blogs, Facebook pages and organizations connect individuals with Autism Spectrum Disorders (ASD). Many of these gifted adults have overcome their developmental challenges to achieve remarkable levels of occupational, social and personal success. Published autobiographies by such gifted individuals have documented their personal triumphs and ongoing struggles of adult life, as well as the altruistic desire to share their stories with others who might benefit. Building upon existing methods of personal narrative, we have developed a live workshop model for interactive sharing of stories of success that we call *Self-Optimization on The Spectrum*. This report summarizes our experience piloting this model through two workshops involving 57 participants.
Objectives: Our objective is to enhance autonomy and self-advocacy by supporting adults who identify as on the autism spectrum. The workshops are designed to:
1. Describe avenues of success.
2. Share messages of hope.
3. Encourage dialogue regarding challenges in social, educational, and occupational domains.

4. Provide a forum for community building.

Methods: A key element of our model is that it is designed collaboratively by and for adults with ASD. Workshop speakers are all residents on the Spectrum who are able to provide peer-mentoring, successful methods navigating challenges and tips on self-advocacy. They develop formal presentations based on their life experiences, professional skills and interactions with an individual psychotherapist who serves as a coach prior to the workshop. The University of Utah Department of Psychiatry provides organizational support, advertising, registration, space, and other supports (Cambia Health Foundation). Data are collected from satisfaction surveys and a needs assessment.

Results: Attendees registered in response to media advertising for participants over age 22 years who identified themselves as on the autism spectrum. The first workshop was held on a Friday evening and all day Saturday. The second workshop was held on a Saturday for 7 hours. The number of attendees, demographics, and satisfaction survey results are depicted in Table 1.

Conclusions: Feedback from the satisfaction surveys was consistently positive, as was anecdotal responses from participants and their family members.

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59   **107.059** Are We Failing the M-CHAT? Self-Assessment in a Diverse Community Sample

C. B. Nadler[1,2], C. Low-Kapalu[1], L. Pham[1] and S. S. Nyp[1,2], (1)Developmental and Behavioral Sciences, Children's Mercy Kansas City, Kansas City, MO, (2)University of Missouri - Kansas City School of Medicine, Kansas City, MO

Background: The American Academy of Pediatrics (AAP) recommends standardized screening for autism at 18 and 24/30 months, but this standard is met inconsistently. Moreover, when practitioners (and researchers) implement evidence-based screenings, little attention is paid to the fidelity of implementation. In the case of the M-CHAT/F and M-CHAT-R/F, an evidence-based scoring algorithm prompts providers to conduct a structured follow-up interview and/or refer positive screens for evaluation and early intervention. Without the follow-up interview, psychometric value (i.e., sensitivity) of the measure is lost. No quality assurance procedures are available to quantify the degree to which autism screening in practice or research contexts adheres to validated implementation standards.

Objectives: To investigate the implementation fidelity of autism screening via the M-CHAT/F (and/or M-CHAT-R/F) conducted in the primary care clinics of a large urban hospital.

Methods: Electronic health records for 18 and 24/30 month pediatric well child visits during a one-month study period were manually reviewed to extract autism screening implementation parameters.

Results: The review yielded a sample of 281 eligible clinic visits serving children who were majority male (60.9%) and diverse (42.7% African American, 31.7% Hispanic, 10.3% White). Primary care providers documented that 4.3% of visits included a positive screen based on the M-CHAT; in contrast, re-scoring of parent-completed M-CHATs yielded 13.7% of visits with a positive screen (based on both critical item and total score approaches). No visit documented use of the structured M-CHAT follow-up interview, or any components of the M-CHAT-R/F. Providers' sensitivity with the M-CHAT was 0.214 (identifying 6 of 28 positive screens). Providers documented a referral for early intervention or evaluation services in 50% of cases (6 of 12) when a positive screen was identified in clinic; of children who screened positive based on rescoring of the parent M-CHAT, only 14.3% (4 of 28) were referred.

Conclusions: Manual chart review allowed for direct evaluation of the clinical implementation and interpretation of the M-CHAT in a large urban hospital. Despite routine administration of the M-CHAT at 18 and 24/30 months, providers failed to identify over 75% of children who screened positive on the measure. Pediatrician surveillance (i.e., clinical judgment without the aid of standardized tools) is well known to identify only 20-30% of children with developmental delays, and employing a standardized tool incorrectly does not appear to add incremental value in clinical practice. This pilot project demonstrates the viability of quantifying implementation and interpretation fidelity for autism screening. Efforts are underway to use this methodology to monitor quality improvement activities focused on provider education and training, as well as systems-level changes to facilitate standardized autism screening. Future studies are necessary to determine the extent to which other hospitals who use measures like the M-CHAT fail to monitor implementation fidelity, as well as how monitoring improves functional adherence to AAP guidelines. Research with developmental screening tools may also need to routinely include implementation fidelity data to better characterize results in community samples, given consistent (and even explicit) omission of the structured follow-up in recent publications.

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60   **107.060** Autism Research: Contribution from the Arab WORLD

F. Alnemary[1], Y. Alamri[2] and F. Alnemary[1], (1)University of California, Los Angeles, Los Angeles, CA, (2)University of Otago, New Zealand, Los Angeles, CA

Background: Autism/autistic spectrum disorder (ASD) represents one of the more common neuro-developmental disorders. The true prevalence of ASD is still obscure given the lack of rigorous epidemiological studies in the Arab world as a whole. Reported prevalence rates from smaller studies in individual countries vary considerably (1.4-33.3 per 10,000)1. Research is one way to mitigate the limited servcies for these children and their families in the Arab world. However, autism research in that region is yet to be scrutinised.

Objectives: We aimed to comparatively review all published autism research originating from the Arab

world in peer-reviewed English journals.

Methods: Studies where the sample and/or the afflition of one of the authors was from any of the 22 Arab countries was searched in Medline through PudMed, Web of Science and EMBASE databases from 1946, 1947 and 1991, respectively, to January 2014.

Sutdies were coded for several variables including:1) country, 2) research area (i.e., based on the seven areas of research plan of the Autism Inteagency Coordinating Committee report, 2011), 3) methodology and desgin , 4) impact factor and 5) the number of authors per publication. The interrater reliability was 95%, which was calculated for 10 % of the studies using a point-by-point method.

Results: Saudi Arabia and Egypt were the two most active countries, respectively producing 36% and 32% of autism research. The remainder of autism research originated from Oman (8%), UAE (6%), Kuwait (4%), Jordan (4%), Lebanon (3%), Bahrain, Libya, Morocco and Qatar (1% each). With respect the resreach area, 30 % , 21%, 14%, and 12% of the published studies were related to biology, dignostic and screenings, risk factors, and treatmetn and interventions, respectively. The mean impact factor of journals accepting contributions from the Arab world was 2.28 (SD=2.97) ranging from 0-31. With respect to the design, most of the studies were observational, 10 % or the studies were interventional in nature emplying randomised controlled trial desgin.

Conclusions: These findings indicate the urgent need to encourage higher-quality research in this area, as well as raise the awareness of local policy-makers in the Arab world to fund and publicise evidence-based information about autism and its management.

Taha, G. R., & Hussien, H. (2014). Autism Spectrum Disorders in Developing Countries: Lessons from the Arab World. In Patel., V.,B., Preedy V. R., & Martin, C. R. (Eds.), Comprehensive Guide to Autism (pp. 2509-2531). New York, NY, Springer.

61   **107.061** Barriers to Early Diagnosis in Children with Autism Spectrum Disorder: Preliminary Results

S. N. Brasher and J. Elder, College of Nursing University of Florida, Gainesville, FL

Background:

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder with no conclusive cause or cure. ASD is the fastest growing developmental disability in the United States, currently affecting 1 in 68 children (Autism Speaks, 2014). Researchers have established that early recognition and intervention are critical in the long-term outcomes of children with ASD. However, many children do not receive these services in a timely way. Therefore, the purpose of this descriptive study is to elucidate perceived barriers to early diagnosis in children with ASD.

Objectives:

The objective of this study is to identify healthcare professionals' perceptions of barriers to early diagnosis in children with ASD.

Methods:

The investigators developed an Internet survey comprised of open-ended and closed-ended questions. Initial survey questions were constructed based on an extensive literature review. After IRB approval, questions were presented to an interdisciplinary Community Advisory Board (CAB) consisting of nine ASD professionals to obtain feedback. The final survey was constructed online using REDcap (Research Electronic Data Capture) and disseminated to healthcare professionals throughout the state of Florida. Statistical outcomes were calculated in REDcap.

Results:

To date, thirty-four responses have been obtained and more are expected prior to the IMFAR conference. All but two respondents (5.9%) identified barriers to accurate, timely diagnoses in children with ASD. The barriers identified included socioeconomic factors (67.6%), medical insurance constraints (67.6%), geographical location (32.4%), limited transportation (35.3%), limited parental education (85.3%), not knowing where to seek help (85.3%), culture (58.8%), time constraints (23.5%), language (38.2%), uneducated providers (67.6%), lack of family acceptance (70.6%), and provider hesitancy (55.9%).

Conclusions:

These preliminary findings help to validate the clinical impression that barriers to receiving an early diagnosis in children with ASD exist and indicate a need for further research. Furthermore, these findings allow us to understand the types of barriers encountered by families of children with ASD from the perspectives of healthcare professionals. Additionally, these findings inform healthcare professionals about potential barriers to early diagnosis of ASD in children and have the ability to reduce these barriers through an improved understanding.

62   **107.062** Bridging the Gap: Primary Care Physician Self-Efficacy in Assessing and Treating Sleep Problems in Children with ASD

K. S. Kwedar[1], C. R. Engelhardt[1], N. C. Cheak-Zamora[1], M. O. Mazurek[1] and K. Sohl[2], (1)University of Missouri, Columbia, MO, (2)Child Health, University of Missouri - Thompson Center, Columbia, MO

Background: Children with autism spectrum disorder (ASD) are at increased risk for sleep disturbances compared to children with typical development (TD). Sleep disturbances in children with ASD have traditionally been treated by sleep specialists. However, given that sleep specialists are limited in number and that the reported prevalence of ASD has risen in recent years, an increasing number of children with ASD must receive treatment for sleep problems from primary care physicians

(PCPs). Insofar as recent evidence suggests that PCPs feel generally less efficacious in treating children with ASD compared to children with TD, it stands to reason that PCPs might also feel ill equipped to treat sleep disturbances in children with ASD.

Objectives: **1)** To examine differences in PCP self-efficacy in addressing and treating sleep disturbances in children with ASD compared to children with TD. **2)**To examine whether low perceived knowledge among PCPs is associated with reduced comfort in treating sleep problems in children with ASD.

Methods: General pediatricians (n = 52) and family physicians (n = 23) across Missouri completed an online questionnaire assessing: 1) knowledge and comfort in managing sleep concerns among individuals with ASD and TD, 2) factors affecting ability to address sleep concerns, 3) knowledge of specific sleep interventions, 4) educational topics useful for practice, and 5) preferences for sleep education. Comfort composite scores were determined using a scale from 1 [Not Comfortable] to 4 [Very Comfortable].

Results: PCPs feel markedly less comfortable in treating sleep problems in children with ASD ($M = 2.40$; $SD = 0.83$) compared to TD children ($M = 3.22$; $SD = 0.61$), $d = 1.10$, with 95% confidence interval [0.82, 1.41]. A lack of perceived knowledge about treating and assessing sleep problems in children with ASD was associated with less comfort in treating sleep problems in this group ($r = .76$ [.67, .85]). A majority of PCPs want to increase their knowledge of disordered sleep (93%) and medical conditions in children with ASD (91%).

Conclusions: Although PCPs want to address sleep disturbances in children with ASD, a lack of knowledge in this domain limits their comfort in effectively doing so. In a time of subspecialty shortage to diagnosis and treat ASD, it is imperative that PCPs bridge the gap between their desire to help and their expertise. This study supports increasing outreach efforts to PCPs to build capacity for community-based care.

63   **107.063** Characterizing Parent Influence in the Diagnosis of ASD

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Background:
It is commonly understood that increased rates of ASD diagnoses over time may be partially explained by increased awareness of ASD. Scholars – in particular sociologists - have attempted to explain the recent rise in autism diagnoses by examining the diffusion of information about ASD across the social networks of parents.   The argument has been that parents share information about autism with one another in parks, playgrounds and other local public spaces. This information in turn encourages parents to seek out the diagnosis and pursue medical, school and state therapy resources for their children.

On one hand, this finding might be interpreted as concerned and knowledgeable parents being more likely to raise their concerns to their pediatricians and other medical professionals, who might have otherwise overlooked symptoms of ASD. On the other hand, this finding might be interpreted as parents having greater ability to manipulate – either sincerely or cynically - the health care system to obtain supports and services for their child. Further unpacking the mechanisms of patient influence is immensely important for crafting appropriate health care policy.

Objectives:
This research aims to better understand how parents might affect the ASD diagnostic process of health care providers and health care organizations.

Methods:
First, data from the California Department of Developmental Services were used to replicate the discrete-time event history analysis of previous research and demonstrate the same correlation between measures of parent social interaction and rates of ASD diagnosis. Next, a subset of these data were merged with detailed electronic medical records from a large HMO in California (2000-2007 birth cohorts, n = 276,395). Using the HMO data and employing text-mining methods, we disaggregated the diagnostic process into two conceptually-distinct phases: (1) *initial suspicion* of ASD - an extended period of diagnostic uncertainty as signs and symptoms of a medical condition are initially identified (typically by a generalist), and (2) *formal diagnosis* - a diagnosis that resolves this uncertainty (typically by a specialist). To see whether parent social interaction has an impact on who is suspected and/or who is diagnosed (conditional on suspicion), we repeated the discrete-time event history analysis at each phase.

Results:
Consistent with previous research, we find that parent social interaction was positively associated with likelihood of being diagnosed with ASD (OR = 1.156, p < 0.001). However, when the diagnostic process was disaggregated, we found that parent social interaction was positively associated with initial suspicion of ASD (OR = 1.15, p < 0.001), but not associated with a formal diagnosis of ASD (OR = 0.83, p < 0.001).

Conclusions:
Our research provides the first evidence of how and where parents may influence the ASD diagnostic process.   Further examination of the specific social processes at play is critical to understanding patterns of diagnosis and informing health care policy.

64 **107.064** Community General Pediatricians' Barriers to Providing Autism Spectrum Disorder Diagnoses: A Qualitative Study

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Background: Wait times for diagnosis of autism spectrum disorders (ASD) may negatively impact outcomes by delaying access to early interventions. Community general pediatricians (CGPs) are often consulted in cases of suspected ASD, and may play a role in increasing ASD diagnostic capacity in the community setting.
Objectives: The objective of this study was to explore the perspectives of CGPs regarding their role in the system of ASD diagnoses using qualitative methods.
Methods: We performed a phenomenological qualitative study of CGPs' experiences with cases of suspected ASD. Two groups of CGPs were sampled to provide maximal variation in perspectives: a group that had referred patients with suspected ASD for a subspecialist assessment, and a group that regularly attended ASD educational events. Interviews began with a discussion of a case study describing a child with features of ASD. Individual in-depth interviews were recorded and transcribed. Two investigators coded each interview. Thematic saturation was reached when two successive interviews did not generate new codes. Texts were analyzed using a grounded theory approach. A preliminary theoretical framework was developed, summarized and sent to participants with a request for feedback (member checking; currently in progress). Member feedback will be incorporated into the final theoretical framework.
Results: Eleven in-depth interviews were conducted (six males, five females; mean years in practice 17.1). Participants described three elements to the process of assessment: diagnostic determination, communication of the diagnosis, and management of the diagnosis. Each element contained potential barriers to assigning a diagnosis of ASD. Diagnostic determination was affected by patient factors (severity of presentation, age, gender, comorbidities, and the amount of stimulation in the environment), family factors (how the family relays the history), and physician factors (training, practice setup, access to informal expert consultation, access to other staff's observations of the child, and interest in ASD). Family factors were essential considerations in the communication of the diagnosis. It was important that families know enough, but not too much, about ASD; families who knew too much were perceived to need an "expert" opinion. Participants felt a significant emotional burden and were very sensitive to the impact of the diagnosis. They felt ill equipped to deal with the fragmented service delivery system for ASD. Helping families to access services was time-consuming, poorly remunerated, and less satisfying than other areas of pediatric practice. A consistent theme in the interviews was the participants' negative attributions toward cases of ASD, particularly as they related to interfacing with dysfunctional health systems factors.
Conclusions: Though CGPs are frequently consulted on cases of suspected ASD, they experience many barriers to making a diagnosis, leading to increased subspecialist referrals. Efforts to improve diagnostic capacity in this group must focus not only on diagnostic determination, but also on communicating the diagnosis and efficiently connecting families to resources. Health system factors contribute to negative attributions toward ASD, potentially creating stigma and disadvantaging children with ASD from accessing care at the community level.

65 **107.065** Comparison of Adults with Autism Spectrum Disorder with and without a Guardian

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Background: Guardianship is a legal intervention used to protect adults unable to care for their health, safety, or provide self-care by providing them with a surrogate decision-maker who has the same rights and responsibilities over the protected adult that a parent has over their minor child. Legal scholars posit guardianship may not be appropriate for adults with Autism Spectrum Disorders (ASD), especially those considered high functioning.
Objectives: One previous small study examining characteristics of adults with ASD under guardianship found adults with ASD were more likely to be male and were younger than other protected adults under guardianship. We undertook a larger, more detailed comparison of adults with ASD with and without guardianship. We hypothesized that participants with a guardianship would have more severe clinical symptoms, lower IQ, and more co-morbid psychiatric and medical conditions than those without a guardian. We expected participants with a guardian to be more likely to receive a variety of social services
Methods: We studied 144 individuals ascertained 1982-1986 who met criteria for ASD (DSM-III or DSM–IV). Questionnaires and psychometric testing were completed in personal follow-up visits. Data were analyzed using analysis of variance and logistic regression.
Results: Ninety-two percent of guardians were the parent of the adult with ASD, 5% were a guardians *ad litem*, 1.3% were another relative, and 1.3% were unknown. Gender differences were not significant (p=0.27). Adults with ASD under guardianship had significantly higher scores on the Autism Diagnostic Scale (p<0.0001), significantly lower Adaptive Behavior Scale total and subscale

scores, (p<0.0001) were significantly more likely to destroy things in anger (p=0.028), and had significantly lower IQ scores (p<0.0001). Participants without a guardian were significantly more likely to receive vocational rehabilitation (p=0.004) and less like to obtain Social Security (p<0.0001), Medicaid (p>0.0001), and assistance from the Division of Services for Persons with Disabilities (p<0.0001). Contrary to expectations, the two groups did not differ regarding co-morbid psychiatric and overall number of medical disorders. However, more individuals with guardianship had seizure disorders (p=0.001).

Conclusions:
Adults with ASD with guardianship in our sample had significantly more severe autism symptoms and lower IQ scores than those without guardians. However, they did not differ in the number of comorbid medical and psychiatric conditions, suggesting that in aggregate, co-occurring conditions, not including intellectual disabilities, do not play a strong role in obtaining guardianship. Seizure disorders were significantly more common among those with guardianship, suggesting that type/severity of co-morbidity may yet be important. We confirmed our hypotheses regarding service use. While we found no overall gender differences between the two groups, this may have been due to the low number of female participants; further explorations of gender interactions are presented. We note that because the sample was originally ascertained in the 1980's, adults with high functioning ASD are not part of this cohort, so our conclusions are limited to a subset of more severe ASD. In spite of this limitation, our study is the first study to investigate multiple characteristics of adults with ASD with and without guardianship.

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66   **107.066**   Cost-Effectiveness Evaluation for Services Provided to People with Autism: Update and Recommendations

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Background: Cost-effectiveness analysis is a tool that can be useful for autism research and policy. For example, findings from a cost-effectiveness analysis can be used to identify clinical comparative effectiveness research that should be rapidly translated into practice. It can also inform policy about coverage for services and optimal treatment strategies. Unfortunately, there is a lack of understanding about the role and practice of cost-effectiveness that impedes its use among practitioners.

Objectives: The purpose of this paper is to describe state of the art approaches for evaluating the cost-effectiveness of services provided to people with autism specifically focusing on children.

Methods: The US Panel on Cost-Effectiveness in Health and Medicine developed guidelines for conducting cost-effectiveness analysis to create a standard approach so that findings could be compared across different studies, conditions, and population groups. Guidelines exist for other countries, especially the UK, but they differ on specific issues. This paper reviews guidelines for measuring quality adjusted life years and costs to conduct a cost-effectiveness analysis from a societal perspective. We note the special features of child health services that pertain to children with autism. In particular, children with autism are more likely to receive services in multiple settings that create difficulties in measuring costs, there are issues in measuring quality adjusted life years (QALYs) particularly in young children, and family spillover effects can play an important role in calculating the benefits of the intervention. We illustrate these issues using specific examples based on recent findings.

Results: Only one cost-effectiveness evaluation has been conducted on services for people with autism that followed either the US or UK guidelines. In that study, supported employment was found to produce a cost-effectiveness ratio of £5600 per QALY suggesting that such a practice should be adopted on a larger scale. The study lacked data on health utilities for calculating QALYs and had to extrapolate estimates from other conditions. There are no cost-effectiveness evaluations for services provided to children with autism using the cost per QALY metric, despite significant advances in utility data for measuring QALYs. Finally, there is evidence that services for children with autism produce spillover utility benefits for family members and failure to include these benefits can lead to cost-effectiveness ratios that understate the true value of the services provided.

Conclusions: Practitioners in the field of autism research can benefit from a greater understanding of cost-effectiveness evaluation to prioritize service delivery and influence policy. There are a number of exciting developments in the field of cost-effectiveness evaluation relevant to autism research, especially the measurement of QALYs in children and spillover effects of services on family outcomes.

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67   **107.067**   Development and Preliminary Validation of a New Scale to Measure the Social Validity of Skill Building Interventions for Autism Spectrum Disorder

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Background: There is growing evidence that evidence-based interventions for ASD are often not adopted or successfully implemented in community settings. Research suggests that social validity (i.e., the social importance of treatment procedures/outcomes) may strongly influence both the adoption and implementation of treatments. Thus, it is imperative to develop a better understanding

of community stakeholders' views of different evidence-based interventions for children with ASD. While there are established scales for examining the social validity of interventions designed to decrease unwanted behaviors, there are currently no tools for assessing the social validity of skill-building interventions.

Objectives: The primary purpose of this study is to refine a newly developed scale meant to assess the social validity of skill-building interventions for individuals with ASD, and to examine the scale's psychometric properties. The secondary purpose of the study is to use the scale to examine how consumers view different evidence-based, comprehensive interventions for ASD.

Methods: A 35-item measure (Scale of Treatment Perceptions; STP) was constructed to assess the social validity of skill-building interventions for individuals with ASD. In Phase 1, 600 undergraduate students read a vignette describing a young child with ASD, and one of four different comprehensive treatment descriptions (LEAP, EIBI, TEACCH, Floortime). Responses were submitted to item analysis and exploratory factor analysis. The scale was refined to improve the structure and reduce number of items. In Phase 2, 500 parents of young children unfamiliar with ASD interventions were recruited from Amazon mTurk and subjected to the Phase 1 procedure (using the refined version of the STP). This allowed us to investigate the robustness of the psychometric structure of the STP when including individuals who are potential consumers of early intervention. In each phase of the study we also examined the relative social validity of the four interventions as measured by the STP.

Results: Results from both Phase 1 and 2 provided support for a four-factor structure of the scale (acceptability, effectiveness, family impact, and potential risks). Internal reliability was excellent. In both college students and parents, the scale successfully discriminated between treatments both in terms of overall score and across individual factors.

Conclusions: The STP appears to have adequate psychometric properties for examining the social validity of skill-building treatments for ASD. The ability of the scale to evaluate social validity across four dimensions is a considerable strength, as it allows researchers to investigate social validity at a more nuanced level. Findings indicating that well-established treatments targeting skill development in individuals with ASD differ in their overall level of social validity and across these four factors suggest that the STP can be effectively utilized to compare the social validity of existing, evidence-based, interventions. Differences in the social validity of ASD treatments has significant implications for dissemination practices.

68   **107.068** Development of the Autism Family Navigator: A Pilot Study on Barriers to Care

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Background: Navigation is a relatively new area of personalized health care, defined as a "proactive, intentional process of collaborating with a person and their family to provide guidance as they negotiate the maze of treatments, services, and potential barriers" as they seek health care (Fillion, 2012). Originally designed/implemented with patients diagnosed with cancer, navigation is now used for a wide range of health conditions to reduce barriers to health care outcomes (Wells et al., 2013). Multiple sources of evidence suggest the need for navigation support for families affected by Autism Spectrum Disorder (ASD). There are often long delays between parents' first concerns about ASD, diagnosis, and receipt of interventions (Steiman et al., 2008). Throughout this period and beyond, caregivers take on duties of "case managers" and experience serious challenges in navigating complex and uncoordinated systems of care (Nicholas et al., 2013), with disparities reported in access and/or utilization of services (e.g., Savion-Lemieux et al., 2014).

Objectives: The objective of the current pilot study was to identify the most common unmet needs and barriers faced by families while navigating community services. This study will help inform the development of an Autism Family Navigator model to support personalized care for ASD.

Methods: This pilot study was conducted in Montreal (Quebec), Canada where many aspects of health and social care are universal and publically (i.e., government) funded. From an overall group of 47 families routinely followed within a research program in a university hospital, 20 were identified as experiencing barriers in care access and/or coordination. Their children (5 girls; 15 boys) were diagnosed at ages 2-4 years and were 8-10 years old at the time of this study. A pilot Navigator worked with the primary caregiver to identify and address barriers to care. Each case was then reviewed by two authors (TSL, LG) to categorize the nature of concerns, barriers to care, and navigator strategies.

Results: The following categories of unmet needs were identified (including % of families affected per category): child's skills and needs assessment (50%), revisions/issues pertaining to child's diagnosis (25%), issues pertaining to child's mental health (25%), assistance required to apply for government benefits (20%), issues pertaining to caregiver's own mental health (5%). The following barriers were identified: unawareness of available community services (60%); lack of relevant public sector services (30%); long wait lists (25%); financial barriers (20%); language barriers (15%); and issues related to caregiver's health/wellbeing (5%). To reduce barriers, the Navigator used these strategies: liaison with health care agents regarding the family's unmet needs or supporting the caregiver to

communicate with these agents (90%), psychosocial support (90%), and education about services (65%).

Conclusions: The findings illustrate that, even within a universal health care system, there are serious gaps in care access and coordination for families affected by ASD. While follow up is needed to establish whether the identified strategies were successful in reducing barriers, our pilot study demonstrates that navigation should be explored as a method of expanding access to and coordination of community-based care.

69 **107.069** Developmental Trajectories Diverted: Empowering Frontline Community Childcare Providers to Support Children's Social Communication Development through a Coach-the-Coach Model

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Background:
Early detection and rapid mobilization of individualized supports are critical components of ensuring that children at risk for developing ASD obtain their fullest developmental potential. The National Research Council (2001) found that early detection and 25 hours a week of active engagement promoted optimal success for young children with ASD in kindergarten. Knowledge of red flags for ASD and transactional supports to promote active engagement, for example, those derived from the SCERTS framework (Prizant et al., 2005), is vital for providers working in the early childcare setting. Translating this knowledge into practice through collaborative learning experiences with early childhood professionals (ECPs) allows front-line providers to alter disadvantaged developmental trajectories of young children at risk for ASD. Learning "how to" coaching and collaboration strategies is needed for successful collaborative learning experiences between ECPs and childcare providers (Friedman & Woods, 2012). However, there is a paucity of research on the effectiveness of coach-the-coach models with ECPs.

Objectives:
This project aimed to improve collaborative coaching proficiencies within Georgia's Bright from the Start (BFTS): Department of Early Care and Learning (DECAL) professionals via implementation of a novel, three phase coach-the-coach model focusing on increasing knowledge of normative development and detection of red flags for ASD, and using transactional supports to promote active engagement in early childcare settings.

Methods:
This study tracked the progress of 12 ECPs from BFTS: DECAL (5 Infant Toddler Specialists and 7 Inclusion Coordinators) coached to coach childcare providers using a collaborative coaching model. Through the use of coaching and collaboration strategies to promote adult learning, coaching centered on increasing active engagement in the early childcare setting using transactional supports. Coaching by Community Interventionists was conducted in person, via mobile coaching, and through video conferencing across three, 12-week phases with decreasing frequency and intensity to build independence and capacity. Effectiveness of Phase I of the coach-the-coach model was assessed by 1) rate of support and coaching provided by ECPs during video-recorded independent classroom sessions with childcare providers throughout the coaching period; and 2) number of children identified at risk for ASD.

Results:
The rate of coaching and supports provided by ECPs during Phase I significantly increased from baseline ($t_{11}=1.774$, $p=0.05$). In addition, 12 children have been identified with social communication concerns, indicating an increase in awareness of social communication milestones and red flags for ASD.

Conclusions:
These data indicate that the current coach-the-coach model results in increased support and coaching provided by ECPs and an increased awareness of red flags for ASD. Through the coaching-the-coach model, ECPs learned important aspects of coaching and collaboration, used transactional supports to promote active engagement, and increased awareness of red flags for ASD. This enabled them to improve their coaching proficiency of others, thus exponentially multiplying the number of children who receive necessary developmental supports.

70 **107.070** Early Intervention Service Providers Knowledge and Use of Intervention Practices

ABSTRACT WITHDRAWN

Background: Recent research has made significant progress in the identification and description of evidence-based practices (EBP) for working with children with Autism Spectrum Disorders (ASD) (e.g., Wong et al., 2013). However, a "research to practice gap" is widely acknowledged (e.g., Cook, Cook, & Landrum, 2013). For example, unsupported treatments (e.g., sensory integration therapy, vitamin

supplements, and elimination diets) continue to be reported to be used frequently in surveys of both parents (for a review see Carlon, Stephenson, & Carter, 2014) and professionals (e.g., Kadar et al., 2012). Little is known however, about what intervention practices are used in community-based early intervention services for children with ASD, or what factors may facilitate or hinder the uptake of EBPs in such services. This information is vital for improving outcomes for all children with ASD.

Objectives: The present study aimed to explore the level of knowledge and use of EBP and links to organisational culture, individual attitude, and demographic variables in a state-wide community-based ASD early intervention service in Australia using a questionnaire design.

Methods: Participants included 99 staff at an ASD early intervention service including professional (teachers and therapists) and paraprofessional (learning facilitators) staff across both rural/regional and metropolitan areas. Questionnaires measures included the Organisational Culture Questionnaire (Russell et al., 2010); the Evidence-based Attitudes Scales (Aarons, 2004), ratings of knowledge and use of a range of intervention practices (EBP, promising, and unsupported) drawn from the literature (e.g., Odom et al., 2010), and demographics.

Results: Participants reported a moderate level of organisational culture supporting the use of EBP in terms of available resources, culture, and supervisor support. Greater perception of a supportive organisational culture was linked to greater knowledge and greater use of EBP. Participants likewise reported a moderate level of attitudinal support towards the use of EBP in terms of willingness to use EBP if they were a requirement, appealed, and their openness to using EBP. Only openness was linked to knowledge and use. Knowledge and use of EBP were also linked to each other with greater knowledge linked to higher self-reported use. Demographic differences were found in use of EBP including that professionals reported using EBP more than paraprofessionals. Additionally, participants in the metropolitan area reported greater use than rural/regional participants.

Conclusions: This study adds to our knowledge and understanding about factors related to knowledge and use of EBPs in community settings. Results suggest a need for organisations to address staff knowledge and use of EBPs, particularly for paraprofessionals and for staff working in regional/remote areas. These results also suggest that organisational culture and individual attitudes may also affect uptake. Further research using direct observation could extend this research by investigating whether practices are implemented with fidelity and how they align with self-report. Such research would provide valuable insight into the needs of community-based paraprofessionals and professionals to better translate EBP into practice to support the use of high quality interventions with all children with ASD.

71 **107.071** Evaluation of a Parent-Response Scale to Measure the Progress of Children with ASD in State Early Intervention Programs

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Background:
Under the Individuals with Disabilities Education Improvement Act of 2004, state early intervention (EI) programs, which serve children birth to age three, are required to report annually on the developmental progress made by enrolled children in three broad outcome areas: social relationships, acquisition and use of knowledge and skills, and taking action to meet their needs. A key indicator of program performance is the percentage of children with developmental delays who make substantial progress in these areas. However, states are not required to disaggregate their child outcomes data by type of developmental delay or diagnosis. Therefore, the extent to which children with a diagnosis of Autism Spectrum Disorder (ASD) are making progress in response to state EI services is unknown. This is particularly important in that children with ASD represent a growing percentage of the children served in state EI programs.

Objectives:
To evaluate the psychometric properties of a parent-report scale addressing the impact of EI services on the developmental progress of children with ASD.

Methods:
Items for the Impact on Child Scale - ASD Version (ICS-ASD) were developed through a Concept Mapping process conducted with a diverse set of EI stakeholders that included substantial representation of family members of a child with ASD. The 83 items used in this research are displayed in the attached Table; all items used the same 6-point response scale, from 1=very strongly disagree to 6=very strongly agree. The ICS-ASD items, along with other parent measures, were sent to a research sample of 204 families of a child with ASD who was diagnosed either prior to or during participation in the New York State Early Intervention Program. Responses to the ICS-ASD were received from 167 participating families around the time that their child transitioned out of the EI program. Measurement analyses were conducted through the Rasch framework using WINSTEPS (Linacre, 2003) data analysis software. Scale reliability and principal components analysis were

conducted using SPSS.

Results:

Cronbach's alpha for the 83-item ICS-ASD was .99. Point-measure correlations for the items ranged from .66 to .83. Item mean square infit statistics ranged from 0.62 to 1.67, with values for all but 10 items between 0.70 and 1.40. A principal components analysis indicated that all the items loaded substantially (.62-.92) on the first component, which explained 72% of the variance. Five other components together explained an additional 10% of the variance.

Conclusions:

Findings of this study suggest that the ICS-ASD yields reliable measures of the extent to which parents report that EI helped their child with ASD achieve key developmental outcomes. Work is currently under way to examine the validity of the ICS-ASD as a measure of the overall developmental progress of children with ASD in EI. For state accountability purposes, the ICS-ASD represents a highly cost-effective data source that can inform program improvement efforts. Its use also reinforces the importance of family members' participation in the evaluation of EI services for young children with ASD.

72   **107.072** Examining System-Level Resources in Building Employment Capacity for Adults with ASD

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Background:

Despite gains in employment supports for adults with autism spectrum disorder (ASD), substantial gaps remain. The Canadian population-based *Participation in Activity Limitation Survey* (PALS, 2006) database suggests that adult males (25-64 years) with ASD, have remarkably lower labour market participation. Only 40% of adult males in this category are employed. Less than half participate in the labour force (employed or unemployed but looking for work). These employment outcomes are approximately 10% lower than other disabled male counterparts. Given these outcomes, it is not surprising that there is a substantial reliance on social assistance and disability benefits (PALS, 2006). Vocation-related service needs for adults with ASD have thus emerged with increased urgency as a growing cohort of adolescents with ASD are aging into adulthood.

Objectives:

This study addressed employment access and support for adults with ASD. It examined the perceived quality of employment supports, and the experiences of adults with ASD, families and employment support service providers, relative to employment support.

Methods:

A mixed method study was conducted in five regionally-distinct provinces across Canada, comprising the following methods:

(A) An employment support capacity survey, and

(B)   Qualitative interviews with key stakeholders.

Results:

 (A) An employment support capacity survey was completed by n=95 senior level service providers (one per organization) across Canada. Participants ranked, based on percentages, their ASD employment support capacity (followed in parenthesis by mean capacity ranking): (i) organizational capacity to provide employment support to individuals with ASD (88.9%), (ii) organizational capacity to meet the broader needs of adults with ASD (beyond only vocational needs) (75.4%), (iii) organizational capacity for evidence-informed service planning and evaluation (62.2%), and (iii) broader community capacity of the region to meet the employment support needs of adults with ASD (57.8%). With regard to the first three domains, there was general, although mixed and incrementally decreasing, agreement among respondents that their respective agencies were variably successful in addressing the employment support needs of individuals with ASD. In the fourth domain of "community capacity", there was a decrease in terms of perceived effectiveness to meet employment support needs for adults with ASD.

(B) Qualitative interviews were conducted with n=141 stakeholders, consisting of adults with ASD (n=45), parents/caregivers (n= 60), and service providers (n=36). Interviews indicated that current services are insufficient to provide the extent and nature of support needed by persons with ASD to achieve desired engagement and success in employment and other adult life contexts.

Conclusions:

Vocational challenges for persons with ASD were compounded by a lack of access, coordination and collaboration between agencies, secondary and post-secondary schools, and government systems. Funding was repeatedly not equitably distributed across the ASD spectrum in terms of employment

support, and participants consistently conveyed that support agency/program criteria can emerge as a barrier to resource access. Heightened challenges for families with lower SES were identified. Overall, greater opportunity for employment access, retention and advancement for adults with ASD is needed, as are strategies to build employer capacity. Practice and policy implications will be offered.

73 **107.073** Examining the Overlap of School Disciplinary Action, Hospitalization, and Police Contact in Individuals with Autism Spectrum Disorder: Predictable Factors for Preventable Outcomes

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Background: Children and adolescents with autism spectrum disorder (ASD) are at a greater risk for adverse outcomes, such as psychiatric hospitalization, police contact and school disciplinary actions, than other children. Little research has examined these outcomes in the same sample. If different child characteristics predict different outcomes, it would suggest that prevention strategies should differ for these different outcomes. If these outcomes are correlated and similar child characteristics predict all of them, it would suggest potential concurrent points of prevention for several adverse outcomes.
Objectives: To examine associations among school disciplinary actions, police contacts, and psychiatric hospitalizations for children with ASD, and demographic and clinical factors associated with each and all of these adverse events.
Methods: Survey data from a statewide ASD-specific needs assessment provided data for this study. Data were included from 2,525 parent/caregivers with a child with ASD in elementary, middle, or high school. A police contact was defined as having any interaction with the police leading to disciplinary action. A school disciplinary action was defined as detention, in and out of school suspension, and expulsion. A hospitalization was defined as admittance to an emergency room or hospital or hospital-like setting for behavioral or psychiatric reasons. Frequencies describing the outcome variables and demographic variables were tested for significance using chi square analysis. Logistic regression will be used to estimate the association between these outcomes and demographic and clinical variables.
Results: In our sample, 378 individuals (15%) had a school disciplinary action, 196 (8%) experienced a hospitalization, and 199 (8%) had contact with the police. Variables that will be included in the regression analyses include parent or caregiver marital status, primary diagnosis, and age. A significant amount of individuals experienced greater than one negative outcome, 156 experienced two of the three negative outcomes, and 31 experienced all three. Early results suggest that family structure, primary diagnosis, and age may be significant predictors of these negative outcomes.
Conclusions: School disciplinary action, psychiatric hospitalizations, and police contact are traumatic for individuals with ASD and their families and costly to the systems that serve them. The results of this study suggest their significant overlap, and that experiencing one of these outcomes is a risk factor for the other two. Although the present study was cross sectional, it may be that children experiencing negative outcomes early on (most likely school disciplinary actions), are at high risk for hospitalization and police contact, and should be targeted for more intensive interventions and supports. Demographic and clinical characteristics predicting these outcomes offer important points for intervention or to identify groups at high risk.

74 **107.074** Factors Affecting Caregiver Satisfaction with a Family-Centered Evaluation for Autism Spectrum Disorder (ASD)

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Background: Research consistently shows that the needs of children with ASD are complex and involve medical, educational, social, community, and family factors. These complex needs often necessitate multidisciplinary care and coordination of services from a wide range of providers (Volkmar et al., 2014). Unfortunately, studies have identified difficulties when families of children with ASD attempt to access empirically-validated services in a coordinated way, thus reducing family satisfaction and delaying initiation of services (Liptak et al., 2006). Furthermore, although ASD can be diagnosed in children as young as 12 months, delays in accessing healthcare systems often prevent diagnosis until age four (CDC, 2014). This delay in diagnosis prevents the family from accessing early, intensive behavioral interventions which have been empirically validated to significantly improve the social, communication, cognitive, and adaptive functioning of children with ASD (Wong et al., 2014). Given wait-times for ASD evaluation that exceed one year, a single-visit evaluation clinic where children are evaluated within one month was developed in a hospital setting to rapidly assess a family's needs and expedite medical diagnosis and recommendations.
Objectives: Minimal research has investigated caregiver satisfaction with a hospital-based, single-visit evaluation clinic for children with ASD. Thus, the aims of the study were to: 1) assess if pre-existing diagnosis impacts caregiver satisfaction; 2) assess if type of recommendations offered during the evaluation impacts caregiver satisfaction; and 3) assess if child's age impacts caregiver satisfaction.
Methods: Following participation in the evaluation clinic, caregivers (n = 67) completed questionnaires that assessed satisfaction with the evaluation. Caregivers were divided into groups based on pre-existing diagnosis (no diagnosis, ASD diagnosis, other mental health diagnosis) and

child age (four and under, over four). Recommendations offered during the evaluation were obtained via chart review.

Results: Overall caregiver satisfaction with the evaluation was high (M =28.58 out of 35, SD = 7.5). Caregivers of children with no pre-existing diagnosis were more satisfied [$F(2, 57) = 4.94$, $p = .011$] and reported greater stress reduction as a result of the evaluation [$F(2, 57) = 5.48$, $p = .007$]as compared with those whose children had a pre-existing diagnosis (see Figure 1). Caregivers of children four years and younger were significantly more satisfied than parents of older children [$F(1, 59) = 7.85$, $p= .007$] (See Figure 2). The recommendations provided (e.g., referred for further testing) did not impact caregiver satisfaction.

Conclusions: Preliminary data indicate that a rapid, one-visit evaluation meets family's needs for diagnosis, particularly when they lack prior diagnostic clarity or if their child is under age four. Additionally, the outcome of the appointment, such as whether further testing was recommended, did not impact satisfaction. The preliminary results of this study offer a cost-effective model for diagnosis of ASD that meets family's needs and supports access to empirically-validated interventions.

75   **107.075** Home and Community Based Services Waivers for Children with Autism Spectrum Disorder

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Background:

Autism spectrum disorder (ASD) is a complex lifelong neuro-developmental disorder associated with repetitive behaviors, restricted interests and impairments in social communication that affects one in 68 children. The disorder often co-occurs with significant behavioral and communication challenges. While the causes of autism are unclear, early diagnosis and evidence-based treatment, such as therapy delivered by trained behavior analysts for up to 40 hours per week, have been shown to enhance cognitive and adaptive functioning. Although several states have enacted policies to facilitate access to care, such as insurance mandates or mental health parity laws, many families of children with ASD experience significant barriers to obtaining needed services.

Objectives:

To describe characteristics of 1915(c) Home and Community Based Services (HCBS) waivers for children with ASD across states and over time. While increasingly popular, little is known about these Medicaid waivers. Understanding the characteristics of these programs is important to clinicians and policy makers in designing programs to meet the needs of this vulnerable population and to set the stage for evaluating changes that occur with the implementation of health care reform.

Methods:

HCBS waiver applications that included children with ASD as a target population were collected from the Centers for Medicare and Medicaid Services (CMS) website, state websites, and state administrators. A data extraction tool was used to document waiver inclusions and restrictions, estimated service provision and institutional costs, and the inclusion of four core ASD services: respite, caregiver support and training, personal care, and behavioral treatments.

Results:

Investigators identified 29 states offering 49 current or former waivers that explicitly included children with ASD in their target populations. Of these waivers, 10 were exclusively targeted to children with ASD while the others included either adults with ASD or adults and children with other developmental disabilities. Waivers differed substantially across states in the type and breadth of ASD coverage provided. Specifically, waivers varied in the (1) minimum or maximum age for inclusion (i.e., no restrictions, 0-2, <8, 0-21); (2) limits on the length of time one could be served by the waiver (no limit, 3 years); (3) individual cost limits (i.e., dollar limits that individuals were not allowed to exceed based on level of service designations or estimated institutional costs); (4) geographic exclusions; (5) limits on the amount, frequency or duration of specific services; (6) the maximum number of participants that could be served in a year (30 – 110,000); (7) state estimated cost of services ($6,295-$161,040), and (8) specific services offered to children with ASD (ABA to respite only).

Conclusions:

HCBS waivers for children with ASD are very complex and are not consistent within or across states. As states and advocacy groups continue to develop these programs to facilitate access to care for individuals with ASD, understanding and evaluating current programs is critically important. Further efforts are needed to examine the characteristics of these programs that are associated with improved access to care and clinical outcomes to maximize the benefits of these programs to individuals with ASD and their families.

76   **107.076** Identifying Interventions for Dissemination and Implementation Research Using the National Database for Autism Research (NDAR): Promises and Pitfalls

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Background:
The National Database for Autism Research (NDAR) is an NIH-funded research data repository created with the express purpose of accelerating autism research by integrating heterogeneous datasets through data sharing agreements with the National Institute of Health.
Objectives:
This study summarizes a user-developed catalog of interventions shared in NDAR that would assist health services researchers and implementation scientists interested in autism studies that could be targeted for dissemination and implementation.
Methods:
This descriptive study was conducted through October 15, 2014 to review all shared NDAR data using the "data from labs" query. The term "intervention" refers to any treatments or services provided to children with autism to improve core impairments and other associated symptoms. Each NDAR project was reviewed using its research description in the NIH Research Portfolio Online Reporting Tools to identify if any interventions were involved. A catalog of interventions was then created in an Excel spreadsheet and shared data were downloaded for further investigation.
Results:
A total of 184 research projects have shared data with NDAR involving 108,386 subjects by age (54,053 affected subjects by age and 54,333 control subjects by age) whose ages ranged from toddlers to adults. Sixty-three projects (34%) involving interventions were identified. These projects were categorized further as observational (7), effectiveness (10), health services research (11), and efficacy (35) studies. However, 30 projects appearing in NDAR have not yet released their data and at least 20 projects are still ongoing, resulting in 11,972 subjects with information currently available. Interventions include pharmacotherapy (3), early intensive behavioral therapy (5), cognitive behavioral techniques (3), community health services (3), and others (e.g., peer-engagement, sensory integration based therapy, school integration service, language integration).
Conclusions:
The NDAR has high promises for data aggregation and secondary analyses to guide dissemination and implementation of interventions. However, missing data seems to be a prominent problem in those previously sharing data. In addition, researchers require clinical background knowledge on a large number of measures used in autism to enable data aggregation. Despite some inconvenience associated with finding needed data, downloading time, and data cleaning, NDAR provides rich data for the autism research community without charge. Future improvements to NDAR and those providing data can be expected that will greatly improve functionality for services research to extract information on treatments or interventions provided to individuals with autism.

77 **107.077** Imprinting Variation in the Diagnosis of ASD at Two Specialty Clinics

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Background:
A large part of the public controversy over ASD stems from the process of diagnosis. Like many other disorders presenting as mental or behavioral rather than immediately physiologic, diagnosis is made on the basis of interpretation against a set of qualitative behavioral criteria in the Diagnostic and Statistical Manual of Mental Disorders (DSM). Intellectually, health care providers must connect specific observed symptoms to abstract criteria. Because the process of inference is opaque, it is unclear whether too few, too many, or simply the wrong people are being diagnosed.
Variation in medical practice among health care providers has been well documented in a number of settings (e.g. Dartmouth Atlas). Applied to the diagnosis of ASD, it is likely that there exists substantial variation in diagnostic practice among health care providers – not only in the structure of the evaluation and the use of specific instruments such as the ADOS, but also in the way in which evidence is assessed against diagnostic criteria.
Sociologists of organizations and professions have studied how technical knowledge may diffuse across individuals or remain localized. The processes studied by sociologists may explain the distribution in diagnostic knowledge and, therefore, differences in diagnostic outcomes both temporally and spatially.
Objectives:
This research examines diagnostic 'styles' among health care providers and how these styles are shaped by factors in the health care workplace.
Methods:
We obtain data from a large HMO which operates two clinics specializing entirely in ASD diagnosis. Data include electronic medical records of eight birth cohorts (n=276,395) as well as qualitative data including: direct observation of evaluations at the clinics, 28 interviews, and internal documents describing the history of ASD diagnosis at the HMO. These qualitative data amount to over 200 pages of field-notes and interview transcripts.
Results:
We demonstrate a 30 percentage point difference in ASD diagnosis rates between the two clinics even after controlling for patient characteristics. Methodologically, we accomplish this by (1) including controls in regression models and (2) exploiting a natural experiment based on changes in clinic catchment areas. These results suggest that local organizational, cultural factors may be responsible for the observed diagnostic difference.

Organizational factors are identified and described using qualitative data. We find that the local style of diagnosis was influenced by key individuals at each clinic during the opening of each clinic. These differences in diagnostic styles persists even as these key individuals have left the HMO or have taken on different roles, and despite efforts by organizational leaders to establish a uniform diagnostic process throughout the HMO.
Conclusions:
It is commonly understood that increased diagnosis reflects an increased awareness of ASD, especially in the health care community. The implications of this are underexplored however. Namely, this suggests that variation in knowledge across health care providers and health care organizations shapes the observed patterns of ASD diagnosis. Our research is among the first to study the health care organization directly and muster substantial evidence describing how organizational processes can lead to unexpectedly large differences in diagnosis rates.

78   **107.078** Improving Early Access to Care in Underserved Communities

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Background: Early diagnosis of autism is associated with earlier access to intervention which increases optimal outcomes, yet research suggests that racial and income disparities exist in early detection of developmental disabilities including autism. While symptoms of autism may be noted as early as 12 months of age, the average age of diagnosis is 4-5 years and is significantly higher among African American and Hispanic children. This delay means that young children with ASD might not get the help they need. Children with low SES, racial and ethnic minorities and those with limited English proficiency are less likely to be identified with ASD despite no known prevalence differences. When identified as having ASD, those with low SES, racial or ethnic minorities are often identified at later ages. Reasons for disparities in identifying autism and developmental disabilities are varied and may include access difficulties due to insurance or transportation issues as well as lack of available local service providers.
Objectives: A model program was created to provide free community-based developmental screening within underserved communities in order to improve early access to care.
Methods: Target sites for screening clinics were located primarily in low income cities having large percentages of racial minority, Hispanic/Latino, and/or Spanish-speaking households. The free clinics were held in locations near public transportation and easily accessible such as libraries, recreation or community centers or daycare centers. Screening staff had expertise in child development and provided screenings to children ages 11-66 months in English or Spanish. The Ages and Stages Questionaire-3 (ASQ-3) was administered interactively with the child and accompanying parent/guardian. Resources to promote child development and anticipatory guidance were provided to all families and those screened as at risk were also given resources for further evaluations and information to be shared with their healthcare provider. Phone follow up for those at-risk was provided one month following screening to determine if further help was needed to access services.
Results: 715 children were screened, with 50.3% found to be at risk. The children identified as at risk had not been previously seen by a developmental specialist. At one month follow up, 59% of those at risk were able to be contacted. Those not contacted had disconnected phones or did not respond to 3 phone messages.Of those contacted, 96.3% had arranged diagnostic evaluation, early intervention, and/or school-based services.
Conclusions: A model developmental screening program was created to reduce healthcare disparities in early access to care among an underserved population. Provision of free, quick interactive bilingual screenings in easily accessible community locations eliminated access barriers such as insurance, transportation, and difficulty finding services, and resulted in identification of young children not previously identified as at risk for developmental disabilities including ASD. Of note is that the ASQ-3 allows for alternative administration methods and materials for children from different cultural backgrounds and was normed with culturally diverse populations. Cross-cultural considerations of screening programs will be discussed.

79   **107.079** Improving the Patient Experience for Families of Children with Autism Spectrum Disorder through Use of an Autism-Specific Care Plan

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Background: Hospital admissions can be difficult for patients with autism spectrum disorder (ASD) and their families. Therefore, as part of a quality improvement initiative at MassGeneral Hospital *for* Children, we created an autism-specific care plan (ACP) to be used during hospital admissions. The ACP is an electronic document completed by families or physicians which delineates a patient's ASD-specific needs related to a hospital admission (e.g. mode of communication, sensory issues, safety concerns) and is loaded into the patient's medical record.

Objectives: The objective of this pilot study was to compare the experience of care for children with ASD who used an ACP to children with ASD who did not an ACP.

Methods: In April 2014, we mailed surveys to all parents of children with ASD (ICD-9 code 299.0 or 299.8) who had a hospital admission between January 2013-December 2013 (n=143). Of these, 33 used an ACP and 109 did not. The ACP group was self-selected and response rate was 69.6% in the ACP group and 64.2% in the non-ACP group. Question domains included general experience with hospital care and experience related to the patient's ASD. We then used multivariable linear regression to assess the association of experience of care with ACP use, while adjusting for reason for hospital visit and autism severity.

Results: The ACP group was more likely to be admitted for a medical versus psychiatric diagnosis, and had more severe autism symptoms than the non-ACP group. Parents who used the ACP reported better experience of care relating to their general hospital experience (B coefficient 1.48, p<0.001) and staff attention to the child's ASD specific needs (3.06, <0.001) compared to those without an ACP.

Conclusions: Based on this pilot study, care plans may hold promise to improve the experience of care for children with ASD and their families in the hospital setting. Limitations include non-randomized study population and small sample size. More rigorously designed trials are needed to determine if these findings persist.

80   **107.080** Mapping the Diagnosis of Autism Spectrum Disorders By Age 7 in Australia: 2010 – 2012

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Background: The early diagnosis of young children with Autism Spectrum Disorder (ASD) is critical to ensure access to early intervention services. ASD can be accurately and reliably diagnosed by 24 months; however, diagnosis often does not occur until a later age.

Objectives: The frequency and age of diagnosis (AoD) of ASD in children, under 7 years, living in Australia was investigated to examine trends across states, metropolitan, regional and remote areas and the child characteristics of sex, diagnosis type, Indigenous, and cultural minority group status.

Methods: Secondary de-identified data regarding 15,096 children aged 0 – 7 years registered through the national Helping Children with Autism Package between 2010 and 2012 were utilised. ASD diagnoses consistent with the DSM-IV were confirmed by a pediatrician, psychiatrist or multidisciplinary team assessment. The number of cases by state was calculated and compared to the estimated population of children in the specified age range.

Results: On the basis of this data, 0.74% of the population of children aged 0-7 in Australia are currently diagnosed with ASD. The average age of diagnosis of ASD (by age 7 years) was 49 months, with the most frequently reported diagnostic age being 71 months. Differences were evident in the frequency of ASD and average AoD across states (see Figure 1) and between major cities, regional and remote areas. There was no difference in AoD between Indigenous and non-Indigenous Australians, but children from a culturally and linguistically diverse background were diagnosed 5 months earlier than other children.

Conclusions: The current AoD of ASD in Australia indicates a substantial gap between the age at which a reliable and accurate diagnosis is possible, and the age at which most Australian children are diagnosed with ASD. Findings suggest that the frequency of ASD in Australia has increased substantially from previous estimates.

81   **107.081** Meta-Analysis of Community-Based Early Intervention Programs for Children with Autism Spectrum Disorders

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Background:

Careful measurement of interventions delivered in community settings is an important component of developing effective and sustainable programs. Part of the rationale of measuring community-based intervention is to identify intervention characteristics that are associated with improved child outcomes. Recent results from early intervention trials suggest significant variability in the extent to which children with ASD make gains in community-based early intervention programs. For example, children in some community preschool programs make equivalent gains to children in university-developed programs (Boyd et al., 2013), while children in other programs make much smaller gains (Magiati et al., 2007). To date, however, results from community-based early intervention programs and usual practices have not been examined systematically. Estimating the variability in and predictors of outcomes from published reports of community early intervention programs offers a first step to identifying active ingredients that are potentially effective in community settings.

Objectives:

To calculate the average effects and predictors of cognitive, adaptive behavior, communication, and social outcomes among children receiving community-based early intervention.

Methods:

Studies of community-based early intervention for children with autism were identified through a systematic search of online databases (PsycInfo, Medline, Eric, and Proquest dissertation), hand-searching relevant journals, and reviewing citations from previous meta-analyses and systematic reviews. Community-based early intervention was defined either as "treatment as usual" control groups in randomized or quasi-experimental trials or in studies that explicitly examined outcome in community settings. Changes in cognitive, adaptive behavior, communication, and social functioning from pre-treatment to post-treatment were assessed using standardized mean gain scores. Effect sizes (Hedges' g) were calculated by dividing the mean change from pre to post-treatment by the pooled standard deviation of the difference score. Overall effect sizes were estimated using random effects models. The Q-statistic and the I^2 index were used to examine heterogeneity of effect sizes. Potential moderators included type of intervention, geographic location of intervention, year of intervention, sample section methods, sociodemographic characteristics of participants, and length of intervention; their effects were assessed using analysis of variance of mixed-effects models and meta-regression analyses.

Results:
Analysis, especially of moderators, is ongoing. Preliminary results based on 22 studies showed an average effect size of 0.2 (95% CI 0.1 -0.3), 0.5 (95% CI 0.3-0.8), 0.4 (95% CI 0.3 -0.6), and 0.4 (95% CI 0.2-0.5) for cognitive, adaptive behavior, communication, and social outcomes respectively.   Hedges' gs for individual studies ranged from 0.0-0.7 for cognitive outcomes, 0.1-1.3 for adaptive behavior outcomes, 0.0-1.1 for communication outcomes, 0.0-0.9 for social outcomes. Significant heterogeneity across studies was identified for adaptive behavior, communication, and social outcomes.

Conclusions:
Children receiving community-based early intervention make small to medium sized gains on average. The heterogeneity in outcomes suggests significant variation in program quality. Examination of intervention features associated with more effective community-based early intervention programs could offer insight into program features that may be important to consider in the implementation of other community-based programs.

82   **107.082** Missed Opportunities: Use of Early Services and Age of ASD Diagnosis Among African American Children

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Background:
Early identification and accurate diagnosis of ASD are critical for tailoring autism-specific early intervention services, guiding parents, and accessing resources. On average, parents visit multiple professionals, wait a year for diagnosis, and report dissatisfaction with the overall process (Goin-Kochel, Mackintosh, & Myers, 2006; Wiggins, Baio, & Rice, 2006). Interpreting research on age of diagnosis is complicated by disparities based on race and SES in access to services. African American children, on average, receive diagnoses later than Caucasian children (Mandell et al., 2009).
Objectives:
The goal of this study was to determine early service use and its relationship to age of ASD diagnosis for African-American children.
Methods:
Fifty-three children (42 males and 11 females) with a confirmed ASD diagnosis and their primary caregivers participated in the current study. An additional 30 participants are expected before May 2014. Family variables and service history were obtained via the ACE-2 EHCI: Diagnostic Odyssey Instrument (Shattuck, Mandell, & Constantino, 2013). Child functioning was ascertained using the Differential Ability Scales, Second Edition and the Autism Diagnostic Observation Schedule, Second Edition.
Results:
The average age of first diagnosis was 5 years old (SD = 33.77 months). There was no correlation between autism severity or intellectual level and age of diagnosis. Eighty-one percent of children obtained services before diagnosis, at an average age of 3 years, 1 month (SD = 20.46 months); creating a gap of 22 months between accessing services and diagnosis. There was no significant difference in age of diagnosis between children with a history of services prior to diagnosis (M = 61.74 months, SD = 29.14) as compared to those who had never received services (M= 53.60 months, SD = 34.88; $t(51)$ = 0.68, p = 0.27). Whether services were provided through public or private programs (F (3, 39) = .37, p = 0.78) (61% public, 23% private, 9% combined) and total number of services (F (2, 40) = 1.41, p = 0.26) were not related to age of diagnosis. Parent education (r = 0.33, p = 0.03) was related to number of services received, though neither education nor family income were associated with age of diagnosis. Of children receiving prior services, 59% received speech, 32% occupational therapy, 10% behavioral intervention, and 10% special education. Service type was unrelated to age of diagnosis with the exception of occupational therapy (t (41) = -0.83, p= 0.01). Children receiving OT received an earlier diagnosis (M = 56.74) than children without OT (M = 65.71).
Conclusions:
Despite recognition of the need for services, children experienced delays in diagnosis. Accurate

diagnosis is needed to educate parents and professionals, ensure access to appropriate intensive services, and refer for additional medical work-up and sibling monitoring. While most participants received services, they did not receive early, intensive Autism-specific services. In this almost two year gap, children missed opportunities for maximizing outcomes (e.g., public education services). When concerned, pediatricians should immediately refer children (especially African Americans) for both services and diagnostic evaluation. Service providers should also be empowered to refer for evaluation.

83   **107.083** Patterns of Psychiatric Comorbidity in a Sample of School-Aged Children with Autism Spectrum Disorder Receiving Community and School Based Mental Health Services

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Background: Psychiatric comorbidity in children with autism spectrum disorder (ASD) is common with rates reported at greater than 70% (Leyfer et al, 2006; Simonoff et al., 2008). Given these high rates, publicly-funded community and school-based mental health (MH) programs play a significant role in treating youth with ASD. Understanding common patterns of psychiatric comorbidity in children with ASD served in publicly-funded MH programs is important to implement appropriately tailored interventions.
Objectives: To identify child sociodemographic and clinical characteristics associated with psychiatric comorbidity for children served in publicly-funded MH services.
Methods: Preliminary data are drawn from baseline assessments from an ongoing randomized community effectiveness trial of AIM HI ("An Individualized Mental Health Intervention for ASD") conducted in publicly-funded community and school-based MH services. AIM HI is a clinical intervention and training model that targets challenging behaviors in children with ASD and designed to be delivered by community MH providers. The current sample includes 103 children (86% boys) ages 5-14 (M = 8.83 years; SD= 2.51) with existing ASD diagnoses (validated by the ADOS-2) and their primary caregivers. Children were drawn from 17 participating publicly-funded community and school-based MH programs, receiving care from 91 therapists. Non-ASD psychiatric diagnoses were assessed using the MINI-KID (Sheehan et al., 1998) that was adapted for use and conducted by six study personnel with primary caregivers. Sociodemographics were assessed via parent-report, social communication skills were assessed via parent-report on the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005), child behavior problems were assessed via parent-report on the Eyberg Child Behavior Inventory Intensity Scale (ECBI; Eyberg & Pincus, 1999), and child cognitive skills were assessed using the Wechsler Abbreviated Scale of Intelligence-II (Wechsler, 2011). Multivariable logistic regression analyses were conducted to identify child sociodemographics and clinical characteristics associated with meeting criteria for a non-ASD disorder. Data were examined by five diagnostic categories: ADHD, ODD, anxiety, mood, and a Tic Disorder. A model was calculated for each diagnostic category.
Results: Approximately 88% of children met criteria for a non-ASD disorder on the MINI-KID. Factors significantly associated with meeting criteria for an Anxiety Disorder included: less severe social communication difficulties (B = -0.14, p < .05) and higher ASD symptom severity (B = 0.23, p < .05) on the SRS. Factors significantly or marginally associated with meeting criteria for ODD included: greater behavior problems on the ECBI (B = 0.16; p < .01) and ADOS-2 classification as Autism Spectrum (vs. Autism) (B = -1.36; p = .06). No child characteristics were associated with meeting criteria for ADHD, a Mood Disorder, or a Tic Disorder. Child age, race/ethnicity, gender, or cognitive abilities were not associated with any disorder.
Conclusions: The majority of children with ASD receiving publically-funded MH care in this sample met criteria for at least one additional psychiatric condition. Child clinical characteristics were associated with meeting criteria for an Anxiety Disorder and ODD. Results suggest that child clinical correlates may facilitate differential diagnosis and inform appropriate tailoring of intervention for youth with ASD served in general child MH settings.

84   **107.084** Provider Practices Regarding the Treatment Referrals and Recommendations Made to Parents of a Child with ASD

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Background: Literature in the autism spectrum disorder (ASD) field has highlighted that parents endorse individual recommendations as being critical in the choices that they make about service use for their child with ASD. However, research has yet to examine how intervention-related knowledge and referrals are provided to parents by providers in the community. The current study sought to clarify providers' experience when attempting to guide parents to the appropriate services for their child.
Objectives: The current study sought to determine: 1) the types of referrals made by community providers to parents of a child with ASD (i.e. generic referrals versus specific referrals); 2) provider-reported barriers when making referrals to ASD services in the community; and 3) the variables that predict providers' referrals to high quality, evidence-based practices (EBPs).
Methods: 82 providers working with of children with an ASD diagnosis completed an online survey that

assessed the following: 1) provider demographic information; 2) years of experience working with children with ASD; 3) professional confidence; 4) professional competence; 5) perceived barriers to making service recommendations in the community; 6) belief in evidence-based practices; 7) service referrals commonly made; and 8) strategies used to make referrals. Service referrals were broken down in order to analyze the variables that predicted providers' likelihood of making referrals to evidence-based practices (EBPs).

Results: Overall, 86.14% of the referrals that providers reported making were to EBPs. As part of preliminary data analysis, a stepwise, multiple linear regression was used to determine the variables that predicted the number of referrals that providers made to EBPs. As can be seen in Table 1, the final model explained 25% of the variance in referrals made to EBPs, with provider confidence and perceived barriers to service referrals as significant predictors of evidence-based referrals. Finally, providers noted many barriers when making referrals to services for families of a child with ASD in community settings. The most common of these barriers were a lack of availability of services, and a lack of insurance coverage for particular services, each being reported by over 65% of participating providers.

Conclusions: Research within the ASD field has already documented that parents endorse individual recommendations as being critical in the choices that they make about service use for their child with ASD. However research had yet to examine how these recommendations are made to parents by providers in the community. The current study provides perspective on providers' experience in making referrals, and provides important implications for the ways in which we disseminate EBPs into community settings.

85   **107.085**   Reducing Disparities in Timely Autism Diagnosis through Family Navigation

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Background: Emerging evidence demonstrates that Autism Spectrum Disorder (ASD) can be reliably diagnosed by age two, and that early identification, defined as diagnosis before age 3, can improve outcomes. Low-income and minority children with ASD, however, are diagnosed later than their white and more financially advantaged peers. Feasible, culturally appropriate interventions with broad scale-up potential are necessary to reduce this disparity. One promising strategy is patient navigation. Patient navigation has its origins in cancer care and has demonstrated efficacy in improving adherence to follow-up visits after a screening abnormality and decreasing the time from an abnormal screen to diagnostic resolution. We reframed the model from patient to family navigation and focused on a defined episode of care, beginning with an abnormal autism screen and ending with the completion of the diagnostic assessment.

Objectives: To assess the feasibility and acceptability of family navigation and its potential to decrease time to diagnostic resolution among of low-income and minority families of children, ages 15 months to 3 years, who have positive behavioral screens indicating a need for an ASD diagnostic assessment.

Methods: Pilot RCT of 40 children who failed the M-CHAT or whose clinicians have clinical concerns related to ASD and who receive primary care within an integrated urban healthcare network. Children with confirmed risk for ASD, based on the results of the M-CHAT Follow-up Interview, are randomized to receive either Family Navigation (FN) until diagnostic resolution or usual care (UC).We are examining the following process measures: participant recruitment and flow, delivery of navigator services, collection of follow-up data, and family satisfaction with FN. The primary outcome is time to diagnostic resolution. We will conduct an intention-to- treat analysis and compare time to diagnosis between groups by survival analysis, creating Kaplan-Meier plots and applying a Cox proportional hazards model.

Results: To date, we have screened 50 children of whom 34 met eligibility criteria and 32 were randomized. The FN and UC groups are demographically similar. Children were 59% male; mean age 26 months. Families were 77% non-white and 93% low-income. All FN families have had at least 2 visits with navigator, with an average of 4 encounters. To date, 11 of 16 FN families versus 7 of 16 UC families have completed the diagnostic assessment; 4 FN and 4 UC families remain in process, and 1 FN family versus 5 UC families have not completed the diagnostic assessment during the follow-up period. Among the 18 families who have completed the diagnostic process, 10 received an ASD diagnosis; mean time from confirmatory screening to diagnostic resolution among all completers was 77 days (SD 39).

Conclusions: Results support the intervention's feasibility and promise to increase the proportion of children who complete an ASD diagnostic assessment. They are consistent with an earlier pilot trial in which 19 of 20 FN families versus 10 of 19 UC families completed the diagnostic assessment. This model will be expanded and tested in a recently awarded NIMH R01, Early Identification and Service Linkage for Urban Children with Autism.

86   **107.086**   Relations Among School Professionals' Knowledge, Previous Experience, and Self-Efficacy for Working with Students with ASD

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Background: Teachers and other school professionals who work with students with autism spectrum disorders (ASD) face unique challenges (Busby, Ingram, Bowron, Oliver, & Lyons, 2012) and frequently report high levels of burnout (Jennett, Harris, & Mesibov, 2003). Teacher self-efficacy may buffer teachers and school professionals against stress and burnout. Teacher self-efficacy has been associated with quality of instruction, innovation in teaching methods, and more effective classroom management, among other positive outcomes (Ruble, Usher, & McGrew, 2011). Fostering self-efficacy among school professionals may therefore be a useful goal in working toward providing quality education for students with ASD, and some evidence suggests that training teachers in a given approach for working with students with ASD is positively related to feelings of self-efficacy (Jennett, Harris, & Mesibov, 2003).
Objectives: The objective of the present study was to examine the self-efficacy of school professionals working with students with ASD, focusing on the predictive ability of variables including school professionals' knowledge about ASD, previous training regarding ASD and evidence-based practices, and years working with students with ASD.
Methods: Participants in the present study were school professionals from New York State school districts participating in a series of trainings on best practices for educating students with ASD. Prior to beginning training, school professionals completed the Autism Self-Efficacy Scale for Teachers (ASSET; Ruble, Toland, Birdwhistell, McGrew & Usher, 2013) and an assessment of knowledge about ASD and evidence-based practices created specifically for the current project. School professionals also provided information about the number of years they had been working with students with ASD and previous training they had received on ASD and evidence-based programs, specifically positive behavior support (PBS). Preliminary results from the study (data collection ongoing) are based on 41 school professionals who participated in trainings during September-October, 2014.
Results: Bivariate correlations among the variables revealed that self-efficacy, knowledge about ASD, previous training on ASD, and previous training on PBS were all positively correlated (See Table 1). Number of years working with students with ASD was not correlated with any of the previously mentioned variables. Multiple regression was employed to examine the relative utility of each of the four independent variables (knowledge about ASD, previous training in ASD, previous training in PBS, and experience working with students with ASD) in predicting self-efficacy. When all four predictors were entered together, the full model accounted for 55% of the variance in school professional self-efficacy. Among the variables, previous training on positive behavior support was the best predictor of self-efficacy (β=0.495, t=3.260, p=.002).
Conclusions: The results of the present study suggest that the self-efficacy of school professionals for working with students with ASD is related to individual knowledge about ASD and previous training in ASD and evidence-based practices such as PBS. When taken together, training in PBS provided the best prediction of self-efficacy. This finding suggests that it is not merely time spent with students with ASD or training on ASD in general that has the largest impact on self-efficacy, but rather specific training on evidence-based practices.

87 **107.087** Supporting Students with ASD in the Inclusive Classroom: Teacher Perspectives

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Background:
While parents and education personnel agree that interventions addressing the social skill deficits of students with ASD are needed for students to attain independence and success (Brown, Odom, & Conroy, 2001), research suggests general education teachers do not feel prepared to implement such interventions. General education teachers have specifically noted concerns about their lack of knowledge and training related to ASD (Finke, McNaughton, & Drager, 2009) and some even hold misconceptions related to ASD (Segall & Campbell, 2012). Further, while educational professionals have indicated they want parents to be involved in their child's education, educators have reported difficulties establishing such collaborative relationships (Bezdek, Summers, & Turnbull, 2010).
Objectives:
The purpose of this study was to understand elementary, middle, and high school educators' perspectives of the social support needs of students with ASD educated in inclusive settings, their own needs as educators, and their perceptions of parent roles.
Methods:
Six focus groups and one interview were held over a one year period in one school district in a southeastern state. General and special education teachers (n = 34) who had experience working with students with ASD educated in inclusive classrooms from six different schools (two at each level of elementary, middle, and high school) were invited to participate in the focus groups. Focus groups were recorded and transcribed. Data were coded using a constant comparative method (Strauss & Corbin, 1998). Themes and subcategories were generated, reviewed, revised, and organized in order to group the data into discrete categories. While reviewing the data, memo writing (Charmaz, 2000) was used to identify relationships within the transcripts and help the researchers better understand the participants' perspectives regarding their students and professional development needs.
Results:

Themes emerged in three main categories. First, teachers across all grade levels noted several key characteristics of their students with ASD interfering with their successful inclusion in the school setting, and noted social support needs of students with ASD to include: (a) social-relationships, (b) social- academics, (c) self-advocacy, (d) transitioning, and (e) peer related needs. Second, based on these characteristics, teachers indicated a need for education and professional development in the following areas: (a) ASD and students' individual characteristics, (b) accommodations for students' academic and social needs within inclusive classrooms, and (c) promotion of advocacy for students with ASD. Third, teachers discussed their perceptions of parents' roles in supporting students with ASD, which included: (a) parental advocacy and (b) facilitating skill development at home.
Conclusions:
The study's results illuminated the critical need for social-related interventions for youth with ASD in inclusive classrooms, professional development for teachers related to facilitating successful inclusion of students with ASD, and promotion of greater parent-teacher collaboration. A collaborative approach is needed in which special and general education teachers as well as parents, collaboratively problem solve drawing on their own expertise to make successful inclusion truly work for all – teachers, peers, *and* students with ASD.

88   **107.088** The Effectiveness of an ABA Training Workshop for Teachers and Health Care Professionals in China

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Background: Applied behavior analysis (ABA) is a science in which the principles of the analysis of behavior are applied systematically to improve socially significant behavior, and in which experimentation is used to identify the variables responsible for change in behavior (Cooper, Heron & Heward, 1987). There is a growing need for trained clinicians to provide ABA-based treatment for children with autism. However, demand for Board Certified Behavior Analysts (BCBA) professionals greatly outstrips the current supply, which is evidenced by the case of Tianjin where the need for ABA intervention has continued to grow with the increasing prevalence of ASD in China. However there is a paucity of peer-reviewed evidence comparing the accessibility, effectiveness, and cost-effectiveness of different approaches to training.
Objectives: In the current paper, we examined the effectiveness of a group ABA training workshop for teachers and health care professionals in China.
Methods: 150 educators and health care professionals were recruited to participate in a five-day workshop in Tianjin, China, which was conducted by three BCBA's from Canada and Hong Kong. The workshop covered the following areas: Autism Spectrum Disorders (ASD), Early Intensive Behavior Intervention (EIBI), Applied Behavior Analysis (ABA), Discrete Trial Teaching (DTT), Natural Environment Teaching (NET) and Positive Behavior Support (PBS). The participants completed tests before and after the workshop, and the results of the tests were analyzed. The study used a causal design. The independent variable was the participation of the 5-day workshop. The dependent variable was the participants' understanding of the concepts taught, demonstrated by the scores of their tests.
Results: During the pre-test, the average score was 41%. Most participants got 40% correct. The maximum score was 70% and the minimum score was 10%. During the post-test, the average score rose to 61%. Most participants got 60% correct. The maximum score was 100% and the minimum score was 20%. Most participants obtained high scores in the areas of ASD, general ABA knowledge, EIBI, and milieu teaching strategies. In the area of applying evidence-based strategies to manage problem behaviors, the scores were significantly lower. Social validity was measured through a workshop evaluation. The scores for all likert scale of 1 to 5, items ranged from 4.5 to 4.9.
Conclusions: The group training was found to be an effective and acceptable method in increasing knowledge and understanding of ABA-based teaching strategies. It is suggested that large-group cross-cultural ABA training can be a cost effective way for training professionals across the globe.

89   **107.089** The Effects of Medicaid Home and Community-Based Services Waivers on Unmet Needs of Children with Autism Spectrum Disorder

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Background:
Traditionally, families of children with autism spectrum disorder (ASD) have had difficulty obtaining coverage for ASD services. The challenges in identifying, accessing, navigating and paying for ASD services can place a substantial burden on parents and caregivers of children with ASD. In response, several states have expanded Medicaid coverage for children with ASD through 1915(c) Home and Community-Based Services (HCBS) waivers. However, these waivers vary considerably across states, and little is known about their effectiveness in reducing family burden.
Objectives:

In this study, we use detailed information about HCBS waivers for ASD across all states, combined with national survey data, to examine the effects of the waivers on the perceived level of unmet need among families of children with ASD. Our goal was to determine which characteristics of these waivers appear to be most effective at reducing unmet need.

Methods:

We combined data from multiple waves of the National Survey of Children's Health and the National Survey of Children with Special Healthcare Needs with state-level data we assembled regarding characteristics of Medicaid HCBS waivers from 2000 through 2013, extracted from source materials that were submitted by states in their wavier applications. Unmet need was defined across surveys by combining questions that probe for difficulties in receiving needed care. Key HCBS waiver measures included (1) expected annual cost per enrollee, (2) annual cost limit per enrollee, (3) enrollment limit, and (4) whether the waiver specifically targeted ASD or broader developmental disabilities. With the exception of the ASD targeted measure, which is dichotomous, we normalized each of the policy variables to have mean=0 and standard deviation=1 within the sample to ease interpretation of results. We then used multivariable logistic regression in a difference-in-difference design that exploited differences in HCBS waivers within states over time to identify effects for children with ASD relative to children without ASD (controls) to characterize the relationship between unmet needs and waiver characteristics, controlling for other covariates. To examine robustness, we estimated the model using several different samples, including (1) all children, (2) children in families with income < 200% FPL, (3) all children in Medicaid, and (4) children in Medicaid living in families with income < 200% FPL.

Results:

We identified a total of 370,193 children, of whom 8,218 had ASD. The multivariable logistic regression results show that each of the waiver policies was associated with reductions in rates of unmet needs for children with ASD relative to children without ASD, and that the associations were stronger in samples limited by income and by Medicaid enrollment status. For example, 1 standard deviation increases in the cost limit and the enrollment limit were associated with ORs of 0.63 (p<.001) and 0.53 (p<.001), respectively, in the sample limited to Medicaid-enrolled children in families with income <200% FPL.

Conclusions:

Medicaid HCBS waivers have reduced unmet need among children with ASD. The characteristics of those waivers, however, are important. Our results will be useful to policymakers as they consider policies to improve access to care for children with ASD.

90   **107.090** Timeliness of Autism Spectrum Disorder Diagnosis and Subsequent Use of Services

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Background: Little national data are available regarding how delays in autism spectrum disorder (ASD) diagnosis correlate with use of autism-related health and educational services.
Objectives: We assessed the relationship between age of ASD diagnosis and delay in ASD diagnosis with current use of psychotropic medications, intensive behavioral interventions (IBI), complementary and alternative medicine (CAM), and school-based therapy, in a nationally-representative sample of U.S. elementary school-aged children.
Methods: The Center for Disease Control's 2011 Survey of Pathways to Diagnosis and Services was used to assess age and delay in ASD diagnosis, and its relationship with health services use, among 722 children age 6-11 with autism spectrum disorder. Older age of diagnosis was defined as diagnosis at age 5 years or older. Longer delay in diagnosis was defined as 3 or more years between first parent concern and ASD diagnosis. Bivariate and multivariable logistic regression analyses were used to assess the association between age and delay and current use of psychotropic medications, IBI, CAM, and school-based therapy
Results: Nearly half (44.8%) of children were diagnosed at age 5 or older (95% confidence interval [CI] 38.5%-51.3%), and 39.6% (95% CI: 33.3%-46.3%) experienced a diagnostic delay of 3 or more years. Multivariable regression results showed younger age of diagnosis was associated with more frequent use of school-based therapy (adjusted odds ratio [AOR]: 2.21, 95% CI 1.12-4.35). Longer delay in diagnosis was associated with increased likelihood of CAM use (AOR: 2.55, 95% CI: 1.38-4.73). Use of psychotropic medications or IBI did not have any significant associations with age or delay in diagnosis on adjusted analysis.
Conclusions: Both older age of diagnosis and longer delay in diagnosis were associated with different health and educational services utilization patterns among elementary school-aged children with ASD. Results suggest that prompt and early diagnosis may be associated with increased use of conventional therapies for ASD.

91   **107.091** Trajectories of School-Based Services for Youth with ASD

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Background: For children with autism spectrum disorder (ASD), educational systems are a central treatment source (Mandell et al., 2005), providing the most accessible route to services (White et al.,

2007). Though individuals with ASD often utilize numerous treatments simultaneously, some have been identified as uniquely applicable to ASD (speech, occupational therapy (OT) and physical therapy (PT); Goin-Kochel et al., 2007), while others target more general academic and mental health needs (e.g., resource room and mental health counseling; Wei et al., 2014; Hammill & Wiederholt, 1972; Griswold et al., 2002). Interestingly, cross-sectional studies suggest that younger children with ASD are more likely to be enrolled in ASD-specific services than older children (Goin-Kochel et al., 2007). It has also been noted that families and teachers of children with ASD seem initially more concerned with addressing core social deficits in the early years of a child's education before placing an emphasis on academics in later years (Pollard, 1998). As the relative *need* for services addressing core ASD deficits tends to remain stable or increase across development (Picci & Scherf, 2014), further understanding is needed regarding trajectories of ASD-specific and nonspecific services for students with ASD (Thomas et al., 2007).

Objectives: To explore the trajectory of school-based services for youth with ASD over time. We hypothesize that the amount of ASD-specific school-based services would decrease over time, while nonspecific services would increase.

Methods: Caregivers of seventy-one youth with DSM-IV-TR-confirmed pervasive developmental disorder (PDD) diagnoses (N=71; 59 male; M_{age}=10.17, SD=3.15, range=6-17) completed educational histories from Kindergarten to the child's current grade, including school-based services received in each grade. Presence as well as intensity (minutes/week) of ASD-specific and nonspecific services was examined. Hierarchical linear growth modeling was used to assess trends within educational service history and between participants over time.

Results: 92.4% of students received ASD-specific services and 65% received nonspecific services at some time during their academic career. Binomial hierarchical modeling of presence of services indicated that as youths progressed through school they were less likely to receive ASD-specific services (speech therapy: OR = .60, p<.001; PT: OR=.65, p<.01; OT: OR=.76, p=.05), and more likely to receive nonspecific services (counseling: OR=1.71, p<.001; resource room: OR=1.37, p=.04). In terms of intensity, total minutes per week of occupational therapy services diminished as youths continued through school (B = -5.06, p <.001). No other trends in service categories over time were observed.

Conclusions: Results of this study suggest a decrease in ASD-specific services, and increase in nonspecific services as youth progress through school. The results support the view that as children progress through the educational system, goals may shift from intervening for social and communication problems to increasing academic success. As school-based services are essential to treatment of students with ASD, and their need for such services usually does not decrease over time, these findings show an increasing gap between needed and delivered service categories across school. Further investigation into the cause of differential service trajectories is crucial to ensuring effective treatment access.

92   **107.092** Using Parents' and Children's Input to Inform a Peer-Mediated Intervention for Young School-Aged Children with Autism Spectrum Disorder

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Background: There is growing awareness of the research-to-practice gap in evidence-based interventions (EBI) for children with autism spectrum disorder (ASD) at school. The dearth of school-based EBIs targeting social skills for children with ASD is particularly concerning, as successful peer interactions are among parents' most valued outcomes for their children with ASD. Peer-mediated interventions (PMI) have shown initial efficacy for targeting social-communication impairments of children with ASD. Moreover, PMI is a practical approach for resource-limited schools. A peer-training approach based on Pivotal Response Treatment (PRT) holds high heuristic value for implementation in schools, given its emphasis on embedding learning opportunities into everyday contexts and routines. However, little is known about how acceptable this approach would be for individuals with ASD, parents of children with ASD, or parents of typically developing (TD) peers. Given families' roles in decisions regarding interventions for their children with ASD, it is imperative to seek their input to improve the feasibility and acceptability of school-based interventions. The views of individuals with ASD have only recently been elicited in the design of interventions.

Objectives: The current study aimed to fill a void in the literature by considering families' perspectives alongside the development of a peer-mediated, play-based PRT intervention for children with ASD in the first year of school. The goals of the study were to broadly inform peer-mediated and social skills interventions for children with ASD at school, and to inform the development of the specific proposed peer-mediated PRT intervention. Acceptability and feasibility of the proposed intervention in the school setting, as well as families' recommended modifications were examined.

Methods: Semi-structured interviews were conducted with 6 parents of children with ASD (5-10 years), 6 parents of TD children (5-10 years), and 10 youths with ASD (10-12 years; *N* = 22). The interviews examined respondents' perspectives of EBIs and PRT in general, and the overall acceptability and feasibility of the proposed intervention. Interview data were analyzed using descriptive content analysis.

Results: Overall, peer-mediated PRT was considered to be acceptable and feasible. Parents and youths agreed that communication and peer interaction skills (i.e., skills addressed in the proposed

intervention) are important intervention targets, and that the first year of school (i.e., age 4-6 years) is an ideal time to facilitate peer interaction skills for children with ASD (i.e., as in the proposed play-based intervention). Some specific challenges with respect to peers as intervention implementers were identified; these differed by participant group. Parents and youths also provided specific advice regarding components of PMI and social skills interventions broadly (e.g., concerning the acceptability of older TD children as intervention implementers).

Conclusions: Key findings provided important direction with regard to the implementation of the proposed peer-mediated PRT intervention within schools, including recommendations that informed how to frame the intervention to parents and their children with and without ASD. The current study contributes to the literature by considering family perspectives on a proposed intervention during its design. The result of this collaboration is the development of an intervention with a higher probability of uptake in the school context.

93 **107.093** Using a Wireless Measure of Electrodermal Activity: Comparisons to Traditional Wired Equipment

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Background: Electrodermal activity (EDA) has long been utilized as a physiological measure of arousal, stress, and anxiety. Traditional wired measures of EDA require a laboratory setting, electrodes attached to a polygraph by wires, and a stationary subject. New wireless EDA equipment can record in the real world without the obtrusiveness of traditional equipment. However, despite these advantages, the validity of such equipment has not been widely examined in pediatric or special needs populations.

Objectives: The purpose of this study was to compare the EDA data obtained from wireless equipment (Q-Sensor) to data from traditional, gold-standard equipment (BIOPAC). Our hypotheses were: (1) wired and wireless EDA measures would be moderately-to-highly correlated, and (2) wireless skin conductance level would be significantly lower than the wired signal due to electrode type and placement.

Methods: Participants were 37 children 6-12 years old (n=19 typical, n=17 autism spectrum disorder, ASD). EDA data using wired and wireless equipment were recorded from children in their home environment during a passive attention-sustaining task. Wired electrodes were place on distal phalanx of the second and third fingers of the non-dominant hand; wireless equipment was fit into a strap worn around the wrist, with electrodes touching the anterior surface of the wrist. A low-pass filter was applied to data from both wired and wireless sources to filter out noise and reduce artifacts. Correlation analyses to compare the average skin conductance level (SCL) and non-specific skin conductance response frequency (NS-SCR) across subjects were undertaken. Additionally, in order to measure the overall signal similarity (OSS) we computed a point-by-point Pearson's correlation coefficient between the wired and wireless signals from each subject.

Results: No significant correlation was found in SCL between wired and wireless equipment in either group (typical r=.03; ASD r=.29; p's≥.26). Additionally, the wireless SCL was significantly lower than wired results in both groups (p's<.001). Due to the extremely low SCL of the wireless signal, no NS-SCRs of ≥.05μS were obtained. Therefore, analyses were required to identify an appropriate smaller amplitude threshold of NS-SCRs for subsequent Q-Sensor evaluation. Starting with .05μS we decreased the amplitude threshold, testing 17 potential amplitudes until the highest correlation was found between wired and wireless NS-SCR frequency (threshold = .002μS, r=0.57). Comparing the NS-SCR frequency using the smaller amplitude threshold for wireless signals to the traditional .05μS amplitude for wired signals, large correlations of NS-SCRs between wired and wireless equipment were found in children with ASD (r=.71, p<.01) and all children combined (r=.57, p<.01), but not in the typical-only group (r=.11). Weak but significant OSS measures were found between the wired and wireless EDA waveforms in the ASD group (median correlation value r=0.28 with 100% of participants p<.05) and TD group (r=0.23, with 89% of participants p<0.05).

Conclusions: Preliminary support exists for the use of the new, wireless Q-Sensor when investigating NS-SCR frequency and OSS in children with ASD. However, further research is required in clinical and non-clinical populations to examine the ideal electrode type and placement for wireless EDA collection in ambulatory settings.

94 **107.094** Variables Associated with Coverage for Educational, Mental Health, and Medical Services in Autism Spectrum Disorder

S. J. Lee, J. W. Lee, L. Kraus and L. V. Soorya, Psychiatry, Rush University Medical Center, Chicago, IL

Background: The rising prevalence of ASD has been associated with increased healthcare expenditures in the United States and United Kingdom. Recent reports also suggest differential burden on public aid relative to private insurance companies with fewer services covered by private insurance in the U.S. In addition to systems level variables, demographic variables associated with coverage have potential to inform policy, improve access, and reduce economic burden related to

ASD. For example, literature in pediatric mental health care has identified multiple variables influencing service coverage. Contrastingly, diagnostic and demographic variables associated with service coverage in ASD are not well known.

Objectives: To explore potential demographic variables affecting service coverage and out-of-pocket expenditures in individuals with autism spectrum disorder (ASD), ASD and comorbid psychiatric conditions, and control groups.

Methods: Surveys were posted on institutional webpages and available for completion via the phone. Parents/caregivers (n=571) completed survey questions related to services sought, received, covered by insurance, and out-of-pocket expenses for dependents. Comparisons were made across four diagnostic groups: ASD (n=355), ASD/Psychiatric (n=101), non-ASD developmental disorders (DD, n= 41), and non-DD psychiatric disorders (n=94). Logistic regressions were completed to examine relationships between diagnosis, age, race, and income on healthcare coverage. Household income, age, and race were evenly distributed across diagnostic categories. Data are presented here from logistic regressions for three service categories: Educational, Mental health, and Medical/Auxiliary services.

Results: Coverage for educational services was predicted by diagnosis only. Individuals with ASD were two times more likely to receive coverage for educational services relative to control groups (odds ratio = 2.01). Mental health services were predicted by diagnosis, race, and age. For ASD, the odds ratio was 0.60, indicating dependents with ASD were 40% less likely to receive coverage for mental heath services sought. Dependents who were Caucasian were 60% more likely to receive coverage for mental health services (odds ratio = 1.60). As individuals grew older, the likelihood of receiving coverage for mental health services increased by 43% per age group (odds ratio = 1.43). Dependents in the ASD/Psychiatric diagnostic category were nearly three times as likely to receive coverage for medical/auxiliary services sought (odds ratio = 2.67).

Conclusions: Survey data indicate psychiatric comorbidity, age, and race were associated with service coverage for individuals with ASD. Caregivers of dependents with ASD reported higher rates of coverage for educational services relative to psychiatric and DD controls. Substantially higher rates of medical service coverage were associated with ASD and psychiatric comorbidity. Taken together with age-related findings on mental health coverage, data suggest potential to improve healthcare access via mental health delivery systems in pediatric ASD. Results also support well known findings of racial disparities in mental health care and a need for culturally sensitive diagnostic and educational programming in minority communities to improve awareness about psychiatric comorbidities in ASD.

Poster Session
108 - Brain Function
11:30 AM - 1:30 PM - Imperial Ballroom

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95 **108.095** Changes in Parietal Cortex Response in Children with Autism Followed By a Visualizing Reading Intervention

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Background: Poor language comprehension is a major clinical feature of autism spectrum disorders (ASD). Previous studies suggest that individuals with ASD may rely on compensatory mechanisms such as increased use of visuospatial abilities, which are relatively spared or even superior in ASD, to better facilitate language comprehension. Such compensation may underlie altered brain activity and connectivity in ASD individuals while processing language tasks. The current study takes a translational neuroimaging approach to use visual spatial strength in ASD to address language comprehension difficulties through a reading intervention.

Objectives: The main objective of this study was to test the impact of an intensive visual imagery-based reading intervention in improving language comprehension and in changing the brain circuitry underlying language in children with ASD.

Methods: Functional MRI data were used from 20 high-functioning children with ASD and 13 typically developing (TD) control participants. The ASD participants were randomly assigned to a Wait-list control group (ASD-WLC; n = 10) and an Experimental group (ASD-EXP; n = 10). The TD group was scanned once and both the ASD-WLC and ASD-EXP groups were scanned pre- and post-intervention, with only the ASD-EXP group receiving the intervention before their second scan. Participants went through an established reading intervention program (visualizing and verbalizing for language comprehension and thinking; 10-week, 200 hours of face-to-face instruction) created by the Lindamood-Bell Learning Processes. In the fMRI scanner, the participants read a series of sentences and made judgments as to whether the sentences made sense or not (e.g., *When I want to play baseball, I grab a swimsuit and go to the pool*). fMRI data were analyzed using AFNI and SPM8 softwares.

Results: The main results are: 1) before intervention, the ASD participants, relative to TD, showed significantly reduced activation ($p < .05$, corr.) in frontal (medial prefrontal cortex, right superior frontal gyrus), ventral temporal (left parahippocampal area, right fusiform gyrus), and occipital regions (bilateral middle occipital, right cuneus) and increased activation in left inferior parietal lobule

while processing absurd and control sentences; II) the ASD-EXP group showed an increase in brain activation in occipital regions (bilateral middle/superior occipital and calcarine sulcus) compared to the ASD-WLC group post-intervention; III) intervention-related changes in brain activation were observed in the ASD-EXP group post-intervention in right precuneus, calcarine, and superior parietal lobule; and IV) multiple regression analysis, while controlling for verbal IQ, showed that changes (pre-post) in Gray Oral Reading Test (GORT) scores significantly predicted post-intervention activation in the ASD-EXP group in regions such as precuneus, middle occipital, and right IFG.

Conclusions: The findings of this study revealed that reading intervention increased the brain activity in ASD-EXP children in parietal areas associated with visual imagery. It should be noted that the increase in activation was accompanied by improvement in language comprehension in these participants. This study provides novel evidence of improvement in brain functioning in autism in the context of an innovative and rigorous imagery-based reading intervention that is designed to use nonverbal sensory input, an area relatively spared in individuals with ASD.

96 **108.096** Abnormal Induced Neural Oscillations in 16p11.2 Deletions and Duplications

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Background: Rare genetic copy number variations (CNVs), specifically the recurrent ≈600 kb (BP4-BP5) 16p11.2 deletion and duplication, are known to contribute to a range of neurodevelopmental disorders, including autism spectrum disorders, language delay, and intellectual disability. Here, we examined changes in oscillatory activity derived from magnetoencephalographic imaging (MEG-I) in a large cohort of individuals recruited as part of the Simons VIP project (Simons VIP Consortium, Neuron 2013 73:1063-1067).

Objectives: We hypothesized that gene dosage in this interval is critical for the development of abnormal neural oscillatory networks in the brain that in turn are associated with behavioral phenotypes.

Methods: Data were acquired using 275-channel whole-head biomagnetometers (CTF; Vancouver, BC) installed at UCSF and CHOP. During MEG recording, participants engaged three tasks: 1) an auditory discrimination task of spoken words into semantic categories - living or non-living ; 2) a visual discrimination task differentiating between faces and patterns; 3) a picture naming task in which the subject responded by overtly naming the object on a picture. Tomographic reconstructions of oscillatory activity across the alpha, beta, gamma and high-gamma frequency bands were stimulus and response-locked and generated using an adaptive spatial filtering technique implemented in Nutmeg (nutmeg.berkeley.edu). For the picture naming task, we also compute laterality index (LI) from oscillatory activity in the left and right frontal and temporal hemispheres to evaluate language dominance.

Results: Induced high gamma activity was reduced bilaterally in auditory cortex for 16p11.2 deletion child participants only relative to their control group, in response to auditory stimuli occurring at ~100 ms post-stimulus onset. Induced high gamma activity was also reduced in the right fusiform cortex in 16p11.2 child deletion participants, in response to faces. In the picture naming task, while typically developing adults (mean age = 32.6) and children (mean age = 11.3) exhibited left-hemisphere dominance (LI>0.1 in 70% adults and 69% children), 54% of 16p11.2 child deletion carriers exhibited right-hemispheric or bilateral patterns of activity. LI was significantly lower in the 16p11.2 deletion group (p=0.0035) when compared to matched controls. Importantly, LI (or the degree of leftward laterality) in deletion carriers was positively correlated with non-word repetition (CTOPP) scores (r=0.53) – a test of phonological processing. Interestingly, in 16p11.2 adult duplication carriers, only 20% were right-hemispheric dominant, and laterality patterns were comparable to controls.

Conclusions: These results suggest pervasive abnormalities in induced neural oscillations across multiple sensory cortices in participants with 16p11.2 deletions. These findings also indicate that one versus two copies of gene(s) at 16p11.2 alter hemispheric specialization of language.

97 **108.097** Searching for Neuroimaging Targets for Interventions in ASD

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Background: As humans, we are constantly engaging in social cognition, using cues from facial expressions, gaze shifts, and body movements to infer the intentions of others, predict their actions, and plan our own actions accordingly. Considerable advances have been made in the past 20 years in the fields of cognitive, social, and affective neuroscience in identifying neural-circuit-level mechanisms of dysfunction in ASD.

Objectives: In this talk, I will describe my laboratory's research using neuroimaging techniques

including functional magnetic resonance imaging (fMRI), electrophysiology (EEG), and functional near infrared spectroscopy (fNIRS) to chart the development of brain mechanisms for social cognition in typically developing children and adolescents.

Methods: Our work has served to characterize the functional properties and development, from infancy to adulthood of a set network of interacting, distributed neuroanatomical structures dedicated to processing social meaning. In particular, I will focus on our work describing the identification of neuroimaging biomarkers for emotion regulation and the perception of biological motion.

Results: With this understanding of the typical development of the neural basis of social cognition as a backdrop, I will describe our efforts to utilize these candidate biomarkers in a developmental experimental therapeutics approach to using social neuroscience findings in the developmental and evaluation of behavioral and pharmacological treatments for autism and related neurodevelopmental disorders.

Conclusions: Availability of well-studied neuroimaging tasks that reliably engage neural circuitry of social functioning in typically developing children and in children with ASD is a prerequisite for deploying experimental-therapeutics approaches aimed at discovering novel interventions for ASD .

98   **108.098**   Thalamo-Cortical Underconnectivity during Sensory Stimulation in Youth with ASD

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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). Rates of SOR are over five times higher in children with ASD than in typically developing (TD) children (e.g., Baranek et al., 2006; Ben-Sasson et al., 2007) and SOR is associated with increased functional impairment (e.g., Liss et al., 2006; Pfeiffer et al., 2005). Previously, we found that individuals with ASD and SOR have hyperactivation in the amygdala and sensory cortices in response to mildly aversive sensory stimuli. Further, SOR was related to decreased neural habituation in these areas (Green et al., 2014; Green et al., under review). The present study extends these findings by examining thalamo-cortical connectivity in response to tactile and auditory stimuli in youth with and without ASD. The thalamus is considered the "hub" of the brain's sensory systems, and furthermore there is evidence for reduced thalamo-cortical structural connectivity in individuals with Sensory Processing Disorder (Owen et al., 2013). We focused on the pulvinar specifically because this thalamic nucleus is thought to aid in interpretation and integration of sensory information (e.g., Sherman & Guillery, 1996).

Objectives: To compare functional connectivity within the brain's sensory networks in youth with and without ASD during exposure to sensory stimuli.

Methods: Participants were 19 children and adolescents with ASD and 19 TD matched controls, between 9-17 years of age. During fMRI, participants were presented with mildly aversive auditory stimuli (noisy traffic sounds) and tactile stimuli (scratchy sweater rubbed from wrist to elbow). The block design paradigm included 4, 15-sec trials of each stimulus type: the auditory stimulus, tactile stimulus, or both. A psychophysiological interaction (PPI) analysis was conducted to examine functional connectivity during exposure to both sensory stimuli with the pulvinar area of the thalamus as a seed region. The pulvinar seed was functionally defined by first masking a 5mm sphere around the peak coordinate of activation in each group during the Joint condition and then adding the two masks. Within- and between-group-level analysis were thresholded at $Z > 1.7$ and corrected for multiple comparisons at $p < .05$. Both positive and negative connectivity were examined.

Results: Results are illustrated in figure below. The TD group demonstrated widespread task-based thalamo-cortical connectivity, including negative connectivity between pulvinar and primary and secondary somatosensory cortex, as well as positive connectivity between pulvinar and additional frontal and temporal cortical regions. In contrast, the ASD group had no significant task-based thalamo-cortical connectivity. Furthermore, a small volume analysis focused on the amygdala demonstrated that the ASD, but not TD group showed positive connectivity between pulvinar and amygdala.

Conclusions: In one of the first fMRI studies of sensory over-responsivity in children with ASD, we show task-related underconnectivity in ASD. Results suggest decreased cortical-thalamic inhibition, and an exaggeration of stimulus salience in ASD. These findings could help explain sensory integration deficits in ASD as well as reduced somatosensory cortical habituation to tactile stimuli.

99   **108.099**   Self-Related Processing and Its Reflections in Memory: An fMRI Study of Youth with and without ASD

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Background:
Previous studies of memory in Autism Spectrum Disorder (ASD) have pointed to specific difficulties in autobiographical memory in ASD (Lind, 2010). Furthermore, several fMRI studies have shown abnormalities in brain activation during self-processing in persons with ASD (Lombardo et al., 2009; Kennedy and Courschesne; 2008; Pfeifer et al., 2013). Yet little is known about the neurobiological correlates of autobiographical memory in ASD. To our knowledge, this is the first study to examine the functional neurobiological correlates of self-related memory, in both ASD and Typically Developing (TD) youth.

Objectives:
To determine the brain activation associated with self-related words, and their subsequent memory, in ASD and TD youth.

Methods:
Participants: Twelve youths with ASD and 15 TD youths, matched for age (range: 8-18; mean=13.3±2.9), gender (70% male) and IQ (FSIQ range: 81-141; mean=115±15) participated in the study. ASD diagnosis was confirmed using ADOS and ADI-R.

Experimental Task: While in the scanner, subjects were presented with 60 trait-words, which participants evaluated as self-descriptive or not (Self Condition); and the same words with jumbled letters, which participants evaluated for presence of the letter 'e'. Thirty minutes later, outside the scanner, subjects were presented with a recognition task including the 60 trait-words they had seen and 60 distracters.

Data analysis: BOLD activation was compared using a 2 x 2 random effects ANCOVAs, with age and VIQ entered as covariates. Two levels of thresholding were used: strict (False Discovery Rate correction with a q=0.005 and Cluster Size Threshold Estimation (CSTE) at $p<0.05$); and lenient ($p<0.005$, CSTE threshold of $p < 0.05$).

Results:
Behavioral: There were no significant group differences in self-endorsement nor in memory recognition rates.

Brain activation:
Self-processing: During Self (>Orthographic) processing, both ASD and TD participants significantly activated the left Superior Frontal Gyrus (SFG), the left Inferior Frontal Gyrus (IFG), Middle Frontal Gyrus (MFG) and the Middle Temporal Gyrus (MTG). During Orthographic (>Self) processing, participants significantly activated their precuneus bilaterally. No group differences were found at the stricter threshold, but at the more lenient threshold the left Precuneus was significantly more active in the TD than ASD participants.

Memory: The left Anterior Cingulate and Lingual Gyrus were significantly more active for Forgotten than Remembered words at the more lenient threshold; and no group differences nor interaction effects were found at either threshold.

Conclusions:
The regions activated by both ASD and TD participants during self-related orthographic and memory processes are in line with previous fMRI studies of self-related (e.g., Lombardo et al., 2009; Kennedy and Courschesne; 2008; Pfeifer et al., 2013), orthographic (e.g., Bolger et al., 2008); and memory processes (Kim, 2010) suggesting that our results are robust. Further, while it is possible that ASD individuals may be impaired on other, more complex, personal memory tasks, the fact that no group differences were found at the strict threshold for self-processing, and at either threshold for memory-related processing (and that no behavioral differences were found for this task), suggests that ASD and TD participants engage similar brain regions when processing, and remembering, self-related trait-words.

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100 **108.100** A Pilot Neuroimaging Study of Phelan Mcdermid Syndrome

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Background: Deletions and mutations of the *SHANK3* gene, located at 22q13.3, are one of the more common monogenic causes of autism spectrum disorders (ASD). Loss of one copy of *SHANK3* results in Phelan McDermid Syndrome (PMS), characterized by global developmental delay, hypotonia, delayed or absent speech, and ASD features. While the association between PMS and ASD is well documented at the behavioral level, there is a striking paucity of data on the underlying abnormal neural systems. Qualitative clinical profiling suggests above average rates of neuropathology in PMS, but no studies so far have included comparison data.

Objectives: The goal of this study is to investigate the effect of *SHANK3* deficiency on brain structure and function and contribute to parsing the heterogeneity in ASD. Individuals with PMS are compared with individuals with idiopathic autism (iASD). Here we present data from diffusion tensor imaging (DTI) and functional MRI.

Methods: In this preliminary study, 11 children with PMS and 9 comparison children with idiopathic autism underwent MRI under light sedation. All PMS participants met ADOS and ADI criteria for ASD;

severity of autism symptoms and developmental quotient did not differ significantly between groups. The fMRI paradigm was a passive auditory task, developed by Pelphrey and colleagues, which presented communicative (e.g., speech, vocalizations of agreement, disgust) and non-communicative sounds (e.g, sneezing, walking, water).

Results: Tract-based spatial statistics revealed significantly reduced fractional anisotropy (FA) bilaterally in the PMS group relative to the iASD group in numerous association, commissural, and projection tracts. All major long-range tracts were more impaired in the PMS than iASD group, which is striking given that ASD has been associated with significant reductions in FA in long-range tracts relative to typically developing controls.

With respect to fMRI, previous research has shown that the superior temporal gyrus/sulcus (STG/STS) is sensitive to communicative versus non-communicative sounds. Here, selective STG activity was detected in the PMS group during communicative relative to non-communicative sounds, but not in the iASD group. Moreover, better orienting toward social sounds was positively correlated with activity in the STG and medial prefrontal cortex (MPFC), relevant for theory of mind, in the PMS group. Interestingly, activity in STG and MPFC was inversely related to ASD symptom severity in both groups, but in different domains - the social affect domain for the PMS group and the repetitive behavior domain for the iASD group.

Conclusions: These initial findings suggest that long-range structural connectvity may be more compromised in PMS than in iASD. In contrast, selective functional activity in the STG appeared to be sensitive to communicative versus non-communicative sounds in the PMS group despite severe receptive and expressive language impairment. While caution is warranted given the small sample size, these data represent a first step in characterizing the neural phenotype of PMS and identifying common and distinct neurobiological substrates with ASD more broadly.

Poster Session
109 - Cognition: Attention, Learning, Memory
11:30 AM - 1:30 PM - Imperial Ballroom

101   **109.101** A Child-Friendly Eye-Tracking Paradigm Reveals Impaired Implicit Repetition Learning in Adults and Children with ASD

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Background: In the domain of memory adults with ASD tend to experience difficulties in repeating back sequences of stimuli in their order of presentation (Poirier et al., 2011; Gaigg et al., 2014). When tasks require participants to respond as quickly as possible to repeating sequences of stimuli children with ASD sometimes demonstrate typical learning rates (Barnes et al., 2008; Brown et al., 2010; Travers et al., 2010) and sometimes not (Motofsky et al., 2000; Gordon & Stark, 2007). This pattern is of considerable interest because explicit and implicit serial order memory processes play a critical role in children's language development (e.g., Ullman, 2004). It is therefore possible that individual differences in this domain contribute to the heterogeneity in language development in ASD. To examine this issue fully it is necessary to device methods that can be used to study serial order memory in children of any age and ability level.

Objectives: Our primary objective was to develop a novel eye-tracking paradigm that is suitable for examining serial order memory processes in children and adults of any age and ability level.

Methods: Two experiments are reported that involved 38 adults (19 ASD; 19 TD) and 54 children (31 ASD; 23 TD) respectively. The adults in experiment 1 all had IQs within the typical range whereas experiment 2 included children with and without substantial learning difficulties. In both experiments participants were asked simply to 'watch out for' a rabbit that appeared in a repeating sequence of 5 (out of a possible 8) rabbit holes on a screen. A Tobii eye-tracker was used to monitor gaze latencies to the rabbit and to quantify the number of times participants anticipated the rabbit in a particular location.

Results: In both experiments gaze latencies to the rabbit and anticipatory fixations indicated significantly reduced implicit repetition learning in the ASD groups. Importantly, and in line with observations from explicit serial order memory tasks, both groups appeared to learn in which of the 8 locations the rabbit was likely to appear. In other words, both groups anticipated the rabbit progressively more frequently in one of the 5 locations that formed part of the sequence, even if they did not anticipate it in the correct location at the correct time. Moreover, both groups also demonstrated reliable primacy effects, whereby gaze latencies to the first rabbit in the sequence decreased significantly more over successive trials than gaze latencies to the other rabbits in the sequence.

Conclusions: Both experiments extend the findings from explicit serial order memory tasks (e.g., Poirier et al., 2011) in showing that adults and children with ASD experience relatively specific difficulties in learning about the order of events. Moreover, the observations suggest that eye-tracking paradigms such as these will proof fruitful for examining the developmental trajectory of serial order memory processes in ASD in the future.

109.102 A Meta-Analysis of the Wisconsin Card Sort Task in Autism

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Background: Despite 30 years of research, there remain inconsistencies in reports of the nature of the executive dysfunction of autism. One of the most widely used tests of executive function is the Wisconsin Card Sort Task. There are numerous conflicting reports of the nature and magnitude of purported impaired facets of performance, as well as presumed facets of intact performance. Executive function is a broad concept, and a more refined understanding of executive dysfunction in autism will inform both intervention programs and neurodevelopmental theory.

Objectives: We conducted a meta-analysis of Wisconsin Card Sort Task performance in participants with autism to consolidate and clarify the inconsistencies in the literature, and examine potential explanatory factors such as participant sample characteristics and experimenter versus computerized administration.

Methods: We were able to retrieve 31 studies reporting on a total of 793 participants with autism, published over a 30-year span. We also obtained five raw data sets, with a combined 191 participants with autism. We calculated Cohen's *d* effect sizes for four measures of performance: sets completed, perseveration, failure-to-maintain-set, and non-perseverative errors. We examined effect sizes as a function of participant sample characteristics, year of publication and diagnostic criteria, and manual versus computerized administration. We also analysed relationships among participant age, verbal and performance IQ, and ADI scores with performance within the combined raw data sets.

Results: We found the average weighted effect size ranged from 0.30 (failure to maintain set) to 0.82 (perseveration) for each measure, all of which were statistically greater than 0. As study authors more often than not concluded that failure to maintain set and non-perseverative errors, the failure to detect these small to medium effect sizes is likely due to small sample sizes. We also found a decrease in the magnitude of perseveration impairment in samples diagnosed under DSM-IV criteria relative to older criteria. We did not find any evidence for systematic variation as a function of mode of administration (experimenter versus computer). In the raw data, we found that age and IQ appear to influence overall performance via unique influences on perseverative and non-perseverative error rates. Age, ADI, and perseveration were associated with one-another. Performance and Verbal IQ were associated with non-perseverative errors and number of sets completed. We did not find any associations with failure to maintain set.

Conclusions:
We conclude that failure-to-maintain-set and non-perseverative errors represent facets of impaired task performance in autism often overlooked due to small sample sizes and that the impairment is less pronounced than perseveration. We further conclude that perseveration decreases with age in autism, a relationship somehow tied also to symptomology, while non-perseverative errors are driven by cognitive abilities reflected in both verbal and performance IQ, independent of age and symptomology.

109.103 Absent Optimism Bias in Updating Beliefs about Future Life Events in Adults with High-Functioning Autism

ABSTRACT WITHDRAWN

Background:
People update their beliefs about their own future outcomes in an optimistically biased way because they tend to neglect undesirable new information. Theoretical explanations of this bias assume that motivational mechanisms related to the pleasure of having positive future outlooks interact with and guide cognitive mechanisms such as egocentric and confirmatory thinking. In adults with high functioning autism (HFA), however, the motivational-affective influences on decision making are diminished as evident in their rule-based reasoning in response to social cues, as well as in response to emotional framings of risky gambling options.

Objectives:
Is this enhanced logical consistency in HFA also present in updating beliefs about future outcomes?

Methods:
Adults with HFA (n = 20, 4 females, mean age 41.5 years; F84.0 and F48.5 with an at least average IQ) and typically developing controls (n = 20; 2 females, mean age 38.9 years) matched on age, gender, years of education and IQ were recruited. Diagnoses were established within a systematic assessment in a specialized outpatient clinic by two independent psychiatrists and in consideration of an extensive neuropsychological profile of the person concerned.

In the update experiment, participants estimated the probability of an adverse future event to occur in the lifetime. Next, they were presented with the official base rate of the respective event and were then given the opportunity to make a second estimation and to adjust their first estimate to this new information. Estimations were made for 44 different adverse events, concerned either oneself or a similar other, and were confronted with either desirable (i.e., lower than the first estimate) or undesirable (i.e., higher than the first estimate) base rates. Unbeknownst to participants, presented base rates were manipulated in order to control for the size of estimation errors calling for belief updates across the four experimental conditions (self_desirable base rates, self_undesirable base rates, other_desirable base rates, other_undesirable base rates).

Results:

The optimism bias was replicated in the control group as *updates* (differences between the first and the second estimate) *after undesirable base rates* were significantly *smaller*than updates after desirable base rates, and this effect was present exclusively in self-related judgments. However, in the HFA group, there were no significant differences in update sizes dependent on the desirability of the new information, neither in self- nor in other-related judgments.
Conclusions:
In contrast to typically developing controls, adults with HFA did not show an optimistically biased updating of beliefs about their own or others' future. This indicates an increased logical consistency in HFA in general prospective thinking which may be explained by diminished motivational-affective influences on decision making. Future research would need to investigate the benefits and disadvantages of the increased logical consistency in HFA for different domains such as professional and private decision making and affective state.

104 **109.104** Accuracy, Response Time and Visual Search Strategies of Adolescents with and without Autism Spectrum Disorder during a Disembedding Task

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Background: The Weak Central Coherence Theory (WCC) and Enhanced Perceptual Functioning (EPF) are two main theories which described the differences in visuo-spatial processing among individuals with Autism Spectrum Disorders (ASD). It was purported that individuals with ASD process sensory information in a way that deviates from a top down manner and shows preference to local information. Disembeding tasks, or tasks that require the locating of hidden figure is one assessment to examine the presence of possible local processing in ASD. When comparing with typically developing (TD) counterparts, previous research found that children with ASD process information differently in visuo-spatial tasks. However, the performance and visual search strategies of adolescents with in disembedding figure tasks remain unknown.
Objectives: The aim of the current study was to examine performance and visual search strategies of adolescents with and without ASD to provide insights in to the theories of WCC and EPF.
Methods: An established experimental protocol was employed including a standardized assessment of visual perceptual skills, the Test of Visual Perceptual Skills 3rd Edition to investigate disembedding performance of 27 adolescents with ASD and 30 matched peers. The accuracy and time required to respond was measured. A remote eye tracker device was used to record the visual search strategies, i.e, number of fixations and duration of fixations of the participants.
Results: There were no differences in terms of accuracy in disembedding tasks among adolescents with and without ASD. However, adolescents with ASD were slower at completing the disembedding task. There were no differences in visual search strategies with the exception of an increased number of fixations and the duration of first fixations to the irrelevant white space.
Conclusions: These results provide limited evidence for the notion of a local preference in ASD and contradict the WCC and EPF theoretical viewpoints that a local preference contributes to superior performance in disembedding tasks.

105 **109.105** An Eye-Tracking Study of Visual Attention to Human Faces and Nonhuman Graphics in Children with Autism Spectrum Disorders

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Background: It was reported that typically developing children show preferential attention to social rather than inanimate stimuli, and they also prefer to focus on the more socially revealing features of the face, such as the eyes rather than the mouth; in contrast, individuals with autism seem to lack these early social predispositions.
Objectives: This study explored the visual fixation patterns of ASD children when viewing human faces and inanimate stimuli by an eye-tracking study.
Methods: Fourteen children with ASD (male vs. female=12:2, Mage=5.60, SD=1.63) aged from four to seven and thirteen age-matched TD children (male vs. female=7:6, Mage=5.63, SD=0.55) participated study one in which 30 black and white photographs showing human faces with neutral facial expressions were displayed in sequence interval, and each one was displayed 3s with 1s interval. And then they participated the experiment again a week later. Their gaze behaviours were measured via an integrated Tobii TX300. In study two, sixteen videos of graphic movements and transformations were displayed in sequence interval, and each one was displayed 5s with 1s interval. Eighteen children with ASD (male vs. female=15:3, Mage=8.03, SD=3.05) aged from four to seven and twenty-two age-matched TD children (male vs. female=10:12, Mage=5.87, SD=1.42) participated study two. The proportion of total Fixation time to the region of interest (ROI), such as, left eye, right eye, nose, mouth, the main part of face, the whole face and body were investigated.
Results: In study one, children with ASD fixed significantly less on the main regions of face than TD group. No differences were found on the fixations of ASD between the first and second week, which showed that memory did not affect their attention, but TD children showed less fixation on the left eye and left face region in the first week than in the second week. In study two, ASD children fixation significantly less on the movements and transformation of inanimate graphics than TD group, which is different from the reported findings that ASD had no impairment on their cognition to

inanimate/nonhuman information.
Conclusions: In summary, ASD showed impairments on social information cognition and graphics cognition.

106 **109.106** Assessing Tactile Perceptual Inference and Learning in Autism Spectrum Disorders

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Background:
Recently, some Bayesian theories were suggested to explain how our perception of the world emerges and how it could be altered in Autism Spectrum Disorders (ASD)[1,2]. In these theories, the representation of a stimulus would be influenced by both the precision of the encoding of the stimulus and the *priors* we have on incoming sensations. *Priors* correspond to our internal references that are dynamically adjusted through implicit or explicit learning. Thanks to *priors*, we are quickly able to identify a stimulus as being part of a category. Nonetheless, *priors* also bias our perception: the information received will be perceived as closer to the *prior*than it is.
In ASD, the perception of the world might be less biased than in neurotypical (NT) individuals. This perception, which one could refer to as "too close to reality" would explain subsequent impairments such as failures in generalizing and making suitable predictions. Two hypotheses were suggested to explain this particular perception in ASD: 1-*Hypo-prior hypothesis*: *priors* would be too blurred and would poorly influence perception[1]; 2-*Sensory accuracy hypothesis:* sensory information would be encoded very precisely and would have an important weight[2], resulting in a too acute representation of the inputs.
Objectives:
Our current project aims to better understand *prior* construction and their influence on perception in ASD, and to test whether the *hypo-prior* hypothesis prevails in ASD.
Methods:
We investigated tactile frequency discrimination and the influence of the global perceptual context on behavioral performance, with NT (n=20) and ASD participants (n=16). At each trial, participants received two successive non-painful electrical finger stimulations to be compared. Given the range of delivered frequencies, they were able to build-up a *prior*on the forthcoming frequency of stimulation, centered on the mean value of the already perceived frequencies. In NT subjects, such a design results in a perceptual bias: the first stimulation (to be memorized) is underestimated when it is larger than the average of the delivered frequencies; and overestimated when smaller. This task reflects how subjects learn about the global range of stimulations and how this strongly influences their perceptual decisions.
Results:
As expected, NT participants showed a perceptual bias, also known as a time-order effect (Figure 1-a). However and surprisingly, ASD participants showed an even stronger effect (Figure 1-b). Our preliminary interpretation is that in ASD, the stability of the learning context would favor the construction of "hyper *priors*".
Conclusions:
This study contributes to elucidate the mechanisms underlying perceptual learning in ASD. We hypothesize that in ASD, the influence of the *priors* can either be too strong ("hyper *prior*") in a stable learning context, or too weak ("hypo *prior*")[1] in a changing learning context. Neuroimaging studies will be performed to test these hypotheses and to explore the neural correlates of *prior* construction.
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107 **109.107** Assessing the Use of Eye-Blinking As a Measure of an Individual's Engagement with Ongoing Visual Content

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Background: Reduced social engagement is a pervasive, early-emerging feature of Autism Spectrum Disorder (ASD). Yet research in this area has been neglected, largely due to the absence of measures capturing an individual's subjective perception of stimulus salience. This study provides a methodological solution, building upon an approach that quantifies engagement by analyzing patterns of eye-blinking among groups of viewers. Given that blinking results in a loss of visual information, viewers unconsciously modulate blink-timing: they are *least likely* to blink during moments perceived as *most* salient. While this provides insight into what is engaging to a *group*, quantifying what an *individual*perceives as engaging presents challenges. For instance, individuals blink relatively infrequently – thus, moments of engagement (indexed by statistically significant blink inhibition) are

more readily quantified within a group. Overcoming this challenge is critical: individual metrics of engagement can provide much-needed insight into the subjective experience of a child with ASD. Objectives: Determine whether meaningful information can be recovered from an individual's eye-blinking, by examining: 1) the conditions under which eye-blinking can be used to classify individuals by experimental group during a highly-controlled pilot task; 2) whether patterns of eye-blinking can be used to classify individuals by diagnostic group (TD or ASD) during a free-viewing task. Methods: *Pilot:* Eye-tracking data were collected while 21 typical adults watched videos alternating between scenes of water animals and scenes of land animals. The categories of content were differentially engaging to viewers: half of the participants were instructed to count the number of water animals, and the other half, land animals. *Natural Viewing:*Eye-tracking data were collected while school-age TD children (n=48) and children with ASD (n=48) watched scenes of social interactions. Results: *Pilot*: An SVM classifier correctly labeled 95% of participants by experimental group, using eye-blink timing (Figure 1). Classification was robust over varying scene durations and over viewers with very low or high blink rates. *Natural Viewing*: To determine when TD and ASD viewers were most engaged, we identified moments of blink inhibition for a subset of each diagnostic group ("training groups"), using permutation testing. We then calculated blink rates of the remaining TD and ASD viewers ("test groups") during moments perceived as highly engaging by the training groups. As predicted, TD test viewers blinked *less* during moments perceived as engaging by the TD training group than during moments that ASD viewers perceived as engaging. ASD test viewers showed the opposite pattern (Figure 2). However, *individuals*within the test groups did not show this pattern. Conclusions: Pilot task analyses demonstrate that individual patterns of eye-blinking can be used to classify participants according to the timing of their engagement. In the naturalistic paradigm, different moments were identified as engaging to the TD and ASD training groups. Critically, two independent samples of TD viewers (TD train and TD test) showed similar patterns of eye-blinking, as did the independent samples of ASD viewers. Future analyses will explore the conditions under which individual patterns of eye-blinking during naturalistic viewing can be used as a diagnostic classifier.

108 **109.108** Attention Biases in Anxious Youth with Co-Occurring ASD Symptoms

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Background: Children with anxiety disorders typically show numerous processing biases that favor negative or threatening information and these processes are believed to be responsible for the etiology and/or maintenance of these disorders. Children with autism spectrum disorders (ASD) frequently show elevated levels of anxiety, and examining the cognitive mechanisms in children with ASD symptoms and co-occuring anxiety may prove useful in better understanding the co-occurrence of these disorders.

Objectives: We explored if children with elevated ASD traits demonstrate an attentional bias towards threat similar to that of typically developing, low-ASD children. We used a standard dot-probe task that assessed attentional biases towards emotional (threatening or happy) vs neutral faces.

Methods: Fifty-nine typically developing children with a primary anxiety disorder diagnosis (mean age = 11.52) completed a dot-probe task (500 ms presentation). ASD symptoms were assessed with the Social Responsiveness Scale-Parent Version (SRS-P). Anxiety disorders were diagnosed using the Anxiety Disorders Interview Schedule for Children, a semi-structured interview for diagnosing anxiety and other disorders. Continuous measures of anxiety were assessed using the Multidimensional Anxiety Scale for Children, administered to parents and children.

Results: Of the 59 participants, 29 had elevated ASD symptoms (as determined by cut-off scores of 60 or higher, indicating moderate to severe symptom severity). Children in the elevated ASD group were found to have higher parent-reported anxiety $t(57) = -2.76$, $p = .01$ and child-reported anxiety, $t(57) = -3.05$, $p = .00$. Children in the elevated ASD group had more cases of a primary diagnosis of social phobia, χ^2 (1, N=59) = 9.05, and this was included as a control factor in regression analyses. At the group level, neither group (low or elevated ASD) showed a significant bias towards threatening or happy faces. However, regression analyses using parent-reported anxiety, ASD symptoms, and their interaction significantly predicted bias scores for happy faces, R^2=.22, $F(4,55)$=3.61 $p<.01$. Both SRS-P scores (β= .86, $p < .05$) and the interaction between SRS-P scores and parent-reported anxiety (β=-1.90, $p< .05$) significantly predicted biases towards happy faces. Specifically, those with elevated SRS-P symptoms and high parent-reported anxiety showed an attention bias toward happy faces. In contrast, those with high ASD symptoms and low parent-reported anxiety showed an attention bias away from happy faces.

Conclusions: In the present sample, no overall differences were found in the attentional biases of children with and without elevated ASD symptoms. However, a significant interaction between parent-reported anxiety and SRS-P symptoms was observed, such that children with high ASD symptoms and high anxiety were more likely to attend to happy faces than children with low SRS scores or low anxiety. Considering the majority of studies examining children and adults does not find biases towards happy faces, these results suggest that happy faces were particularly favored in attentional processing, perhaps due to being perceived as threatening, due to the difficulties in social processing seen in children with elevated ASD symptoms. These results suggest that ASD symptoms play a role in the relationship between attentional biases and anxiety.

109 **109.109** Attention Does Not Modulate the Imitation of Biological Motion Kinematics in Autism Spectrum Disorders

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Background: Interpersonal contexts require imitation of biological motion. Such imitation is impaired in autism spectrum disorders (*autism*) due to top-down processes associated with social modulation and attention orientation, and lower-level visuomotor control processes. This is based on examining biological motion during automatic imitation, or using voluntary imitation and manipulating movement speed. Here, we examined voluntary imitation using a novel methodology that displayed models with the same movement time, but different biological motion. A non-human agent model was used to control social modulation. To investigate the effects of attention we examined imitation under general attention, and selective attention to the biological motion during observation.
Objectives: (1) examine imitation of biological motion kinematics; (2) examine whether the imitation of biological motion is influenced by attentional control.
Methods: Eleven adults with autism, diagnosed by a clinical assessment and ADOS, plus eleven adults (control) participated in a four-phase study, which was approved by the local ethics committee. In a General-Attention phase, participants were instructed to "observe and copy the dot". In a Selective-Attention phase, participants were instructed to "observe and copy exactly how the dot moves". There were two biological motion models: atypical and typical velocity. All participants then performed a multiple object tracking task and a biological-motion-perception-task.
Results: Planned comparisons indicated that although the groups did not differ in the imitation of typical velocity ($p > 0.05$), the *control* group imitated atypical velocity more accurately than the *autism* group ($p < 0.001$). When attention was directed to the model, the *control* group more accurately imitated the typical velocity compared to general-attention phase. Imitation by the *autism* group remained the same for *atypical* and *typical velocity* irrespective of attentional instruction. The multiple object tracking task showed the *control* group (96% accurate) was more successful ($p = 0.02$) at tracking objects than the *autism* group (84% accurate). The biological-motion-perception-task indicated the *autism* group (74% accurate) and *control* group (70% accurate) were similarly successful in judging differences between biological motion models.
Conclusions: Compared to the control group, we showed imitation of biological motion was impaired in *autism.* When instruction directed attention to the model, imitation performance was not improved in the *autism* group. It is therefore unlikely that low-fidelity imitation of biological motion in the *autism* group can be explained by participants not observing the kinematics presented by the model. Moreover, although there was a group difference in general attention ability as evidenced by the multiple-object tracking task, the *autism* group still performed successfully (84% accurate). Also, the *autism* group was equally successful as the *control* group in perceiving and judging differences between two single-point-light dots presenting different forms of atypical velocity. Taking into consideration the effects for attention and perception of kinematics, in a situation where we controlled for social modulation, these findings suggest the deficit in imitating biological motion kinematics in autism is most likely related to the sensory-motor integration and representation of biological motion.

110 **109.110** Attentional Sensitivity to Features of Angry Faces and Domain-General Cognitive Characteristics

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Background:
An atypical face and emotion processing in ASD have received wide attention in the research of ASD. It is, however, still not clear whether/ how their processing is different from typical people. In the current study, to assess their basic feature regarding emotional responses, we focused on the "anger superiority effect (ASE)". ASE refers to a phenomenon where an angry face is detected more quickly than a happy or neutral face in a crowd of distracters (i.e., face-in-the-crowd task). This is believed to stem from the attention-getting properties in such threatening stimuli. Previous studies have reported that ASE is also observed in individuals with ASD (Ashwin et al., 2006; Krysko & Rutherford, 2009; Isomura et al., 2014), but the underlying mechanisms may be different from those in TD. Although ASE is known to require the configuration of features in faces (Fox et al., 2000; Tipples et al., 2002; Weymer et al., 2011), for some individuals such as individuals with ASD who have local-biased cognitive characteristics, single isolated facial features may be sufficient to activate the systems of quick attention allocation to anger. Furthermore, the mechanisms for that may be attributed to more domain-general cognitive mechanisms depending on each individual's characteristics.
Objectives:
In this study, we examined whether ASD and TD children would show feature-based anger superiority effect, and explored the association with their domain-general cognitive characteristics, by focusing on global/local perceptual attentional bias.

Methods:
Sixteen children with ASD and 16 TD children aged 7- to 13-year-old participated in this study. First they were given the face-in-the-crowd task that included three types of face-conditions: whole, eyebrows, and mouth conditions. In the eyebrows and mouth conditions, stimuli involved only the respective features with a facial contour. Global/local attentional bias was assessed by a Navon task, in which a bigger letter composed of smaller elements were identified at the global or local level. The size of individual global/local interference (namely, the Navon index) was calculated using individuals' response times based on a previous study (Zhu et al., 2010), and was used for a correlation analysis with their performance on the face-in-the-crowd tasks.
Results:
The quicker detection of angry faces over happy faces (i.e., Anger Superiority Effect) was observed both for TD and ASD children in the whole and eyebrows conditions. By contrast, in the mouth condition, only the ASD group showed the quicker detection of downward mouth over upward mouth. The results of the correlation analysis revealed that, in ASD, individuals who showed stronger local-biased perceptual characteristics tended to show the stronger single feature-based Anger Superiority Effect. In TD, by contrast, such relationships were not observed.
Conclusions:
The findings suggested that, for ASD individuals, who have local-biased perceptual characteristics, emotion-related facial features may work as emotion-evoking stimuli. Extracting local features and perceiving emotions may be a foundation of quick attention allocating to angry faces in individuals with ASD

111   **109.111** Atypical Binocular Rivalry Dynamics of Simple and Complex Stimuli in Autism

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Background: Binocular rivalry occurs when conflicting images are presented to the same retinal location of each eye. The two percepts compete for perceptual dominance, and conscious perception alternates between the two. The dynamics of binocular rivalry are proposed to index the balance of excitatory and inhibitory connections in the brain, and have therefore been proposed as markers of an imbalance in excitatory/inhibitory transmission that may characterize autistic neurobiology. Two studies have compared rivalry dynamics in individuals with and without Autism Spectrum Conditions (ASC), each using stimuli of different levels of visual complexity. While both found results in the expected direction, only one found significant differences in rivalry dynamics between the two groups.
Objectives: First, we hoped to replicate our previous finding of a slower rate of rivalry with longer mixed percepts in ASC in a new, expanded sample of participants. Second, we tested whether this finding was selective for stimuli of a particular level of visual complexity.
Methods: 53 participants (26 with ASC) completed twelve 40s trials of binocular rivalry (6 with object stimuli, 6 with grating stimuli) and 24 control trials. Participants continuously reported either dominant or mixed percepts throughout the trial. We analysed the rate of perceptual transitions and average percept durations as well as ratios of percept durations.
Results: We tested rivalry dynamics with Stimulus Type as between-subject factor and ASC Diagnosis as within-subject factor in repeated measures ANOVA. ASC subjects perceived a lower rate of switches ($F(1, 51) = 4.3$, $p < 0.043$) with longer mixed percepts ($F(1, 51) = 14.7$, $p < 0.001$). The differences in average mixed percepts and proportion of mixed percepts were confirmed with non-parametric comparisons of means to be significant in both stimulus conditions, while the difference in switch rate was significant only in the grating condition.
Conclusions: We replicate our previous findings of a slower rate of binocular rivalry with increased mixed percepts in ASC, and show that these effects are present at low levels of stimulus complexity. These results are predicted by an increased ratio of excitatory/inhibitory synaptic transmission in autism, and suggest that this imbalance may manifest as early as V1.

112   **109.112** Behavioral Differences in Reward Salience but Not Motivation in Toddlers with ASD: Results from a Visual Search Task

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Background: Visual search is consistently documented as an area of superior skill in adults and adolescents with ASD (Kaldy et al., 2013); however, few studies have been conducted in younger samples or samples with a broad range of functioning. It has been hypothesized that children with ASD find social stimuli less rewarding than do people with typical development (Dawson et al., 2004; Dawson et al., 2005). Based on current evidence, it is unclear whether differences in reward processing are specific to social stimuli. Questions also remain about what aspects of reward processing are different in ASD.
Objectives: There were three main goals of this study: (1) to develop a visual search task for very young children with ASD that could be completed without any verbal instructions by using gaze-contingent eye-tracking; (2) to test differences between children with ASD and typical development in

the motivation for and saliency of social and nonsocial rewards; and (3) to examine the effect of social and nonsocial reward on learning.

Methods: Two groups of two year olds participated in this study: ASD (N =21) and typically developing (TD = 23). During the visual search task, participants were rewarded with either a social or nonsocial video when they fixated on the target shape among a circular array of distractor shapes. Key dependent eye-tracking variables were reaction time (RT) to finding the target and looking time (LT) at the reward video when it played.

Results: Two sets of multilevel models were examined with RT and LT as the dependent measures, group (ASD vs. TD) as a main effect, condition (social vs. object) as a repeated measure, and block of trials as the time variable. Three models were tested: no growth, linear, quadratic. In the best fitting model of RT the ASD group demonstrated faster RT. There was no significant interaction between group and reward condition, indicating no difference in motivation based on reward type. Both groups demonstrated learning on the task as indicated by a significant decrease in RT across the task. The group by time interaction was not significant. Learning did not vary in either group depending on reward condition (i.e., there was no group by time by condition interaction). In the best fitting model of LT, a significant group by condition interaction was found, where children in the ASD group looked less at the social videos than nonsocial videos; whereas, the TD group had the opposite pattern of visual attention.

Conclusions: Results replicate findings of superior visual search in children with ASD compared to TD children (Kadly et al., 2011). These results also add support to previous reports of lower saliency of social stimuli for toddlers with ASD compared to TD controls (Shic et al., 2011). Although there was a group difference in saliency, there were no differences in motivation or learning based on reward type for either group. According to these results, children with ASD may work to obtain social rewards to the same degree as TD children, but engage more with nonsocial stimuli.

113   **109.113** Bootstrapping the Hippocampus? Atypical Learning Characterizes Adolescents with Autism Spectrum Disorders

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Background:
Individuals with ASD are thought to exhibit intact semantic memory for facts, details, and routines, but manifest deficits in episodic memory and generalizing learning. The underlying neurobiology of this pattern, which may include impairments in the medial temporal lobe (MTL) and the prefrontal cortex (PFC), remains unclear. We have argued that young adults with ASD are more reliant on the hippocampus (HC) than on the PFC, given their cognitive control deficits.

Objectives:
We investigate this contention in adolescents with ASD, using behavioral measurements that assess MTL, HC, and PFC contributions to encoding, retrieval, and generalization.

Methods:
Participants included 27 12-18 year olds with ASD (mean age = 14.8) and 25 age, gender, and IQ-matched participants with typical development (TYP) (mean age = 14.8). To assess MTL and HC contributions to learning and memory, we administered the Relational and Item-Specific Encoding task (RISE; Ragland et al., 2012), which requires respondents to make item-specific and relational judgments, and to provide response confidence estimates. Performance measures include accuracy rates and d'. Familiarity and recollection also were analyzed using ROC curves. To assess PFC contributions to learning and memory, participants completed California Verbal Learning Test-Children's Version (CVLT-C; Delis, Kramer, Kaplan, & Ober, 1994). ANOVAs and t tests were performed using SPSS 22.

Results:
On the RISE, ASD versus TYP showed poorer item-specific accuracy (t(49) = 2.2, p = .0.03) and d' (t(49) = 2.7, p = .009), but comparable relational encoding accuracy and d'. ASD also showed a reduced contribution of familiarity when making relational judgments (t(49) = 2.3, p = .025). This may suggest that ASD benefitted disproportionately from the deeper spatially-oriented encoding involved in the relational condition because they possess a relatively intact HC and/or other MTL regions that support recollection. On the CVLT-C, ASD versus TYP showed poorer list learning (t(52) = 2.2, p = .032) and free and cued recall at short [free recall: t(52) = 3.345, p = .002; and cued recall: t(52) = 3.32, p = .002] and long delays [free recall: t(52) = 4.74, p < .001; and cued recall: t(52) = 3.23, p = .002]. ASD also exhibited lower recall consistency (t(52) = 3.82, p < .001) with more perseverations (t(52) = 2.17, p = .034), suggesting they have PFC deficits which impede the deep encoding of semantic materials that supports generalization (Shohamy & Wagner, 2008). Both groups relied comparably on semantic and serial clustering strategies thought to require the HC.

Conclusions:
Findings are inconsistent with the view that ASD exhibit intact lower-level learning and memory and impaired higher level learning and memory. Instead, they suggest that ASD actually may be relatively worse at lower-level learning of items that is prefrontally-mediated or that involves areas of the anterior temporal system (Ranganath & Ritchey, 2012) including the lateral and orbito-fronal cortices, and the perirhinal cortex, and relatively better at relational versus item-specific encoding under

conditions involving spatial processing, that is sub-served by a relatively more intact posterior medial system including the HC and the parahippocampal cortex.

114 **109.114** Brain Organization Underlying Superior Math Problem Solving Abilities in Children with Autism

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Background: In addition to social, communicative and sensorimotor processing deficits, it has been reported that individuals with autism spectrum disorder (ASD) can exhibit remarkable strengths, such as the ability to rapidly absorb and precisely remember tremendous amounts of details, or a particular interest towards regular sets with repeatable rules (i.e. "hyper-systemizing"). A synergistic interplay of these cognitive processes seem to have a role in predisposing to special abilities of savant sort. Mathematics represents the most concrete instantiation of these processes, as it is built upon systematic axiomatic procedures, and therefore represents an ideal domain to experimentally measure the cognitive and neural bases of superior-like abilities — and their heterogeneity — in ASD. Critically, the cognitive and brain mechanisms that might support such interplay — and thus foster proficiency in math — remain elusive. An emerging theoretical account of ASD has proposed that superior abilities in analytical and procedural thinking are attributable to greater engagement of primary sensory visual areas.
Objectives: We investigated: (i) whether greater engagement of primary sensory visual areas or their patterns of neural activity could explain better math abilities in children with ASD; and (ii) whether functional connectivity between these higher-order visual areas and medial temporal lobe systems implicated in procedural memory processes could support better math abilities in ASD.
Methods: We tested a group of 7-12 year old children with ASD, and a group of age-, gender-, and IQ-matched neuro-typical peers. Cognitive measures included standardized tests of calculation and problem solving, as well as strategy assessments. Brain measures included task-based functional magnetic resonance imaging (fMRI) during math problem solving.
Results: Behaviorally, we show that, on average, children with ASD showed superior math problem solving skills and relied on sophisticated analytical strategies more frequently than neuro-typical peers. Yet, not all individuals with ASD displayed proficient skills in math problem solving. Neurobiologically, we report differences between children with ASD and their neuro-typical peers in patterns of activity related to arithmetic problem complexity in the ventral temporal-occipital, parietal, and temporal cortices that support visuo-spatial, numerical, and mnemonic processes. Activation levels as well as multivariate activation patterns in ventral-temporal occipital cortex predicted individual differences in math problem solving abilities in ASD, but not in neuro-typical children. Remarkably, task-based multivariate connectivity analyses revealed that the interactions between regions of the ventral-temporal cortex, and the medial temporal lobe significantly and uniquely modulated individual math abilities in ASD.
Conclusions: Our results suggest that superior math abilities in children with ASD are engendered through a unique pattern of brain organization characterized by differential recruitment of posterior regions of the ventral stream and their functional coupling with memory systems. This is consistent with the hypothesis that analytical thinking is attributable to different engagement of posterior visual areas in ASD. Critically, our data extend this model to incorporate mnemonic systems residing in the medial temporal lobe as a locus for enhanced procedural thinking in ASD. More generally, these circuits can provide candidate biomarkers for explaining individual differences of superior cognitive skills in ASD.

115 **109.115** Building a Percept: Early Influences on Mid and Higher-Level Visual Abilities in Autism Spectrum Disorder

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Background: Individuals with Autism Spectrum Disorder (ASD) present a perceptual profile that is defined by atypical performance on tasks mediated by lower- (primary visual areas), mid- (extra-striate areas) and higher-level (large-scale neural mechanisms) visual analysis (Simmons et al., 2009). These differences characterize the distinct visuo-perceptual phenotype in ASD, broadly described as strengths in detailed, local processing (mediated by lower-level analysis) with or without concurrent difficulty in global or integrative processing (mediated by mid- and higher-level analysis). The visuo-perceptual phenotype in ASD has been based largely on isolated levels of processing, providing little information with respect to how performance within the same individual varies with increasing task complexity. Alterations occurring in earlier stages of visual analysis arguably affect those occurring at higher levels (Bertone et al., 2010). It is therefore important to elucidate the relationship between perceptual abilities mediated by different levels of analysis to understand how alterations in the building blocks of perception affect higher-order cognitive and social functions in ASD.
Objectives: The present work systematically investigated whether enhanced local processing in

lower-levels of visual analysis influenced higher-level perception in the same group of children and adolescents with and without ASD. Specifically, we examined whether enhanced local perception at earlier stages of processing affected higher level perception by asking the following questions:
1) Does enhanced local processing in low-level visual analysis predict greater local interference in mid-level visual analysis?
2) Does greater local interference in mid-level visual analysis predict a decreased global performance in higher-level visual analysis?
Methods: A total of 27 and 48 respective children and adolescents with and without ASD performed three tasks, each soliciting a progressively complex visual analysis: (i) low-level perception was assessed by measuring contrast sensitivity to vertically oriented, sine-wave luminance- defined gratings of different spatial frequencies; (ii) mid-level perception was assessed by measuring local and global reaction times for consistent and inconsistent stimuli in a Navon task (Navon, 1977); and (iii) higher-level perception was assessed by measuring thresholds in a face-identity discrimination task.
Results: Simultaneous multiple regression analyses revealed no significant relationship between low- and mid-level processing in either the TD or ASD groups; specifically, enhanced local processing on the low-level task, reflected by an increased sensitivity at high spatial frequencies, did not predict slower performance on the mid-level task when local information conflicted with the identification of global information (i.e. increased local interference). The effect of mid- on high-level perception, however, revealed that an increased local interference on the mid-level task predicted a decreased performance on the higher-level, face identity discrimination task in the ASD group alone. These results suggest that an increased effect of local processing for mid-level perception in ASD impacts higher-level perception, typically requiring a global analysis.
Conclusions: Our findings establish a significant association between mid- and higher-level mechanisms in ASD. Such a relationship suggests that alterations in the "building blocks" of early perception are responsible for differences in higher-order visual processes in ASD, and possibly, functions in the domains of socialization and communication.

116 **109.116** Cognitive Control of Visual Attention in ASD in Response to Social and Non-Social Stimuli

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Background: Narrowed interests, perseverative patterns of attention and reduced visual exploration have been linked to restricted, repetitive behaviors (RRBs) in Autism Spectrum Disorder (ASD). Circumscribed interests (CIs) in ASD, are unusually intense interests in a narrow range of subject areas, and these activities (i.e., collecting, manipulating, reading, conversing about their interest) often lead to functional impairments. Eye-tracking research investigating responses to categories of images reflecting CI that capture attention during passive viewing tasks has found that children and adults with ASD display an attentional bias towards certain categories of nonsocial images (e.g. train, automobiles, electronic devices, computers). This bias has been conceptualized to reflect increased visual salience of nonsocial images relative to social images (e.g. faces) and other, commonplace, nonsocial information (e.g. furniture, clothing, dishes).
Objectives: This eyetracking study aimed to extend findings regarding atypical patterns of attention in children with ASD by investigating the cognitive control over visual attention in response to social and non-social images.
Methods:
40 individuals ranging in age from 9-18 years old participated. Of those, 19 individuals had a diagnosis of ASD (mean age(stdev)= 13.92(±3.05), 16 male) and 21 were typically developing controls (mean age (stdev)= 14.06(±2.79), 19 male). Participants completed a visual saccade paradigm where, on each trial, first a central crosshair was presented followed by a social or nonsocial image to the left or right side of center. The task included both a prosaccade condition ("look towards a peripheral target when it appears") and an antisaccade condition ("look to the opposite side of the screen when a peripheral target appears"). Stimuli varied between social images (smiling faces) and non-social images previously shown to be related to CI's in ASD ("high interest" images) and commonplace, everyday objects ("low interest" images).
Results: The primary dependent measure was the difference between antisaccade and prosaccade errors, reflecting the influence of cognitive control over visual attention. Children and adolescents with ASD demonstrated an increased overall rate of error relative to typically developing controls, t(38)=2.21, p<.03. A repeated measures analysis of variance did not reveal stimulus or a group x stimulus interaction was revealed (p's>0.20). Between groups t-tests were carried out to investigate group differences in saccade errors in response to each of the 3 stimulus categories. Relative to typically developing controls, the ASD group made an increased number of errors in response to both non-social stimulus categories- "high interest" (t(38)=2.23, p<.03) and "low interest" images (t(38)=2.64, p<.01). Groups did not differ in saccade errors in response to faces (t(38)=1.09, p<.28). Within the ASD group, error rate was significantly related to social-communication impairments and restricted and repetitive behaviors calculated from the ADOS-2. Exploratory comparisons across children with ASD and a small cohort with another development disorder

characterized by repetitive behaviors (pediatric OCD; n=9, mean age(stdev)=15.43(±1.01)), will also be presented.
Conclusions:
Impairments in cognitive control of visual information appear to be domain general and a powerful predictor of ASD symptom severity. This study provides support for the use of visual attention and oculomotor behavior to quantify impairments in ASD.

117   **109.117** Colour Perception in Autism and Williams Syndrome

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Background: Recent studies report a varied visual function profile in Autism Spectrum Disorders (ASD; Simmons et al., 2009), with relative strengths and weaknesses found in dorsal and ventral stream functions. The genetic disorder Williams Syndrome (WS) has been described as illustrating a contrasting social profile to ASD, but socio-communicative deficits overlap in the two conditions (Klein-Tasman et al., 2009) as do sensory processing difficulties, with profound deficits in dorsal stream visuo-spatial processing in WS. Given the increasing importance of understanding sensory processing difficulties and sensory reactivities in both conditions, there is a need to better differentiate between the two sensory profiles. The ventral stream primarily processes visual properties which underlie key aspects of socio-communicative ability (e.g. face/object recognition). Colour perception (a key function of the ventral stream) is relatively understudied in ASD and WS. Despite this, there is an increasing use of colour in behavioural interventions for ASD (e.g. sensory rooms, coloured overlays; Ludlow et al., 2006).
Objectives: To assess colour perception as a measure of ventral stream visual function in ASD and WS, relative to typically developing children (TD), at different levels including chromatic-discrimination (sensory level) and colour preference (cognitive/affective level).
Methods: 15 individuals with ASD (7-18y), 26 with WS (7-20y), matched individually on the Ravens Coloured Progressive Matrices to TD (4-8y), took part in the study. Two tasks were used to examine different aspects of colour perception. First, a chromatic-discrimination task measured chromatic-discrimination thresholds along three colour directions, the cone-opponent ("red-green", "blue-yellow") and luminance colour axes. The task required participants to identify the direction of a briefly flashed arrow of variable contrast against a grey background (staircase procedure). To measure colour preference, a two-alternative-forced choice task was used in which participants chose the preferred colour from each of all possible pairs of nineteen colours varying systematically in hue, lightness and saturation.
Results: Performance patterns differed between ASD and WS groups relative to the TD group. On the chromatic-discrimination task, significant interaction between colour axis and group was found between ASD and TD (p<0.01), with ASD "Blue-Yellow" axis performance significantly worse relative to TD (p<0.01). No significant differences were found between the WS and TD groups (p=0.39). For colour preference,   patterns differed between groups. TD and ASD groups show similar preference patterns across hues, but whereas the TD group show increased preference for lighter-vs-darker colours, the ASD group do not (p<0.01). The WS group displayed greater inter-individual variation.
Conclusions: These findings provide evidence for atypical colour perception in both ASD and WS but with condition-specific patterns. Relative to mental-age TD controls, in ASD "low-level" chromatic-discrimination is impaired, and colour preference depends on hue but lacks dependence on lightness. In WS, chromatic-discrimination is unimpaired, but colour preference shows high inter-individual variation. These results suggest that in behavioural interventions for ASD, it is more important to consider affective responses to hue than to lightness of colours, whereas in WS, colours should be tailored to the individual. Future research will further inform better use of colour in behavioural interventions.

118   **109.118** Concurrent and Longitudinal Predictors of Theory of Mind in TD Children and Children with ASD

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Background: Delayed or deficient theory of mind (TOM) development in children with ASD has been attributed as a root cause of many other patterns of social and cognitive impairment in autism. Indeed, school-age children with ASD usually perform significantly more poorly on TOM tasks than age-matched TD children (2, 3). Both linguistic and social measures have been shown to correlate with concurrent TOM performance (1, 4, 5); however, the longitudinal predictors/precursors of TOM are still not established. Moreover, it is still unclear whether the same longitudinal predictors will be found for TD children and children with ASD. We address these gaps with data from a longitudinal study in which both linguistic and social developmental precursors of TOM are collected.
Objectives: We investigate both social and linguistic predictors of TOM, both concurrently and longitudinally, in 5-to 6-year-old children with TD or ASD.
Methods: The participants were 27 TD children ($MA_{\text{visit 1}}$=1.7 years) and 17 children with ASD (MA_{visit}

$_1$=2.71 years). The TD and ASD groups were matched on Mullen expressive language at Visit1; however, by Visit 3, when the TOM tasks were administered (TD$_{MA}$=5.58 years, ASD$_{MA}$=6.54 years), the TD group had higher language scores (ps<0.05). The Vineland Adaptive Behavior Scales, and the Mullen Scales of Early Learning were administered at Visits 1 and 2 (TD$_{MA}$=3.33 years; ASD$_{MA}$=4.5 years); the Test of Auditory Comprehension of Language-3 (TACL) was administered at V3. Two TOM tasks were administered: an unexpected contents task and an unexpected change in location task. Scores were averaged for an overall percent correct.

Results: As expected, the TD group (Mpercent correct=89%, SD=16.69) had higher scores than the ASD group (M=43%, SD=40.43). Figure 1 shows 2 subgroups in the ASD sample; one subgroup scored in the TD range. Bivariate correlations revealed that the TACL-Q and Mullen-RL at V1 correlated positively with TOM scores in both groups (rs>.361, ps<.05). The TACL-Elaborated Sentences also correlated with TOM only in the TD group (r=.431,p<.05); the Vineland Communication at V1, MullenRL at V2, and TACL-morphology correlated with TOM only in the ASD group (rs>.663,ps<.05). Regressions revealed that for the ASD group the only significant predictors of TOM were the Vineland Communication at V1 (DR^2=.546, p=.002) and Mullen-RL at V2 (DR^2=.109, p=.075). For the TD group, the only significant predictor of TOM was TACL-Elaborated Sentences at V3 (DR^2=.172, p = .034). Conclusions: A subset of children with ASD appears to reach TD levels of TOM; however, their concurrent and longitudinal predictors differed from the TD group. As predicted, complex syntax was the strongest predictor of TOM in the TD group (1, 4). In contrast, both social and more general linguistic measures were the strongest predictors of TOM in the ASD group. Thus, TOM may develop from different roots in children with ASD compared with TD children.

119 **109.119** Contextual Influences on Eccentric Viewing in Young Children with ASD

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Background: Children with Autism Spectrum Disorder (ASD) show atypical visual behaviors either during object exploration (Mottron et al. 2007; Ozonoff et al. 2008; Hellendoorn et al. 2014) and social interactions (Noris et al. 2012). In general, they tend to produce eccentric gazes (EG), which seem mainly to serve the function to filter details during visual exploration of objects. A subtype of EG, downcast gaze (DG), are probably functional to shift attention away from over-arousing visual stimuli (Noris et al. 2012; Bogdashina 2003). However, despite the relevance of contextual factors as possible triggers of EG (namely the presence of objects or over-arousing stimuli), previous studies observed children in a single context, not comparing the frequencies of EG under different contextual conditions.

Objectives: This study aimed to investigate whether contextual factors might influence the frequency of EG in young children with ASD, and specifically the occurrence of DG.

Methods: 20 preschoolers with ASD mean age 4,8 years (3,7 to 6,4 years, SD= 10 months), mean non verbal IQ 106 (Leiter-VR range 87-131, SD= 12.86) were included in the study. All the children were diagnosed by expert clinicians according to DSM-IV criteria for ASD and standardized diagnostic instruments (ADOS and ADI-R). We observed the children in two video-recorded conditions: COND-1 (free play with toys); COND-2 (structured social interaction and free play with toys). Frequency of EG performed by the children towards 8 possible directions (up, up-left, up-right, lateral-left, lateral-right, down, down-left, down-right) were coded from the videos. The mean frequency of DG and of EG per minute in each condition were considered in the analysis.

Results: The results indicated that, in general, the mean frequency of EG performed by the children in COND-2 was significantly lower than in COND-1 (COND-1=6.33 [SD=3.66]; COND-2=9.12 [SD=4.11]; t=3.77, df=19, p=0.001). Specifically, DG were more frequent in COND-2 than in COND-1 (COND-1=0.98 [SD=0.90]; COND-2=2.47 [SD=1.34]; t=5.1, df=19, p<0.001).

Conclusions: The results indicated a significant effect of the context on the mean frequency of EG. In general, EG were significantly more frequent in the most stimulating condition, in which the children were playing with toys and interacting with the experimenter. Specifically, such a difference was mainly accounted by a higher frequency of DG, which were rare when the children were only playing with toys. These findings seem to confirm the possible function of DG in reducing sensory overload.

120 **109.120** Decreased Habituation to Naturalistic Stimuli in Autism

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Background: Habituation plays a fundamental role in dynamically changing saliencies of environmental stimuli. Reduced habituation reduces stimulus suppression and immerses an individual in an unrelentingly salient, and hence potentially overwhelming, world. It would also compromise the ability to 'detach' attention from a given stimulus. Thus, an impairment in habituation can, in principle,

help account for sensory hypersensitivities as well as sustained interest in a limited set of stimuli, two prominent correlates of autism.

Objectives: In work that we presented last year, we showed that habituation to low-level sensory stimuli (metronomic auditory sequences) is reduced in autistic participants compared with neurotypical controls. This study aims to extend our previous work to more naturalistic stimuli.

Methods: We investigated the habituation response to repeated presentations of naturalistic video stimuli, using a measure of galvanic skin response (GSR). Participants were shown 1 minute of neutral baseline stimuli, followed by five repetitions of an exciting 30 second video clip. The convenience and ease of collecting GSR signals allowed us to enlist a wide range of participants on the autism spectrum, including individuals with minimal language abilities.

Results: We found consistent differences in the time-course of GSR signals from ASD participants compared with age-matched neurotypical controls. For the ASD group, the slopes of GSR signals over time showed a flat or increasing trend, indicating compromised habituation to the repeated video stimuli. Conversely, for neurotypical participants, GSR signals over time consistently showed a decreasing trend, indicating habituation to the stimuli. Further computational analysis of these results, using a machine learning classifier, showed differentiation between the neurotypical and ASD groups, based on the slope of the line of best-fit to the GSR signal over time. The classifier successfully differentiated between these two groups with ~75% accuracy.

Conclusions: These results can help to explain several commonly observed features associated with individuals with ASD: restricted and repetitive interests, and associated behaviors such as repetitive intake of media such as videos and music. Furthermore, these results provide support for a broader hypothesis of reduced predictive abilities in autism. Given the simplicity and ease of administering the protocol, we believe that there are possible applications in the measurement of habituation profiles in infancy, which may help with early identification of autism. Furthermore, the results could inform the development of learning environments and interventions best suited to the unique sensory profiles of individuals with ASD. Importantly, we argue that these findings are not due to extraneous factors such as general arousal levels, agitation, movement, or inattention, although further study is required. Future investigations will assess the specificity of the reduced habituation profile in autism compared with other conditions, its occurrence in other sensory modalities, and with naturalistic stimuli in modalities other than vision. At this stage, however, the consistency of our results across a wide range of ages and cognitive abilities points towards reduced habituation as a possible endophenotype that may yield a better understanding of some key aspects of the autism phenotype.

121 **109.121** Distribution of Visual Attention When Comparing Paired Faces in Typically Developing Infants and Infants Later Diagnosed with Autism

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Background: Previous prospective research with infants later diagnosed with an autism spectrum disorder (ASD) has shown differences in how they scan a face (Jones & Klin, 2013). Many infant paradigms of face perception and memory require the infant to compare faces that vary on either novelty, or perceptual aspects such as emotion, gender, and attractiveness. No research exists on whether these infants also differ in how they compare or scan more than a single face.

Objectives: To study how 11-month old infants who were later diagnosed as being typically developing (TD), non-typically developing (NT) or having autism (ASD) differed in their eye tracking when presented with two faces to compare.

Methods: A prospective study design compared the distribution of visual attention of typically developing infants (n=49), infants assessed as non-typically developing (n=7) and infants diagnosed with ASD (n=7) at either 24, 36, or 48 months of age. Eye tracking data were collected at 11 months of age while all infants completed a visual paired comparison task. Stimuli were face pairs of two different females who had similar (neutral/positive) facial expressions. Infants received six different pairs of faces to compare. The infants' visual attention both within a face and across the pair of faces was determined by designating 14 areas of interest (AOIs) (see Figure 1).

Results: All three groups spent significantly (based on t-tests) more time looking at the bottom as opposed to the top half of the faces. Comparisons of the amount of looking to the left vs. right side of the face showed that the TD group looked longer to the right side of the face demonstrating a previously reported left visual field (LVF) bias (t(46)=1.98, p=.05). In contrast, this LVF bias was not seen in the other two groups. With respect to paired face comparisons, there were group differences in the proportion of congruent mouth-to-mouth saccades (F(2, 58)=6.71, p<.00). Infants with ASD made the largest number of mouth-to-mouth comparisons (M=.17, SD=.14), followed by the TD group (M=.06, SD=.09), and the NT group (M=.00, SD = .00). Group difference were also found in the proportion of scans that went from a non-internal facial feature of one pair member to a non-internal feature of the other pair member (F (2, 58) = 4.93, p = .01). Essentially, NT developing infants made more (M = .47, SD = .27) (t (52) = -2.950, p < .00) extraneous comparisons than did TD (M = .22, SD= .20) infants.

Conclusions: First, similar to previous studies of infant sibling populations (Dundas et al., 2012), only the typically developing infants displayed a LVF bias at 11 months of age. This suggests that the LVF bias observed during the viewing of singularly presented faces remains intact during the scanning of face pairs for typically developing infants. Second, differences found in visual attention distribution and saccade congruency were predictive of diagnostic outcome in early childhood. In particular, the

mouth region seems primary in discriminating typically developing, non-typically developing, and autism outcome groups.

109.122 Do Children with Autism Change Their Behaviour in Response to Volatility in the Environment?

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Background:
Adults can track reward probabilities across trials to estimate the volatility (or uncertainty) of the environment and use this information to modify their learning rate (Behrens et al., 2007). For example, in a stable environment, participants take account of outcomes over many trials, whereas in a volatile environment, they weight their recent experience more strongly than their distant experience. It has been suggested that individuals with autism may make less use of prior information (Pellicano & Burr, 2012), in which case, they may not change their behaviour in response to the statistics of the reward environment.
Objectives:
We investigated whether children with autism use information about the reward environment in a similar way as typically developing children to guide their decisions. Specifically, we hypothesised that children with autism would change their behaviour in response to volatility in the environment to a lesser extent than typically developing children.
Methods:
We administered a developmentally appropriate version of Behrens et al.'s (2007) task to 35 children with autism aged between 6 and 14 years, and 36 age- and ability-matched typically developing children. Participants were shown a green and a blue pirate chest, each associated with a randomly determined reward value between 0 and 100 points, with a combined total of 100 points (Figure 1). On each trial, the reward was given for only one stimulus. Participants initially completed a training phase where they passively monitored which of the two stimuli was rewarded on each of 20 trials before being required to estimate the ratio of rewards for the different colour chests. In the test phase, participants were required to choose either the green or blue pirate chest using response pads, and were awarded points if they chose the correct stimulus (see Figure 1). Children completed this task under two conditions each consisting of 80 trials. In the *stable environment* condition, the ratio of the blue or green response being correct (and therefore yielding a reward) was fixed at 75:25. In the *volatile environment* condition, the ratio alternated between 80:20 and 20:80 every 20 trials. We estimated the learning rate for each participant by fitting a delta rule model, and compared these across conditions and groups.
Results:
Overall, children increased their learning rate in the volatile condition compared to the stable condition. Unexpectedly, however there was no effect of group and no interaction between group and condition.
Conclusions:
Children with autism use information about the volatility of the environment to guide their decisions to a similar extent as typically developing children. In decision-making, therefore, it appears that children with autism employ prior knowledge just as typically developing children do.

109.123 Do Children with Autism Show Reduced Susceptibility to Visual Illusions?

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Background: Many theories of autistic perception propose that individuals with autism are less susceptible to perceptual biases than typically developing individuals. One class of evidence in support of this claim comes from visual illusions, with reports of reduced susceptibility in autistic individuals for a range of different illusions (Happé, 1996; Ishida et al., 2013; but see also Ropar & Mitchell, 1999, 2001). It is generally assumed that differences in responses to visual illusions reflect differences at the level of the percept. However, it is possible that group differences instead reflect differences in higher-level decision-making strategies.
Objectives: We aimed to measure the perceptual biases of children with autism and typically developing children as purely as possible, by minimising the influence of cognitive factors such as decision rules.
Methods: We used a 2-alternative-forced-choice method with a roving pedestal (Morgan, Melmoth & Solomon, 2013) to quantify internal noise and decision biases for Ebbinghaus stimuli in 20 children with autism aged 6 to 14 years and 26 typical children matched in age and non-verbal ability. Children were presented with a reference stimulus and two comparison stimuli (see Figure 1), and asked to identify which comparison stimulus had a central circle most similar in size to that of the reference stimulus. One comparison stimulus was a pedestal, which had a central circle either 5%

larger or 5% smaller than the reference stimulus. The other comparison stimulus had a central circle that was an increment larger than the pedestal. The pedestal size (+5%, -5%) was randomly interleaved throughout the task, so that children did not know which of the two comparison stimuli was the pedestal on a given trial. Children completed this task in two context conditions: once with small surrounding circles on the reference and large surrounding circles on the comparison stimuli (S-L), and once with large surrounding circles on the reference and large surrounding circles on the comparison stimuli (L-S; see Figure 1). The data were fit with a cumulative normal psychometric function using the maximum likelihood estimate technique, modelling the effect of context condition as an equivalent pedestal with no effect on internal noise. A difference score was computed between the biases in each context condition, in order to determine the extent of bias for each participant. Results: Children with autism differed from typical children neither in their levels of internal noise nor in their degree of perceptual bias.

Conclusions: Our findings suggest that children with autism are just as susceptible to the Ebbinghaus illusion as typical children when decisional and response biases are minimised. Our results are inconsistent with theories proposing reduced contextual integration in autism (e.g., Frith & Happé, 1994). Furthermore, our findings suggest that previous reports of reduced susceptibility to illusions arise from differences in response or decisional criteria. We are currently collecting data with the Muller-Lyer illusion to investigate the generalisability of this result.

124 **109.124** Do Individuals with Autism Spectrum Disorder Process Own- and Other-Race Faces Differently?

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Background: It has been well documented that individuals with autism spectrum disorders (ASD) exhibit atypical eye scanning patterns when processing human faces. For example, they display reduced attention to faces and their core features (eyes, nose, mouth), especially the eye region (e.g., Klin et al., 2002; Pelphrey et al., 2002). Most of the previous studies on atypical face processing in ASD, however, have used only faces of individuals from the same racial group as the participants. A growing literature has demonstrated a robust "other-race effect" (ORE) in typically developing (TD) individuals. That is, TD observers recognize and discriminate own-race faces more accurately than faces from other racial groups. This effect reflects the role of visual experience in shaping face recognition expertise. We investigated whether individuals with ASD scan own- and other-race faces differentially using eye tracking. Considering that there is inconsistency in the evidence regarding the existence of a behavioral ORE in ASD (Chien et al., 2014; Wilson, 2011), we investigated face scanning patterns using eye tracking, to provide a different measure of processing race information from faces.

It has been shown that both adults and infants display differential scanning of own- and other-race faces. For example, Asian observers tend to focus on the central region (i.e., the nose) of Chinese faces and the eye region of Caucasian faces (Fu et al., 2012; Liu et al., 2011).

Objectives: The present study examined whether individuals with ASD would, like typical individuals, show differential patterns of visual scanning when viewing own- and other-race faces.

Methods: The study included 15- to 25-year-old Chinese adolescents and young adults with ASD, age-matched typically developing (TD) individuals, and individuals with intellectual disability (ID). Participants completed a face recognition task with both own- (Chinese) and other-race (Caucasian) faces, while their eye movements were tracked. We analyzed fixation durations within each area of interest (AOI) and compared them between groups and races.

Results: Results, as shown in Figure 1, indicated that (a) in terms of recognition, the ASD and ID groups, although not the TD group (due to a ceiling effect), displayed superior recognition of own-race faces relative to other-race faces; (b) different from TD individuals and individuals with ID, individuals with ASD showed atypical face processing patterns regardless of face race; (c) similar to TD and ID individuals, individuals with ASD scanned own- and other-race faces differentially: they fixated on the eyes of other-race faces longer than those of own-race faces, whereas they looked at the nose and mouth of own-race faces longer than those of other-race faces.

Conclusions: The results suggest that there are similar cross-race differences in the face scanning patterns of ASD and non-ASD individuals. The findings corroborate the behavioral evidence of an other-race effect in children with ASD (Wilson et al., 2011) and suggest that similar to TD individuals, individuals with ASD are sensitive to face race information: their visual scanning and recognition of faces are both influenced by asymmetrical experience with different types of faces.

125 **109.125** Does Being Bilingual Impact Executive Functions in Autism Spectrum Disorders?

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Background: Executive functions comprise skills essential for daily life. One of these is cognitive flexibility, often measured by set-shifting tasks (Eigsti, 2011). Some studies have shown enhanced executive functioning in bilinguals relative to monolinguals (e.g., Bialystok & Martin, 2004; Bialystok & Viswanathan, 2009), ascribed to the control bilinguals need to exert over the competing activation of

their two languages (Bialystok, 2007; Green, 1998). However, this so called "bilingual advantage" has not been found consistently (e.g., Engel de Abreu, 2011; Namazi & Thordardottir, 2010).

Objectives: While many studies have examined the impact of bilingualism on executive functions (EF) in typically-developing children, few have investigated this relationship in a neurodevelopmental disorder with known EF impairments. If a bilingual advantage exists, it might mitigate executive dysfunction in such a case. Individuals with Autism Spectrum Disorders (ASD) demonstrate EF impairments, specifically, children with ASD tend to exhibit perseverative responses on set-shifting tasks (e.g., Ozonoff et al., 2004). Conversely, children with ASD show spared skills in other cognitive domains such as verbal short-term memory (e.g., Boucher et al., 2012; Zinke et al., 2010). We examine the impact of bilingualism on set-shifting abilities in ASD. We hypothesized that bilingual children with ASD would be impaired in set-shifting relative to bilingual typically-developing (TYP) children, but would be less impaired than monolinguals with ASD (biTYP> biASD> monoASD). As a control we hypothesized that short-term memory would not differ between groups.

Methods: Bilingual TYP, bilingual ASD, and monolingual ASD groups were matched on nonverbal IQ, chronological age, gender and socioeconomic status. The target sample includes 20 biTYP, 15 biASD, and 15 monoASD 5- to 9-year-olds. Participants include French, Spanish or English speakers (or speakers of any 2 of these languages). To evaluate set-shifting skills we used a computerized version of the Dimensional Change Card Sort task (DCCS; Zelazo, 2006), where the dependent variable is passing 5 of 6 post-switch trials. In addition, we obtained a parental report of executive function behaviors in daily life via the Behavior Rating Inventory of Executive Functioning (BRIEF; Gioia et al., 1996). Short-term memory was assessed by the number repetition subtest of the Clinical Evaluation of Language Fundamentals (CELF-4; Semel et al., 2003).

Results: Preliminary data is available from 10 biTYP, 6 biASD, and 12 monoASD children. Findings generally pattern in line with our predictions. On the DCCS bilingual children with ASD perform better than their monolingual counterparts, and in fact better than TYP bilinguals (percent of children passing the DCCS post-switch phase: biTYP= 60%; biASD= 83%; monoASD = 50%). Parent ratings on the BRIEF set-shift subscale also follow predictions (lower scores = higher functioning: biTYP M = 45; biASD M = 62; monoASD M = 64). In contrast, short-term memory was not significantly different across groups (number repetition standard score biTYP M = 10.1; biASD M = 9.3; monoASD M= 7.7).

Conclusions: Data collection is ongoing and will allow us to investigate in a larger sample if the set-shifting difficulty experienced by monolinguals with ASD is significantly reduced in bilinguals with ASD.

126   **109.126** Downcast Gaze and Hypersensitivity to Direct Gaze in Young Children with ASD

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Background:
The use of eccentric viewing has been found to be common in ASD and it is likely to allow the filtering of details during visual exploration (Mottron et al., 2007; Noris et al., 2012). Specifically, a subset of eccentric glances (EG), downcast gazes (DG), is believed to occur in order to reduce sensory overload (Bogdashina, 2003; Simmons et al., 2009). In Noris et al. (2012) children with ASD during a social interaction were more likely to look downwards compared to matched TD children. These findings left open the question whether DG) are linked to the hypersensitivity to high-frequency visual information or they result from a hypersensitivity to social stimuli. Indeed some individuals with ASD are likely to show gaze aversion (Tottenham et al., 2013; Dalton et al., 2005) and atypical face scanning (Chawarska & Shic, 2009).

Objectives:
Our study involving a sample of young children with ASD investigated whether the patterns of attention to pictures of human faces with direct gaze, recorded by means of an eye-tracker, vary in relation to the frequency of EG during a social interaction episode with an experimenter.

Methods:
22 preschoolers with ASD mean age 4.8 years (3.7 to 6.4 years, SD= 10 months), mean non verbal IQ 111 (Leiter-VR range 90-133, SD = 13.5) were included in the study. Subjects were diagnosed by expert clinicians according to DSM-IV criteria for ASD and standardized diagnostic instruments (ADOS and ADI-R).

The children were shown a series of 6 images of neutral faces with direct gaze. Each image lasted 5 seconds on the screen of the eye-tracker Tobii T60, frequency and duration of fixations on eyes, mouth and the whole face were recorded and computed as a ratio to gaze-time on screen. Participants were video-recorded during an interaction with an adult administering selected items from the ESCS (Mundy et al., 2003). Mean frequency of EG per minute was coded from the videos and the median of this measure was used to divide the sample in two groups: low frequency (n=11, group LFreq), high frequency (n=11, group HFreq).

Results:
Children in the HFreq group produced a significantly higher mean frequency of DG during the ESCS interaction (HFreq=3.07 [SD=1.33]; LFreq=1.63 [SD=1.08]; t=2.765, df=20, p=0.012). Independent sample T tests revealed that children in the HFreq group showed significantly reduced attention to the eyes area of the pictures, in terms of frequency (HFreq=0.43 [SD=0.15]; LFreq=0.60 [SD=1.12]; t=2.975, df=20, p=0.007) and duration (HFreq=0.48 [SD=0.21]; LFreq=0.68 [SD=1.15]; t=2.539,

df=20, p=0.02) of fixations, while no significant difference resulted for the mouth area, or for the whole face in itself.
Conclusions:
Our results seem to suggest a relationship between DG and hypersensitivity to direct gaze. Children with ASD might look downwards in order to regulate excessive arousal caused by the direct eye gaze of a social partner.

127 **109.127** Evaluating Gender Differences in Perceptual Profiles of Individuals with Autism Spectrum Disorder

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Background: Concurrent demonstrations of superior performance on visuo-cognitive, non-social tasks (i.e., Block Design Task (BDT); Shah & Frith, 1993), and decreased performance on some social tasks (i.e., face identification and discrimination; Dawson et al., 2005) are considered as defining perceptual characteristics of Autism Spectrum Disorders (ASD). These dichotomous performances can, at least in part, be explained by a local processing bias in ASD. However, since ASD's sex ratio is as high as 16 males to 1 female for high-functioning individuals (Rivet & Matson, 2011), a strong argument can therefore be made that the central tenets of perceptual theories based on the aforementioned findings in ASD are based largely on male abilities.
Objectives: Assess whether ASD-specific perceptual profiles based on non-social and social task performance are equivalent in both males and females with ASD.
Methods: Participants. Ten females and 10 males with ASD were recruited and matched on age and Full-scale Wechsler IQ. All participants completed the same two tasks. Task 1. A non-social, computerized reversed BDT: a target block design (matrix size of 4, 9, or 16) was presented centrally on a touch-sensitive screen, with four possible probes (one matching the target) presented simultaneously around it. The perceptual coherence of the block designs was also manipulated by varying the number of 'adjacencies' of opposite-coloured edges; low-coherence (LC) designs necessitating increased local analysis to be resolved (block-by-block-processing) relative to high-coherence (HC) designs. Task 2.A social, face identity discrimination task (FID): a target face image was presented centrally, with four possible probes (one matching the target) presented simultaneously around it in same view (biasing local analysis) or viewchange (biasing global analysis) orientations. For both tasks, participants were asked to choose the probe matching the target as quickly and accurately as possible. Reaction time (RT) was measured as dependent variable for both tasks. A control, motor task was included to ensure that participants had similar motor reactivity.
Results: No gender differences were found on control motor task across conditions. Task 1: A significant main effect of Condition was found ($p < .001$), with mean RTs significantly shorter for LC trials. No significant main effect of Gender ($p = .689$), nor a Gender x Condition interaction was found ($p = .397$). Task 2: A significant main effect of Condition was found ($p < .001$), with RTs for same view trials significantly shorter than for viewchange trials. No significant Gender x Condition ($p = .454$) nor main effect of Gender was found ($p = .520$.)
Conclusions: Although non-significant, females with ASD tended to respond faster than males on the more global, view-change condition of the FID task. Although previous studies have suggested gender differences for traditional BDT performance (Koyama et al., 2009) for individuals with ASD, and correlations between autistic traits and impairment in face identity in males (but not in females) (Rhodes et al., 2013), the results of this study, at this point, suggest that perceptual profiles based on social and non-social task performance are equivalent in both males and females with ASD.

128 **109.128** Examining Attentional Bias for Facial Features Across Development and in Autism

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Background: Critical behavioral and biological markers of a disorder that are present early in development may be transient or may be later masked by disease progression. Thus, one challenge for researchers investigating neurodevelopmental disorders is to design tasks that can be used across broad age ranges and developmental levels so as to identify and track these markers throughout development.
Objectives: We designed and evaluated performance in a task that provides an index of attentional bias in individuals from infancy through adulthood. Specifically, we designed a paired visual comparison (PVC) version of the "bubbles" face processing task (Gosselin & Schyns, 2001;

Humphreys et al., 2006).

Methods: The final sample included 24 school-aged children (n=12 typically developing (TYP); n=12 with autism according to CBE, ADOS, and ADI-R) and 13 typically developing infants between 6 and 14 months-of-age. Stimuli were modified "bubbles" stimuli based on Gosselin and Schyns (2001). Bubbles presented on either side of fixation revealed one of three facial areas: Eyes, Mouth, or Other Facial Parts (OFPs) such as forehead, cheek, or nose. These Areas Of Interest (AOIs) were viewed in three possible pairings: Eyes vs. Mouth, Eyes vs. OFPs, and Mouth vs. OFPs. Stimuli were presented in Tobii Studio and gaze was recorded with a Tobii X120. We computed three measures of gaze for each AOI: 1) Number of trials the AOI is fixated first, as a proportion of valid trials, 2) Time to fixate the AOI, and 3) Time spent on AOI, as a proportion of time spent on screen.

Results: There were few overall differences between TYP children and children with autism: TYP children spent a larger proportion of time on the AOIs ($p=0.015$) and were faster to reach the AOIs than children with autism ($p=0.012$). No Group x Part interactions were observed, indicating that both groups showed similar attentional biases. Overall, the children fixed the Eyes first more often than the Mouth and OFPs (ps<0.001). They also arrived at the Eyes faster than the Mouth ($p=0.012$) and OFPs ($p=0.001$). They spent an equal proportion of time on the Eyes and Mouth, but a greater proportion of time on these areas than the OFPs (ps<0.001).

Like the school-age children, the infants fixated the Eyes first more often than the Mouth and OFPs (ps<0.001). They spent a greater proportion of their looking time on the Eyes than the Mouth and OFPs (ps<0.001), and Mouth compared to OFPs ($p=0.006$). There was no significant difference between time to fixate Eyes, Mouth, or OFPs.

Conclusions: School-age children with and without autism, and infants, show similar viewing patterns on this paired visual comparison version of the "bubbles" task. All the groups show a bias toward eyes in terms of what they fixate first, how quickly they arrive there, and proportion of viewing time, but a bias for mouths over other face parts was less clear. This task appears to be useful for measuring attentional bias to facial features across a wide range of ages and developmental abilities.

129 **109.129** Exploring the Clinical and Cognitive Phenotype of Child Savants with ASD

ABSTRACT WITHDRAWN

Background: Whilst savant syndrome has traditionally been associated with intellectual disability and the negative symptoms characterizing autism spectrum disorder (ASD), recent empirical studies suggest there is very little evidence for such association.

Objectives: To isolate clinical features and cognitive abilities that distinguish savant and non-savant children with ASD. Specifically, we tested two hypotheses: (i) are unique talents in ASD explained by the degree of symptoms' severity in the disorder, or (ii) can they be explained by a specific profile of cognitive strengths and weaknesses?

Methods: We tested a group of children with ASD displaying talents in the domains of mathematics, music and art, on a range of diagnostic tests and standardized measures of intellectual ability. Test profiles were then compared with those of a group of age-and IQ-matched non-savant children with ASD.

Results: The results from our study showed that talents in ASD are positively associated with highly focused attention, superior fluid intelligence, and superior working memory. Although savants and non-savant groups did not differ on measures of social/communication deficits or on measures of obsession, savants were less impaired on measures of imagination/creativity and sensory processing than non-savants.

Conclusions: Our results highlight and characterize cognitive strengths in talented individuals with ASD, prompting us to consider interactions between these strengths and the clinical characteristics of ASD in understanding savant syndrome.

130 **109.130** Exploring the Driving Behavior of Young Novice Drivers with an Autism Spectrum Disorder: A Driver Instructor Questionnaire

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Background:
Driving allows autonomy and permits maintenance of social- and work-related contacts. Nevertheless, adolescents and young adults with an autism spectrum disorder (ASD) depend to a great extent on friends and family for their transportation needs. Although little research exists of driving ability in young novice drivers with ASD, Cox et al. (2012) surveyed parents/caregivers of adolescents and young adults, attempting, or previously attempting, to learn to drive. In comparison to relatively easier driving tasks (e.g., maintaining lane position), complex driving skills, such as merging into traffic or multi-tasking, were reported as being problematic for young novice drivers with ASD. Other reported difficulties were: interpreting the behavior of other road users, dealing with unexpected situations, and sustaining attention.

Objectives:
This study, which is part of the ongoing Yes I Drive project, extends on Cox et al. (2012) by surveying driver instructors. Driver instructors are important sources of information and might be complementary to the opinion of parents/caregivers, by more objectively reflecting the teaching process.
Methods:
A web-based link of the survey was sent to Flemish driving schools in Belgium. Several questions queried the driver instructors' advice for teaching young novice drivers with ASD how to drive, and for improving the current driving education methods to better fit the needs of young novice drivers with ASD. Furthermore, respondents were asked to indicate whether specific characteristics, often associated with ASD, have an impact on the driving ability (e.g., 'difficulties with motor planning', 'difficulties with emotional self-regulation'). Data collection is still in progress.
Results:
Preliminary results: A total of 52 driver instructors (40 males) acknowledged potential problems for teaching adolescents and young adults with ASD to drive. ASD related characteristics rated to have the highest impact on driving were 'Difficulty with concentration/attention', 'Difficulty with emotional self-regulation' and 'Difficulty with unexpected routine changes'. The least problematic (i.e., although still rated above average) ASD characteristics were 'Difficulty with motor planning' and 'Difficulty with sensory overstimulation'. Results however also showed that the relation between ASD and driving performance might not always be negative and can even be positive (e.g., a focus on details might be an asset). Advice for teaching young novice drivers with ASD to drive mainly focused on a need for structure, clarity, visual demonstration, practice and repetition. The reported diversity of young novice drivers with ASD, requiring an individualized teaching strategy, supports the current classification of autism as a "spectrum" disorder with ASD related symptoms and behaviors varying from person to person. In conclusion, and similar to Cox et al. (2012), the current results indicate that learning to drive presents a substantial challenge for young novice drivers with ASD. Confirmation based on opinions from the population of young novice drivers with ASD however is still lacking.
Conclusions:
Final results will be presented at the congress.

131 **109.131** Exploring the Role of Verbal Mediation in Executive Functioning in Children with Autism

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Background: Children with autism spectrum disorder (ASD) exhibit deficits in executive function (EF; Bennetto et al. 1993), including planning abilities (Hill, 2004). However, it is unclear what accounts for these deficits. One hypothesis is that language use influences EF (Zelazo et al., 1997). In typical development, EF performance is facilitated by verbal mediation (Diamond et al., 2002) and disrupted by articulatory suppression (Lidstone et al., 2010). In the autism literature, however, the link between EF and language is inconclusive (Joseph et al., 2005; Russell-Smith et al., 2014; Williams et al., 2012).
Objectives: The present study aimed: (1) to examine the role of verbal mediation in a complex EF task, the Tower of London, by comparing performance of typically developing (TD) children and children with ASD, and (2) to examine whether performance disruptions arise from suppression of verbal mediation or imposition of general dual-task demands.
Methods: Fourteen TD children and 14 children with ASD were matched on age and non-verbal IQ. The TD group had significantly better language skills than the ASD group (see Table 1). Children were administered a computerized Tower of London task under three conditions: no secondary task (NST), motor suppression task (MST), and articulatory suppression task (AST). Participants moved beads to match the model shown on the screen and were instructed to plan their moves prior to moving the first bead. Total number of moves, time to first move (planning time), and time to complete the trial after the first move (execution time) were recorded for each trial.
Results: ANOVAs (2x3) were conducted separately for each dependent variable with group (TD vs. ASD) as the between-groups variable and condition (NST vs. MST vs. AST) as the within-group variable. A main effect of condition was observed for total number of moves ($p=0.004$) and execution time ($p<0.01$), where MST and AST required significantly more moves and execution time than NST (all $p<0.05$). However, MST and AST did not differ significantly (ps>0.05), and groups did not differ significantly. For planning time, analyses revealed a main effect of condition ($p=0.04$), where MST took the longest time, and AST took the least ($p=0.03$), and a main effect of group ($p=0.04$) where children with ASD took significantly less time to plan than TD. There were no significant interaction effects.
Conclusions: The results revealed that the ASD group was impacted by verbal suppression in a planning task, similar to the TD children. This is contrary to previous work that suggested articulatory suppression does not impede EF performance in ASD (Russell-Smith et al., 2014) due to lack of verbal mediation. However, findings also indicated both groups of children were similarly disrupted by articulatory and motor suppression, suggesting that EF disruption in an articulatory suppression task is due to general dual-task processing demands, rather than verbal mediation. Although children with ASD took significantly less time to plan than the TD children, these cognitively-matched groups performed similarly in total number of moves and execution time.

132   **109.132** Extending the Characterization of Semantics in ASD to Non-Verbal Domains

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Background: Recent research on semantic memory – using semantic dementia, the prototypical neurologic semantic disorder, as a model – has demonstrated an amodal global semantic knowledge system that underlies both verbal (i.e., language-based) and non-verbal semantic challenges seen in this disorder. In autism spectrum disorders (ASD), verbal semantic impairments are well-recognized and common. However, the characterization of semantics in ASD has been almost exclusively limited to verbal semantics; non-verbal semantic knowledge has yet to be examined in depth.
Objectives:
(1) To characterize verbal and non-verbal semantic knowledge of 7–15-year-olds with ASD vs matched typically-developing controls (TYP).
(2) To examine the relationship between verbal and non-verbal semantic deficits in 7–15-year-olds with ASD.
Methods: Participants with ASD, functional language, and PIQ≥85 as well as age- and PIQ-matched TYP participants underwent IQ testing (WASI-II) and a computer-adapted semantic battery to assess semantic knowledge across various modalities. Response accuracy (percent incorrect) and mean response latency (for correct responses) were collected on two sets comprised of corresponding verbal and non-verbal tasks that use the same semantic stimuli: (1) Naming (of a pictured object; *Nam,* verbal), Comprehension (matching word to picture; *Comp,* verbal), and Semantic Association (matching related pictures; *SemA,* nonverbal); and (2) Word-Picture (*WP,* verbal) and Sound-Picture (*SP,* non-verbal) Matching tasks. Accuracy and (item-wise) response latency differential scores were defined for corresponding nonverbal versus verbal tasks. Two-sample *t*-tests were used to assess between-group differences in accuracy and response latencies. Differential scores were compared within and between groups with one- and two-sample *t*-tests, respectively.
Results: ASD participants (n=19) displayed lower accuracy (higher percentage of incorrect responses) than TYP participants (n=20) on all verbal tasks (*Nam* p=0.02; *Comp* p=0.04; *WP* p= 0.005) and one non-verbal task (*SemA* p=0.02), but performed no differently from TYP participants on the other non-verbal task (*SP* p=0.3). Latencies for correct responses did not differ between ASD and TYP on any verbal or non-verbal tasks (p≥0.3). Comparing accuracy on non-verbal versus corresponding verbal tasks, ASD participants exhibited the same pattern as TYP of greater accuracy on *SemA* than *Nam*, similar accuracy on *SemA* and *Comp*, and less accuracy on *SP* than *WP*. Both groups exhibited longer latencies on *SemA* than *Comp* (both p<0.001), but only TYP exhibited significantly longer latencies on *SP* than *WP*(p<0.001 vs. ASD p=0.06). No significant differences between groups were found for differential accuracy or response latencies on non-verbal versus verbal tasks.
Conclusions: As anticipated, ASD participants exhibited lower accuracy on verbal semantic tasks than TYP participants. ASD participants also demonstrated impairments on a non-verbal picture matching task, but not a non-verbal auditory-picture matching task. This profile suggests an intact underlying global semantic knowledge system in ASD, with differential impairments in various verbal and non-verbal semantic tasks resulting from modality-specific abnormalities (e.g., language) in the semantic network. Future multivariable regression analysis will investigate semantic task performance differences adjusting for age, PIQ, and standardized verbal semantic tasks to yield a better understanding of the relationship between verbal and non-verbal semantic task impairments and deficits in different non-verbal semantic domains.

133   **109.133** Familiarity and Affect in Adolescents with Autism Spectrum Disorder

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Background: In typically developing (TD) individuals, increased familiarity with stimuli generally results in greater affinity toward them. This phenomenon, called the mere repeated exposure (MRE) effect, is robust and pervasive. It has also been found to influence real-world behaviours; specifically, individuals are more likely to approach and less likely to avoid stimuli that have become familiar through MRE. We hypothesized that an abnormal MRE effect would be observed in Autism Spectrum Disorder (ASD) for several reasons, including evidence of: 1) a preference for the familiar in those with ASD, 2) slowed stimulus habituation in individuals with ASD, and 3) atypicalities in the neural reward circuitry of those with ASD, relative to TD comparison participants.
Objectives: The main goal of the current project was to test the hypothesis that the MRE effect would be atypical in individuals with ASD. We also sought to examine the influence of stimulus type (i.e., social vs. non-social) on the MRE effect, as well as the association between the MRE effect and several individual difference variables (i.e., anxiety, intolerance of uncertainty, and restricted and repetitive behaviours).
Methods: We administered a standard MRE task to 28 12- to 17-year-olds with ASD and 28 age, sex,

and IQ-matched TD comparison participants, all with estimated IQs of at least 80. In an exposure phase, participants were shown a series of unfamiliar neutral visual stimuli drawn from three categories at a range of exposure frequencies. In a subsequent rating phase, they were asked to assign liking ratings to both previously-exposed and novel stimuli. Several characterization measures (the Screen for Child Anxiety Related Emotional Disorders, the Intolerance of Uncertainty Scale for Children, and the Repetitive Behaviour Scale - Revised Edition) were also administered.

Results: A 2 (Diagnostic Group) x 3 (Stimulus Category) x 4 (Exposure Frequency) repeated measures ANOVA revealed a Diagnostic Group x Exposure Frequency interaction [$F(3, 52) = 3.07$, $p = .04$; $\eta_p^2 = .15$]. Specifically, while TD adolescents displayed a MRE effect, the liking ratings of participants with ASD did not increase across stimulus presentations, even at the highest exposure frequency. The pattern of liking ratings across exposure frequencies was similar across stimulus categories for both the TD and ASD groups. Few relationships between MRE findings and individual difference variables were observed.

Conclusions: The results of the current study suggest that the relationship between familiarity and affect is disrupted in adolescents with ASD. That is, we observed that TD participants demonstrated rising and then falling liking ratings across a range of stimulus exposure frequencies (i.e., the expected MRE effect), but youth with ASD did not. This pattern of results was similar across three categories of visual stimuli. Additional research will be required in order to clarify whether our findings reflect the protraction or absence of the MRE effect in ASD. These findings provide important insight into one of the processes that may contribute to familiarity preference and novelty aversion in ASD (i.e., a disrupted MRE effect).

134 **109.134** Habituation Speed and Novelty Preference to Faces in Preschoolers with ASD

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Background:
Impairments in face processing and recognition may be apparent in the early development of ASD, with toddlers aged 18 to 30 months with severe symptoms of ASD needing more time to habituate to faces than comparison groups (Webb, Jones et al. , 2010). Differentiation of familiar vs. unfamiliar faces is also delayed in ASD at this age, with the delay related to the degree of social adaptive delay (Webb et al., 2011).

Objectives:
To assess the influence of facial familiarity on behavioral measures of face processing and memory impairment in preschoolers aged 24 to 48 months with ASD symptoms.

Methods:
Two groups were tested: preschool aged children with ASD (N=61) and preschool aged children with typical development (N=61). In addition to diagnostic and developmental testing, each child took part in four habituation experiments, in a two stimulus (Face, Object) by two stimulus set (Set A, Set B) design across 2 visits. Children viewed a picture of a face or a toy until they met a habituation criterion; after a delay, children viewed the familiar picture and a novel picture. Variables included time to habituate, number of looks during habituation, and novelty preference. Faces were rated for similarity to the mother's face. As two different face sets were used (A / B), we compared habituation variables when the face set was similar vs. dissimilar to mother's face.

Results:
Total time, mean look, first look and total number of looks for habituation to faces was similar in both the ASD and TYP groups (Fs<.49, ps>.4). The look to the novel face was shorter for the ASD than TYP group (F=3.8, p=.05) although both groups (F=.385, p=.53) demonstrated a novelty preference (ts>27, ps< .01). There was no difference between habituation variables and Visit Order (F<1.9, ps>.17) nor Face Set (Fs<.13, ps>.26). Preliminary modeling of familiarity (based on hair style/color match) suggests that match to mom's face may influence total time to habituation and length of first look differentialy in the ASD group vs TYP group (Group x Similarity interaction: Fs<2.9, ps<.09) in our set of faces that had long hair (Set A).

Conclusions:
Habitation patterns may provide important information about early attention skills in children with ASD. We have suggest that attention, particularly social attention, is critical in supporting more complex social learning. Thus, altered learning about faces may be an important target of early interventions. Our preliminary analyses suggest that the overall pattern of attention to faces is normative between 2 and 4 years of age but that attention to the novel face after habituation and the influence of facial similiarity/familiarity may alter attention patterns by group.

135 **109.135** Hazard Perception Abilities of Young Novice Drivers with an Autism Spectrum Disorder: A Driving Simulator Study

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Background:
Driving is a complicated, goal-directed task. Some ASD characteristics, for instance difficulties with executive functioning and interpreting the behavior of others, might interfere negatively with driving. Although little research exists on the relation between ASD and driving, Sheppard et al. (2010) investigated hazard perception in adult males with ASD. Hazard perception refers to the ability to recognize and respond to hazards that (might) develop on the road (e.g., when a school bus stops children may cross the road from behind the bus). The results indicated slower overall response times to road hazards, and increasingly slower response times to social (e.g., a pedestrian) versus non-social hazards (e.g., a vehicle). Hazard perception was studied through the evaluation of video material. Although dynamic, this does not equal the act of driving, and it is not clear therefore to what degree these results generalize to the driving task. Furthermore, Sheppard et al. (2010) only included non-drivers with ASD. Hazard perception however improves greatly with increased driving experience and is therefore especially problematic for young novice drivers.
Objectives:
Our study, which is part of the ongoing Yes I Drive project, aims to investigate hazard perception, and the underlying mechanisms (i.e., executive functioning and action observation), in young novice drivers diagnosed with ASD, using a driving simulator, an eye tracker, and computer tasks (e.g., a computerized stop signal task assesses response inhibition).
Methods:
Driving abilities of 50 young novice drivers with ASD (i.e., aged 17-25, maximum 2 years of driving experience) will be compared to a matched control group of healthy young novice drivers. The research consists of two segments: 1) A driving simulator scenario; 2) A computer task battery. The driving scenario contains several driving environments in which the driver encounters 24 road hazards (i.e., social and non-social). Standard driving measures will be collected throughout the drive (e.g., speed). Eye tracking measures (e.g., time of first fixation) will be calculated to assess hazard perception. Finally, computer tasks will measure: attention, response inhibition, working memory, and action observation.
Results:
Data collection is still in progress at the moment, and data analyses are planned for spring 2015.
Conclusions:
Results will be presented at the congress.

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136   **109.136** How Genetically Induced Enhanced Synaptic Plasticity and Regional Cortical Rededications Account for Autistic Superior Performances: The Trigger-Threshold-Target-Neglect Model for Autism

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Background: Autism is characterized by enhanced synaptic as well as enhanced regional plasticity. This phenomenon seem to be the result of genetic mutations involved in the disorder which mostly up-regulate early synaptic development. This cascade of genetic as well as biological events seem to account for the pattern of enhanced regional activity in visual associative cortex that systematically occurs during perceptual processing tasks in individuals with autism. Yet, not all individuals with autism present enhanced perceptual functioning, and there is tremendous heterogeneity across the spectrum. This leads to examine the hypothesis of a causal link between increased synaptic and regional plasticity, and the effect of variability in perceptual activity on different subgroups within the autism spectrum.
Objectives: We here aim at investigating how enhanced synaptic and regional plasticity are responsible for opposite patterns of cognitive enhancements across subgroups within the autism spectrum.
Methods: We use two complimentary theoretical accounts of functional plasticity in autism: (i) *microstructural plasticity* wherein synaptic plasticity is the byproduct of the genetic mutations involved in autism, and (ii) *regional plasticity* wherein differences in functional and structural patterns of brain activity and grey matter integrity trigger heterogeneity in brain activity during perceptual tasks. Specifically, the latter account examines the overlap between regions of structural differences between autistic and control individuals, enhanced activation during visual and auditory perceptual processing, and regions identified as extremely plastic in rededicating functions within the context of cross modal plasticity models following congenital sensory impairment.
Results: (i) the main cognitive domains enhanced in autism are sub-served by the most plastic cortical brain region, the multimodal associative cortex; (ii) autistic cognitive enhancements and cortical rededications are overlapping with those involved in cross modal plasticity following sensory impairment; (iii) autism is associated with enhanced topographical variability of task-related activation in perceptual and motor associative regions, suggesting enhanced regional plasticity in functional allocation; (iv) regions of enhanced activity during perceptual auditory tasks differ in autistics individuals with and without speech onset delay.

Conclusions: According to the Trigger-Threshold-Target-Neglect (TTTN) model, autism is the result of a plastic reaction triggered by heterogeneous alterations, largely genetic in nature. These genetic mutations are responsible for setting a lower threshold of brain reorganization targeting ''sensitive'' cerebral territories. Within this account, the plastic reaction would be the only consequence of the genetic alteration in non-syndromic (or primary) autism, whereas syndromic (or secondary) autism would occur when the mutation alters typical plasticity mechanisms, resulting in intellectual disability and dysmorphism. Differences in the regional target (perceptual vs. linguistic) of brain reorganization might account for the widespread heterogeneity characterizing the autistic spectrum phenotype. As a result, functions that are not targeted within and by this reorganization would be responsible for autistic deficits or lack of expertise. The TTTN model accounts for pairs of specific strengths and deficits in the phenotype of autism, such as the coupling between speech delay and perceptual strengths in classical autism, as well as the coupling between precocious speech strengths and motor clumsiness in Asperger syndrome.

137   **109.137**   Individual Cognitive Strengths and Weaknesses in Autism Spectrum Disorders: Diversity Is the Rule

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Background: The extant cognitive literature reveals little about whether individuals with ASD have a consistent cognitive profile and, if so, what it is. Logically, a range of possibilities exists, from a situation where all people with ASD have a similar pattern of cognitive strengths and difficulties to perfect heterogeneity, with no consistent cognitive profiles. Yet the comparison of group averages does not, and cannot, reveal evidence for or against these alternate hypotheses. Claims that people with ASD in general have stronger non-verbal than verbal skills have not been adequately tested in 'high-functioning' samples. We aimed to use a multiple single case study approach to investigate the nature and range of cognitive diversity within individuals with ASD, most of whom had normal-range intelligence.

Objectives: Our objective was to seek evidence for one or more characteristic ASD profiles based on standard cognitive tests, which could serve as means to supporting diagnosis and as a step towards the elucidation of ASD biomarkers. The discovery of sub-groups defined by their cognitive profile would have profound implications for understanding distinct etiologies, treatment needs and prognoses.

Methods: Participants comprised 104 children (81% male; mean age = 11.4 years, SD=2.96, range = 6.2 to 16.9), diagnosed with ASD by a team of expert clinicians on the basis of ADI-R and ADOS scores. IQ was measured using the Wechsler Intelligence Scale for Children – Fourth UK Edition (WISC-IV). All participants had fluent language and were in mainstream education; 82% had a full-scale IQ >70.

Results: Previous literature indicated relatively strong Picture Concepts, Similarities and Matrix Reasoning characterize a 'typical' WISC-IV profile, in combination with relatively weak Comprehension and Symbol Search. We searched for children with this profile, defined according to Flanagan-Kaufman criteria (a standardized measure of discrepancy within WISC profiles). Just 1/104 participants had this 'typical' WISC-IV profile. Diverse patterns of relative strengths and difficulties were common. Only 14 children (13%) had neither strengths nor difficulties; 76 (73%) had both at least one strength and at least one difficulty. Greatest diversity was seen in verbal similarities, comprehension and coding (proportions with strengths and weaknesses differed at p<0.001). Block design, often cited as a relative strength in ASD, was not discriminating; 14 (13%) had a weakness and just 18 (17%) had a relative strength in this task.

Conclusions: Unevenness of WISC-IV subscale scores is the norm in children with ASD. Using cognitive profiles as potential endophenotypes for distinctive biomarkers, such as characteristic patterns of neural activity, is unlikely to be productive. A typically 'autistic' WISC-IV profile is rare even among high-functioning children. There is no consistent strength in any verbal or non-verbal subtest. Cognitive testing has no predictive value in the evaluation of ASD in diagnostic terms.

138   **109.138**   Integration of Visual and Proprioceptive Perception of Movement Kinematics in Children with and without Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) often exhibit deficits in sensory information processing, yet the nature and consequence of these deficits is unclear. An important goal of sensory information processing is the integration of information from multiple sensory modalities for perception of body and limb movements in space. Vision and proprioception are usually the two most informative modalities serving this purpose. According to current models of sensorimotor integration, if uncertainty increases in one modality (e.g. vision), the contribution of the other (proprioception) should increase.

Objectives: We used robotic technology and psychometric modeling to test the hypotheses that children with ASD exhibit deficits in multimodal sensory integration for motion perception relative to typically developing (TD) children (i.e. that children with ASD favor proprioception over vision to a

greater extent than TD controls).

Methods: Ten high-functioning children with ASD and ten TD children performed a two-interval, forced choice, hand path curvature discrimination task. Seated participants grasped the handle of a robotic device that moved in the horizontal plane and / or watched a cursor representing the hand move on the screen (Figure 1a). Task instructions were presented on the screen (Figure 1b). We characterized the ability to discriminate between hand and / or visual cursor paths (both called endpoint paths) of differing curvature (Figure 1c) and to characterize the relative importance of vision vs. proprioception in the perception of endpoint motion. Children performed the task under single-modality (visual or proprioceptive stimuli) or bimodal conditions (simultaneous visual and proprioceptive stimuli). We additionally investigated how uncertainty in the visual stimuli might influence perception by varying the width of the cursor's Gaussian spatial distribution on different trials (Figure 1d). We estimated two psychometric variables from standard cumulative Gaussian functions fitted to the task response data: the standard deviation of the underlying psychometric model (also called discrimination threshold) and the point of subjective equality (PSE). We used these variables to estimate the contributions of vision and proprioception to the perception of endpoint motion. The discrimination threshold is inversely related to the precision in which participants discriminate between curvatures.

Results: Children with ASD were more variable in their discrimination (i.e. they exhibited increased discrimination thresholds) during the bimodal condition as compared to TD children, and as compared to discrimination during the single-modality experiments (Figure 2a). By contrast, both groups of children exhibited systematic re-distribution of sensory weights such that visual dominance over proprioception decreased as the amount of visual uncertainty increased (Figure 2b).

Conclusions: We identified deficits in the precision in which children with ASD discriminate hand path curvatures when provided simultaneous visual and proprioceptive information. Contrary to our original hypothesis, we found no evidence for ASD-related deficits in the re-weighting of visual and proprioceptive information for perception of hand-path kinematics. Our findings suggest that the neural mechanisms underlying multisensory re-weighting remain intact in high-functioning children with ASD, whereas mechanisms underlying multisensory perception of movement kinematics are compromised.

139 **109.139** Intolerance of Uncertainty, but Not Anxiety, Predicts Sensory Sensitivities in Autism

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Background:
Sensory sensitivities have risen to greater prominence with their inclusion in the recent DSM-5 criteria for autism. Yet very little is known about their underlying mechanisms. Some studies have reported significant links between sensory sensitivities and another common feature of autism, anxiety, although the causal direction of this relationship is not fully understood. Alternatively, one recent theory of autism suggests that sensory sensitivities in autism might be due to fundamental differences in the way that individuals deal with an uncertain or unpredictable environment (Pellicano & Burr, 2012).

Objectives:
Here, we investigated the relationships between children's propensity to deal with uncertainty, their sensory sensitivities and anxiety levels. The objectives of this study were threefold. First, we investigated the relationship between sensory sensitivities with the construct, 'intolerance of uncertainty', a predisposition to react negatively to uncertainty on a cognitive, behavioural and emotional level (Buhr and Dugas, 2009). Second, we examined the relationship between sensory sensitivities and anxiety symptoms. Finally, we examined whether children's anxiety levels might mediate (fully or partially) the putative relationship between intolerance of uncertainty and sensory sensitivities.

Methods:
We administered questionnaires to parents of 65 children with autism aged between 6 and 14 years, including the Short Sensory Profile (McIntosh et al., 1999) to tap children's sensory sensitivities, the Intolerance of Uncertainty Scale (Rodgers et al., 2012) and the Spence Children's Anxiety Scale (Spence, 1997). Children were administered the Wechsler Abbreviated Scales of Intelligence – 2nd Edition and the ADOS-2. We used correlation and regression analyses to examine the associations between scores on these measures.

Results:
Sensory sensitivity scores showed a clear association with scores on intolerance of uncertainty ($r = .59$, $p < .001$) and anxiety ($r = .61$, $p < .001$). Intolerance of uncertainty scores were also strongly associated with anxiety scores ($r = .78$, $p < .001$). A hierarchical regression analysis in which anxiety scores were entered in the first step and intolerance of uncertainty scores were entered in the second step showed that intolerance of uncertainty made a unique contribution to the variance in children's sensory sensitivities once the effects of anxiety were accounted for (R^2 change $= .091$, *F* change $= 8.30$, $p = .006$). In the final model, intolerance of uncertainty scores significantly predicted sensory sensitivity scores ($\beta = .44$, $p = .006$) but anxiety scores did not ($\beta = .29$, $p = .070$). Individual differences in gender, age and IQ were not associated with sensory sensitivity scores.

Conclusions:
Sensory symptoms, anxiety and intolerance of uncertainty are robustly associated with each other in

children with autism. Intolerance of uncertainty has previously been shown to predict anxiety (Boulter et al., 2014). Here, we show that it also – and uniquely – predicts sensory sensitivities. The effect of anxiety on sensory sensitivities was not upheld when both anxiety and intolerance of uncertainty were entered together as predictors in the model, suggesting that intolerance of uncertainty could potentially explain the relationship between anxiety and sensory sensitivities.

140   **109.140** Isolating Visual- and Proprioception-Based Generalization of Motor Learning in Autism Spectrum Disorder

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Background: Individuals with autism spectrum disorders (ASD) show impaired acquisition of social communication skills, a defining feature of ASD; in addition, other more basic skills are also impacted. Development of new skills requires integrating information from multiple sensory modalities. This input is then used to form internal models of action that can be accessed when both performing skilled movements, as well as understanding those actions when they are performed by others. Learning skilled gestures is particularly reliant on integration of visual and proprioceptive feedback and may provide a critical developmental building block for social communication.
Objectives: We used a modified serial reaction time task (SRTT) to decompose proprioceptive and visual generalization components and examine whether the patterns of skill learning differ in ASD participants as compared to healthy controls (HC).
Methods: Data were analyzed from 18 ASD participants (16 male, 38.72±18.362 years) and 11 healthy controls (6 male, 36.36±17.42 years) while performing a modified SRTT. Visual cues appeared in one of four positions, corresponding to one of four buttons on a response pad. To isolate different motor learning components, two separate sessions of the task were used for each participant. During both sessions participants trained using the dominant right hand. A test generalization period using the left hand followed where either the visual pattern of the sequence was kept constant (with the finger pattern mirrored) or the finger (proprioceptive) sequence was kept constant (with the visual pattern mirrored). Diagnostic differences in generalization during visual- and proprioceptive-based sessions were assessed using a repeated measures two-way ANOVA on learning scores.
Results: Analysis revealed a significant effect of generalization domain on reaction time learning scores (p=0.025) with greater generalization in the visual domain as compared to the proprioceptive domain. There was no main effect of diagnosis (p=0.284). However, there was a significant interaction between generalization domain and diagnosis on learning score (p=0.003). During the visual component, healthy controls showed greater improvement than ASD participants (p=0.010). Single sample t-tests revealed that only the control group showed significant visual generalization (HC: p=0.001; ASD: p=0.799). The two groups did not significantly differ in proprioceptive generalization (p=0.483), with neither group showing any significant learning effect (HC: p=0.637; ASD: p=0.618).
Conclusions: Findings revealed significant group differences when visual feedback was required for generalization of the learned motor sequence: healthy controls showed robust visual generalization whereas ASD participants demonstrated little generalization. In contrast, no group differences were observed when proprioceptive feedback was required for generalization, with both groups showing limited generalization. The findings suggest that when learning a motor sequence, individuals with ASD tend to rely less on visual feedback than do healthy controls. Visuomotor representations underlie imitative learning and action understanding and are thereby thought to be crucial to development of social skills and social cognition. It follows that anomalous patterns of procedural learning, with a tendency to discount visual feedback, may be an important contributor in the development of the core social communication deficits that characterize ASD.

141   **109.141** Item-Memory for Words, Pictures, Abstract Shapes and Nonsense-Words in Adults with Autism Spectrum Disorder

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Background: Memory in ASD is characterised by a specific pattern of strength and difficulties (Boucher & Bowler, 2008) that include impairments in episodic memory whilst semantic memory is relatively preserved (Tulving, 2002). Memory in ASD is usually tested by asking individuals to memorise a list of words or a set of pictures of daily objects. Since ASD is associated with varying degrees of language and social-communication impairments (APA, 2013; Bennett et al., 2008), it is possible that memory difficulties in relation to such materials reflect language difficulties to some extent. This could be related to difficulties of ASD individuals to use categorical information to support their memory (Gaigg et al., 2008). Therefore it is unclear if findings generalise to non-verbal materials.
Objectives: The aim was to replicate prior findings of difficulties with episodic but not semantic memory in ASD with a larger sample. We were also interested to see if findings for words and pictures

can be generalised to non-meaningful pictorial and verbal materials. Finally, it was of interest to examine which materials would be remembered best by both groups.

Methods: Sixty-four (32 TD, 32 ASD) adults (age-range: 22-65 years) matched on intelligence, age and gender were asked to study a sequence of blocks of words, pictures, nonsense-words and abstract shapes with 10 items each. Their memory was tested after all blocks using a 'yes-no' followed by the 'Remember-Know' (RK) recognition memory procedure (Tulving, 2002). Participants were also asked to justify any R responses by describing what they remembered. After the task they were given a questionnaire enquiring about the strategy they used for remembering the materials (e.g. I looked at the item, I imagined the word as a picture in my head, I told myself a story about the item). In three follow-up tasks participants were asked to assign names to the pictures or form associations for nonsense-words and shapes to measure participants' ability of establishing meaning for the materials.

Results: Preliminary data (25 TD, 19 ASD) suggest that pictures were remembered better than all other materials by both groups. Both groups showed significantly higher R compared to K responses. In addition the TD group presented significantly higher R responses compared to the ASD group. The TD groups' recognition performance was overall better than the ASD groups' recognition. There was no difference in the quality of R responses between groups. Recognition differences between groups seem to be related to differences in strategy use and differences in establishing meaning for the materials to support memory. The TD group used more elaborate associative strategies compared to the ASD group and showed better performance in establishing meaning for the non-meaningful materials.

Conclusions: Results extend and replicate prior findings on memory in ASD. Memory difficulties in ASD might be related to difficulties to establish meaning for material to support memory and strategy use might play a role in task performance. Results will be discussed in relation to broader theories about memory functioning in ASD and speculations will be made about underlying cognitive processes.

142   **109.142** Joint Action Coordination in Children with Autism Spectrum Disorder

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Background: Impaired motor skills are seen in a large majority of children with Autism Spectrum Disorder (ASD) and are considered a possible origin of the social and communicative deficit characterizing the disorder. The different views on the origin of motor deficit in ASD range from the impairment in action planning to predictive mechanisms supporting action execution. A specific deficit in anticipating the perceptual consequences of their own and others movements may lead ASD children to experience difficulties in interpersonal interactions that include joint-actions, namely those motor interactions whereby two people coordinate their actions to achieve a change in the environment. Studying the movement during motor interaction tasks could help in elucidating the motor control mechanisms possibly altered in ASD, providing cues for novel intervention strategies.

Objectives: To analyze, in TD and ASD children, the reach-to-grasp movements in a joint-action task, and elucidate the influence of action context on movement performance and kinematics.

Methods: Five high-functioning ASD children (mean [SD] age = 94 [10.8] months) and five TD children (mean [SD] age = 92.5 [8.9] months, SD) participated in a joint-action task with the experimenter. Children were required to execute the same action - reaching and grasping little objects - in two contexts (cooperative CP vs. competitive CM). Each session was video recorded, and a magneto-inertial sensor was fixed through a support on both children and experimenter wrists. Five measures were obtained: (a) reaction time (RT); (b) movement time (MT); (c) peak acceleration (peak Acc); (d) time of peak acceleration (peak Acc Time); and (e) time at which each child started reaching as a function of the experimenter movement (ExMT%). Each variable was analyzed using RM ANOVAs to test group differences and the effect of the social context. Significance was setted at $p<0.05$.

Results: Analysis of RTs and ExMT% showed a significant interaction between group (ASD, TD) and social context (CP, CM). Both groups showed faster RTs ($p<0.001$) and lower ExMT% ($p<0.001$) in CM than in CP context. However, RTs and ExMT% in CM were respectively slower ($p = 0.04$) and higher ($p<0.001$) in ASD with respect to TD group. A main effect of social context ($p<0.001$) reflecting faster MTs in CM than CP context was found. MTs were slower in the ASD than the TD group ($p=0.005$). Analysis of Peak Acc and Peak Acc Time revealed a main effect of Group ($p<0.001$), reflecting lower and more delayed peak acceleration for the ASD than the TD group.

Conclusions: Our results support the view that motor execution is impaired in ASD. MTs, indeed, were strongly delayed, and peak acceleration was lower and more delayed compared to TD children. ASD children were partially able to modulate their movements according to the context of the action. In the competitive task, however, in which greater predictive abilities were required, their movements did not show the same differences with respect to the cooperative task as in typical children.

143   **109.143** Joint Attention and Information Processing in Higher Functioning ASD

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Background: Research indicate the experience of initiating joint attention deepen stimulus encoding to a greater extent than the experience of following the attention of others (Bayless et al. 2013; Boothby et al. 2014; Kim & Mundy, 2012). Theory also suggests that children with ASD may not display the typical pattern of cognitive benefits from the experience of joint attention (Mundy & Kim, 2010).

Objectives: The goal of this study was to test the hypothesis that the experience of initiating joint attention would have different impact on the visual stimulus encoding of higher functioning children with ASD (HFASD) than typical peers or children with other clinical conditions, such as ADHD.

Methods: Thirty-two 9 to 13 year-olds with HFASD (IQ = 105, SD = 14.9) and age and IQ matched samples of 27 children with ADHD (IQ = 101, SD = 15.1) and 23 children with typical development (TD, IQ = 112, SD = 14.1) were presented with a virtual reality paradigm developed by Kim & Mundy (2012). They studied pictures in one condition where an avatar followed their attention to the pictures (IJA analogue). In another condition children followed the gaze of the avatar to pictures on study trials (RJA analogue). The dependent measure was the number of pictures correctly recognized in conjunction with each condition corrected for rates of false positive recognition. ASD symptom presentation was confirmed with parent report on the Social Communication Questionnaire (Means = 21, 4.9, 2.3 for the ASD, ADHD, & TD groups) and the Autism Spectrum Symptom Questionnaire (Means = 18, 7.5, 1.8 respectively). ADHD symptoms were confirmed with parent report on the Conner-3.

Results: A mixed ANOVA with IQ as a covariate revealed a significant groups by condition interaction, $F (2, 82) = 6.25$, $p < .003$, $eta^2 = .13$. Children in the comparison groups displayed significantly better picture recognition in the IJA rather than RJA condition. There was no evidence of this effect in the ASD group (See Fig. 1). The ASD group displayed worse recognition memory in the IJA condition than the other two groups ($p < .01$), but there was no evidence of recognition memory differences in the RJA condition (See Fig, 1). IQ was positively correlated with IJA recognition ($r = .37$, $p < .03$) in the ASD group but RJA recognition ($r = .05$) was not. The former was significant different than the respective correlations in the ADHD ($r = -.11$) and TD samples ($r = .16$), $F (1.82) = 4.67$, $p < .03$.

Conclusions: These results are consistent with research adults but indicate that children also display information processing benefits from the experience of IJA. However, children with HFASD do not display this benefit. Joint attention disturbance may be difficult to observe in children with HFASD, but may be evident in the information processing benefits related to joint attention. Also, ASD children with higher IQs are more likely to experience IJA information processing benefits, *or* ASD children who experience these benefits are more likely to have higher IQs.

144 **109.144** Longitudinal Changes from 11 to 16 Months in Visual Attention to Dynamic Social Scene Among Infants at High and Low Genetic Risk for Autism

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Background: To understand the origins and emergence of autism symptomatology, research has investigated infants who have an older sibling with autism spectrum disorder (ASD) and are at heightened genetic risk for the disorder. Findings by the Baby Siblings Research Consortium suggest that several developmental pathways to ASD are present from 18 to 36 months of age (Chawarska et al., 2014). This study focused on early visual attention profiles that emerge from 11 to 16 months of age to further our understanding of developmental pathways that are indicative of genetic risk and/or ASD.

Objectives: The study examined developmental changes from 11 to 16 months in visual attention to a dynamic social scene among infants with (high-risk; HR) and without (low-risk; LR) an older sibling with ASD. It was expected that HR infants would demonstrate less visual attention to the upper half of the face at 16 months than 11 months of age. It was also expected that differences in visual attention would not emerge until 16 months, with HR 16-month-olds demonstrating less visual attention to the upper half of the face compared to LR 16-month-olds.

Methods: A prospective, longitudinal design was used to compare visual attention of HR infants (n=21) with LR infants (n=19) across early development (from 11 to 16 months). Eye-tracking data were collected while infants viewed a dynamic social scene of an adult speaking and showing toys. Regions of interest were drawn to quantify infants' attention to scene elements (e.g., upper/lower facial regions, objects). Infants participated at both 11 and 16 months. These infants will be assessed at 24, 36, and/or 48 months and provided an outcome designation as typical, non-typical or ASD based on assessment tools including the Autism Diagnostic Observation Schedule-Generic (Lord et al., 1999). Assessments are ongoing.

Results: Analyses indicate that when attending to the face, LR and HR infants demonstrated similar proportions of looking time to the upper half of the face at 11 months (M=.27, SD=.31; M=.26, SD=.29). However, from 11 to 16 months, HR infants displayed a decrease in the proportion of looking time to the upper half of the face (M=.06, SD=.09), whereas LR infants remained consistent between the two age points (M=.30, SD=.28). This is shown by the significant interaction (risk X age) in Figure 1 (F(1,32)=4.05, p=.05).

Conclusions: A significant interaction between risk and age was found regarding infants' distribution of attention within the face. Importantly, HR infants demonstrated a decrease in the proportion of looking time to the upper half of the face from 11 to 16 months while LR infants' attention remained stable. This suggests that a decline in visual attention to the upper half of the face may be an early developmental pathway of the broader autism phenotype or ASD. It broadly

highlights the importance of identifying visual attention profiles of HR infants across early development since deficits may emerge after the first year of life. Further analyses may elucidate the early developmental trajectories of HR infants' visual attention based on later diagnostic outcome (ASD, non-typical).

145 **109.145** Mental Rotation: A High-Level Perceptual Strength of Young ASD Children

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Background: Some individuals with autism spectrum disorder (ASD) perform more proficiently in particular low- (e.g. discrimination) and mid-level (e.g. visual search) visual tasks than may be predicted by their general cognitive performance. How these low- and mid-level visual abilities relate to performance in high-level tasks such as pattern manipulation is poorly understood.
Objectives: We sought to determine whether young ASD children of typical intelligence perform better in a pattern manipulation task, mental rotation, than typically developing children.
Methods: Mental rotation was measured with the first 10 questions of the "Rotations" part of the modified Purdue Spatial Visualization Test (PSVT:R; Guay, 1977). This test measures an individual's ability to determine by mental rotation whether three-dimensional shapes, rotated around a particular axis, are identical or different representations of the same object. All participants were recruited from public nursery schools in Kanazawacity (Japan), Kanazawa University Hospital and prefectural hospitals in Toyama (Japan). Eighteen ASD children were included (age: 83.9 months [59 – 111], mean IQ 105 [77 – 145]).They were diagnosed with childhood autism (n = 13), atypical autism (n = 4) or Asperger's syndrome (n = 1) according to the Diagnostic Interview for Social and Communication (DISCO) criteria. Cognitive skills were assessed with the Japanese adaptation of the Kaufman Assessment Battery for Children (K-ABC). Exclusion criteria were an IQ below 70 (i.e., two standard deviations below the mean), hearing loss, or an identified neurological condition other than autism. Eighteen typically developing children (TD; age: 85.9 months [54 - 122], mean IQ 103 [69 - 134]) matched in age, gender and general cognitive ability were included as controls.Written informed consent was obtained prior to enrolment in the study. The Ethics Committee of Kanazawa University Hospital approved themethods and procedures, all of which were in accordance with the Declaration of Helsinki.
Results: ASD children performed the task with a meanspeed of 11.4 s (4.9 – 18.0) whereas TD children of equivalent intelligence performed the task with a mean speed of 14.8 s (9.0 – 30.3). ASD children performed the task significantly faster than TD children (t = 2.11 P = 0.042). The number of correct responses was similar between the two groups (mean proportion of correct answers: 0.26 [0 - 0.60] in ASD children and 0.27 [0.1 – 0.7] in TD children).
Conclusions: These findings replicate and extend those of Soulières et al (2011). ASD children perform mental rotation tasks faster than may be predicted by their general cognitive performances, showing that enhanced perceptual functionning extends beyond pattern detection, to the manipulation of visual patterns.

146 **109.146** Negative Emotionality Disrupts Pattern Separation in Adults Diagnosed with Autism Spectrum Disorders

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Background: Cognitive function is frequently and broadly disrupted in autism spectrum disorder (ASD) in areas of cognitive control, attention, and memory. However, many questions of specificity remain: which cognitive functions are disrupted for which individuals in which dimensions of function. Growing evidence indicates that significant levels of anxiety in ASD may be associated with difficulties in cognitive decision making in a circuit involving amygdala, hippocampus, and medial frontal lobes.
Objectives: This study aims to discover how pattern separation memory—the ability to keep sets of similar memories distinct from each other--is affected by emotion regulation in ASD.
Methods: Participants for the memory task included 70 adults ages 17 to 36, including 25 adults diagnosed with an ASD and 45, age- and IQ-matched college student controls. There were no significant between-group differences in age or Full Scale IQ. Participants viewed digital images of everyday objects appearing one at a time. Three categories of images appeared in random order: One group of images (foils) only appeared once during the experiment. A second group of images (repeats) appeared twice throughout the study. The final group (lures) consisted of paired images that were visually and conceptually similar but not identical to previously-shown images. For each image, participants were asked to determine if the image was *new*, *old*, or *similar*. 42 participants (24 ASD and 18 Control) completed an additional battery of emotion symptom questionnaires.
Results: On the memory task, the ASD and control groups performed similarly when responding to

novel "foil" stimuli. However, when responding to "repeat" stimuli, the ASD group chose "new" and "similar" (incorrect answers) significantly more often than controls. The ASD group also chose "new" more often than controls for the "lure" stimuli. Analysis of these errors in relation to the survey data showed significant associations between the *repeat-as-new* and *lure-as-new* choices with cognitive worry, state and trait anxiety, depression, and BAS activation arousal score. The control group had no such correlations between memory scores and emotion regulation measures.

Conclusions: The ASD group's increased tendency to identify as "new" many stimuli that were either identical or very similar to ones seen before seems to indicate particular problems with memory. Some of this trouble may reflect distraction due to emotion regulation difficulties in the ASD group. We have previously suggested that decision making in autism reflects a risk-avoidance strategy that may be in play here, in that the ASD group tries to avoid being tricked by new stimuli and thus oversamples from that choice. This unique association between negative emotionality and everyday cognitive memory skills suggests the need for further exploration of memory substrates in ASD but also for intervention tailored to a risk-avoidance style.

147 **109.147** Neural Correlates of Goal-Directed Reaching Movements in Children with Autism Spectrum Disorder

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Background:
Children with Autism Spectrum Disorder (ASD) exhibit restricted interests and repetitive behaviors that may represent aversion to environmental uncertainty and an attempt to prevent or minimize change (Gomot and Wicker, 2012). When environmental change does occur, challenging behaviors can ensue. Thus, brains with ASD appear to respond differently to environmental uncertainty than do typically developing brains.

Objectives:
We used a novel robot and functional magnetic resonance imaging (FMRI) to measure blood oxygenation-dependent (BOLD) signals related to fast, goal-directed wrist movements (reaches) made against predictable and unpredictable robotic loads. We compared movement kinematics and BOLD signal changes produced by high-functioning children with ASD and by typically developing (TD) children. We evaluated two competing hypotheses: (1) Children with ASD and TD children solve the predictable motion task using similar feedforward control strategies that recruit similar neuronal networks, but that these patterns are fragile in ASD and susceptible to disruption in the presence of environmental uncertainty; (2) children with ASD and TD children solve the sensorimotor task using neural control strategies that differ in recruitment of feedforward and feedback mechanisms.

Methods:
Nine high-functioning children with ASD and eleven TD children reclined in a magnetic resonance imaging (MRI) scanner and held the handle of a plastic robot. They made 250 wrist flexion movements (one per trial) against spring-like loads that either remained constant (trials 1-50) or varied unpredictably across trials (trials 51-250). Subjects were to capture targets on a video screen using a cursor controlled via by the robot handle. We analyzed movement kinematics to obtain a model of each participant's trial-by-trial prediction of upcoming load. The technique quantifies the extent to which sensorimotor memories from past performances influence future movements. We analyzed functional MR images to compare the neural control networks recruited by the two groups of children exposed to the constant and variable loads.

Results:
Both groups used memories of prior performances to adjust aim on subsequent trials. Both groups undershot the target, although children with ASD moved ~10% less than TD children. Movement errors were more variable in ASD. We included the mean and standard deviation of movement error as co-factors in the image analysis to control for possible group-wise bias. Neuroimages from constant load trials revealed widespread BOLD signal activations in the TD group in regions previously implicated in feedforward or feedback control. By contrast, activation volume in the ASD group was ~17% of TD volume and was represented more heavily in the feedback control network; Within select feedback control regions, BOLD impulse responses were markedly larger in ASD vs. TD. For both groups, we found no difference in BOLD signal changes across load conditions.

Conclusions:
Our findings support the hypothesis that children with ASD and TD children solve the target capture task using neural control strategies that differ in their recruitment of feedforward and feedback control mechanisms. The strategy used by the children with ASD appeared to favor feedback control regardless of load condition, even though this strategy resulted in movements that were less accurate and more variable.

148 **109.148** Pitch Direction Perception Predicts the Ability to Detect Local Pitch Structure in Autism and Typical Development

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Background: Most individuals with Autism Spectrum Disorders (ASD) have atypical sensory perception, particularly in the auditory domain. Some studies have reported enhanced low-level pitch discrimination (Bonnel, 2010) and higher-level processing of local pitch structure on global-local tasks (Heaton, 2005). However, auditory perception in ASD is understudied and results are inconsistent. It is unclear how low and higher-levels of auditory perception are related in ASD or typical development (TD), nor how these skills may change with development.

Objectives: The aims of this research were to test: 1) for performance differences between children with ASD and TD controls on both low-level pitch processing (pitch direction) and higher-level pitch processing (global-local pitch) tasks, 2) the relationship between low and higher-level auditory perception, and 3) the effect of age on task performance.

Methods: Participants were 17 children with high-functioning ASD and 19 TD children who had no neurological or psychiatric history. Participants were recruited from the NeuroDevNet ASD Project (Zwaigenbaum et al, 2011) and groups were matched on age (mean age 13.3 years, range 9-18 years) and IQ (mean IQ 113.5, SD 13.6). In the low-level pitch direction task (Foster et al., 2014), participants heard two tones of different frequencies on each trial and judged whether the pitch rose or fell. In a higher-level global-local task (Ouimet et al., 2012), stimuli consisted of 9-tone melodies, each containing three triplet (3-tone) sequences. Participants discriminated between ascending and descending pitch direction at the global (across triplets) and/or local (within triplets) level. The relationship between performance (percent accuracy) on these two tasks and the effect of age was assessed using linear regression.

Results: There were no significant group differences between ASD and TD in terms of overall performance accuracy on either of the pitch tasks. Overall accuracy on the low-level pitch discrimination task predicted overall accuracy on the higher-level global-local pitch task across all participants (P<0.001), but was particularly driven by performance on local pitch judgements (P<0.001; see Figure 1). The TD and ASD groups both showed a similar positive relationship between performance profiles on the low versus high-level pitch tasks. However, a trend suggests that there is a tighter coupling between low and high-level pitch task performance in ASD versus TD. There was also a trend toward a positive main effect of age on the pitch direction task performance only (and not the global-local task) across all participants.

Conclusions: The present findings suggest that: 1) low-level pitch direction ability strongly predicts performance of higher-level global-local pitch perception in general, but most prominently for local pitch judgments in ASD compared to TD, 2) pitch direction ability improves with age similarly in TD and ASD, but global-local perception is constant, and 3) superior abilities in ASD in low and high-level pitch tasks may be specific to particular task paradigms, or subgroups within the autism spectrum. The study of auditory perception in ASD serves as a complementary lens to more symptom-based studies, to better understand individual differences and to refine ASD endophenotypes.

149 **109.149** Pitch Perception in Adults with Autism Spectrum Disorder Speaking a Tone Language

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Background:
Some individuals with Autism Spectrum Disorders (ASD) possess enhanced auditory perception ability when compared to neurotypical individuals. There is higher incidence of superior auditory processing and perfect pitch in individuals with ASD than the general population. These phenomena have been explained by theories of Weak Central Coherence and Enhanced Perceptual Functioning. Emerging evidence also showed that variations in the stimuli context (e.g., pure tone, speech, music) have differential effects on their performance in auditory perception tasks.

Cantonese Chinese is a tone-language which makes use of pitch differences to encode lexical meaning. Given the heavy functional load of pitch in the language, much evidence attested that tone-language speakers demonstrate superior ability in pitch processing tasks. It would be interesting to investigate if superior auditory perception in individuals with ASD would also be observed in population speaking tone languages.

Objectives:
To compare pitch perception performance of Cantonese-speaking adults with and without high-functioning ASD.

Methods:
Participants were all native Cantonese speakers with average intellectual functioning. They included 20 adults with ASD and 20 matched neurotypical (NT) controls. The matching parameters included gender, age, education background, and experience of formal musical training. Participants received a series of pitch discrimination tasks with auditory stimuli including monosyllabic real words, nonsense words, and non-speech analogues. The stimuli were paired according to different levels of pitch differences. Participants had to determine whether the stimuli in a pair were the same or different.

Results:
There was no significant difference between ASD and control groups in discriminating the pitch differences in all the three stimulus types. Across both groups, participants made significantly more errors in speech conditions (real word and nonsense word stimuli) than non-speech condition. Regardless of group membership, individuals with formal musical training showed better performance in detecting small differences in pairs in all three stimulus types.
Conclusions:
Cantonese-speaking individuals with ASD did not show superior pitch perception ability when compared to NT controls with real word, nonsense word, and non-speech stimuli. It may be possible that the native use of tone enhances pitch perception ability in speakers in general population, diluting the effect of enhanced performance in the ASD group. This claim may also be supported by the significant effect of musical training in both ASD and NT individuals. Future research may investigate pitch perception in Cantonese population in broader contexts, such as detecting pitch differences in speech intonation and musical melody.

150 **109.150** Playing Games with Your Eyes: An at-Home Video Gaming System for Training Attention Orienting in ASD

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Background: In addition to the social, communicative and behavioral triad of symptoms that define Autism Spectrum Disorders (ASD), individuals with ASD have difficulty re-orienting attention quickly and accurately. Similarly, fast re-orienting saccadic eye movements are also inaccurate and more variable in both endpoint and timing in individuals with ASD. The brain circuitry that guides the redirection of spatial attention is shared with the circuitry used to shift gaze. This suggests that gaze-contingent training could be a unique way to improve attention orienting skill.
Objectives: 1) Demonstrate the feasibility of using gaze-contingent video games for low cost in-home training for high functioning adolescents with ASD. 2) Demonstrate improvement of spatial attention orienting and eye movement behavior after 8 weeks of play on these gaze-contingent games in a small group of adolescents with ASD.
Methods: We designed and deployed PC-based gaze-contingent video games using the Unity game engine and an EyeTribe eye tracker (see Figure). The games were designed around training principles to train fast and accurate attention orienting behavior as well as stable fixation.   In addition, the game system was designed to be sufficiently robust for long-term at-home use. Eight adolescents with ASD participated in an 8 week training, flanked by pre- and post-testing of eye movement and attention control.
Results: Six of eight adolescents completed the 8 weeks of training and all of those six showed improvement in attention orienting, eye movement control or both. All of the game systems remained intact for the duration of training. Each participant could use the system independently.
Conclusions: We delivered a low cost and robust gaze-contingent game system for home use that, in our pilot training sample, improved the attention orienting and eye movement performance of adolescent participants in 8 weeks of training. The next steps involve a small clinical trial to assess the importance of gaze-contingency and what aspects of training, if any, transfer to real-world tasks.

151 **109.151** Privileged Role of Symbolic Number Sense in Mediating Math Abilities in Children with Autism

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Background:
Despite reports of enhanced mathematical ability in individuals with autism, little is known about basic number processing abilities in children with the disorder. In typically developing (TD) children, both *non-symbolic* (the ability to compare quantities of dots) and *symbolic* (the ability to compare Arabic numerals) number sense have been linked to individual differences in math ability. Based on known strengths in individuals with autism, including local processing bias and hyperlexia, both non-symbolic and symbolic processing could be important components of number sense that contribute to math skills in this group. Understanding basic quantity processing abilities and their relationship to math ability has the potential to inform the design of educational interventions and employment opportunities for individuals with the disorder.
Objectives:
We first investigated whether non-symbolic and symbolic number sense are spared or enhanced in children with ASD. We then investigated whether children with ASD show the same pattern of relations between number sense and math ability as their TD peers.
Methods:
We examined number sense in 36 high functioning children with ASD and 61 matched controls (aged 7-12). In separate tasks, participants identified the larger value in pairs of either Arabic numerals or arrays of dots. Number sense acuity was measured using the Weber fraction (w), which captures the

smallest ratio that an individual can reliably discriminate. We examined the relationship between *w* and math ability, as measured by participants' math composite score on the Wechsler Individual Achievement Test-II. Finally, we used a mediation model to assess the extent to which symbolic number sense mediates the relationship between non-symbolic number sense and math ability.
Results:
Children with ASD had intact symbolic estimation skills but showed significant impairments in non-symbolic (dot) estimation relative to TD children. For both groups, symbolic acuity was a stronger predictor of math performance than non-symbolic acuity, but this effect was more pronounced in children with ASD. Finally, we found that symbolic comparison ability mediated the relationship between non-symbolic comparison and math performance in children with ASD, but not in TD children.
Conclusions:
Contrary to previous suggestions of superior non-symbolic number sense in ASD, our results indicate that children with the disorder are impaired in non-symbolic estimation, and relative to their TD peers, this capacity plays a weaker role in the development of math skills in children with ASD. Intact symbolic number sense and its strong correlation with math achievement scores together suggest a privileged role for symbolic processing in the acquisition of mathematics proficiency in ASD. Building on symbolic strengths in children with ASD may facilitate acquisition of mathematical skills in a way that non-symbolic quantity information may not. Our findings further suggest that symbolic notation may be a useful tool for organizing imprecise, continuous information in children with ASD.

152 **109.152** Procedural Learning and Language Impairment: Evidence of a Deficit in Autism Spectrum Disorder with LI but Not in Specific Language Impairment

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Background: In language development procedural memory has been implicated in learning and storing regularities and rule-based information, as required for phonology and grammar (Ullman, 2001). Deficits in procedural memory have been hypothesized to explain language impairment in Autism Spectrum Disorders (ASD) as well as in Specific Language Impairment (SLI) (Ullman, 2004). The hypothesized language-linked deficit in procedural memory would be most apparent in the subgroup of ASD children with concomitant language impairment. Yet, few studies have investigated procedural memory in *language-impaired* children with ASD, and none have compared their performance to that of children with SLI on the same measure.
Objectives: To clarify whether proposed procedural memory deficits are shared across children with language impairment or if deficits are disorder-specific we compared the performance of language-impaired children with ASD and children with SLI on a visual procedural learning task.
Methods: We tested 14 language-impaired children with ASD and 14 children with SLI, matched on age (6-to 10-years-old) and NVIQ on a Serial Reaction Time task (SRT; Thomas & Nelson,2001). The SRT assesses implicit learning of a visual pattern presented on a computer screen. It involves five blocks of 40 trials: in blocks 2,3, and 5 the child sees a dog appear in one of four quadrants of the screen in a repeated 4-item sequence. In blocks 1 and 4 the dog moves randomly. The child is instructed to "catch" the dog as fast as possible by pressing a button corresponding to the quadrant of the screen where it appeared. Sequence learning is indicated by significantly faster reaction times in block 5 (sequence) in comparison to block 4 (random). This was measured by a *sequence learning* score (mean of block 4 – mean of block 5)/(mean of block 4 + mean of block 5). After the task we asked participants if they had noticed a pattern that helped them "catch the dog," providing a measure of *explicit knowledge of the sequence.*
Results: Groups showed similar ability to perform the SRT task as indicated by the number of errors in blocks 4 and 5; $U=82$, $p=.47$. However, the *sequence learning score* in the ASD group (*Mdn*=0.05) was significantly lower than in the SLI group (*M*dn=.18); $U=52.5$, $p=.04$, $r=-0.4$. Within-group comparisons showed significantly faster responding in block 4 than 5 in the SLI group; $T=0$, $p<.001$, $r=.88$, but not the ASD group; $T=30$, $p= .17$, indicating that the SLI group learned the sequence while the ASD group did not (Figure1). Finally, similar proportions of children with ASD (5 of 14) and SLI (4 of 14) showed explicit knowledge of the sequence and were able to recreate the sequence they had learned.
Conclusions: Our results demonstrate diminished sequence learning in a language-impaired ASD group but intact learning in an SLI group matched on age and NVIQ. This suggests that procedural learning deficits are not shared across forms of language impairment and that they are particulary implicated in ASD. If replicated, procedural learning could be used to differentiate SLI from ASD and be integrated in ASD treatment.

153 **109.153** Psychometric Properties of the Revised Executive Function Challenge Task (EFCT)

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Background:
Children with ASD have flexibility and planning deficits that inhibit their ability to socialize, succeed in mainstream school settings and complete every day tasks. Recent reviews of the literature reveal difficulty consistently capturing these observed executive functioning (EF) deficits with laboratory measures (Kenworthy et al., 2009; Geurts et al., 2009). We have previously described a treatment sensitive observational measure, the EFCT, which challenges children to be flexible and planful (Kenworthy, Anthony et al., 2014).

Objectives:
To investigate the internal consistency and validity of the EFTC and to explore its ability to distinguish children with autism spectrum disorder (ASD) from typically developing children (TDC).

Methods:
30 TDC (age M=10.2 years, SD=1.7; FSIQ M=115.9, SD=11.3) and 63 children with ASD (age M=9.5 years, SD=1.1; FSIQ M=108.3, SD=18.1) were evaluated with a shortened form of the EFCT, three standardized activities on which behavior is coded for flexibility and planning. Examiners achieved inter-rater agreement >90%. Parents completed the Behavior Rating Inventory of Executive Function (BRIEF).

Results:
Chronbach's alpha statistics indicate good internal consistency for the EFCT average Flexibility Scale (FS; α=0.79) and Planning Scale (PS; α=0.69) scores, and item total correlations are all in the acceptable range. Convergent validity was demonstrated between the FS and PS and the parent reported BRIEF Shift and Plan/Org scores (r's > 0.42, p's < 0.001) for the combined TDC/ASD data. The FS and PS clearly distinguished individuals with ASD from the TDC group (t's > 7.3, p's < 0.001). The larger ASD and TDC groups were not matched for age, sex or FSIQ, however. A subset of the ASD (n=20) and TDC (n=20) participants more closely matched for those variables (p's > 0.39) was investigated regarding EFCT FS and PS scores, revealing significantly greater problems in the ASD than the TDC group (t's >4.0, p's < 0.001). See Table. Discriminant function analysis indicated that the EFCT total score correctly classified 85% of the children with ASD and 90% of the TDC children.

Conclusions:
In addition to showing sensitivity to a cognitive behavioral EF treatment, the EFCT: can be coded reliably; has good internal consistency; distinguishes children with ASD, who are know to have flexibility and planning deficits, from TDCs; and is moderately correlated with parent report of flexibility and planning problems. The EFCT has the potential to capture a unique set of EF behaviors that are important in characterization and treatment research efforts.

Table: Demographic and EFCT Scores ASD and TDC Groups

	Total Sample			Matched Sample		
	ASD (N=63)	TDC (N=30)	p value	ASD (N=20)	TDC (N=20)	p value
Male	88.9%	50%	.000	70%	65%	.500
	Mean(SD)	Mean(SD)		Mean(SD)	Mean(SD)	
Age in years	9.55(1.1)	10.19(1.7)	.071	9.87(1.3)	9.66 (1.5)	.636
FSIQ	108.32(18.1)	115.87(11.1)	.016	116.10(16.7)	119.85(10.3)	.398
BRIEF Shift	70.25(12.68)	45.10(8.93)	.000	69.80(10.91)	43.75(7.69)	.000
BRIEF Plan/Org	66.35(12.71)	46.93(10.2)	.000	65.75(13.05)	45.55(9.85)	.000
EFCT Flexibility	.97(.59)	.23(.36)	.000	.82(.62)	.18(.33)	.000
EFCT Planning	1.43(.47)	.29(.37)	.000	.90(.34)	.13(.27)	.000
EFCT Composite Score	1.20(.42)	.26(.29)	.000	.86(.40)	.16(.19)	.000

154 **109.154** Reduced Anticipatory Responses during Dynamic Object Interactions in Autism

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Background: The dynamic world presents challenges to those with autism. Previous studies indicate difficulties in navigating traffic and driving (Autism Wandering and Elopement Initiative, awaare.org; Feeley, 2010). First person accounts highlight difficulties with dynamic playground games (Robison, 2006). These reports are puzzling given that moving objects are not inherently aversive to those with autism. Indeed, many individuals with autism are especially drawn to moving objects, enjoy video games (Mazurek et al., 2012), repeatedly set objects in motion, and engage in visual stimming involving motion. What then underlies autistic individuals' difficulties with dynamic objects? Several studies have shown that basic motion detection and direction perception thresholds are largely unimpaired in autism (Bertone et al., 2003; Milne et al., 2005; Mottron et al., 2006). However, interacting with dynamic objects involves a crucial step beyond detection: anticipating where the moving object will be and adjusting motor movements to intercept/avoid the object. Computational systems for dynamic object tracking rely on predictive techniques such as Kalman filtering (Welch and Bishop, 2001; Gao et al., 2005). They demonstrate that a key consequence of impaired prediction is errors in online position estimation. In daily life, these errors would render difficult seemingly straightforward tasks like catching an object or avoiding an oncoming car, even when basic motor skills are seemingly adequately developed.
Objectives: This study tested whether the difficulties that autistic individuals face in interacting with dynamic objects may arise from impairments in prediction. The task of ball-catching, combined with high speed video recording and computational analysis, were employed to reveal differences in predictive abilities with dynamic objects.
Methods: High-speed video recordings were captured of neurotypical and autistic children performing ball-catching. Throws varied systematically in distance from the participants, sometimes eliciting reaching, thereby testing participants abilities in anticipating the ball's trajectory. Three observers reviewed the videos and assigned a rating to the participant's predictive abilities. Additionally, computer vision techniques were applied to extract flow fields from each video, providing a detailed, quantifiable trajectory for both the ball and the child's hands.
Results: Initial individual data suggest that autistic participants exhibit reduced accuracy of spatio-temporal relations between the hands and ball, compared to age-matched controls. Anticipation scores for ASD participants were lower on average than those of neurotypicals. The patterns seen in a small number of detailed computer vision tracings of the hand and ball quantify increased accuracy in prediction in NT participants relative to ASD participants (Fig 1).
Conclusions: This study is consistent with impaired spatial-motor anticipation in ASD. Results mesh with a broader hypothesis of impaired prediction in autism, and may help to explain broader impairment in interactions with dynamic objects in ASD. Future experiments will investigate variations on the features of dynamic stimuli, such as speed, size, and task demands. Future work will evaluate differences in other dynamic object tasks and correlate performance with features of the autism phenotype, as well as examine specificity to autism. Results could translate into development of effective safety skills and other dynamic tasks that autistic individuals encounter in everyday life.

155   **109.155**   Self-Referential Metacognition in Adolescents with ASD Learning Mathematics

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Background:
Theory of mind has been argued to comprise of two distinct sets of processes: an understanding of one's own mental states (self-referential metacognition) and the mental states of others (other-referential mindreading). A wealth of research has focused upon deficits in the appreciation of the mental states of other people ('mindreading') in ASD, yet there is little research has explored whether this deficit extends to an appreciation of their own mental states ('metacognition'). The limited research to date suggests that children and adults with ASD can have deficits in metacognition and it has been argued that metacognition may be more impaired than mindreading in ASD. One area that metacognition has been found to be highly predictive is with respect to learning performance (more predictive than IQ). As an example, knowing we have made an error ourselves (metacognitive awareness) can be important for responding appropriately (metacognitive regulation) to guide future learning.
Objectives:
To identify if learners of mathematics with ASD have impairment in metacognition, specifically: 1) knowing when they have made an error (metacognitive awareness); and 2) when an error has been made, thinking that they meant to make the error (metacognitive regulation).
Methods:
This study explored metacognitive awareness and regulation in 21 males with ASD and 16 typically developing male controls who were being educated at the same level. An index of IQ (WASI-UK, Wechsler, 1999) was also taken for the ASD sample. Verbal IQ ranged from 63 to 108 (mean = 89.69, sd=10.59) and performance IQ ranged from 60 to 126 (mean = 96.42, sd = 16.46). Participants were asked a series of fifteen mathematics questions. Based upon previous research, after each question they were asked two metacognitive questions: 1) whether they thought they had got the answer correct or not (or 'don't know') and, 2) whether they meant to get the answer correct or not (or 'don't know').
Results:
Participants with ASD were significantly more likely than the typically developing group to erroneously

think that they had got an incorrect answer correct. Having made an error, those with ASD were also significantly more likely to report that they had meant to make an error. Different patterns in the types of errors made were also identified between the two groups.
Conclusions:
Deficits in metacognitive awareness and regulation were identified for the ASD group in the learning of mathematics. This is consistent with metacognitive research from different contexts. Interventions based upon developing metacognitive skills have been found to be highly beneficial within the typically developing population and should be evaluated for those on the autism spectrum who may have specific metacognitive deficits.

156 **109.156** Skill Learning in Young Minimally-Verbal Children with Autism and the Effect of Vestibular Stimulation

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Background: People with autism spectrum disorder (ASD), and especially the severe minimally-verbal individuals, often fail to learn basic perceptual and motor skills despite intensive repetitive practice. The reason for this learning deficit is currently unknown and overcoming it could have significant therapeutic implications. Previous findings suggest beneficial effects of vestibular stimulation in the normal, ADHD & LD populations, but the data regarding ASD are limited.
Objectives: to investigate the evolution in time and basic characteristics of skill (sequence) learning and the modulatory effect of vestibular stimulation in 3 groups of children ages 6-13: minimally-verbal ASD, ADHD and typical development (TD).
Methods: All children (N=39) 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 measure for learning was the median 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 session. Most children were also tested on a second sequence to examine the sequence-specificity of the learning gains.
Results: All groups showed a gradual median RT improvement with significant and similar speed gains across the training period (~150 ms, 15-30% of initial RT). The ASD children (n=9) were overall slower (by ~300 ms), with initial intermittent pauses that required prompting to resume, but each individual child showed significant speed gains across the training days. Importantly, the ASD sub-group who received vestibular stimulation (n=5) had larger median speed gains compared to the other sub-groups (by ~100 ms), with a significantly larger effect observed when comparing the sequence trials with the fastest RTs (first decile values), which correspond to sub-sequence improvements. In comparison, vestibular stimulation had only a small or minimal effect on the non-ASD groups, but increased sequence-specificity of learning in all groups.
Conclusions: These results suggest that 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. Our current (limited) data also support the hypothesis of a positive effect of vestibular stimulation on learning in the severely autistic, which may have important therapeutic implications.
We suggest that the difficulty of severely autistic children to learn even basic skills is not due to a primary deficit in procedural learning, but in the translation of explicit knowledge to procedures.

157 **109.157** Superior Vocal Identity Memory in Autism

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Background: Faces and voices are the most important social stimuli in the visual and auditory domains. Individuals with autism have difficulty in memorizing faces. Since children with autism exhibit less preference toward mother's voice, and brain activation related to voice perception is less significant in individuals with autism than in neurotypical individuals, it is important to investigate how individuals with autism perceive voices.
Objectives: This study adopted a quantitative methodology to examine vocal identity recognition in individuals with autism.
Methods: Fourteen individuals with autism (3 females) and 14 age- and IQ-matched neurotypical adults (3 females) participated in this study. The study consisted of three experiments: (1) gender discrimination, (2) vocal identity recognition via naming, and (3) a familiarity test. In the first experiment, the participants identified the genders of the speakers (5 female and 5 male speakers). In the second experiment, the participants learned the correlation between the voices (heard in the first experiment) and their names. In the third experiment, the participants identified familiar voices

(from the 10 previously heard speakers) and unfamiliar voices (from another 10 speakers).
Results: In the first experiment, the performance of both groups reached the ceiling level, and there was no significant difference between the groups. In the second experiment, the performance of both groups improved after training, and there was no significant difference between the groups. In the third experiment, the performance of the autism group was significantly better than that of the control group.
Conclusions: The results show that individuals with autism could recognize speakers' gender and memorize speakers' identity. The superior performance in the familiarity test contrasts with the mixed results in previous studies where the performance of the autism group was similar or worse. When compared with previous studies using long uttered sentences, the short uttered words used in this study provided timbre cues instead of prosody cues for vocal identity recognition. Therefore, the superior performance in the autism group might result from their superior perception of timbre cues in voices.

158 **109.158** The Co-Occurrence of Autistic and Dyspraxic Symptomatology in the General Population

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Background: 21-100% of individuals with an Autism Spectrum Disorder (ASD) present with motor abnormalities similar to that seen in dyspraxia (Gowen & Hamilton, 2012), indicating motor impairment as a potential diagnostic symptom in ASD. Individuals with dyspraxia (Creavin et al., 2014) and those with ASD (Anketell et al., 2013; Coulter et al., 2013) are more likely to have poor stereopsis. Stereopsis, or depth perception, may play a fundamental role in motor coordination activities such as navigation/object avoidance, reaching, grasping and object manipulation. To date, no systematic study has investigated the relationship between autistic traits (such as social difficulties) and reduced motor ability (increased 'clumsiness') in the general adult population and whether poor stereopsis may contribute to this association.
Objectives: To determine whether autistic and dyspraxic characteristics co-occur in a large, typical population-based sample and if poor stereopsis plays a role in this relationship.
Methods: Three validated questionnaires – the Stereopsis Screening Inventory (Coren & Hakstian, 1996), the Adult Developmental Coordination Disorder Checklist (Kirby, Edwards, Sugden, & Rosenblum, 2010), and the Autism-Spectrum Quotient (Baron-Cohen et al, 2001) - were used to explore whether stereopsis was correlated with dyspraxic symptomology (clumsiness) and/or autistic traits. 650 participants completed the questionnaires. 290 cases were missing a response for at least one item; missing data was imputed using random forest modelling. Factor analysis was used to determine whether clumsiness and autistic traits shared the same underlying basis (stereopsis).
Results: Preliminary analyses showed that both stereopsis (r = 0.29, p < 0.001) and clumsiness (r = 0.64, p < 0.001) correlated with autistic traits and with each another (r = 0.27, p < 0.001). An exploratory factor analysis (EFA) on all items from all screening measures revealed ten underlying factors. Factors were largely composed of items from a single scale, indicating that any co-occurrence of poor stereopsis, clumsiness and autistic traits cannot be attributed to a single underlying mechanism.
However, when the factor scores from the EFA were correlated with one another, it was found that stereopsis correlated with social skills (r = -0.22, p < 0.001) and isolation due to motor proficiency (r = 0.27, p < 0.001). As stereopsis became worse, social skills decreased and isolation due to motor proficiency increased. Interestingly, social skills showed a negative correlation with isolation due to motor proficiency (r = -0.43, p < 0.001). These results indicate that isolation due to motor proficiency mediates the relationship between stereopsis and social skills.
Conclusions: Although autistic and dyspraxic characteristics co-occur in the general adult population, they are independent of one another and do not share the same underlying mechanism. However, there is a relationship between reduced stereopsis and poor social skills that is mediated by motor ability. This is in line with the literature indicating that motor skill proficiency plays a role in the development of social communication skills. Determining the specific aspects of motor skill acquisition that are affected by poor stereopsis could inform social skill interventions for individuals with ASD.

159 **109.159** The Cost of Attentional Engagement: Target Switching during Visual Search in 2-Year-Old Toddlers with ASD

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Background: Children with ASD exhibit over-focused attention at times and excessive distractibility at other times. The development of attentional factors that contribute to these seemingly contradictory behaviors are not clear. Earlier, we found that young toddlers with ASD are able to deploy their visual attention in a highly goal-driven manner (Blaser et al., 2014, *Sci Rep*; Smith et al., 2014, *VSS*), yet they may be inefficient in responding to changes in the environment (Greenaway & Plaisted, 2005, *Psych Sci*).
Objectives: We investigated the cost of increased attentional engagement during visual search. We modified the classic visual search paradigm to test whether toddlers with ASD and age-matched typically developing toddlers (TYP) are able to switch their task goal from one search target to

another.

Methods: 15 ASD and 28 TYP toddlers participated (ASD: 14 males, mean age: 28.3 months, MSEL Composite: 63.1; TYP: 11 males, mean age: 26.6 months, MSEL Composite: 103.5). Participants sat on their caregivers' lap while a Tobii T120 eye-tracker recorded their eye movements. A block of 20 trials were presented: two familiarization trials, three single-feature training trials, then a sequence of 15 feature-conjunction test trials. Stimuli were 8 items defined by a feature-conjunction of color (isoluminant orange/green) and shape (apple/carrot). Feature-conjunction displays consisted of a target and a non-target (a green apple [A] and orange carrot [C]), plus 6 distractor items (green carrots and orange apples). Importantly, the 15 feature-conjunction trials were broken into three five-trial Phases defined by which object was highlighted as the target (counterbalanced across participants [ACA or CAC]). Each trial started with the target flying in and jumping up-and-down in the center of the screen (highlighting). Then, the search display appeared for 4 s, after which the target rotated back-and-forth for 2 s, accompanied by a sound effect; acting as both feedback and reward.

Results: In Phase 1, ASD and TYP toddlers found (fixated) the target more often than the non-target, and looked longer at the target than any other item in the display; an indication of task understanding. After the target switch (Phase 2), search performance of both groups decreased, and looking duration to the non-target increased. Interestingly, in Phase 3, when the target was again the same as in Phase 1, TYP toddlers recovered their initial search performance, whereas toddlers with ASD did not. This difference was also reflected in total looking durations.

Conclusions: Toddlers with ASD are capable of exercising goal-driven attention during visual search, yet this attentional focus appears to come at a price. ASD toddlers demonstrated an inability to flexibly change task goals, even when the initial task rules were reinstated. Our finding suggests that in young children with ASD, attention is over-focused at the level of task goal selection.

160 **109.160** The Go/No-Go Task Online: Evidence of an Inhibitory/Excitatory Imbalance in Autism in a Large Sample

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Background:
One theory of the aetiology of autism spectrum conditions (ASC) implicates an inhibitory/excitatory (E/I) imbalance in the brain. This theory has been supported by neuroimaging findings, findings implicating GABA receptor genes, and the comorbidity of epilepsy. However, behavioural manifestations of this imbalance, i.e. motor inhibition, primarily measured as an increase in false alarm response during a Go/No-go (GNG) paradigm, have been mixed. Some studies report decreased inhibition in individuals diagnosed with ASC relative to controls, others find this effect under specific conditions only (e.g. higher working memory load, social GNG) and others still find no difference between ASC and controls.

Objectives:
In the current study we aimed to better understand behavioural inhibition in ASC by examining GNG performance in a large sample of ASC and controls.

Methods:
Participants were 213 high-functioning adults diagnosed with ASC (103 females) and 414 controls (285 females) who completed a GNG task. The GNG task consisted of 300 trials; 220 trials elicited a Go response (pressing an arrow key) and 80 trials (26.7%) elicited a No-go response (not pressing any key). A Go response in a No-go trial was counted as a false alarm (FA) response. The effect of diagnosis on FA was examined.

Results:
As predicted by the E/I theory, individuals diagnosed with ASC had a significantly higher rate of FA errors than controls ($t_{(625)}=-3.45$, $p<.001$, Cohen's d=-.28).

Conclusions:
Utilizing a large sample of high-functioning individuals diagnosed with ASC and controls we find a significant effect of diagnosis on number of FA errors. This finding should be explored as a behavioural phenotypic measure alongside neuroimaging studies of motor inhibition, measures of GABA-ergic activity, and in the context of polymorphisms in the GABA receptor genes, to better understand its potential role in the aetiology of autism.

161 **109.161** The Relation Between Classical Conditioning and Prototype Learning in Individuals with ASD

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Background:
Studies of implicit learning have indicated a mixed pattern of impaired and intact performance in individuals with ASD (Eigsti & Mayo, 2011). Several studies of implicit learning in ASD have indicated a

relationship between implicit task performance and verbal and non-verbal reasoning abilities (Gastgeb et al, 2012; Klinger et al., 2007). Taken together, these findings suggest better performance on implicit learning tasks may be directly related to better reasoning in individuals with ASD.

Objectives:
The primary objective of this study was to examine the relation between implicit learning and verbal reasoning in ASD across two implicit learning tasks. Participants participated in a classical fear conditioning and prototype learning task.

Methods:
Twenty children with ASD and 17 age- and IQ-matched children with typical development (ages 7 to 14 years) completed two implicit learning tasks. The conditioning task consisted of three phases (habituation, acquisition, and extinction). During acquisition, one color (i.e., the conditioned stimulus) was paired with a loud noise (i.e., the unconditioned stimulus). Skin conductance responses were recorded. The prototype task consisted of a familiarization and test phase. Eight different members from a category were presented during the familiarization phase. The test phase consisted of old, new, and prototype (i.e., mathematical average of category members) test trials and participants made "yes/no" recognition judgments. Prototype learning was measured as false recognition of the prototype animal which, in fact, was not shown during familiarization. Verbal Reasoning was measured by the vocabulary and similarities sub-test of the WASI (Wechsler, 2000).

Results:
Linear regression analyses were conducted to examine the relation between verbal reasoning and diagnosis to both classical conditioning task performance (CCTP) and prototype learning task performance (PLTP). For each model, verbal reasoning, diagnosis, and a diagnosis by verbal interaction term were hierarchically included. Diagnosis significantly predicted CCTP, $F(1, 34)=11.18$, $p<.01$, however no significant effect was found for verbal reasoning or the interaction with diagnosis (p's>.42). In contrast, verbal reasoning significantly predicted PLTP ($F(1, 34)=8.32$, $p<.01$), with a small effect of diagnosis, $F(1, 34)=3.06$, $p=.09$, and a small interaction between verbal reasoning and diagnosis, $F(1, 34)=2.85$, $p=.10$. A final regression analysis examined the relationship between PFTP and CCTP. Using PLTP as the dependent variable, CCTP, diagnosis, and diagnosis by CCTP interaction were hierarchically included in the model. Results indicated a significant diagnosis by CCTP interaction, $F(1, 33)=5.00$, $p=.03$, and no significant effects for CCPT or diagnosis (p's>.20) showing that CCTP and PLTP were highly related for participants with ASD but not for participants with typical development.

Conclusions:
The present findings observed impairments in two implicit learning tasks in individuals with ASD. A marginally significant interaction between diagnosis and verbal reasoning was also seen in the prototype task (but not the conditioning task) suggesting explicit reasoning may play a role in implicit learning for individuals with ASD but not for individuals with typical development. Conditioning and prototype task performances were highly related for participants with ASD but not typically developing participants suggesting that these tasks tap common characteristics only for those with ASD.

162   **109.162** The 'Reading the Mind in the Eyes' Test: Complete Absence of Typical Sex Differences in Performance in ~400 Men and Women with Autism

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Background:
The 'Reading the Mind in the Eyes' test (Eyes test) is an advanced test of theory of mind. Typical sex differences have been reported (female advantage). Individuals with autism show more difficulty than typically developing individuals, yet it remains unclear how this is modulated by sex, as previous studies have been relatively small scale and females with autism have been under-represented.

Objectives:
We recruited a large, sex-balanced sample to test for the effects of sex, diagnosis, and any interaction of these, on the performance of the Eyes test. We also tested if the patterns of group differences fit predictions from the 'extreme male brain' (EMB) theory of autism.

Methods:
The Eyes test was administered online to 395 adults with autism (178 males, 217 females) and 320 typical adults (152 males, 168 females). Performance was examined in terms of total correct score, using a 2 x 2 factorial design. Correlation between Eyes test correct score and self-reported empathy (measured using the Empathy Quotient, EQ) and autistic traits (measured using the Autism Spectrum Quotient, AQ) were examined separately for the four groups. Support Vector Machine (SVM) classification, stratified by sex, was also performed.

Results:
Two-way ANOVA showed a significant sex-by-diagnosis interaction ($F(1,711) = 5.090$, $p = 0.024$, $\eta_p^2 = 0.007$) arising from a significant sex difference between typical males and typical females, and a complete abolition of sex difference in males and females with autism ($p = 0.907$, $d = 0.01$). Case-

control differences in males and females were observed. The pattern of group differences was in line with the EMB theory predictions (typical females > typical males > males with autism ≈ females with autism). Eyes-EQ and Eyes-AQ correlations were significant only in females with autism ($r = 0.35$, $r = -0.32$, respectively), but not in males with autism, typical males, or typical females. SVM on Eyes items classified autism diagnosis at higher accuracies for females than males (males, 63%; females, 72%). Furthermore, an SVM model trained within one sex generalizes equally well when applied to the other sex.
Conclusions:
In a large adult sample we confirmed that performance on the Eyes test is a *sex-common* phenotypic marker of autism, reflecting core social-communication difficulties in autism. Given the existence of typical sex differences, performance of females with autism differs from same-sex controls more than that of males with autism. The findings also provide support for the EMB theory predictions in both sexes in terms of overall performance.

163 **109.163** Thermal Pain Perception in Adults with Asperger Syndrome

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Background:
Case studies and caregiver reports often describe pain hypo- or insensitivity in individuals with autism spectrum disorders. Diminished or altered observable reactions to pain might have several reasons, including true hyposensitivity but also communication deficits or altered emotional expression in body language or a different understanding of the concept of pain. Experimental studies that assessed pain perception in autism spectrum disorders are rare. To our knowledge, no study has measured pain thresholds in individuals with autism spectrum disorders empirically yet.
Objectives:
The aim of our study was to assess objective pain measurements in the thermal domain (absolute temperature thresholds) in individuals with Asperger syndrome and typically developed control participants, and to relate these measures to their subjective pain experience in terms of intensity and quality ratings and verbal attributes at the measured heat levels as well as to autistic personality traits.
Methods:
Thermal pain onset (TPO - the temperature at which heat perception turns into pain) and thermal pain tolerance (TPT - the temperature at which pain perception is not tolerated any longer) were measured at the volar forearm in 29 adults with Asperger syndrome (AS) and 29 control participants (CG). To prevent injuries, thermal stimulation stopped automatically at a temperature of 52°C. Thermal pain range was calculated as the difference of the mean TPT and TPO. Subjective pain experience was rated at TPO and TPT regarding quality (from neutral to uncomfortable) and intensity (from no pain to maximal self experienced pain) and additionally assessed with the McGill Pain Questionnaire. Autistic personality traits were assessed with Baron-Cohen's Autism Questionnaire (AQ), Alexithymia was assessed with the Toronto Alexithymia Scale. Performance and verbal IQ were estimated with two tests of the Wechsler Adult Intelligence Scale (WAIS-III).
Results:
Thermal pain range was higher in the AS group. Absolute temperature levels of thermal pain onset and thermal pain tolerance did not differ significantly between the two groups. Neither differed the subjective pain intensity and pain quality ratings of the two groups. However, within the AS group, individuals with more pronounced autistic traits (in terms of higher AQ scores) tolerated significantly higher temperatures and rated their subjective pain experience as lower regarding pain intensity and pain quality. The same was observed in AS individuals with higher alexithymia scores, which themselves were highly correlated with the AQ scores. AS individuals with higher AQ scores chose less words on the McGill Pain Questionnaire to describe their pain experience. Over all participants, those with higher IQ estimates showed lower pain quality ratings at pain onset (TPO).
Conclusions:
Our results could be interpreted as signs of an altered understanding of the concept of pain in individuals with Asperger syndrome especially those more severely affected. The absolute temperature thresholds of thermal pain onset and tolerance did not differ from the not affected control group, indicating intact thermal pain sensitivity.

164 **109.164** Three Facets of Visual Orientation Processing in ASD

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Background: It has been suggested that altered visual perception, such as superior visual abilities, underlies some of the social difficulties associated with the Autism Spectrum Disorder (ASD)

phenotype (Dakin & Frith 2005; Behrmann, Thomas, & Humphreys 2006). The precise source for these atypicalities, however, remains a source of debate. The crux of the argument is whether the differences arise at the level of basic, low-level visual processing or further downstream at stages involving more complex, higher-level tasks and stimuli. A recent study has shown visual acuity in ASD to be equivalent to that of neurotypical controls. This suggests the earliest levels of retinal processing to be an unlikely candidate as the source of differences (Tavassoli et. al. 2011). The next potential level for divergent visual processing are those involved in processing simple aspects of visual stimuli, such as orientation and spatial frequency, considered to be functions of early visual cortical processing. One study supporting the low-level view of atypical perceptual abilities found that participants with ASD were superior in identifying the orientation for simple, first-order gratings at cardinal angles (Bertone, Mottron, Jelenic, & Faubert 2005). Yet, other, more rudimentary aspects of orientation perception, such as detection and discrimination, have not been assessed systematically within this population. Characterizing differences in the most basic visual abilities is necessary to determining the origins of these variances within the ASD phenotype, and what impact these alterations have for more complex levels of visual perception.

Objectives: The goal of this study was to characterize (i) sensitivity, (ii) precision, and (iii) accuracy for perceiving orientation in the same cohort of participants with ASD in comparison to age- gender- and IQ-matched neurotypical controls. Each experiment allows for both qualitative and quantitative assessment of the *oblique effect*i.e., the typical finding of superior performance at cardinal and as compared to oblique orientations.

Methods: In three psychophysical experiments we measured (i) contrast detection thresholds (ii) orientation discrimination thresholds and (iii) biases in perceived orientation of a 3 cycles/degree Gabor patch of varying base orientation.

Results: For all three experiments, our results indicated that participants with ASD perceive orientation of low-level stimuli in a qualitatively as well as quantitatively similar manner to neurotypical controls. Oblique effect was evident in both groups: at cardinal orientations (i) stimuli were easier to detect (ii) precision was higher and (iii) perception was veridical as opposed to oblique orientations where perception is found to be biased. Additionally, performance in all three tasks were quantitatively indistinguishable in the two groups of participants. We found no evidence of superior processing in detection, precision, and accuracy aspects of orientation perception in participants with ASD.

Conclusions: Our findings suggest that low-level visual processing of orientation is unremarkable for people with ASD. These results suggest that the source for altered perceptual abilities should be sought elsewhere, possibly in subsequent levels of visual processing.

165 **109.165** Time Course of Facial Emotion Recognition in First-Degree Relatives of Individuals with ASD: An Eye-Tracking Study

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Background: Previous studies have found impaired facial emotion recognition and atypical gaze fixation patterns when looking at faces in participants with Autism Spectrum Disorders (ASD) (Klin et al, 2002). Specifically, participants with ASD look more at the mouth and less at the eyes, while typically developing participants show an opposite pattern. Several studies found the same pattern in unaffected siblings and parents of children with ASD, suggesting that it may be a feature of Broad Autism Phenotype (BAP) (Adolphs et al, 2008). However, this finding has not always been replicated; furthermore, it was proposed that other traits, such as alexithymia, can better explain the atypical eye:mouth ratio found in ASD (Bird et al, 2011).

Objectives: Little is known about the time course of gaze fixation on faces in relation to ASD symptoms. Preference for looking at the eyes or the mouth could be a consequence of automatic tendency to immediately fixate on the eyes, in which case the difference would be seen early on, or be a part of a conscious strategy. Averaging total fixation duration over a given interval of time (which was commonly done in previous studies) does not allow to disambiguate between these two factors. Our aim was to investigate the time course of facial emotion processing in first-degree relatives of individuals with ASD.

Methods: We employed the visual world paradigm: At the beginning of each trial participants heard a word indicating a target emotion, and at the same time saw photos of four different people presented in the four quadrants of the screen. The task was to respond whether one among the four photos expressed the target emotion. The outcome variable was the probability of fixation within a given region of interest at each time point.

Results: Preliminary data from 7 parents of children with ASD and 15 control participants indicate that participants from both groups start to look towards the target emotion around 150-200 ms after trial onset. However, the probability of fixation on target emotion increased at significantly slower rate in the BAP group (compared to control). With respect to eye:mouth ratio, both participant groups initially looked more at the mouth, but later switched towards looking at the eyes. In the typical group, probability of fixation on the mouth continued to increase, albeit at a slower rate, while the BAP group fixated mainly on the eyes (Group (BAP, Control) *Region (Eyes, Mouth) * Time (300, 500,

700 ms) interaction, $F(2,40)=5.61$, $p=.021$).

Conclusions: Eye:mouth ratio is task-dependent, and it follows a particular time course. Contrary to previous findings, the BAP group did not avoid looking at the eyes, arguing against lower eye:mouth ratio being an endophenotypic feature of ASD. However, the BAP group focused exclusively at the eyes, while the typical group explored all facial features in parallel, suggesting that just like people with a clinical diagnosis of ASD, their first-degree relatives analyze facial expressions based on single feature.

166 **109.166** To See but Not to See: Visual Perception Mediates Imitation in ASD

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Background: The ability to imitate is an early and important developmental milestone providing the foundation for turn taking, joint attention and theory of mind. Imitation deficits are well documented in individuals with Autism Spectrum Disorder (ASD). Impairments in imitation performance have been identified in meaningful gestures (i.e., goal-directed action), meaningless gestures and even style (e.g., harsh versus gentle). The Self-Identification theory suggests that individuals with autism fail to imitate the style of the examiner due to a lack of interpersonal connectedness. Underlying cognitive factors, including the relationship of visual perception to the imitation of style, have not been fully explored. To our knowledge, this is the first study to design perceptual tasks assessing discrimination of *style* in ASD.

Objectives: A case-control study was conducted to: a) determine if individuals with ASD are successful in imitating and discriminating the goal and the style of actions; and b) to investigate the role of underlying cognitive mechanisms including visuomotor integration (VMI), working memory (WM), visuoperceptual processing (VP) and discrimination of style in predicting group membership.

Methods: Nineteen adolescents with high functioning autism (HFA) and 22 typically developing controls (MA = 12.1, SD = 2.4 and MA =12.2, SD = 1.9 respectively) were tested on four newly designed tasks of discrimination of style (e.g., harsh versus gentle and fast versus slow) of object use, intransitive (social) gestures and pantomimes. Four imitation tasks, adapted from Hobson and Lee (1999), were tested: Strumming a pipe rack on a stick, using a stamp and ink pad, flattening a toy frog with a roller and pressing a bobble head.

Results: No significant between group differences were evident in imitating the goal; however, the ASD group was significantly poorer at imitating the *style* of the action: pipe rack and stick, [X^2 (1, N = 41) = 5.13, p = .038; stamp and ink pad X^2 (1, N = 41) = 5.26, p = .036; frog and roller x^2 (1, N = 40) = 19.93, p = <. 001 and atypical use of the bobble-head, x^2 (1, N = 41) = 15.33, p = .003]. Results from a series of multivariate logistic regression models suggested that visuomotor integration and discrimination of the style of intransitive gestures successfully predicted group membership, [OR = .89, p - .013; OR = .38, p = .020]. Results of the discrimination tasks showed significant between-group differences in discrimination of transitive gesture style, t_{39} = -2.54, p = .015, Cohen's d =-.79, and intransitive gesture style, t_{39} = -2.99, p = .005, Cohen's d = -.92.

Conclusions: Our findings support and extend the results of Hobson and Lee (1999) revealing significant difference in the imitation of *style* in ASD and highlight that impairments in visuomotor integration as well as the ability to discriminate the style of gestures may account for this imitative deficit. These findings replicate and extend the original study of Hobson and Lee (1999) suggesting that a primary deficit in visual perception may underlie a deficit in imitation of style in ASD.

167 **109.167** Transitive Inference in Children with Autism Spectrum Disorder and Limited Verbal Ability

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Background: Memory functioning in Autism Spectrum Disorder (ASD) follows a characteristic pattern, including good rote memory (Kanner, 1943) and cued recall (Bowler, Matthews & Gardiner (1997). Impairments have been demonstrated in the free recall of semantically related items (Tager-Flusberg, 1991), and the recognition of combinations of features (Bowler et al., 2008, 2014). This suggests a difficulty with *relational binding*- the ability to encode items and events, and the relationships between them, to allow for adaptive use of the information (Opitz, 2010).

Objectives: Studies of relational binding in ASD have mainly been carried out with verbally able adults, using verbalisable stimuli (e.g. words). The current study aimed to extend these findings to lower-functioning individuals with ASD. A non-verbal transitive inference paradigm (if A > B, and B > C, then A > C) was adapted (Maclean et al., 2008). Typical adults tend to use a relational strategy during these tasks (Moses, Villate, and Ryan, 2006), whereas non-human animals tend to use an associative, pair-by-pair strategy (von Fersen et al, 1991), suggesting that language may be important in the construction of relational strategies.

Methods: 24 children with ASD and limited verbal ability (AD), and 24 typically developing children (TD), matched on non-verbal IQ. Pairs of stimuli were presented in hierarchical order; participants were required to find the "higher-ranked" of the two by touching it onscreen; feedback was given after each trial regarding their choice. A test phase was then presented, comprising two trial types:

adjacent pairs of stimuli already seen during the training phase, and re-pairings of the stimuli into novel combinations of non-adjacent stimuli (e.g. B-D). Participants must use information from the adjacent training pairs to infer the higher-ranked stimulus of a non-adjacent pair, which requires the flexible processing of the relations between pairs. The current study predicted no group differences during the test phase where adjacent stimuli were presented, whereas participants with ASD would be impaired in the non-adjacent pairs, because of the flexible relational binding required to solve those trials. An additional task in which participants were shown all the stimuli on the screen and asked to "put them in order" was included to determine participants' awareness of the hierarchy. **Results:** Performance during training in the transitive inference task was > 70% for all participants. During the test phase no group differences in performance were found between the two trial types (adjacent and non-adjacent); indicating that the level of performance was comparable between the groups, regardless of trial type. However, there was a significant group difference in the stimulus hierarchy awareness task, $t(46) = -3.0$, $p = .004$, with impaired performance in the AD group. **Conclusions:** Results indicate that children with ASD and limited verbal ability can solve a task requiring transitive inference. However, these participants also appear to be less aware of the stimulus hierarchy, which may imply that they are using an associative rather than a relational strategy, and therefore support the idea of the importance of language in the construction of relational strategies.

168 **109.168** Understanding of Prior Intention in the Children with Autistic Spectrum Disorder

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Background: Young children with Autistic Spectrum Disorder (ASD) have some understanding of others' intention. However, it remains to be seen whether they understand others' prior intention. Objectives: This study extended the Carpenter et al. (2002) paradigm and explored whether young children with ASD benefited from others' prior intention in social learning of a causal task. Methods: Participants consisted of 24 young children with ASD (M= 46 months), 16 children with developmental delay (DD) who were CA- and MA-matched, and 24 typical developmental children (TD) who were MA-matched. They were diagnosed by a multidisciplinary team using ADI-R, ADOS and clinical judgment with DSM-IV. Children from each group were randomly assigned to one of two conditions: Prior Intention and No Prior Intention conditions. Children in the Prior Intention condition knew what the experimenter was trying to do (opened a series of containers) before demonstrating how to open a wooden box via two action steps; children in the No Prior Intention condition saw the demonstration paired with irrelevant actions on the containers. Results: Results revealed that TD (91.7%) and DD (100%) children opened the box significantly more often than children with ASD (58.3%) in the Prior Intention condition. There was no group difference in No Prior Intention condition (ASD: 58.3%, DD: 75%, TD: 58.3%). ASD children opened the box equally frequently in the Prior Intention and No Prior Intention conditions. By contrast, children from the TD and DD groups were more successful in the Prior Intention condition than in the No Prior Intention condition. Conclusions: The findings showed that contexts of prior intention facilitate observational learning in TD and DD children but not in young children with ASD. Theoretical and clinical implications were discussed in relation to their difficulty in understanding a person's intention within the context of the task.

169 **109.169** Use of an Experimental Design to Examine Factors That Contribute to Episodic Memory Deficits in Children with High Functioning Autism

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Background: Children with autism spectrum disorders (ASD) have been found to demonstrate impairment in episodic memory (EM). Factors that could contribute to or magnify EM impairment in ASD have not been examined.
Objectives: To examine factors, specific to ASD, that potentially influence EM performance on conventional assessments such as impaired expressive language, the method of prompting (verbally or visually) for memory recall, the salience of the event to the individual, and various cognitive factors.
Methods: This study examined 62 children (56 males, 6 females), aged 6-13 years, with High-Functioning ASD assessed for participation in a study using CBT to treat core ASD symptoms. During the administration of the experimental assessment, participants were shown a series of five slide shows, each of which depicts an emotion (happy, sad, angry, nervous, and embarrassed) and consists of a story that ends with a film of a child portraying the emotion which corresponds to the story. Methods of recall were systematically varied as participants were then asked to recall the stories verbally and non-verbally to examine the role of expressive language in memory recall, with a visual or verbal prompt to understand if method of cueing effects memory recall, and events that were of either high or low preference to determine if salience impacts quantity and quality. Additionally all participants were administered the WISC to determine their IQ.

Correlations were run using the EM measure's T scores and the participant's scores on the WISC (full scale IQ and subscales) to determine the relationship between various cognitive processes and EM performance. An Analysis of Variance (ANOVA) was also run to examine if participants demonstrated a difference in performance in various conditions of recall, thus implicating potential

confounds in EM assessment.

Results: Verbal ability and working memory scores as determined by WISC subscales were found to correlate with all EM conditions and total scores with the exception of the non-verbal response. The ANOVA indicated that there are differences in recall across all four conditions and that the number of details recalled accurately as well as the chronological order of recall are impacted by the salience of the event and method of recall.

Conclusions: The EM measure sought to examine if expressive language deficits, method of recall and salience of the event impacted EM recall in children with ASD. It was found that both the salience of the incident to the individual and the role of expressive language impacted the participant's memory for details and sequential recall of events. It appears that children with ASD may recall more details than they are able to verbalize without a given structure. Additionally, cognitive factors such as working memory and verbal ability may also impact EM performance. The results suggest that the presentation and severity of EM deficits in children with ASD could be due to or impacted by outside cognitive factors.

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170 **109.170** Vertical but Not Oblique Line Orientation Discrimination Is Disturbed in ASD Children

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Background: Neurophysiological studies suggested that excitation/inhibition (E/I) imbalance might underly visual perception abnormalities observed in some children with Autism Spectrum Disorder (ASD). Behaviorally, the E/I imbalance in visual cortex can affect the "oblique effect" - better discrimination ability for cardinal compared to oblique line orientations. Previous studies on typical developing subjects (TD) failed to find association between autistic traits and cardinal orientation discrimination thresholds, but found it for lines with oblique orientation (Brock et al., 2011, Dickinson et al., 2014). No studies examined the "oblique effect" in ASD children.

Objectives: The aim of our study was to examine the orientation discrimination threshold for oblique and cardinally orientated lines in TD and ASD children.

Methods: Subjects were 16 ASD boys and 32 TD boys, aged between 6 and 15 years with IQ > 71: intellectual ability was assessed by the Kauffman Assessment Battery (Kauffman&Kauffman, 2004). The experimental procedure was similar to those used by Dickinson et al., 2014. The orientation of the first grating was held fixed at 0° in the "vertical" condition and 45° in the "oblique" condition, the second grating was rotated either clockwise or counterclockwise. The orientation difference between the gratings was adjusted using two interleaved one-up two down staircases that converged on 71% correct performance. Participants were asked to judge the direction of this rotation. The logarithm of orientation discrimination threshold for vertical and oblique lines assessed in degrees was taken as a dependent variable.

Results: The ANCOVA with Orientation (Vertical vs. Oblique) as a within-subject factor, Group (ASD vs. TD) as a between-subject factor, and Age and IQ as the covariates was applied to the data. The effects of interaction Orientation*Group and Orientation*Age were significant, and the univariate ANCOVA was further applied separately for Vertical and Oblique conditions. For the Oblique condition the only significant effect was the effect of Age: the oblique lines' orientation discrimination improves with age in both groups. Noteworthy, the ASD and TD groups had similar oblique discrimination thresholds (10.8±1.5º vs. 9.0±0.6º). However, the significant Group effect was present in the Vertical condition: ASD boys had enhanced discrimination threshold as compared to TD boys (4.7±1.1º vs. 1.4±0.1º). The significant Group*Age interaction suggested that difference between ASD and TD diminished with age.

Conclusions: Our study provides evidence for a reduced "oblique effect" in ASD boys comparing to their TD peers. Unexpectedly, this was due to ASD difficulties with orientation discrimination of vertical lines, whereas the threshold for oblique line orientation did not differentiate ASD and TD boys. Previously, it was shown, that "oblique effect" increases with age, potentially reflecting the tuning of neuronal network to the environmental statistics through GABAergic modulation (Liang et al., 2007, Girshick et al. 2011, Shen et al., 2014). Therefore, the deficits in vertical orientation processing, seen in ASD children, might represent the E/I imbalance, which delays adequate visual system tuning and reduces the natural bias toward cardinal orientation.

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171 **109.171** Writing Ability and Working Memory in Children with Higher Functioning ASD

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Background: Children with high-functioning ASD (HFASD) or ADHD have difficulty with writing (Myles et al., 2003; Pennington & Delano, 2012; Re, Pedron, & Cornoldi, 2007). One possibility is that problems with working memory lead to the problems in both groups (Mayes, Calhoun, Mayes, & Molitoris, 2012; McCutchen, 2006).

Objectives: This study examined the degree to which school-age children with HFASD and ADHD exhibit similar or different difficulties with writing. It was also designed to examine the role of working memory in writing development in these children.

Methods: Seventy-two children with HFASD (age=11.29 years (SD=2.12), FIQ=100.37 (SD=14.30)) were compared to 38 children with ADHD (age=11.78 years (SD=2.35), FIQ=101.03 (SD=15.23)) and 39 children with typical development (TD) (age=11.59 years (SD=2.24), FIQ=115.22 (SD=14.56)). HFASD was confirmed with the ADOS–R, and ADHD was assessed with parent report on the Conners–3. Working memory was measured with the Wide Range Assessment of Memory and Learning–2 (WRAML). IQ was assessed with the Wechsler Abbreviated Score of Intelligence–II. Writing was assessed with the Wechsler Individual Achievement Test–3.

Results: A Diagnostic Group ANCOVA of the WIAT overall writing score, with IQ as a covariate, revealed a significant group effect, $F(2,143)=7.62$, $p<.001$, $eta^2=.10$ (see Figure 1). The clinical groups were significantly lower than the TD group on writing achievement, but the former did not differ. MANCOVA indicated that the groups also differed on the four WRAML measures, $F(8, 298)=6.01$, $p<.001$, $eta^2=.14$. On story memory, the HFASD group was significantly lower than the ADHD and TD groups, which did not differ (ps<.001). On verbal working memory, the HFASD group was lower than the ADHD group ($p<.03$), which was lower than the TD group ($p<.003$, see Figure 2). Regression analyses revealed that age ($\beta=-1.9$), symbolic working memory ($\beta=2.38$), and story memory ($\beta=2.68$) made significant contributions to explaining variance on the overall writing score, $R=.49$, adjusted $R^2=.18$, $F(5, 65)=4.21$, $p<.002$. In the ADHD group, story memory (2.18) and finger windows (-3.48) explained variance in overall writing scores, $R=.66$, adjusted $R^2=.34$, $p<.002$. The regression model with working memory and age was not significant in the TD sample.

Conclusions: School-aged children with HFASD and ADHD display comparably lower quality written texts than TD peers. However, regression analyses suggested that different factors were associated with writing difficulties in the two clinical groups. In the HFASD but not ADHD group, relative writing performance deceased with advances in age. Symbolic working memory was a factor for the HFASD sample but not the ADHD sample. Alternatively, story memory, which may reflect an executive capacity to organize memory along organized narrative lines, impacted writing in both groups. These results provide information relevant to the educational needs of school-age children with HFASD and can help understand how working memory may be playing specific roles during writing tasks.

172 **109.172** "Scattered Attention" in Face Perception: The Case of Co-Morbid ASD+ADHD

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Background: Early atypical attention to faces in ASD is hypothesized to lead to downstream effects on social cognition, causing impairment in everyday social interaction. Although some research using infrared eye tracking paradigms suggests reduced attention to faces (particularly the eye region) in ASD versus typical development, many other studies find no effects. These null results may partially result from small sample sizes and significant within-group heterogeneity in ASD (e.g., high rates of co-morbid ADHD that likely affect gaze patterns). To our knowledge, large-scale eye tracking studies of ASD plus co-morbid ADHD do not exist in the literature.

Objectives: Compare large samples of children with ASD+ADHD vs. ASD alone on an eye-tracking metric of "scattered visual attention" to faces and objects, as well as eyes and mouths.

Methods: Children with ASD (N=125) and ASD+ADHD (N=110) watched 3 16-second sets of 4 video clips, 1 in each quadrant of a 32-inch screen, while their gaze data was collected at a rate of 60 Hz using a Tobii X120 system. Groups did not differ on sex-ratio, age (mean=10y), or IQ (mean=103; all participants >70). Each set of videos included 2 naturally moving neutral faces and 2 moving objects (e.g., car on highway). Areas of interest (AOI) included faces, objects, eyes, and mouths. The number of visits made to faces vs. objects and eyes vs. mouths were compared between diagnostic groups using omnibus repeated measures ANOVA with planned t-tests to determine directionality.

Results: Overall visual attention to the screen did not differ by group ($t=-.08$, $p=.93$). An index of "scattered attention" (visit count to the four screen quadrants) was significantly higher in the ASD+ADHD group than the ASD alone group ($t=3.24$, $p=.001$). A 2x2 repeated measures ANOVA on visit count with Stimulus (face, object) as a repeated measure and Group (ASD, ASD+ADHD) as a factor revealed a main effect of Group ($F=10.48$, $p<.001$, $\eta_p^2=.04$) and no Group x Stimulus interaction. A similar ANOVA focused within the face with Stimulus (eyes, mouth) as a repeated measure revealed a main effect of Group ($F=7.16$, $p=.008$, $\eta_p^2=.03$) and a Group x Stimulus interaction ($F=4.17$, $p=.04$, $\eta_p^2=.02$). Planned t-tests revealed that the ASD+ADHD group looked more frequently at the eyes than the mouth, whereas the ASD only group did not, and this translated to longer raw time spent on the eyes in the ASD+ADHD group than the ASD group (all $ps<.05$).

Conclusions: Children with ASD and ADHD attend to faces differently than those with ASD alone, focusing relatively more on the eyes, and they are significantly more active in their exploration of visual information. This might represent ADHD-driven "scattered attention" or other fundamental differences between the ASD groups, such as decreased social motivation in those with ASD alone. Ongoing analyses are exploring these hypotheses, as well as relationships to face recognition ability and neural representations measured with fMRI (e.g., FFA activation).

173 **110.173** Are Social Cognitive Deficits Relative in Autism? Examination Using a Social Versus Nonsocial Salience Paradigm

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Background: When left to their own, how do children with autism "spend" their attention and time, and what might this suggest to us in our search for models of pathogenesis and treatment of autism? As parents of children with autism know, these children spend a disproportionate amount of time seeking out and engaging in idiosyncratic and primarily nonsocial patterns of behavior and interest.
Objectives: When viewed from the perspective of experience-dependent brain and behavioral development, such a narrow, nonsocial pattern of behavior and interests likely diminishes social experience, and, in turn opportunities for social learning and development. *Does this pattern of autistic development unfold as a result of a predisposition to avoid social stimulation, or a predisposition to approach nonsocial stimulation?*In this study we examine if the presence of nonsocial stimuli can alter social information processing in children with ASD.
Methods: Preferential viewing tasks can serve as objective measures of salience, with a greater proportion of viewing time to one item indicative of increased salience. The current task used gaze-tracking technology to examine patterns of visual attention to stimulus pairs that varied in social and nonsocial content. Pairs included a social image (face) and a picture of one of two types of objects: objects found in previous studies to be of high interest to individuals with ASD (HAI images; e.g. trains, electronics) and objects found to be of low interest to individuals with ASD (LAI images; e.g. clothing, furniture). Participants included both adolescents diagnosed with ASD (N = 33, mean age = 13.9 years) and typically developing (TYP; N = 32, mean age = 14.1 years); groups were matched on IQ and gender.
Results: Repeated measures ANOVA revealed an increased latency to social images in individuals with ASD only when the social image was paired with an HAI nonsocial image [$F(1,63) = 4.3, p = .042$]. Individuals with ASD spent a greater proportion of time looking to objects, regardless of array type [$F(1,63) = 15.4, p = .005$], while TYP individuals spent a greater proportion of time looking to social images [$F(1,63) = 20.1, p = .001$]. Fixation patterns differed between groups only for social images, with TYP individuals displaying significantly longer fixations to social images than ASD, regardless of array type [$F(1,63) = 25.7, p = .0001$]; object fixation duration did not differ between groups [$F(1,63) = .22, p = .794$] or between array types [$F(1,63) = 1.0, p = .31$].
Conclusions: These results suggest that in ASD, deficits in social information processing may be relative and context-dependent, as opposed to being a fixed core feature of the disorder. In this model, social inattention may occur as a secondary byproduct of a positive attention bias to nonsocial information. In ASD, the presence of nonsocial sources of stimulation can significantly increase the latency of look time to social sources of information. In an ecologically valid context, this could translate to either delays in social information processing or to missing critical social information entirely.

174 **110.174** Examining the Impact of Repetitive and Restricted Behaviors on Adaptive Functioning of Children with ASD

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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). Bishop et al. (2006) found stronger relationships between RRBs and IQ with increasing age in children with ASD. However, earlier research 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 RRB's per se. This study uses a newly standardized measure, the Behavior and Sensory Interest Questionnaire (BSIQ) to classify a wide range of RRBs. Furthermore, subject characteristics such as age, cognitive and adaptive functioning, gender and autism severity will be utilized to compare children with high and low RRBs.
Objectives: By utilizing the BSIQ, this study aims to compare a wide range of RRBs and there relationship to subject characteristics (age, cognitive and adaptive functioning, gender and autism severity). In addition, the total and type of RRBs will be examined.
Methods: A sample of 237 children with ASD (85% male; NVIQ=93.7, SD=20) was drawn from the Simons Simplex Collection and the Boston Autism Consortium. Participants ages were between 27-272

months, (mean=94.9, SD=49.6). The BSIQ, designed to evaluate the number, type, and intensity of RRBs, was administered to a parent. Testing also included child cognitive, behavioral and adaptive functioning assessments. Generalized linear models were employed to explore the relationship between different subject characteristics, cognitive functioning and RRBs.

Results: Analyses revealed a significant weak negative trend of age on RSM behaviors (p=0.004) when controlling for IQ, however no significant trend was revealed of age on IS behaviors. It is important to note that a significant interaction of age and IQ was found for RSM but not IS behaviors. Furthermore, RSM behaviors had a significant negative impact on overall adaptive behaviors as measured by the Vineland composite standard score (p=0.02) however the same effect was not observed with IS behaviors (p=0.51). All analyses were controlled for IQ, age and gender.

Conclusions: Expanding on previous research, we employed a more comprehensive measure to observe the impact of age and IQ on RRB's. We found significant effects of RSM but not IS on adaptive functioning. Further research is necessary to determine which adaptive behavior subdomains are directly impacted by RSM and not IS behaviors. Furthermore it's important to determine if RRB severity differentially affects adaptive functioning to attempt to understand the impact of RRB's on the functioning of children with ASD.

175   **110.175** Grit in Children and Adolescents with Autism Spectrum Disorder

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Background:
Grit is defined as "perseverance and passion for long-term goals" and is composed of two primary factors: consistency of interests over time and perseverance of effort (Duckworth et al., 2007). Grit is strongly predictive of a variety of long-term positive outcomes, ranging from higher academic GPA to greater job retention (e.g., Duckworth et al., 2007; Eskreis-Winkler et al., 2014). Despite the long-term positive outcomes associated with grit, there are no studies in the extant research literature that have examined grit in children and adolescents with Autism Spectrum Disorder (ASD).

Objectives:
The aim of this study was to examine diagnostic group differences in grit between children and adolescents with ASD and typical development.

Methods:
Children and adolescents with typical development ($n = 8$) and ASD ($n = 10$), as well as their parents, participated in the current study. Children and adolescents ranged in age from 9-17. Diagnostic groups were matched on age, $t(16) = -0.96$, $p = 0.35$, verbal IQ, $t(16) = 1.62$, $p = 0.12$, performance IQ, $t(16) = 0.56$, $p = 0.58$, and gender, $\chi^2 (1, N = 18) = 0.68$, $p = 0.41$. Parents used the Short Grit Scale to report on their child's level of grit (Duckworth & Quinn, 2009). Preliminary ANCOVAs was used to evaluate the effect of diagnostic group (typical development vs. ASD), controlling for age and verbal IQ, on three dependent variables: the Grit Total Scale, the Consistency of Interests Subscale, and the Perseverance of Effort Subscale. As age and verbal IQ did not have a significant effect in any of the preliminary analyses, they were removed from the final analyses.

Results:
There was a significant effect of diagnostic group on the Grit Total Scale, $F(1, 16) = 7.42$, $p = 0.02$, $\eta^2_p = 0.32$, and the Consistency of Interests Subscale, $F(1, 16) = 19.35$, $p < 0.01$, $\eta^2 p = 0.55$, such that parents rated children and adolescents with typical development as being more gritty and having more consistent interests over time than children and adolescents with ASD. There was not a significant effect of diagnostic group on the Perseverance of Effort Subscale, $F(1, 16) = 0.34$, $p = 0.57$, $\eta^2 p = 0.02$.

Conclusions:
This study suggests that children and adolescents with ASD are less gritty than children and adolescents with typical development, due almost exclusively to less consistency in interests over time. Although children and adolescents with ASD consistently show restricted interests over time (e.g., Joseph et al., 2013), the specific nature of these restricted interests may change over time, making it difficult for children and adolescents with ASD to steadily focus on and pursue long-term goals. Old goals associated with old restricted interests may be replaced by new goals associated with new restricted interests, such that goals are regularly replaced and rarely attained. This research suggests that maintaining consistent interests over time may be integral to building grit in children and adolescents with ASD and attaining long-term social, educational, and/or vocational goals.

176   **110.176** Hobbies in Adults with ASD: An Exploratory Descriptive Analysis

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Background:
Hobbies make up an integral aspect of peoples' everyday lives. In neuro-typical individuals these activities foster social relationships, increase positive emotions, increase skill and knowledge

acquisition, and generally improve quality of life (Brajsa-Zganec & Merkas, 2011). Unfortunately, almost no research exists examining the nature of interests and hobbies in adults with ASD. Two studies suggested that adults with ASD engage in interests that are more "systemizing" than those of neuro-typical controls (Caldwell-Harris & Jordan, 2013; Jordan & Caldwell-Harris, 2012). However both studies used the Cambridge University Obsessions Questionnaire to either elicit or classify responses, potentially constraining the breadth of possible responses. Given the lack of empirical data on the interests and hobbies of adults with ASD, in order to gain a full understanding it is important to have adults with ASD identify their interests and hobbies without a priori structuring of response categories in a manner that reflect researchers' conceptualizations.

Objectives:
This study will describe the interests and hobbies of a sample of community-based, high-functioning adults with ASD. Understanding of the nature these interests and hobbies can lead to their integration into therapeutic programs for improving the communication, vocational and social skills of these individuals.

Methods:
Participants were 397 individuals between the ages of 21 and 73 years (M=37.2) who met a conservative cut off score of 32 on the Autism-Spectrum Quotient (Woodbury-Smith, Robinson, Wheelwright & Baron-Cohen, 2005) and completed an online survey. Participants were asked, via an open-ended question, to indicate their top five hobbies/ interests. Participants' hobbies were coded into six categories: Cognitive (e.g., video gaming; WWII history; reading), Social (e.g., my children; autism advocacy; sex), Physical (e.g., soccer; weight-lifting; walking), Passive Entertainment (e.g., listening to the radio; Japanese animation), Domestic (e.g., gardening; cooking; hobby farming) and Music/Cultural (e.g., composing music; going to the theatre). Category construction was based on previous research and overarching themes in the data.

Results:
First, we determined the number of hobbies participants identified. Of the 397 participants, 1% identified as having no hobbies, 23.4% identified hobbies fitting into only one category, 38.5% identified hobbies fitting into two categories, 28% identified hobbies fitting into three categories, 6.8% identified hobbies fitting into four categories, 0.8% identified hobbies fitting into five categories and 2.5% of participants indicated no hobbies or did not respond. Next we determined the relative frequency of the various categories. The most frequent type of hobby/interest reported was Cognitive (96.9%) followed by Physical (32.7%) and Music/Cultural (32.7%), Passive (22.5%), Domestic (20.2%) and Social (13.6%).

Conclusions:
The results demonstrate that interests are broader than typically conceptualized. That is, although many participants reported highly specific interests (e.g., geodesic domes; collecting 78 rpms records), many also reported a large number reflecting typical interests (e.g., snowboarding, reading, watching TV). These findings most likely reflect this study's open response format as well as the general focus on hobbies/interests as opposed to special interests. Implications for future research and clinical practice are discussed.

177 **110.177** Measuring Restricted Interests and Repetitive Behaviors in Infant Siblings at-Risk for ASD: Comparing Home Setting Versus Clinic Performance of 12 Month Olds

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Background:
Approximately 20% of younger siblings of children with autism spectrum disorder (ASD) are at an increased risk for developing ASD (Ozonoff, 2011). According to the DSM-5, ASD symptomatology involves restricted, repetitive patterns of behavior (RRB), interests, or activities; however, these indicators are not yet thoroughly researched in very young siblings. During the second and third year, repetitive hand and finger mannerisms become more pronounced among children with ASD and less pronounced among children with developmental delays (DD) and typical development (TD). (Chawarska & Volkmar, 2005; Evans et al., 1997; Moore & Goodson, 2003; Werner et al., 2005). More recently, Stronach and Wetherby (2012) examined RRB among toddlers at a mean age of 20 months in the clinic and home settings, identifying a higher presence of RRB in the clinic, given the nature of structured probes and repeated presentations of objects.

Objectives:
The purpose of this study was to examine the relationship between home observation and clinical assessment of RRB of 15 (projecting 25 by May 2015) 12-month old infants considered at risk for ASD, given sibling status.

Methods:
High-risk, 12-month old infant siblings were seen for communication assessments as part of a large, federally-funded longitudinal study examining risk and resilience in the first two years. The assessment battery included two samples of early social communication behavior: Communication and Symbolic Behavior Scales (CSBS-DP; Wetherby & Prizant, 1993) video-recorded in a clinic, and a video-recorded home observation. The Systematic Observation of Red Flags of ASD (SORF), an ASD-specific screening instrument, was used to rate early symptomatology within clinic and home

observations. Analysis included examining differences/similarities regarding 4 of the 22 SORF red flags, specifically: (1) repetitive movements with objects, (2) repetitive body movements/posturing, (3) sticky attention to objects, and (4) unusual sensory exploration/excessive interest in sensory aspects of environment. Differences in SORF values between clinic/home observations were assessed using paired t-tests and Wilcoxon signed-rank tests. Pearson's correlation was utilized to gauge linear association between total clinic/home SORF results.

Results:
Pearson's correlation indicated a moderate but non-significant association between total red flags on home SORF and clinic SORF ($r = 0.302$; $p = 0.246$). However, total red flags on home SORFs were significantly lower than clinic SORFs, ($p = 0.006$). Clinic SORFs picked up significantly more RRB red flags than home SORF ($p < 0.001$). There was no significant difference for Social Communication and Social Interaction Impairment items on the clinic SORF versus home SORF ($p = 0.060$). In addition, clinic SORFs revealed significantly higher scores than home SORFs for RRB items including: repetitive movements with objects ($p = 0.010$), repetitive movements or posturing of body ($p = 0.005$), sticky attention to objects ($p = 0.026$), and unusual sensory exploration/excessive interest in sensory aspect of environment ($p = 0.016$).

Conclusions:
Findings suggest that while the CSBS is primarily examining communication, structured tasks involving objects and communicative temptations may reveal increased amounts of RRB, and therefore, expose earlier symptomatology and provide more quantitative assessment of red flags in this diagnostic domain.

178 **110.178** Modeling Higher-Order Repetitive Behavior in the C58 Mouse Strain

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Background: The diagnostic domain of restricted, repetitive behavior (RRBs) represents a heterogeneous set of behaviors but has been shown to cluster into two subtypes: lower-order repetitive body movements (e.g., hand flapping) and higher-order repetitive behavior, such as circumscribed interests and insistence on sameness. Most work with mouse models relevant to the repetitive behavior in ASD have focused on lower-order repetitive behaviors with less attention to modeling higher-order repetitive behaviors. The C58 inbred mouse strain exhibits a robust lower-order repetitive behavior phenotype involving high levels of hindlimb jumping and backward somersaulting (Muelhman et al., 2012; Ryan et al., 2010). This model has yet to be systematically characterized for the presence of higher-order repetitive behaviors. Understanding the pathophysiology of the full range of repetitive behaviors is critical to identifying therapeutic drug strategies for individuals with ASD.
Objectives: The purpose of this study was to extend characterization of the C58 animal model to include higher-order repetitive behavior by examining resistance to change or inflexibility using reversal learning of a positional discrimination as well as extinction of this conditioned behavior. C58 mice were compared to control (C57BL/6) mice on these measures using an appetitive operant nose-poke task.
Methods: C58 (n=11) and C57BL/6 (n=8) mice of both sexes were tested for lower-order motor stereotypy at 8 weeks of age. At 9 weeks of age, all mice were food deprived across 3-4 days to approximately 85% of their free feeding weight and behavioral testing sessions were conducted daily. Each session was 70 minutes, which included a 10 minute habituation session in the operant chamber with the house light off prior to each 60 minute operant session. During the operant testing, mice were reinforced on a fixed ratio schedule (FR1) to either the right or left side of the operant chamber. Once a mouse met acquisition criterion of 85% correct for 4 consecutive days, reversal learning was tested by switching the nose poke side associated with reinforcement. Once the reversal learning criterion was reached (85% correct, 4 consecutive days), the mouse entered the extinction phase and nose pokes to either side of the chamber did not result in reinforcement.
Results: Our findings demonstrated that C58 mice had greater difficulty in switching during reversal learning and exhibited higher rates of perseverative responding during extinction compared to C57BL/6J mice. Additionally, frequency of hind limb motor stereotypy was directly correlated with perseverative errors.
Conclusions: Overall, these findings suggest that C58 mice demonstrate cognitive inflexibility relative to C57/BL6 mice and that the two forms of RRB may have overlapping neurocircuitry. Futhermore, these data show the viability of the C58 stain as a model for both higher-order and lower-order repetitive behavior. Extending animal model work to include higher order repetitive behavior is critical to identifying the underlying novel potential therapeutic targets that can be used in the development of pharmacotherapies for ASD.

179 **110.179** Obsessive and Circumscribed Patterns of Interest (OCPI) of Children with Autism Spectrum Disorder

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Background:
Obsessive and circumscribed patterns of interest (OCPI) have been a hallmark of Autism Spectrum Disorder (ASD) across diagnostic systems and eras. Studies of OCPI in ASD have been mostly conducted with small samples of high-functioning adolescents. There is little information on the prevalence or expression of OCPI in ASD from large, well-defined, populations. By specifying systematic aspects of OCPI, it may be possible to develop interventions to improve the social and communication skills of individuals with ASD.
Objectives:
The objectives of this study were to: determine the prevalence of OCPI in a large cohort of ASD children, assess whether there were demographic or functional differences between ASD children who exhibited OCPI and ASD children without indication of OCPI and to describe the most frequent topics of OCPI, among children with ASD.
Methods:
A complete cycle (2010) of data from ASD surveillance in the New Jersey metro region, according to the Centers for Disease Control and Prevention (CDC) multiple source ascertainment method was analyzed for the presence of OCPI. OCPI was defined as one or more indications of such interest, in one or more professional evaluations. Sex, and race information was recorded from the source documents. Cognitive status and severity of ASD impairment were derived from source documents and the standard ASD case determination process. Chi-square tests were used to determine if race, sex, IQ and level of impairment were associated with OCPI. Subjects with only non-specific indication(s) of OCPI were removed from further analysis. The topics of OCPI were described by percentiles.
Results:
Overall, 401 (males = 340, 85%; females = 61, 15%) in a total population of 696 (58%) 8-year old children with surveillance-confirmed ASD had documented OCPI in professional evaluations, through age 8. Sex was not associated with the likelihood of displaying OCPI, but race was associated with likelihood of OCPI. White non-Hispanic, children were more likely to exhibit OCPI than African-American non-Hispanic and Hispanic children (p<.01). Level of impairment due to ASD and cognitive level were not associated with the likelihood of displaying OCPI. Each specific indication of OCPI was sorted into a category based on preferred topic: vehicles (17%), television shows (15%), reading/letters (11%), animals (6%), time/clocks (6%), videogames (5%), dolls (1%) and balls (1%).
Conclusions:
A significant proportion (approximately 60%) of ASD children showed OCPI prior to age 9, underscoring the relevance of this area of impairment. White children were more likely to have OCPI. Additional study is needed to understand this association and to determine the extent to which OCPI varies with age. The most frequently-occurring topics of OCPI: vehicles, television shows and reading/letters were identified in only 17%, 15% and 11%, respectively, of the children with OCPI indicates the significant diversity of the topics of OCPI across ASD children. Additional research is needed to assess the relation of OCPI to other features of ASD and to determine how awareness of an individual's OCPI can be used to develop approaches aiming to enhance the functional status of individuals with ASD.

180   **110.180** Repetitive Stereotyped Behaviour or "Stimming": An Online Survey of 100 People on the Autism Spectrum

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Background:
Repetitive stereotyped behaviour is often described as a core symptom of autism spectrum disorder. There is, however, a disparity between how the scientific and broader autism communities view and describe these behaviours. Within the autism community, so-called repetitive behaviours are commonly described as "stimming", and are considered an important coping mechanism. Also, many self advocates describe autism as an important part of themselves and inseparable from the rest of them (just like gender or sexuality) and therefore, for some, stimming would be considered part of this identity. Yet many of these reports are anecdotal, which means we know very little of peoples' actual experience of stimming.
Objectives:
This research, conducted by an autistic self-advocate, sought to understand the experiences of stimming from people on the autism spectrum, specifically why the person feels that they stim, whether there are any benefits/pifalls, and whether they need additional support.
Methods:
100 participants, ranging in age from 16 to 65 years, completed a 10-item online survey anonymously. Of the 100 participants, the majority (75%) had a formal diagnosis of an autism spectrum condition, and the remaining were self diagnosed, in the process of obtaining a diagnosis or answering on behalf of their autistic children. Participants were largely female (66%). participants were asked a range of questions, including why they stimmed, what kind of stims they had, had they been asked not to stim, and if they had always stimmed.
Results:
Across participants, there were 11 types of commonly observed stims. The most commonly reported included rocking (48.94%), leg shaking (48.94%) and foot shaking (47.87%). In addition, people listed 73 other types of repetitive routine behaviours, compiled in Figure 1. Participants offered a wide

range of reasons for why they stim. The most commonly cited reasons were to reduce anxiety (71.88%), calm down (68.75%) and when overstimulated (57.29%). 80% of participants said they liked to stim generally or sometimes, 9% said they did not like to stim, and 11% said it depended on the stim.

Conclusions:

People on the autism spectrum have a wide range of reasons for stimming, many of which suggested that they viewed stimming as a coping mechanism. Future research should extend this research to researchers and professionals in order to examine potential differences between autism and researcher/practitioner communities. Such research could provide a stimulus for discussion of the value of such behaviours in the lives of people on the autism spectrum.

181   **110.181** Restrictive and Repetitive Behaviors in Young Children with Autism:

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Background: Restricted and repetitive behaviors (RRB) comprise one of two core symptom domains in DSM-5 Autism Spectrum Disorder (ASD; American Psychiatric Association, 2013). RRBs reportedly decrease with age across the life span (e.g., Esbensen et al., 2009) but may develop or remain constant in young children with ASD (Harrop et al., 2014). Further, parents report their child's RRB differently than clinicians (Lemler, 2012). Additional research is necessary to characterize the nature of the relationship between age and RRBs in young children with ASD and by informant.

Objectives: To investigate (1) the relationship between RRBs and age in young children with ASD, and (2) correlations between parent and clinician ratings of RRBs.

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 Repetitive Behavior Scale- Revised (RBS-R; Lam & Aman, 2007) with six dimensions: stereotyped, self-injurious, compulsive behaviors, ritualistic, sameness and restricted interests plus a total score and demographic forms. The Autism Diagnostic Observation Schedule, 2nd edition (ADOS-2; Lord et al., 2012) and Ohio Autism Clinical Impression Scale (OACIS; Butter & Mulick 2006) were administrated by trained, research reliable project staff. This sample includes 45 children (80% male) ages 2-10 ($M = 4.7$ years; $SD = 2.4$), 31% Hispanic, 20% autistic disorder, 2% Asperger's, 16% pervasive developmental disorder, and 56% autism spectrum disorder (all cases validated by positive ADOS-2) and their primary caregivers. Regression analyses were conducted to examine child age associated with each outcome variable. Age groups were constructed: 2 yrs, 3-4 yrs and 5+ yrs; to compare RRBs by age and informant. Pearson correlation coefficients were used to examine relationships between the three measures for each age group.

Results: There was a significant positive relationship between age and both clinician rated scales and parent rated scale, total score on RBS-R, such that as age increases, scores on the RRB measures also increase (see Tables 1 & 2 for all results reported in this section). There was no correlation between any of the RBS-R subscales or total score with clinician rated measures for the overall sample indicating poor agreement of RRBs between parent and therapist. When comparing age categories, a few RBS-R subscales became correlated with clinician ratings. However, these results should be considered exploratory at this point due to the small n per group.

Conclusions: Findings suggest that age is associated with an increase in RRBs for young children with ASD. Overall, there were few reports of RRBs in toddlers compared to preschoolers and children. Additionally, there was poor agreement on RRBs between parent and trained clinical observer. This suggests that age and RRB likely have a unique relationship in early development, perhaps because RRBs are still emerging and may not be as apparent in the youngest age groups. The finding that parent report of RRBs does not correlate with clinician report of RRB also suggests that further research is needed to determine potential factors influencing this disparity.

182   **110.182** Sensory Processing Patterns in Dyads of Children with ASD and Their Parents

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Background: Sensory atypicalities are commonly reported in individuals with autism spectrum disorder (ASD) and their siblings (De La Marche et al., 2012; Leekam et al., 2007); and are included in the diagnostic criteria for ASD (APA, 2013). Heritability of sensory sensitivity has been shown in the general population (Goldsmith et al., 2006) however only one study has reported elevated levels of sensory atypicalities in parents of children and adolescents with ASD (Uljarevic et al., 2014). To date, the relationship between sensory atypicalities in dyads of children with ASD and their parents has not been investigated. Exploring the relationship between sensory processing difficulties in parents of children with ASD and their offspring is critical to understand how phenotypic profiles may be inherited within families.

Objectives: The aim was to explore the profile of sensory processing in child-parent dyads within ASD families.

Methods: Parents of 45 children with ASD, with and without learning disability (LD), aged between 3 and 15 years, and 31 parents of typically developing (TD) children aged between 4 and 13 years were recruited. Parents were asked to complete the Sensory Profile (SP; Dunn, 1999) to provide information about their children's sensory experiences and the Adolescent/Adult Sensory Profile (AASP; Brown & Dunn, 2002) to self-report their personal reactions to sensory events. They were also asked to complete the Social Responsiveness Scale (ASD families, SRS; Constantino & Grubber, 2005) or the Strengths and Difficulties Questionnaire (TD families, SDQ; Goodman, 1997).
Results: Children in both ASD groups (with and without LD) were reported by parents to show significantly more sensory atypicalities than their typically developing peers in all areas of sensory processing. 93.5% of parents of children with ASD reported themselves to have reactions to sensory events different from typical norms by at least 1SD in one or more sensory quadrants (Registration, Seeking, Sensitivity, and Avoiding). Significant group differences for the current cohort were found in the Sensitivity quadrant, where parents of children with ASD and LD had higher scores than parents of TD children ($F_{(2,73)}$=3.431, p=.038). There were no significant differences in any other sensory quadrant scores. Significant correlations were found in the TD dyads for Registration and Sensitivity scores (r=-.59, p<.001; r=-.45, p=.014 respectively). Intraclass Correlation Coefficient analysis (two-way mixed, consistency) did not show significant agreements for any sensory processing pattern between parent-child dyads in any subgroup.
Conclusions: This is a first study to investigate sensory processing atypicalities among parent-child dyads in ASD and TD families. The findings suggest that sensory processing patterns in parents of children with ASD and TD are similar and that there is a lack of association between parent-child scores in any of the sensory quadrants. These results have important theoretical and clinical implications. Familial factors are unlikely to play an important role in the development of the sensory difficulties for children with ASD. Further work is needed to explore genetic and environmental influences on developmental pathways of the sensory atypicalities in ASD.

183 **110.183** Sensory Processing Patterns, Activity Choice and Participation of Children with Autism Across Ireland

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Background:
Participation in daily activities is fundamental to children's social, cognitive and physical development (Law et al., 2004). Many studies highlight that children and young people with autism participate less frequently in less diverse activities than children with other developmental disabilities and typically developing peers (Rodger and Umaibalan, 2011; Marquenie et al., 2011; LaVesser and Berg, 2011; Houchhauser and Engel-Yeger, 2010; Hilton et al., 2008),
Participation in all activities of daily living requires exposure to a plethora of sensory stimuli. Previous research suggests that the sensory preferences of children with autism are related to decreased participation in school, social, physical, leisure and family activities (Zingervich and LaVesser, 2009; Hochhauser and Engel, 2010; Bagby et al., 2012). However, these studies used small sample sizes and are limited by geographic location; no large scale research has investigated the impact of sensory preferences on activity choice and participation of children with autism in Ireland.
Objectives:
The purpose of this study was to determine the relationship between the sensory preferences of children with autism and the types of activity which they choose to participate in and to examine if the level of participation in these activities is affected by sensory preferences.
Methods:
Ethical approval was gained from the University of Ulster Ethical Filter Committee. A convenience sample of parents of children with autism were recruited from all over Ireland (N = 161) through Middletown Centre for Autism. Participants completed and returned two questionnaires, Participation and Environment Measure -Children and Youth (Coster et al., 2010) and the Sensory Profile (Dunn, 1999). All data were analysed using SPSS software (Version 21). Descriptive statistics were used to determine the type and frequency of participation in each activity and to identify the sensory characteristics of the population. Multiple regression was used to examine the extent to which sensory preferences and family demographics were related to the PEM-CY categories.
Results:
This study demonstrated significant relationships between sensory processing patterns and participation and engagement in activities. Multiple regression analysis revealed that having atypical responses to sensory stimuli accounted for a small (<20%) but significant (p<.05) amount of the variance in the frequency and intensity children with autism engaged in a range of activities.
Conclusions:
Results of this study contribute to current knowledge by suggesting that sensory preferences influence the frequency and level of engagement children with autism participate in a range of activities in the home, school and community environment.

184 **110.184** Sensory Response Patterns As Predictors of Adaptive Outcomes in Children with ASD or

Other Developmental Disabilities

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Background: Sensory response patterns of hyperresponsiveness, hyporesponsiveness, and sensory seeking are highly prevalent in children with autism spectrum disorder (ASD) (Baranek et al, 2006; Ben-Sasson et al., 2009; Wiggins et al, 2009). Among children with ASD and other developmental disabilities (DD), significant concurrent negative correlations have been found between hyporesponsiveness and social adaptive skills as measured by the Vineland Adaptive Behavior Scales (Watson et al., 2011). Hypothetically, disruptions of sensory processing impact the development of adaptive skills; longitudinal research on associations between early sensory patterns and later adaptive outcomes can provide support for this hypothesis.

Objectives: (1) to determine the predictive association between earlier sensory response patterns and later adaptive behavior outcomes among children with ASD and DD; (2) to determine whether these associations differ by group.

Methods: The study included 57 children with ASD and 34 with DD. At Time 1 (ages 2 – 12 years), two parent report measures (Sensory Experiences Questionnaire, Sensory Profile) and two observed measures (Sensory Processing Assessment, Tactile Defensiveness and Discrimination Test-Revised) were used. Adaptive outcomes were measured at Time 2 (3-5 years later) with the Vineland Adaptive Behavior Scales (VABS). Separate general linear models were run for the two parent report measures (combined) and the two observed measures (combined) to examine the predictive association between Time 1 hyporesponsiveness, hyperresponsiveness, and sensory seeking and Time 2 VABS Daily Living, Communication, Socialization and Adaptive Behavior Composite (ABC) scores. An interaction term for diagnosis (ASD/DD) and covariates (child's age, IQ, gender, time between assessments, mother's education and income) were included in each model.

Results: Parent-reported hyporesponsiveness and sensory seeking at Time 1 were significantly negatively related to VABS Communication, Socialization and ABC scores at Time 2 when accounting for all covariates. Behaviorally observed sensory response patterns at Time 1 did not predict Time 2 VABS scores. A significant interaction emerged between Time 1 observed hyperresponsiveness, diagnosis, and Time 2 VABS Socialization scores; for children with DD, as Time 1 hyperresponsiveness increased, Time 2 VABS Socialization scores decreased, whereas children with ASD showed the opposite linear trend.

Conclusions: The results suggest that earlier patterns of heightened sensory hyporesponsiveness and sensory seeking negatively impact later adaptive behavior outcomes, especially in the domains of communication and socialization skills, both for children with ASD and those with other DD. However, heightened sensory hyperresponsiveness at Time 1 is only associated with poorer adaptive outcomes for children with other DD. The finding that only parent-reported measures, but not observational measures, of sensory response patterns predicted adaptive outcomes in most models supports the importance of involving parents in the assessment process, in order to get more complete information on an array of sensory responses that may be difficult to fully elicit and observe in a clinical setting.

185   **110.185** Stability of Sensory Subtype One Year Following Diagnosis of Autism Spectrum Disorder

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Background:
Distinct patterns of sensory features, known as sensory subtypes, have been identified in children with Autism Spectrum Disorder (ASD; Ausderau et al, 2014; Lane et al, 2014). Both studies - conducted independently and using different measurement tools - conclude that sensory features in ASD vary based on the severity of parent-reported symptoms, the nature of the sensory response and the sensory modalities affected. Taken together, the findings of these studies suggest that sensory subtypes may provide a profitable method of identifying clinically meaningful ASD phenotypes. The stability over time of classifications made on the basis of sensory subtype, however, has only been examined in a longitudinal design in a single cohort of individuals with ASD who were at varying points along their care pathways (Ausderau et al, 2014). While this study found that subtype membership was stable over time, previous cross-sectional research has suggested that sensory symptoms tend to become less severe with age. Further longitudinal analysis of change in sensory symptoms is warranted particularly as it relates to participation in therapy. Sensory features are a primary target for autism-specific interventions and, therefore, may be expected to vary in presentation as a function of length of time in therapy.

Objectives:
The purpose of this study was to examine the stability of sensory subtype classification one year immediately following ASD diagnosis. We hypothesized that in one-year following diagnosis, sensory symptoms would be less severe than that reported at diagnosis.

Methods:
Participants (n=62) were children aged 2-10 years presenting to a major, Midwestern autism specialist center for diagnostic assessment between 2008 and 2010. All participants were

administered the Short Sensory Profile (SSP) at diagnosis. This tool assesses parent-report of sensory symptoms from which sensory subtypes can be derived (Lane et al, 2014). One year following diagnosis, the SSP was re-administered. Participants were assigned to one of four sensory subtypes at each assessment point: 1) Sensory Adaptive, 2) Taste Smell Sensitive, 3) Postural Inattentive, or 4) Generalized Sensory Difference. A further classification of sensory symptom severity was made. Specifically, 'mild' severity comprised members of Sensory Adaptive; 'moderate' severity comprised members of Taste Smell Sensitive and Postural Inattentive; and 'severe' severity comprised members of Generalised Sensory Difference. We assessed the agreement in classification of sensory subtype and sensory severity between diagnosis and one-year follow-up using the Kappa statistic with 95% confidence intervals.

Results:
There was little evidence of change in sensory subtype classification from diagnosis to one-year follow-up (65% of participants remained in the same subtype; Kappa = 0.51, 95% CI: 0.34, 0.67). Further, most participants did not change sensory severity classification from diagnosis to one-year follow up (74% of participants remained in the same severity category; weighted Kappa = 0.52, 95% CI: 0.32, 0.72).

Conclusions:
The findings of this study suggest that sensory subtype as measured by parent-report is stable one-year following diagnosis. We did not observe significant abatement in sensory symptom severity in this timeframe.

186 **110.186** Stress Regulation in Children with Autism Spectrum Disorders (ASD): A Scoping Review

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Background:
Autism spectrum disorders (ASD) are characterized by difficulties with social interaction and communication. In addition, individuals with ASD tend to have limited interests and repetitive behaviors, which is often reflected in having trouble adapting to changes in routine or environment. The major neuroendocrine system that modulates our ability to react emotionally and physiologically to change and to the stress caused by a novel or challenging environment, is the hypothalamic-pituitary-adrenal (HPA) axis.

Objectives:
The present review aims to investigate the responses of cortisol, a neurobiological stress hormone reflecting HPA axis activity, in children with ASD.

Methods:
The review is organized around four main themes: the cortisol awakening response (CAR), diurnal cortisol variation, cortisol responses to stress and interventions affecting cortisol levels in children with ASD.

Results:
Our analysis of the literature shows strong indications that cortisol levels in children with ASD follow the same pattern as in children without ASD. This means that, similar to typical developing (TD) peers, children with ASD have a diurnal decrease in cortisol, with higher cortisol concentration in the morning than in the evening. Some studies found no differences in the overall level of cortisol in children with ASD compared to children without ASD, while others reported significant higher cortisol levels in children with ASD during the evening or the whole day.

Studies on the evaluation of the CAR in children with ASD are inconsistent. Some suggest that the CAR is mostly absent, while other studies indicate that are no differences in the magnitude, variability or presence of the CAR when compared to typically developing peers.

While children without ASD tend to show an increase in cortisol in response to the child version of the Trier Social Stress Test (TSST-C), children with ASD have been reported to display a reduced cortisol response. There also exists evidence that a playground social stressor or interactions with unfamiliar peers may provoke significantly higher activation when compared to TD children.

Furthermore, children with ASD and TD children potentially also differ in recovery from a social stress environment, as typical developing children showed a significant reduction in cortisol over time, whereas children with ASD maintained an elevated cortisol level. Nonsocial stimuli such as placement in a mock MRI or a blood draw stressor are associated with significantly greater reactivity of the HPA axis in children with ASD as compared to children without ASD.

Physical exercise and relaxation sessions tend to deliver a short-term reduction in levels of cortisol in children with ASD, but long-term significant reductions have not been found. Theatre-based and peer-mediated intervention programs have proven to yield a decline in cortisol by the end of treatment, but also during post-treatment situations.

Conclusions:
This analysis of the literature shows that altered stress regulation and HPA axis activity as measured by cortisol concentrations could form a promising biomarker for ASD, but more research is needed if we would like to understand the complex relationship between stress regulation and ASD.

187 **110.187** The Hardness of Standing Support Surfaces Influences Tip-Toe Behavior of Autistic Children: Evidence from a Pilot Study

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Background: As demonstrated in a previous study, 32% of autistic children observed in our Institute walk on their tiptoes (tiptoe behavior-TTB). TTB may occur in three modalities: class 1(TTB in standing, walking and running); class 2 (TTB in walking and running) and class 3 (TTB only during running). Thus far, the literature has yet to publish a standardized clinical method of assessment to "quantify" TTB during standing or walking.

Objectives: The aims of this pilot study are: 1) to propose a protocol to quantify TTB and 2) to assess whether the hardness of standing support surfaces influences motor behavior in children with ASD

Methods: Seven autistic children with TTB (6 males), age range from 7.1 to 16.4 years diagnosed according to the criteria of DSM V were admitted to this study. All subjects presented an ankle dorsiflexion range of motion wider than 90°. Video recordings were taken during a static task (playing in front of a playing table for 3 minutes) and during a dynamic task (transporting an object from the playing table to a therapist situated 2 meters away and back again for 15 times) over a hard floor surface. Each task was repeated on three different days. The three repeats were repeated again on a soft floor surface (foam mat). An independent therapist not involved in tests operation assessed the videos of the static task trials by calculating the time spent on full foot support versus on tiptoes. The videos of the dynamic task trials count the number of times the child was able to walk the full length with all steps on full foot support versus toe walking.

Results: On the hard floor surface, during the static tests, the subjects stayed on tiptoes for an average of 45.5/180 sec. During the dynamic tests the children toe walked an average of 23.6/30 times of the measured lengths. On the soft floor surface, during the static trials, the children used tip toe posture for an average of 24.6/180 sec. Meanwhile, during the dynamic trials they tiptoed an average of 11.2/30 times of the measured lengths. The p value of the differences were 0.11 for static tests and 0.008 for dynamic tests. The repeat observation values were consistent and reproducible.

Conclusions: The proposed evaluation protocol seems to be a useful tool to monitor TTB behavior. Footing on soft surfaces induces an increase in the time spent on non TTB during static and dynamic tasks. This finding suggests that TW is a reflection of a sensory integration dysfunction or of a vestibular derangement. Further evaluation is needed to clarify the potential pathophysiological implications of this phenomenon.

188   **110.188** The Relation Between Restrictive and Repetitive Behaviors and Family Routine Among Families of Children with Autism

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Background:

Interventions aimed to benefit children with autism spectrum disorder (ASD) often emphasize the importance of implementing structure in the home environment (Wetherby & Woods, 2006). These interventions seek to increase predictability for children, thus reducing the potential for anxiety and ensuing challenging behaviors (Vismara & Rogers, 2010). While numerous studies have cited the benefits of routine implementation, little literature has examined the relation between specific characteristics of ASD and family routine (DeGrace, 2004; Schaaf, 2011). Of specific interest is the presence of insistence on sameness and ritualistic behaviors, which are categories of behaviors within the broad core characteristic of restrictive interests and repetitive behaviors (RRBs). Individuals with ASD who exhibit ritualistic behaviors and insistence on sameness seek to maintain rigid and highly routinized environments; however it remains unclear whether these behaviors are related to family structure and routine. The examination of this relation would help to shed light on when and for whom the implementation of family routine is likely to be most beneficial.

Objectives:

The present study sought to examine the relation between restrictive and repetitive behaviors (RRBs) among children with autism and the level of family routine implemented by their parents.

Methods:

Parent responses to the Repetitive Behavior Scale (RBS; Lam & Aman, 2007) were used to assess insistence on sameness and ritualistic behaviors and the Stability of Activities in the Family Environment (SAFE; Israel & Roderick, 2001) to assess family routine among a sample of parents of children with autism. The SAFE specifically measures the regularity of family activities and routines that occur both in the home (e.g. family meals), as well as family supported activities that occur outside the home or without family members. A rating of the overall regularity of routines and activities in the child's household was used to operationalize family routine for the purposes of the current study. A link to the survey was disseminated via e-mail to parents throughout New York State who were subscribed to a university autism center's mailing list. Additionally, a link was posted on the center's website and in a parent organization's newsletter. Data from 68 parents who completed the online survey were compiled and entered into a database for statistical analysis. A multiple linear regression was run to evaluate the predictability of child RRBs for family routine.

Results:

Multiple regression revealed that child insistence on sameness and ritualistic behaviors significantly

predicted family routine, $F(1,66)=5.597$, $p=.021$. The two predictor model accounted for eight percent of the variance in parent report of overall family routine.
Conclusions:
Results suggest that RRBs are significantly predictive of family routine. This finding may indicate that families of children with autism accommodate their children's symptoms of rigidity by adhering to routines in the home. Future longitudinal studies should be conducted to evaluate the directional nature of the relation, thus disentangling whether parental accommodation to child rigidity may reduce child flexibility over time.

189 **110.189** Toe Walking and Autism: Cross-Sectional Study on Presentation Patterns and Correlation with Autism Severity

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Background: According to the literature, about twenty per cent of individuals with autism walk on their tiptoes. "Toe walking" (TW) may present different functional patterns but thus far, there is no standardized clinical method of examination or assessment. Some authors describe TW as intermittent or persistent , while others grade TW by history and observation (e. g. absent, present in the past, intermittently present, and persistent). Moreover, it seems that the persistence of toe walking can be related to language impairment even if systematic observations in the literature are scarce.
Objectives: The aims of this cross-sectional study are: 1) to assess the prevalence of toe walking in an ASD cohort; 2) to describe the functional patterns of presentation of TW; 3) to evaluate the relationship between TW presentation patterns and the severity of autism with particular regard to language delay.
Methods: The study includes sixty nine consecutive children (56 males; 13 females; mean age = 12,4 years) diagnosed with Autism according to the DSM V criteria and under observation at our institute. A therapist assessed the presence of Tiptoe behavior(TTB) during standing, walking and running using direct observation and interview of the main caregiver living with the children. The severity of autism was established through ADOS (2^{nd}version)
Results: Overall: 22 children (31,88%) presented TTB. Ten children (14,49%) exhibited it while standing, walking and running (class 1), four (5,79%) only during walking and running (class 2) and eight children (11,59%) only during running (class 3). The overall ADOS mean score of all the children was 21.14 (7.93 SD). The ADOS mean score of non TTB children was 20.09 (7.66) vs a value of 23.41 (8.5 SD) in TTB children. There were no significant differences in the mean overall ADOS score of the TTB children according to the three TTB classes 24.9 (9.0 SD), class1 vs 20.25 (7.5 SD), class 2 and vs 23.13 (8.38 SD), class3. We divided the children in four groups, depending on the level of the language, according to the ADOS system: fluent language, able to produce simple sentences, able to produce single words, absence of any language(nonverbal). 44.6% per cent of non TTB children and 72.7% of TTB children were nonverbal (p<0.05). However, language delay severity was not correlated to the severity of TTB.
Conclusions: TTB frequently manifests itself in individuals with Autism. It may occur in three mutually exclusive modalities, which include what is commonly defined toe walking. The presence of TTB is not correlated to autism severity but rather to language delay.

Oral Session
111 - Keynote Address - Lifetime Achievement Awardee
4:00 PM - 5:30 PM - Grand Ballroom

Keynote Address - Lifetime Awardee

4:00 **111.001** Awards Ceremony

4:30 **111.002** Advocate Awardee Address
M. Barua, *Action For Autism, New Delhi, India*

5:00 **111.003** Lifetime Achievement Awardee Address
L. Schreibman, *University of California, San Diego, La Jolla, CA*

Oral Session
112 - New Insights into Social Intervention
1:45 PM - 2:35 PM - Grand Ballroom B

Session Chair: Nirit Bauminger-Zviely, *Bar-Ilan University, Ramat Gan, Israel*

1:45 **112.001** A Randomized Wait-List Control Trial of a Peer-Mediated, Theatre-Based Intervention to Improve Social Ability in Children with Autism Spectrum Disorder

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Background: Four interacting levels have been proposed involving the social brain, cognition, behavior, and functioning to explain variance in social ability. Impairment in social ability is central to autism spectrum disorder (ASD); therefore, treatments developed to improve social skills should aim to assess, treat and measure change across these levels. In the current intervention study, event related potentials (ERP) were used to measure brain activity, a neuropsychological task (NEPSY) measured cognition, direct group play observation measured behavior, and questionnaires measured social functioning to examine the complex construct of 'social ability'.
Objectives: The purpose of the study was to evaluate and extend the impact of a peer-mediated, theatre-based intervention on children with ASD with an emphasis on social functioning. The 10-session program incorporates theatrical approaches, trained typically developing peers and established behavioral strategies. Previous studies using pre-post designs have reported improvement in several skills, such as face memory, theory of mind and social cognition. A primary objective of this investigation was to utilize a true experimental design while evaluating social ability across multiple levels of analysis including neuropsychological, cognitive, behavioral, and functional outcomes.
Methods: Participants included 30 youth with ASD between 8 to 16 years randomly assigned to the Experimental treatment group (EXP, N = 17) and Wait-list control group (WLC, N = 13). Measures included ERP (incidental memory), cognitive (memory for faces immediate and delayed), behavioral (group play) and functional (Social Responsiveness Scale, SRS) conducted before and after treatment and at a two-month follow-up. An Analysis of Covariance (ANCOVA) model was used in which the post-intervention score served as the outcome variable, group (experimental or waitlist control) as a main independent variable, and baseline (pre-intervention) score as a covariate.
Results: Significant differences were observed between the EXP and the WLC groups on memory for faces immediate (MFI) $F_{(2,28)} = 4.02$, $p = 0.05$ and memory for faces delayed; MFD) $F_{(2,28)} = 6.01$, $p = 0.02$. Moreover, significant differences were observed on an incidental memory ERP task in which the EXP group showed increased parietal response to repeated faces, which was not observed in the WLC group $F_{(8,122)} = 2.63$, $p=.01$. Differences were also observed in group play behavior $F_{(2,28)}$, 4.35, $p = 0.04$. Regarding social functioning, significant differences were observed on the SRS (e.g., Social Communication $F_{(2,28)}$ 5.37, $p = 0.03$), and gains were maintained at follow-up.
Conclusions: The study replicates and extends previous findings showing that the theatre-based intervention contributes to improvement in core areas of social ability for youth with ASD. In particular, gains in memory for faces and social interaction skills have been consistently demonstrated supporting the strong link between social cognition and behavior and how improvement in one level of processing can result in gains on another. The findings suggest that the intervention results in increased salience for social information even in the absence of explicit instruction. The importance of peer-mediation, reciprocal social engagement and active practice of socialization are discussed within the context of the findings.

1:57 **112.002** Students' Evaluation of an Autism Peer Education Program: Initial Impressions of the KIT for Kids

K. A. Scheil[1], J. Campbell[2], J. Bowers-Campbell[3], M. C. Davis[4], E. Caldwell[4] and R. Jacob[4], (1)Psychology, University of Kentucky, Lexington, KY, (2)Department of Educational, School, and Counseling Psychology, University of Kentucky, Lexington, KY, (3)Georgetown College, Georgetown, KY, (4)University of Kentucky, Lexington, KY

Background: The prevalence of autism spectrum disorders (ASD) is roughly 1 in 68 children. The increased identification of students with ASD has implications for public education as access to general education and instruction in the least restrictive environment are legal rights. Recent reports indicate that approximately 30-40% of elementary and middle school students with autism receive at least some of their instruction in general education settings. As such, students with ASD and typically developing peers will likely encounter each other during school hours. The practice of inclusive education for students with ASD is based upon protecting children's educational rights and, in part, improving social acceptance. Despite the potential social benefits of inclusion, inclusive education has yet to yield robust and consistent improvements in attitudes, social acceptance and social status for students with ASD. The Kit for Kids (KfK) was developed by the Organization for Autism Research (OAR; see attached Figure) in order to provide evidence-based educational messages to elementary and middle school students to improve peers' knowledge, initial attitudes, and behavior towards students with ASD.
Objectives: Investigators documented elementary and middle school students' initial impressions of

the KfK materials using a (a) 5-point rating scale and (b) semi-structured interviews. The overall goal of the research was to conduct an initial evaluation of the materials, particularly students' reactions to the materials and suggestions for improving peer education efforts on behalf of students with ASD. Methods: Researchers delivered the KfK program to five classrooms, two 8th grade classrooms and three 5[th]grade classrooms. One week later, 15 students, three per classroom, were randomly selected to complete (a) ratings of the materials and (b) semi-structured interviews about their impressions of the materials. Students rated the (a) information presented, (b) booklet, and (c) poster on a 5-point scale ["Excellent" (5) to "Poor" (1)]. Responses to the interviews were audio recorded, transcribed, and coded according to grounded theory.
Results: All selected students consented to take part in the project. Participant ages ranged from 10-15 years (M = 12.2 years; SD = 1.5). Participants rated the information (M = 4.53; SD = 0.64), booklet (M = 4.53; SD = 0.64), and poster (M = 4.53; SD= 0.64) favorably, with average ratings falling between the "Good" to "Excellent" range. Student responses were organized into nine familial codes that reflected students' impressions of the messages and quality of the materials. Students recalled specific details from the presentation regarding: sensory symptoms associated with ASD, a need to understand students with autism to change their behavior to support them in the classroom, and understand services delivered within the educational environment to support students with ASD.
Conclusions: Peers responded favorably to OAR's KfK materials. Interviews revealed that students recalled various aspects of the materials, particularly the need to better understand students with ASD to modify their own behavior to support their inclusion. Students recommended supplementing the presentation with guest speakers, video examples, and hands on activities to better understand autism.

2:09 **112.003** Randomized Controlled Trial of the Classroom Scerts Intervention Project for Students with ASD

__L. Morgan__[1], V. P. Reinhardt[1], N. Sparapani[2], C. Schatschneider[3] and A. M. Wetherby[1], (1)Florida State University Autism Institute, Tallahassee, FL, (2)Arizona State University, Phoenix, AZ, (3)Florida State University, Tallahassee, FL

Background: Current prevalence studies estimate that 1 in 68 children in the US is diagnosed with Autism Spectrum Disorder (ASD; CDC, 2014). The significant challenge and expense for schools to effectively educate this population makes the need for comprehensive, evidence-based interventions for students with ASD a priority. The Classroom SCERTS Intervention Project (CSI) is a classroom-based intervention using a cost-effective approach to achieve intensity of active engagement for young elementary students with ASD by training educators to implement SCERTS across the school day.
Objectives: The primary objective of this randomized controlled trial was to evaluate the efficacy of CSI for children with ASD in kindergarten through 2nd grade classrooms. A total of 235 students with ASD in 140 classrooms nested within 64 schools participated in the study. The two treatment conditions were as follows: 1) CSI was provided with access to a 3-day SCERTS training and ongoing coaching during the school year; and 2) Autism Education Training (AET) was provided with access to a series of web-based training resources for educators.
Methods: A stratfied randomized design was used wherein school pairs were matched on demographic variables (e.g., race, % free and reduced lunch, number of students) and randomly assigned to either CSI or AET for a 9-month school year. Effectiveness of CSI and AET was compared using direct observation of student active engagement. The Classroom Measure of Active Engagement (CMAE; Wetherby, Morgan, & Sparapani, 2014) is a multicomponent observational tool designed to measure active engagement in students with ASD. In addition, both conditions were compared using teacher report measures (SSRS, BRIEF), parent report of adaptive behavior (Vineland), and standardized measures of language.
Results: Baseline comparisons indicated equivalency of groups on all measures with one exception on the CMAE (Productivity). After 9 months, students in CSI made significantly greater gains than students in AET on two components of active engagement: (timeXcondition) productivity, F (1, 135)=4.32, p=0.042, and gaze to face, F (1,101)=7.19, p=0.009. On the SSRS, students in CSI made significantly greater improvement than AET on social skills, F (1,143)=12.38, p=0.001, and the problem behavior scale, F (1,143)=11.32, p=0.001. On the BRIEF, students in CSI also made significantly greater gains than AET on the initiate subscale, F (1,145)=6.59, p=0.011, the organization of materials subscale, F (1,145)=7.19, p=0.008, and the global executive functioning subscale, F (1,145)=7.52, p=0.007. On the Vineland, Students in CSI made significantly greater gains than AET on the communication subscale, F (1,116)=5.47, p=0.002, and on the Adaptive Behavior Composite, F (1,116)=4.07, p=0.046. Finally, students in both conditions showed significant improvement on standardized measures of receptive (PPVT) and expressive vocabulary (EOWPVT). These analyses are preliminary as we will use more sophisticated procedures (HLM) to confirm findings.
Conclusions: These findings support the effectiveness of CSI, classroom-based intervention with potential to be cost-effective. CSI demonstrated significantly greater efficacy than AET on measures of active engagement, social skills, executive functioning, and adaptive behavior. These findings are important given the dearth of evidence on comprehensive interventions for students with ASD in educational settings.

2:21   **112.004** Social Validation of Evidence-Based Practices in Autism: Investigating the Evidence of Social Validity for Empirically-Demonstrated Treatments Identified By the National Autism Center and National Professional Development Center on ASD

K. Callahan[1], H. L. Hughes[1], S. Mehta[2], S. M. Nichols[1], H. T. Wang[3] and M. Kutlu[4], (1)Kristin Farmer Autism Center, University of North Texas, Denton, TX, (2)Educational Psychology, University of North Texas, Denton, TX, (3)Special Education, National Taiwan Normal University, Taipei, Taiwan, (4)Special Education, Anadolu University, Eskisehir, Turkey

Background:
Empirically-demonstrated autism treatments considered to be "established" and "confirmed" as evidence-based practices (EBPs) have been identified by the National Autism Center (NAC) and National Professional Development Center on ASD (NPDC). An important factor in the effective and widespread use of these interventions is social validity, generally defined as consumer satisfaction with the goals, procedures, and outcomes of programs and interventions. The extent to which EBPs are socially validated by service providers plays a significant role in whether or not those treatments are adopted and implemented. Without evidence of social validity for empirically-demonstrated autism interventions, there is less chance these treatments will be used effectively in schools, clinics, and homes. Thus, social validity should be a consideration in the selection and effective use of EBPs.
Objectives:
The purpose of this study was to investigate the extent to which EBPs identified by the NAC and NPDC demonstrate evidence of social validation, and to determine the types of social validity used by researchers to provide evidence of social validation.
Methods:
Two separate analyses were conducted. First, researchers compared the correspondence of NAC and NPDC EBPs with 60 autism interventions previously determined to have social validity, as defined as perceived value for their use within a comprehensive autism treatment program (Callahan et al., 2008, 2010). This process resulted in 31 socially valid intervention components determined to align directly with one or more NAC/NPDC evidence-based practices. These interventions were validated by experts in the field of autism treatment to ensure that the socially validated treatments represented the same interventions as reported in the NAC/NPDC studies, with an overall agreement of 99.6%. Next, researchers analyzed all 942 articles cited by the NAC and NPDC studies for the 31 interventions to determine: (a) if the articles contained direct evidence of social validity, and (b) to identify which of seven categories of social validation (Reichow et al., 2011) were included by the authors. Inter-rater reliability ratings were conducted on 21.3% of the articles regarding the presence of social validation evidence, with an overall agreement of 97.4% across all EBPs. Assignment of evidence into social validity categories had an overall agreement of 88.4%.
Results:
Across all EBPs, 24.2% of the articles cited by the NAC and NPDC reported social validity. While all 31 EBPs had evidence of social validation, the results were variable, ranging from only 2.3% of articles for the use of "Extinction" to 60.5% for "Pictorial Story Board Simulations/Social Stories". The categories of "Consumers satisfied with results," "Clinically significant behavioral change," and "Socially important dependent variables" were the most frequently reported social validity indicators. Relatively few researchers addressed the time- and cost-effectiveness of interventions and the settings/service providers associated with the implementation of EBPs.
Conclusions:
The relatively low rates of reported social validity for autism EBPs, especially within behavioral journals, underscores the need for additional research about how best to define, conceptualize, measure, and report social validation in autism efficacy research. Such efforts will significantly improve the effectiveness of applied interventions and outcomes in autism.

Oral Session
113 - Interventions for Adults with ASD
2:40 PM - 3:30 PM - Grand Ballroom B

Session Chair: Nirit Bauminger-Zviely, *Bar-Ilan University, Ramat Gan, Israel*

2:40   **113.001** Designing and Evaluating a Summer Transition Program for Incoming College Students on the Autism Spectrum: A Participatory Action Approach

C. Shane-Simpson[1,2], E. R. Hotez[3], J. T. Pickens[1], M. Giannola[4], A. Donachie[5], J. D'Onofrio[6], A. Alvizurez[7] and K. Gillespie-Lynch[8,9], (1)Psychology, The Graduate Center at the City University of New York, New York, NY, (2)Psychology, College of Staten Island, Staten Island, NY, (3)Psychology, The Graduate Center at the City University of New York/Hunter College, New York, NY, (4)Psychology, The College of Staten Island, New York, NY, (5)College of Staten Island, Staten Island, NY, (6)Center for Student Accessibility, College of Staten Island, New York, NY, (7)Psychology, College of Staten Island, New York, NY, (8)Department of Psychology, College of Staten Island - CUNY, Staten Island, NY, (9)Department of Psychology, The Graduate Center - CUNY, New York, NY

Background: College students with autism may face unique challenges adjusting to college life, including difficulties with socialization, self-advocacy, and anxiety (Adreon & Proctor, 2010; Van Bergeijk et al., 2008). While transition planning is a priority (Interagency Autism Coordinating Committee, 2012), a recent review identified only 20 studies conducted with 69 autistic college students (Gelbar et al., 2014). This study utilized a participatory-action design to evaluate a week-long summer transition program for incoming college students with autism.

Objectives:
1. Identify self-reported needs and characteristics of college students with autism;
2. Evaluate a program designed to improve social skills, self-advocacy, technology skills, and classroom readiness.

Methods: Curriculum was adapted from our peer-mentorship program by incorporating written and focus group recommendations from previous mentors and mentees with ASD. Sessions were partially facilitated by previous mentors/mentees. Twelve autistic students enrolled in the program. Eleven students self-identified and/or were classified as autistic on IEP's. One student exhibited heightened autistic traits (SRS-2 of 92), but did not identify as autistic. Participants consisted of nine freshmen, one returning freshman who was gifted but whose behaviors made it unlikely that he could continue college without supports, and two sophomores with social difficulties (not considered transitioning in analyses). Pre-tests/post-tests assessed autistic traits (SRS-2; Constantino & Gruber, 2012), anxiety (Spielberger et al., 1983), self-esteem (Rosenberg, 1965), autism knowledge (Stone, 1987), disability identity (Darling, & Heckert, 2010), academic self-efficacy (Baker & Siryk, 1987), stigma (Bogardus, 1933), and included interviews assessing knowledge and recommendations. Nonverbal intelligence was assessed with the Test of Nonverbal Intelligence (Brown et al., 1997).

Results: During pre-program testing, students expressed interest in developing social skills (n=9). When asked to define self-advocacy, most could not (n=8), others thought it was standing up for yourself (n=4) or for others (n=1). Students reported varied technology needs ranging from help printing to programming and a variety of academic areas they needed help developing. Although participants' intelligences ranged from the 2nd to 90th percentile, intelligence was unrelated to baseline measures. However, Pearson's correlations (after ascertaining normality of data) revealed that autistic symptoms were positively correlated with anxiety (p=.002) and negatively with self-esteem (p=.04), self-efficacy (p=.045), and autism knowledge (p=.014). Thus, programming focused on core difficulties may be beneficial for autistic students with varied cognitive skills.

T-tests revealed decreased anxiety (p=.043), a trend towards decreased symptoms (p=.059), and increases in disability pride (p<.001), perceived exclusion (p=.033) and medical model orientations from pre- to post-test (p=.011). The same patterns were observed with only the transitioning students except that symptoms decreased (p=.028) and anxiety did not (p=.069). Students also reported learning how to self-advocate and gaining social support.

Conclusions: While improvements in autistic symptoms, anxiety, and disability pride suggest that transition programming may help incoming students with autism, increases in perceived exclusion suggest that programs should include peers with varied disabilities. Future programs should be guided by the interests/needs of autistic individuals and incorporate principles of universal design.

2:52 **113.002** Nonsymbolic Augmentative Communication for Minimally Verbal Adults with ASD and Severe Intellectual Disability: An Intervention Study

J. P. W. Maljaars[1] *and I. Noens*[2]*, (1)Parenting and Special Education Research Unit, KU Leuven, Leuven, Belgium, (2)Leuven Autism Research (LAuRes), Leuven, Belgium*

Background: Communication is indispensable for human beings. Individuals with ASD and co-occurring intellectual disability (ID) form a particularly vulnerable group as often no verbal or other symbolic communication is present. Using symbolic communication strategies for someone who is unable to understand the meaning of symbols may lead to high levels of dependence, frustration, or challenging behavior. Nonverbal individuals are dependent on other communication strategies, such as augmentative and alternative communication (AAC). For individuals with ASD and severe to profound ID the common AAC systems are not applicable, because these typically assume symbolic understanding.

Objectives: Based on a repeated single case design using multiple dependent measures, this study aims to evaluate the effectiveness of individualized nonsymbolic augmentative communication strategies for adults with ASD and ID on individual outcome variables: level of independence, mood, and challenging behavior in daily life.

Methods: Nine participants were recruited from four residential services for adults with ID. Inclusion criteria were: (1) a clinical ASD diagnosis and an ASD classification on a screening questionnaire for ASD in individuals with ID (AVZ-R), (2) a level of severe ID (at least -4 *SD* scores or a developmental age < 48 months on the Vineland), and (3) a nonsymbolic level of sense-making based on the ComFor, an instrument for the indication of augmentative communication (Verpoorten et al., 2008). Based on the ComFor and video observation, an individualized intervention plan for augmentative communication was designed for one activity. Transitions between activities, different steps or choices within the activity were communicated by recognizable sensations, presenting functional objects or by assembling or matching methods. The single case designs comprised a baseline measurement phase (1-2 weeks) and an intervention phase (1-4 months). The dependent variables, level of independence, mood, and challenging behavior, were measured daily based on an observation form (diary card) for caregivers. A monthly video-taped situation will be coded by an

independent observer to measure inter-rater reliability for all three dependent variables and to code treatment fidelity.

Results: Single case results may be interpreted with the use of two different approaches: visual inspection and statistical analysis. To analyze the data, we used hierarchical linear models, a method for repeated single case designs. For level of independence, all participants showed progression during the intervention phases. The statistical results were significant for seven adults ($p < .05$). Mood improved significantly ($n = 6$, $p < .05$), remained stable ($n = 2$), or showed an unstable pattern during both baseline and intervention ($n = 1$). Four participants did not show challenging behavior during this activity; a significant decrease in challenging behavior (e.g., self-injurious behavior) was present in another four participants.

Conclusions: For all participants, improvement on one or more outcome measures was seen during the activity after individualized nonsymbolic augmentative communication was implemented. However, only a small number of participants were included in this study and a quasi-experimental AB-design was used. Possible influencing factors and suggestions for further research will be discussed.

3:04 **113.003** Examining PEERS® for Young Adults: Improvements in Social Responsiveness and Depression and Relations to EEG Activity

B. Dolan[1], K. A. Schohl[1], A. J. McVey[1], S. Stevens[1], K. Reiter[1], S. Potts[1], N. Gordon[1] and A. V. Van Hecke[2], (1)Marquette University, Milwaukee, WI, (2)Psychology, Marquette University, Milwaukee, WI

Background: Social skills deficits among individuals with ASD lead to isolation and lack of friendships. For adults with ASD, poor social skills translate to under- or unemployment and dissatisfying social relationships (Venter, Lord, & Schopler, 1992). The latter is particularly concerning given the high rates of comorbid depression and withdrawal that exist within the ASD population (Stewart, Barnard, Pearson, Hasan, & O'Brien, 2006). The *Program for the Education and Enrichment of Relational Skills for Young Adults* (Gantman, Kapp, Orenski, & Laugeson, 2012) is an empirically based, manualized, caregiver-assisted treatment program designed to teach motivated young adults with high-functioning ASD the social skills needed in order to make and keep friends.

Objectives: There are no published studies that have replicated PEERS for Young Adults outside of its site of development, and no studies that have evaluated effects on brain function. Thus, this study seeks to be an independent replication of PEERS for Young Adults in order to evaluate the effectiveness of the program for improving social skills and decreasing depression, and how the intervention affects measures of brain function related to emotion: EEG asymmetry and ERP responses to emotional face and non-face stimuli.

Methods: The analysis included 27 young adults (18 to 26 years old) with ASD. All participants had a verbal IQ > 70 and diagnoses were confirmed with the ADOS. The intervention was the 16-session PEERS for Young Adults. Measures were taken at pre- and post-intervention and included: (1) the *Social and Emotional Loneliness Scale for Adults* (SELSA: DiTommaso & Spinner, 1993); (2) the *Social Responsiveness Scale* (caregiver report; SRS: Constantino, 2005); (3) the *Beck Depression Inventory* (BDI: Beck, 1987); and (4) a 3-minute continuous, resting state EEG recording and an ERP paradigm including positive and negative social/nonsocial IAPS (International Affective Picture System: Lang, Bradley, & Cuthbert, 2008) images.

Results: For the experimental group, young adults' caregivers at post-treatment reported improvements in social awareness (Wilks' Lambda = .71, $F(1, 25) = 10.07$, $p < .05$), social communication (Wilks' Lambda = .82 $F(1, 25) = 5.48$, $p < .05$), and total social responsiveness (Wilks' Lambda = .82, $F(1, 25) = 5.34$, $p < .05$). On the BDI, group differences did not reach traditional levels of significance; however, young adults receiving PEERS demonstrated a trend toward a decrease in depressive symptoms at post-treatment while the waitlist group exhibited an increase in depressive symptoms. Group differences did not emerge on the SELSA. Planned analyses will include two additional cohorts to further assess PEERS in terms of caregiver-reported social responsiveness and self-reported depression and social loneliness, as well as analysis of the EEG asymmetry and ERP data.

Conclusions: Young adults receiving the PEERS intervention demonstrated a significant improvement in many domains of caregiver-reported social responsiveness. Young adults' self-reported depression also suggested a trend toward a decrease in these symptoms post-intervention. The results from this study corroborate findings reported in the initial pilot study (Gantman et al., 2012) and add to the minimal literature that has examined efficacious social skills interventions for adults.

3:16 **113.004** Increasing Strength and Flexibility of Adults Diagnosed with Autism Spectrum Disorder and an Intellectual Disability through a Strength and Conditioning Program

K. Carr, N. R. Azar, S. Horton and C. A. Sutherland, Kinesiology, University of Windsor, Windsor, ON, Canada

Background: While the prevalence of autism spectrum disorder (ASD) continues to rise, research focused on the adult population remains limited. This is troublesome as current trajectories report poor adult outcomes related to an ASD diagnosis, especially in the presence of an intellectual disability (ID). Though these poor adult outcomes are often attributed to the core symptoms of ASD, health and lifestyle factors should also be considered. For example, during childhood and adolescence, individuals with ASD have lower levels of physical activity compared to typically

developing peers, with participation in sedentary behaviours increasing with age. This trend is evidenced by poor measures of fitness, and increased rates of obesity and secondary health conditions within this population. Therefore, an adapted physical exercise (APEX) program focused on strength and conditioning may be a viable intervention strategy to alter current health patterns and improve adulthood trajectories for individuals with ASD and an ID.

Objectives: To assess the impact of a 12-week APEX program on heart rate, blood pressure, flexibility, and isometric strength in adults with ASD and an ID.

Methods: Fourteen adults with ASD and an ID (age range = 18-62 years; 2 females; IQ scores from previous clinical assessment = 20 to 70) participated in an APEX program twice per week for twelve weeks. Each APEX session was 90-minutes in length and consisted of cardiovascular training on a stationary bike, strength training using weight machines and free weights, and sports and games. All participants completed fitness testing pre-, mid-, and post-program which included: (1) resting heart rate and blood pressure, (2) the sit and reach test as a measure flexibility, and (3) a measure of isometric strength for the upper and lower body.

Results: Significant improvements in upper body strength of the right (F[1,10] = 5.058, p = 0.049, ω^2 = 0.25) and left bicep (F[1,10] = 8.109, p = 0.017, ω^2 = 0.37) were found from pre- (right bicep: M = 21.61 lb.; left bicep: M = 20.62 lb.) to post-testing (right bicep: M = 28.83 lb.; left bicep: M = 29.82 lb.). Significant increases were also found from pre- (M = 10.72 cm) to post-testing (M = 16.63 cm) for flexibility (F[1,11] = 5.690, p = 0.036, ω^2 = 0.27). No significant changes were found for resting heart rate, systolic or diastolic blood pressure, or lower body strength (p > 0.05).

Conclusions: Twelve weeks of APEX programming provided a significant increase in upper body strength, as well as flexibility in adults diagnosed with ASD and an ID. While the remaining fitness measures did not experience significant changes, the observed improvement in lower body strength (right quadricep: 18% increase, ω^2 = 0.16) has potential to yield practical health benefits for participants. Therefore, an APEX program focused on strength and conditioning is a worthwhile service option for adults with ASD and an ID as it elicits improvements in measures of fitness, which may translate into improved outcomes in adulthood.

Oral Session
114 - Prenatal Risk Factors and ASD
1:45 PM - 2:35 PM - Grand Ballroom A

Session Chair: Margaret Fallin, *Johns Hopkins Bloomberg School of Public Health, Baltimore, MD*

1:45   **114.001**   Maternal Mid-Gestational Serum Cytokines and Chemokines and the Risk of Autism with Intellectual Disability: The Early Markers of Autism (EMA) Study

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Background: Increasing evidence suggests a link between immune system dysregulation and autism spectrum disorders (ASD), with immune abnormalities described in individuals with ASD as well as their family members. Furthermore, numerous studies have suggested that maternal immune activation during gestation may negatively impact fetal development, potentially resulting in ASD-like behaviors in the offspring. However, few studies have directly investigated the role of prenatal cytokine and chemokine profiles on neurodevelopmental outcomes in humans.

Objectives: To characterize mid-gestational serum profiles of cytokines and chemokines in mothers of children with ASD, of children with developmental delay without ASD, and of children considered to be typically developing.

Methods: Using a large, population-based, nested case-control study design, maternal serum samples were collected during weeks 15-19 of gestation. The mothers included in this study gave birth to: A) a child with ASD (n = 397), B) a child without ASD but with a developmental delay (DD, n = 163), or C) a child with no known neurodevelopmental disability (TD, n = 439). The ASD group was further divided into those with intellectual disabilities (DQ<70) (ASD-ID; n = 187) and those without (DQ≥70) (ASD-no ID; n = 210). All maternal mid-gestational samples were quantified for 22 cytokines and chemokines using Luminex multiplex analysis technology. Levels of cytokines and chemokines were compared between groups using crude and multivariate logistic regression analyses, adjusting for maternal age, ethnicity, birth country of mother, and weight, as well as matching criteria of infant gender, birth year, and birth month.

Results: Mothers of children subsequently diagnosed with both ASD and intellectual disability (ASD-ID) had significantly elevated mid-gestational serum cytokine and chemokine levels compared to mothers of other children. For example, this group displayed significantly **elevated** levels of serum GM-CSF, IFN-γ, IL-1α, and IL-6 compared to mothers of children with ASD without intellectual disability (ASD-no ID), of children with DD, as well as those with TD children. Conversely, mothers of children with ASD-no ID had significantly **lower** levels of IFN-γ, IL-8, and MCP-1 than mothers of TD children, and they showed no significant differences compared to mothers of children with DD. Similarly, mothers of children with DD had significantly **lower** levels of IL-8 and MCP-1 compared to mothers of

TD children.

Conclusions: Our results suggest that mothers whose children have both ASD and intellectual disability have significantly elevated mid-gestational levels of numerous cytokines and chemokines in comparison to all other groups examined. The immunologic distinction between mothers of children with ASD-ID and those with ASD-no ID or DD suggests that the intellectual disability associated with ASD might be etiologically distinct from DD without autism. This differential gestational immune profile could provide a better understanding of the early mechanisms leading to altered neurodevelopment. Additionally, these findings contribute to the ongoing efforts toward identification of biological markers specific to sub-phenotypes of autism.

1:57 **114.002** Organochlorine Chemical Concentrations in Maternal Mid-Pregnancy Serum Samples: Association with Autism Spectrum Disorders in the Early Markers of Autism Study

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Background: Polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs), widely detectable environmental contaminants in human populations, are known neurodevelopmental toxicants and have been associated with adverse developmental outcomes. Whether prenatal exposure to these pollutants influences development of autism spectrum disorder (ASD) is unknown.
Objectives: In this study, we examined whether concentrations of PCBs and OCPs measured in maternal mid-pregnancy serum samples were associated with risk of ASD in the offspring.
Methods:
Data are from the Early Markers for Autism (EMA) study, a population-based nested case control study that includes women who participated in the prenatal expanded alphafetoprotein screening program in Southern California and delivered children between 2000-2003. Birth certificates were linked to the California Department of Developmental Services (DDS) client databases to identify children with autism and a control group with developmental delay without autism (DD). General population (GP) controls were randomly selected from the remaining birth certificates, matched to cases on child month and year of birth and sex. 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. Concentrations of 37 PCBs and 9 OCPs were measured in stored second trimester maternal serum samples and were available for 545 ASD, 181 DD, and 418 GP children. Analytes detectable for at least 60% of the study population were examined in further analyses; this included 11 PCBs (28, 99, 118, 138/158, 153, 170, 180, 190, 196/203, and 199, as well as their sum) and 2 pesticides (a breakdown product of dichlorophenyltrichloroethane (DDT)- p,pDDE and trans-Nonachlor, a component of oxychlordane). Descriptive statistics were compared between diagnostic groups. Conditional logistic regression was used to calculate crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) for ASD compared to GP controls by quartiles of analyte concentrations, accounting for study matching factors and potential confounding factors based on associations with the analytes and known associations with ASD.
Results: Higher concentrations of PCBs were associated with several demographic factors (higher maternal and paternal age, maternal birthplace, lower maternal education), and several PCB congeners displayed higher geometric means in the ASD group as compared to both DD and GP groups. Overall, positive associations were found with most PCB congeners and ASD; associations remained statistically significant in adjusted analyses accounting for parental age and other demographic factors for two PCBs (for the highest quartile compared to lowest, PCB138/158 adjusted OR=1.83, 95%CI 1.12, 2.99; PCB153 adjusted OR=1.84, 95% CI 1.10, 3.07; p for trend across quartiles=0.03 for each). No significant associations were found with risk of ASD for the two OCPs examined in this study.
Conclusions: Our results suggest that exposure to PCBs during pregnancy could increase risk of ASD. PCBs and other organohalogens should be examined further as potential risk factors for ASD during critical periods of neurodevelopment.

2:09 **114.003** Maternal Sub-Clinical Hypothyroidism and Risk of Autistic Endophenotype in a Risk-Enriched Pregnancy Cohort

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Background: There has been a long-standing speculation about prenatal hypothyroid state as an ASD risk factor. Animal models suggest that maternal hypothyroidism is associated with dysregulated myelination, synaptogenesis, neuronal migration, and arborization in the fetus and there is clear evidence of associations with other disorders involving the brain.
Objectives: To investigate the association between the concentration of maternal thyroid hormones

during pregnancy and early ASD-related phenotype in an ASD high-risk pregnancy cohort (the EARLI cohort – comprised of mothers of a child with ASD followed from the start of a subsequent pregnancy). Specifically, we assessed whether elevated prenatal levels of thyroid stimulating hormone (TSH) and reduced levels of free thyroxin (fT4) (indicative of a hypothyroid state) were associated with elevated scores on the Autism Observation Scale for Infants (AOSI) at 12 months. Methods: Thyroid hormone levels were measured in the earliest available prenatal serum samples for 180 mothers (29, 124, and 27 from the 1st, 2nd and 3rd trimesters, respectively).   The association between ln(thyroid hormone concentration) and AOSI score alternatively parameterized as continuous (ln(total AOSI+1)) and dichotomous (total AOSI≥7) outcomes was estimated using regression approaches with adjustment for potential confounders.

Results: There were 56 (31%) children with total AOSI score ≥ 7. None of the mothers had both hormones outside clinical norms (TSH within 0.35 – 3.30 μ-IU/mL and fT4 within 0.56 – 1.64 ng/dL). However, cases had higher maternal TSH and lower maternal fT4 concentrations compared to referents (*table*). After adjusting for potential confounding by child's sex and gestational age at birth, maternal pre-pregnancy BMI, parity, maternal age, race, ethnicity, and income, we still observed an increased risk of ASD endophenotype with increased concentration of TSH and decreased concentration of fT4. As shown in the *figure* (displaying predicted mean and 95%CI),within normative ranges a doubling of TSH concentration increases risk of a child having an AOSI ≥7 by about 35% (adjusted RR=1.4, 95%CI: 1.0-2.0) and the corresponding effect of halving fT4 doubled the risk (adjusted RR=1.9, 95%CI: 0.9-4.0). The adjustment for potential confounders had negligible impact on effect estimates. Similar results were seen when AOSI was parameterized as a continuous variable or dichotomized AOSI ≥ 6 (68 cases).

Conclusions: Although effect estimates from this analysis are imprecise and should be interpreted with some caution, results support the hypothesis that subclinical maternal hypothyroidism is associated with early ASD-related phenotype.   Other findings from our cohort suggest that 12month AOSI is predictive of 36 month ASD diagnosis (i.e., AOSI≥7 having 70% sensitivity and 90% specificity for 36mos best estimate clinical diagnosis).   The relationship between subclinical maternal prenatal hypothyroidism and ASD risk remains of interest because maternal hypothyroidism is amenable to treatment and there are numerous environmental exposures implicated in causing hypothyroidism which could suggest strategies for primary prevention.

2:21 **114.004** Maternal Blood DNA Methylation during Pregnancy and Autism Observational Scale for Infants (AOSI) Score at 12-Months in the Early Autism Risk Longitudinal Investigation (EARLI)

K. M. Bakulski[1], J. I. Feinberg[2], S. C. Brown[3], C. J. Newschaffer[4], L. A. Croen[5], I. Hertz-Picciotto[6], R. J. Landa[7], S. E. Levy[8], S. Ozonoff[9], J. Pandey[10], A. P. Feinberg[2] and M. D. Fallin[11], (1)Johns Hopkins University, Baltimore, MD, (2)Medicine, Johns Hopkins University, Baltimore, MD, (3)Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (4)Drexel University, Philadelphia, PA, (5)Division of Research, Kaiser Permanente Northern California, Oakland, CA, (6)Public Health Sciences, University of California, Davis, Davis, CA, (7)Department of Psychiatry and Behavioral Sciences, Johns Hopkins School of Medicine, Baltimore, MD, (8)Developmental & Behavioral Pediatrics, Children's Hospital of Philadelphia, Philadelphia, PA, (9)MIND Institute and Department of Psychiatry and Behavioral Sciences, University of California Davis Medical Center, Sacramento, CA, (10)The Children's Hospital of Philadelphia, Philadelphia, PA, (11)Johns Hopkins School of Medicine, Baltimore, MD

Background: Genetic, environmental, and parental demographic factors confer risk of autism spectrum disorders (ASD) through incompletely characterized mechanisms. Epigenetic status represents the intersection of these factors and previous work has shown DNA methylation differences comparing individuals affected with ASD to controls. Maternal genome-wide DNA methylation during pregnancy has not yet been compared with prospective offspring ASD risk.

Objectives: To test the association between maternal pregnancy whole blood DNA methylation and offspring scores on the 12-month Autism Observational Scale for Infants (AOSI) scale.

Methods: In an ASD-enriched birth cohort, the Early Autism Risk Longitudinal Investigation (EARLI), genome-wide maternal pregnancy blood DNA methylation was measured using two complementary techniques: comprehensive high-throughput arrays for relative methylation (CHARM) and the Illumina Infinium 450k HumanMethylation array. Multivariable linear regression was used to test the association between percent methylation and offspring log transformed 12-month AOSI score (ln(AOSI+1)), adjusting for cell composition, laboratory batch, maternal age, and race. Due to differences in probe density between the methods, CHARM data was used to test for differentially methylated regions and 450k array data was used to identify differentially methylated single CpG sites. As a secondary analysis, we also tested AOSI as a dichotomous variable predicting ASD risk (AOSI < 7 vs. AOSI >=7). We tested for enrichment of locations of DNA methylation differences in gene ontology biological processes as well as autism-associated genes in the Simons Foundation Autism Research Initiative (SFARI) autism-related database.

Results: Paired maternal 450k DNA methylation data from any time during pregnancy and 12-month offspring AOSI scores were available on 79 EARLI families. Infant scores ranged from 0-20 (mean(SD)=5.4(4.8)). Across 450k array single-site models from 485,512 CpGs, we observed a lambda genomic inflation factor of 1.06 and top statistically significant CpG sites associated with offspring AOSI scores overlapped previously identified ASD genetic risk loci. CHARM data from over 2.1

million probes linked with AOSI scores were available from up to 4 repeated visits per mom (V1, n=77; V2, n=76; V3, n=59; V4, n=16), which are now being used to characterize any longitudinal trajectories of ASD-associated maternal DNA methylation differences.

Conclusions: We identified genomic locations of DNA methylation sites measured in maternal pregnancy blood that are associated with ASD-related phenotype at 12-months. These appear to be enriched for genes already implicated in ASD risk through traditional genetic associations and thus may provide further insight about the role of maternal genetic and epigenetic influences on the biology of ASD risk. Further work is needed, including replication in additional populations and model organisms, to clarify ASD mechanisms or the potential role of maternal DNA methylation as a risk biomarker.

Oral Session
115 - Neuropeptide Hormones in ASD
2:40 PM - 3:30 PM - Grand Ballroom A

Session Chair: Margaret Fallin, *Johns Hopkins Bloomberg School of Public Health, Baltimore, MD*

2:40 **115.001** Affect, Social Behavior and Communication Among Children Prenatally Exposed to Oxytocin Receptor Antagonists

E. Friedlander[1], D. Mankuta[2], M. Yaari[1], A. Harel[1], R. Ebstein[3] and N. Yirmiya[1], (1)Psychology Department, Hebrew University, Jerusalem, Israel, (2)Department of Obstetrics and Gynecology, Hadassah Ein Kerem University Hospital, Jerusalem, Israel, (3)Department of Psychology, National University of Singapore, Singapore, Singapore

Background: Prematurity is the major cause of neonatal death and morbidity in the developed world. Therefore, measures are taken to delay preterm labor as long as possible. These measures generally include pharmacological inhibition of uterine contractility to allow the administration of corticosteroids to enhance fetal lung maturation. Different agents including calcium channel blocker (e.g. Nifedipine) and oxytocin receptors (OTR) antagonists such as tractocile (Atosiban) can inhibit myometrial contractions. These drugs were recommended as first line of treatment. Atosiban is considered to have minimal adverse effects. However, recent evidence shows that Atosiban had similar tocolytic efficacy as betamimetics and placebo, and more maternal side-effects requiring cessation of treatment. In randomized control trials comparing Atosiban and Nifedipine for treatment of preterm labor, women who were treated with Nifedipine had a lower rate of preterm deliveries and delivered a week later than women treated with Atosiban. More neonates in the Atosiban group were hospitalized at the neonatal intensive care units and for a longer time than those from the Nifedipine group.

A large body of evidence shows oxytocin modulate behavior and cognition across species as well as social memory. Moreover, oxytocin partially mediates the risk of perinatal risk factors in Autism. Although Atosiban crosses the placental barrier and the blood brain barrier rather freely, its long-term effect on brain development has not been examined yet.

Objectives: We hypothesize that we will observe deficits in affect, social behavior and communication even in the absence of autism spectrum disorder (ASD) or social communication disorders in children prenatally exposed to OTR antagonists.

Methods: 162 children between the age of 3:0 and 7:6 (years: months) participated in the current study. The Atosiban group consisted of 71 children prenatally exposed to Atosiban as well as Nifedipine to inhibit premature labor, whereas the comparison group consisted of 91 children who were exposed only to Nifedipine. All children were born between 2003 and 2010 at the Hadassah Medical Centers in Jerusalem to Hebrew-speaking mothers and were assessed between 2009 and 2013. The developmental assessment consisted of state of the art developmental assessment tools: The Mullen Scales of Early Learning, The Vineland Adaptive Behavior Scales and the Autism Diagnostic Observation Scale (ADOS).

Results: The cognitive and the adaptive behavior and daily functioning of the Atosiban group were similar to those of the comparison group. However, there were significantly more social communication abnormalities in the Atosiban group than in the comparison group (F (1,142) = 6.29, p = .013).

Conclusions: The current findings suggest that OTR antagonists may hold additional risk for deficits in affect, social behavior and communication even in the absence of ASD, in comparison to Nifedipine treatment. Therefore, the use of Atosiban to delay labor may have subtle effects on brain development which cannot be detected in the neonatal period, and clinically manifest only later in life. More research, including randomized control studies is needed to further examine these initial findings.

2:52 **115.002** Lessons Learned from Phase I Proof-of-Mechanism and Biomarker Studies in ASD: Measurement and Trial Considerations

J. T. McCracken[1], E. Hollander[2], L. Scahill[3], M. del Valle Rubido[4], F. Shic[5], O. Khwaja[6], L. Squassante[7], S. Sadikhov[8], L. Boak[9], F. Bolognani[10], P. Fontoura[11], C. A. Wall[12], R. J. Jou[13], R. L. Loomis[14], M. C. Lyons[12], A. Gavaletz[13], C. J. Ferretti[15], B. P. Taylor[16], G. Berlin[15], R. Noone[17], L. N. Antar[15] and D.

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Background: Next generation trials of drugs targeting ASD core domains will depend on precision of measurement of social dimensions. From studies investigating biomarkers and potential efficacy signals of antagonists of arginine vasopressin 1a receptor (AVPR1A), data enable comparative analyses of a multi-level panel of potential endpoints. The presentation will present analyses comparing sensory, cognitive, and clinical endpoints from two studies: 1) a single administration study of effects of V1a receptor antagonist RG7713 in ASD; and, 2) a comparative biomarker study testing measures in patients and healthy controls. Possible relevance to RDoC domains will be discussed.

Objectives: To present analyses comparing sesnory, cognitive, and clinical endpoints from two studies.

Methods: In Study 1, 19 adults with ASD (mean age=23.4 ± 5.16 (SD) years (range: 18-40) participated in randomized, double-blind, placebo-controlled, cross-over study. Single doses of RG7713 or placebo were administered intravenously on two different days one week apart. Measures of eye-tracking, affective speech recognition (ASR), emotion processing ("Reading the Mind in the Eyes Test [RMET))", olfactory recognition, social communication, parent-rated measures of social behavior (ABC-scale, 28 item adapted for the study with items 3,4 and 18 removed), and global improvement as measured by blind raters were obtained and compared. Additional comparisons with baseline assessments including the ADOS and Vineland are included. In Study 2, 19 healthy controls (mean age=26.68±4.33 (range 20-35)) and 19 adults with ASD (mean age=24.89±6.45 (range 19-39)) were assessed in a two-visit study of a similar battery used in Study 1. Separate and combined analyses were performed to examine associations; comparisons between post-treatment scores were calculated, as well as overall comparisons between both treatment conditions versus baseline assessments.

Results: Several unique patterns of correlations were observed between measures. Correlations of medium-large (|r|>0.5) effect are emphasized.

For social communication measures, correlations were:

- positive between baseline ADOS social interaction scores and post-treatment ABC adapted (rs~-0.58 – 0.68)
- negative between baseline ADOS subtest scores and post-treatment Scripted Interaction (total) (rs~-0.56 – 0..93)
- negative between ABC adapted and Scripted Interaction total score (negative correlation, r~-0.8)
- negative between ABC adapted and VABS Social Communication (rs~-0.6 – 0.64)

For social perception measures, correlations were:

- positive between baseline RMET and ASR scores (r~ 0.48)
- positive between RMET % correct responses and Smell test scores (positive correlation, r~0.5-0.6). RMET % correct responses were also positively correlated with Verbal and Full scale IQ (rs~ 0.52 – 0.72).
- not seen between eye tracking and other social perception measures

Conclusions: Results from these preliminary comparisons of multiple domains of social behavior, communication, and perception support their consideration as largely independent, though related, dimensions. The high proportion of shared variance of several measures, such as the ABC SW and Scripted interaction, with other well-established clinical tools such as the ADOS and VABS support their further use as ASD trial endpoints.

3:04 **115.003** Effects of Intranasal Oxytocin on Systemizing and Empathizing Tasks in Children with and without Autism

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Background: In Baron-Cohen's Empathizing-Systemizing Theory of Autism, social deficits are described along the continuum of empathizing ability, or the ability to understand and respond to the emotions of others. Non-social aspects are characterized in terms of an increased preference for patterned or rule-based systems, called "systemizing."

Objectives: We developed automated eye-tracking tasks to measure visual attention to 1) more highly organized and structured real-life images ("systemizing"), and 2) images of human eyes in the "Reading the Mind in the Eyes" task ("empathizing"). Then, as part of a randomized, double-blinded, placebo-controlled crossover study, we examined the effect of intranasal oxytocin in 16 male children and adolescents with autism spectrum disorder (ASD), compared with 16 matched-controls.

Methods: In the systemizing task, participants viewed 14 slides, each containing 4 related pictures (e.g. of people, animals, scenes, or objects) that differed primarily on the degree of systemization. In the empathizing task, participants viewed 25 slides containing a picture of human eyes that characterize a particular emotion, and were asked to choose one of four surrounding words or phrases that describe the emotion portrayed. Visual attention was defined in terms of the observation time and count for each image, and was compared between ASD and control groups after receiving either oxytocin or placebo.

Results: In the systemizing task, individuals with ASD preferred to fixate on more highly systemized pictures, while control subjects showed no gaze preference. Intranasal oxytocin reduced systemizing preference in ASD participants, but increased this preference for control subjects. In the empathizing task, ASD participants were significantly less accurate in identifying the correct emotion. While oxytocin did not enhance accuracy, it did increase the time spent by ASD participants viewing the eye region, while decreasing the relative time spent by control subjects (2-way interaction effect).

Conclusions: These results suggest that, while intranasal oxytocin has a contrasting effect in ASD and typical control children, it may enhance empathizing and decrease systemizing in children and adolescents with autism.

3:16 **115.004** A New Vasopressin V1a Antagonist Restores Normal Social Behavior and Reveals a Specific Brain Network in the Rat Valproate Model of Autism

C. Grundschober[1], T. Mueggler[2], F. Knoflach[3], C. Risterucci[3], P. Schnider[4] and B. Biemans[3], (1)Hoffmann-La Roche Ltd, 4070, Switzerland, (2)Roche Pharmaceuticals, Basel, Switzerland, (3)Neuroscience Discovery, F. Hoffmann-La Roche, pRED, Pharma Research & Early Development, Basel, Switzerland, (4)Medicinal Chemistry, F. Hoffmann-La Roche, pRED, Pharma Research & Early Development, Basel, Switzerland

Background: The neuropeptide vasopressin plays an important role in regulating social behavior. In humans, prenatal exposure to the anticonvulsant drug valproate (VPA) has been associated with an increased risk of autism in the newborn. In rats, a single injection of valproate to pregnant dams at day 12.5 of gestation, the time of the neural tube closure, induces a range of behavioral abnormalities in the offspring, such as deficits in social behavior, working and spatial memory and increased locomotor activity. Based on synaptic and phenotypic similarities, the rat VPA model can be considered a valid model of human autism.

Objectives: Investigate the role of central vasopressin 1a (V1a) receptor signaling on the phenotype of the rat valproate model of autism.

Methods: From postnatal day 60 on rats prenatally exposed to VPA were treated daily during 3 weeks with a new brain penetrant V1a receptor-specific small molecule antagonist. Their behavior was assessed in the Morris water-maze and in the 3-chamber social interaction test. Long term potentiation was measured in hippocampal slices. Finally, VPA rats and wild-type controls were scanned by functional magnetic resonance imaging at postnatal day 60 and after 1-week chronic V1a antagonist treatment, to reveal changes in brain perfusion due to prenatal exposure to VPA and potential normalization by V1a antagonism.

Results: Chronic treatment for 3 weeks with our V1a receptor-specific small molecule antagonist completely reversed the impairments in social behavior, spatial memory and learning typically seen in VPA rats. In line with the behavioral finding, the hippocampal LTP deficit seen in VPA rats was normalized by the compound. In functional magnetic resonance imaging VPA rats were found to be characterized by reduced brain perfusion in cortex, nucleus accumbens, hippocampus and amygdala and increased brain perfusion in VTA, dorsal striatum and thalamus compared to control rats. Chronic V1a antagonism specifically normalized brain perfusion in amygdala, dorsal striatum and VTA.

Conclusions: Our data show that chronic inhibition of vasopressin V1a receptors restores normal behavior in VPA rats by normalizing perfusion in a brain network important for salience detection, repetitive behavior and reward. These results suggest that V1a antagonists have the potential to improve social interaction in autism, a core symptom for which there is currently no drug treatment.

Oral Session
116 - International Cross-Cultural Perspectives on Identification
1:45 PM - 2:35 PM - Grand Ballroom C

1:45 **116.001** What Will It Take to Improve Early Identification and Intervention Globally?

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Background: Early Identification and intervention in community based setting remains a major challenge. While this situation applies globally, the challenge is even greater in communities where issues of survival and physical health are also a priority. In global health research, the 10/90 gap refers to the finding that only 10% of spending on health research and development is directed towards problems impacting 90% of the world's population.
Objectives: The INSAR Special Interest Group on Early Identification and Intervention (Global SIG) was set up in 2012 to systematically explore facilitators and barriers to early identification and intervention in community-based settings. A knowledge brokering approach was used to elicit expert input that directly responds to needs and priorities of diverse communities. The Global SIG currently groups 177 members from 21 countries.
Methods: The Global SIG organized four workshops over three years focused on early identification and intervention in diverse settings. Prior to each session, participants were invited to complete a survey in which they submit questions on the topic of research priorities (session 1), screening and diagnosis (session 2), intervention (session 3), and specific considerations in low-resource settings (session 4). Using thematic analysis, results from the survey were used to structure the discussions. Topic experts were then identified and invited to address this participatory agenda and to interact with SIG members. Further thematic content analysis on transcripts of each session was conducted after the sessions.
Results: The Global SIG highlighted a number of facilitators and barriers to early identification and intervention that need to be carefully considered when translating evidence into community based settings. The three categories identified relate to (1) current advances and limitation of research in this area, (2) heterogeneity in the characteristics, needs, and capacity in different communities, and (3) translational issues bridging the state of the science with these needs (e.g., cost-effectiveness, scalability, equity, and cultural sensitivity of existing evidence-based tools and models).
The following cross-cutting lessons emerged across sessions: First, there is a need to integrate advances in autism research with broader child development, human rights, and global health approaches. Second, solutions for autism need to focus on enhancing capacity in and leveraging the strengths of existing health and social systems. Finally, efforts to build capacity for identification should go hand in hand with capacity to address the needs of those affected by the condition.
Conclusions: The Global SIG used a participatory process to bridge expert perspectives with real-world challenges impacting diverse communities. In doing so, the SIG identified several knowledge gaps, addressed misconceptions about research, and facilitated exchange of evidence-based models of care in different communities.

1:57 **116.002** Screening for Autism Spectrum Disorders in Low and Middle Income Countries: An Integrative Review

L. Stewart[1] and L. C. Lee[2], (1)Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Background:
In many low-resource communities globally, screening all children for Autism Spectrum Disorder (ASD) at clinical or educational settings is currently infeasible due to a lack of clinical and professional resources. Multistage case identification using standardized screening and diagnostic tools seems the most feasible option for epidemiological studies of ASD in these settings. However, little is known about the use of ASD screening tools outside of the higher income nations in which they were first developed and validated. The reported psychometric properties of ASD screeners in low-resource settings have not been compared across studies to provide guidance for screener selection. Additionally, recent studies suggest that variation may exist in the cross-cultural appropriateness of screener measures and administration methods.
Objectives:
To review the use of standardized screening tools in low-resource settings and to make recommendations for screening instrument selection and screening approaches in these settings.
Methods:
An integrative review was conducted to understand the use of ASD screening instruments in low- and middle-income countries from studies published between 1992 and 2014. Studies had to use or adapt an established ASD screener in a World Bank designated low or middle-income country and be published in English.
Results:
Twenty-one studies met the inclusion criteria and were reviewed: two were in low-income countries and nineteen in middle-income countries. Among these twenty-one, seventeen different screening instruments were used. Study populations ranged from children ages 18 months to adult. Of the twenty-one studies, thirteen reported psychometrics.
Common screeners included the Modified Checklist for Autism in Toddlers (M-CHAT) (sensitivity ranged

0.25-0.86, specificity ranged 0.77-0.80), Autism Behavior Checklist (sensitivity ranged 0.78-0.98, specificity 0.91) and the Social Communication Questionnaire (sensitivity ranged 0.66-0.94, specificity ranged 0.70-0.89). Sixteen studies assessed or sampled children in a clinical setting. Five studies were non-clinical, community-based. Two out of these five reported psychometric properties: the Twenty-Three questions (23Q) (sensitivity ranged 0.55-0.80, specificity ranged 0.77-0.92) in a Ugandan sample and M-CHAT (sensitivity 0.25, specificity: 0.77) in a Sri Lankan sample.

The majority of screening tools were administered to parents as self-complete. Due to study populations' reported low-literacy and unfamiliarity with completing checklists, four studies administered screeners through an interview with caregivers. Translation and cultural adaptation of screeners were rarely reported or defined. Four studies reported collaboration with local community organizations and clinical resources during study design, recruitment, or screener translation and validation.

Conclusions:

This review found that seventeen different ASD screeners have been used in low-and middle-income settings with wide ranges of sensitivity and specificity. Clinical-based screening for ASD was the most widely reported method. However, community-based screening was also shown to be an effective method for identifying ASD in communities with limited clinical resources. Few studies reported collaboration with local community and clinical resources to ensure appropriate screener adaptation and study design, a practice in other branches of global mental health research. Improved reporting of psychometrics as well as screener administration and adaptation methods will enable the field to establish best practices for ASD research in low-resource settings globally.

2:09 **116.003** Findings from the Minneapolis Somali Autism Prevalence Project

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Background: The Minneapolis Autism Spectrum Disorder Prevalence Project is the largest project to date that has looked at the number and characteristics of Somali children with autism spectrum disorder (ASD) in any U.S. community. The project focused on comparing Somali and non-Somali children in Minneapolis to respond to community concerns about ASD in the Somali community. Objectives: The project was developed to answer the question, "Is there a higher prevalence of ASD in Somali children who live in Minneapolis versus non-Somali children?" Expanded research questions included investigating where children with ASD were more likely to be identified, at what age were children with ASD more likely to be classified, and determining if children with ASD had a co-occurring intellectual disability. Comparisons were made between Somali children and children not of Somali descent.

Methods: The project adopted methodology from the Centers for Disease Control and Prevention's Autism and Developmental Disabilities Monitoring Network (ADDM). There were two phases to the research. In the initial phase, health and special education records were systematically reviewed to identify children with ASD behaviors. The abstracted information was then reviewed by trained clinicians to determine if the child meets the definition of ASD using the DSM-IV-TR criteria.

Results: Results indicate that Somali (1 in 32) and White (1 in 36) children were about equally likely to be identified with ASD. Somali and White children were more likely to be identified with ASD than Black and Hispanic children. In addition to information on autism prevalence, data on intellectual disability was collected. Among those children confirmed with autism spectrum disorder, all Somali children on whom intellectual data were available were found to have co-occurring intellectual disability (ID). The age at first ASD diagnosis was around 5 years for Somali, White, Black, and Hispanic children. In confirming cases, a panel of experts reviewed records and determined case status based on information contained in records, including narrative descriptions of behaviors. These behaviors are categorized in ADDM methodology as associated features and discriminators. Associated features are those behaviors that are not part of DSM-IV-TR criteria but that commonly occur with ASD. Over 80% of children with confirmed ASD were identified with having abnormal mood/affect, argumentative/oppositional, hyperactivity/attention problems, and odd response to sensory stimuli. The most frequent discriminators identified included impaired social skills, previous ASD diagnosis, the need for sameness or routine, and unusual sensory reactions.

Conclusions: This study found similar prevalence rates for Somali and White children and lower rates for Hispanic and Black non-Somali children. Rates were unable to be calculated for Asian and Native American groups due to low numbers of children identified with ASD among these groups. Results of this study highlight the need for improved outreach to culturally diverse families to improve identification of ASD. Further work is needed in understanding why Somali children with ASD had such high rates of co-occurring ID.

2:21 **116.004** Factors Associated with the Utilization of Services for Children with Autism in Saudi Arabia

F. Alnemary[1], H. Al-Dahlaan[2] and F. Alnemary[1], (1)University of California, Los Angeles, Los Angeles, CA, (2)King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia

Background: Services for children with autism spectrum disorders (ASD) are limited in Saudi Arabia and little attention has been directed towards examining the factors associated with the use of

available ones.

Objectives: The aim of this study is to provide an estimate of services use among children with ASD in Saudi Arabia and to examine family and child characteristics associated with the utilization of ASD services.

Methods: An online parent survey was developed and its link was distributed by local professionals and through parent support groups in Saudi Arabia. A total of 205 caregivers, mostly fathers (61%), of children who had ASD and were younger than 21 ($M = 7.9$) years submitted usable forms during the 3-month survey period. (*See table 1 for sample characteristics*). Multivariate regression analysis was used to examine the characteristics of family (e.g., SES, city of residence, knowledge about autism) and children (e.g., severity of the child autistic symptoms) with ASD services use (i.e., age at start of the first treatment and the number of treatments utilized).

Results: The average age at starting the first treatment was 3.3 years. The average age of starting the first treatment increased 0.8 for each year of age of diagnosis and decreased 0.5 years for parents with high educational attainments. With respect to the use of ASD treatments, the majority of parents reported utilizing non-medical treatments (NMD; 94%; e.g., speech therapy, applied behavior analysis therapy, occupational therapy) followed by biomedical treatments (MD; 88%; vitamin and supplements, Hyperbaric Oxygen Therapy, special diets) and cultural/religious treatment (CR; 86%; e.g., reciting Quran, honey, visiting religious/traditional healers). While the average number of NMD treatments decreased 1.1 treatments for children who were diagnosed in non-major cities, it increased 1.5 treatments for mothers who were 45 years or older, 1.2 for children who received at least one treatment out of Saudi Arabia, 1.0 for families with household incomes above the mean of Saudi population's household income, and 0.3 for each MD treatment. The average number of biomedical treatments decreased 0.1 treatments for parents who were more knowledgeable about children with ASD's social and communicative features whereas it increased 0.6 treatments for children who received treatments out of city of residence, 0.5 treatments for fathers of high educational attainment, 0.4 for comorbidity, 0.2 for the number of CR treatments, 0.1 for the number of NMD treatment, and 0.1 for parents who were more knowledgeable about children with ASD cognitive features. The average number of cultural/religious treatments associated with 0.1 treatments for parents who were more knowledgeable about children with ASD social and communicative features. (*See table 2 for linear regression modeling*).

Conclusions: Disparities in service utilization associated with SES factors and cities where services were received point to the need to develop policy, practice and family-level interventions that can mitigate the limited services for children with ASD in Saudi Arabia. Further, understanding the decision-making processes that underlie treatment selection by parents of children with autism in Saudi Arabia is critical for future implementation research.

Oral Session
117 - Scaling Autism Interventions Across Cultures in Community Settings
2:40 PM - 3:30 PM - Grand Ballroom C

Session Chair: Mayada Elsabbagh, *McGill University, Montreal, PQ, Canada*

2:40 **117.001** A Cross-Cultural Comparison of a Caregiver-Mediated Joint Attention Intervention for Children with Autism Spectrum Disorders (ASDs): Malaysia and the UK

A. Pushparatnam *and C. Hughes, Centre for Family Research, University of Cambridge, Cambridge, United Kingdom*

Background: While there is a growing literature on interventions for children with ASDs, there is a dearth of information on the cross-cultural applicability of these interventions. Given the situation for children with ASD and their families in Malaysia, it was decided that parent-mediated interventions would be the most appropriate for the Malaysian context. Thus, an evidence-based caregiver-mediated intervention was chosen that focuses on increasing caregiver-child dyads' joint engagement and encouraging joint attention behaviours in the children.

Objectives: The aim of this study was to compare the efficacy of a caregiver-mediated joint attention intervention for children with ASDs in Malaysia and the UK using a single-subject multiple-baselines design.

Methods: Four Malaysian and three British mother-child dyads participated in the intervention. At the start of the intervention, the children were aged between 3y 3m to 5y 5m, and the mothers were aged between 35y 5m and 43y 3m. Extensive observational data were gathered across 24-27 baseline, intervention, and follow-up sessions per dyad. These quantitative data were examined to identify any improvements in the mothers' accurate use of intervention strategies ('fidelity' to intervention strategies), the children's response to joint attention, and the dyad's quality of interaction as a result of the intervention. The data were analysed in two ways: via visual inspection, as is traditional for single-subject designs, and via multilevel modeling. In addition, qualitative parent- and interventionist-report measures were used to gain insights into the mothers' experiences of having participated in the intervention.

Results: As predicted, there were cross-cultural differences in the baseline levels of the mothers' fidelity to the intervention strategies, with the Malaysian mothers scoring below the British mothers;

however, the treatment effects of the intervention on the mothers' fidelity did not differ across cultures. Thus, the Malaysian mothers started and ended the intervention at lower levels of fidelity than the British mothers (Figure 1). There were also cross-cultural differences in treatment effects with regard to the children's joint attention skills, with the British children showing larger improvements than the Malaysian children (Figure 2). There were no cross-cultural differences in baseline levels of or treatment effects on the dyads' joint engagement. The secondary outcome data revealed that the observed cross-cultural differences could be linked to cultural variations in parenting practices (particularly with regard to the mothers' interaction styles within play settings) and in parents' developmental priorities (e.g., the Malaysian mothers were more concerned than the British mothers about their children's academic abilities). The data also indicated ways in which the length, format, and content of the intervention could be adapted to better suit the Malaysian context. *Conclusions*: The findings from this study illustrate that cross-cultural differences in parenting can have an impact on the outcomes of a parent-mediated intervention for children with ASD. Thus, the findings underscore the importance of further research into cultural factors that may influence the outcomes of interventions for children with ASD, with the goal of establishing interventions that are effective within different cultural and economic settings.

2:52 **117.002** Parent Mediated Intervention for Autism Spectrum Disorder in South Asia (PASS) a Randomized Control Trial

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Background: Low and middle income countries have the majority of the world's children; simultaneously these areas are the most under resourced for services for complex neuro-developmental disabilities such as Autism Spectrum Disorders (ASD). Families of children with ASD countries face two primary challenges; firstly the lack of access to evidence based interventions which have been adapted and evaluated for acceptability, secondly the paucity of trained professionals to deliver outside the reach of specialist centres. This results in a 'treatment gap' leaving most children with ASD without services.
Objectives: This research study aimed to evaluate a systematically adapted intervention for acceptability and feasibility of a parent-mediated communication intervention through a randomised control trial. The original communication intervention, the Preschool Autism Communication Therapy (PACT); had substantial trail evidence supporting it. The aims were to evaluate a) feasibility and acceptability of the resulting PASS intervention b) the success of the "task-shifting" approach in delivering fidelity to the intervention c) The effectiveness of the adapted intervention in replicating original treatment effects the UK trial.
Methods:
Site: This study was carried out in two sites in South Asia; Goa, India and Rawalpindi, Pakistan. Both sites followed similar procedures in the adaptation and trial.
Participants: 30 eligible families were enrolled at each site, and the adapted intervention was delivered to fifteen per site, with an equal number in the treatment- as-usual arm. Eligibility criterion was a confirmed diagnosis of ASD in the 2-9 age group. Exclusion criterion included a non-verbal age equivalent to 12 months or younger; epilepsy with seizures in the previous six months; severe hearing or visual impairment in a parent or the child; or a parent with a severe psychiatric disorder.
Outcome assessments took place 8 months after baseline assessment. The primary outcome was the Dyadic Communication Measure for Autism, a parent-child interaction measure used in the UK trial. This consists of rating a naturalistic play session on three pre-specified variables: proportion of parental synchronous communications with the child; proportion of child communications that were initiations; and proportion of time spent in mutual shared attention.
Results: On parental synchronous interaction, there was a substantial positive treatment effect in favour of the PASS; with adjusted mean difference (AMD) of 0.25(95% CI 0.14-0.37). There was also a positive treatment effect on Child Communication Initiations with parent; AMD 0.15 (95% CI 0.05-0.24)). In both the confidence intervals include values from a small positive to a moderate positive effect. On the third interaction outcome of shared attention there was evidence of a negative effect of treatment; AMD -0.16 with (95% CI -0.278, -0.032).
Conclusions: This moderate-sized initial randomised controlled trial is the first systematic intervention study in relation to ASD undertaken in LMIC. The trial served as a successful test of the effectiveness of the cascade training and supervision model both to achieve adequate non–specialist fidelity; as well as an initial test of whether the adapted intervention could reproduce the treatment effects found in the UK study.

3:04 **117.003** Autism in the African American Community of South Los Angeles: A Community

Partnered Participatory Research Approach

T. Carr[1], C. Franklin[2], A. Gulsrud[3], F. Jones[2], L. Jones[2], C. Kasari[4], E. Lizaola[1], J. Panganiban[5], J. Smith[1], K. White[2], B. L. Williams[6] and A. Wright[2], (1)University of California Los Angeles, Los Angeles, CA, (2)Healthy African American Families, Phase II, Los Angeles, CA, (3)UCLA, Los Angeles, CA, (4)UCLA Center for Autism Research & Treatment, Westwood, CA, (5)University of California, Los Angeles, Arcadia, CA, (6)University of California Los Angeles, Culver City, CA

Background: As treatments for ASD gather empirical support, there is increased need to implement effectiveness trials at the community level. The need for research methods promoting community engagement has been highlighted, but there are few guidelines on appropriate methods in under-resourced communities. Community Partnered Participatory Research (CPPR) has emerged as an effective approach promoting equity and bi-directional learning (Wells et al., 2013).
Objectives: The present study represents the first phase of a project examining the effectiveness of an empirically-supported intervention in South Los Angeles. Rather than extending an existing treatment protocol to the community without first consulting community members, the project began with the formation of a partnership between university academics at UCLA and community stakeholders at Healthy African American Families. It was decided an important initial goal in the collaboration would be to implement a conference informing the community about autism and educating researchers about community-reported issues related to ASD.
Methods: Biweekly workgroups were held to plan the conference. Conference presenters included a combination of academic researchers and community members. Data collected were quantitative and qualitative and were culled from anonymous survey responses, audio-recordings, and observational notes assessing perceptions of ASD in the community.
Results: 250 individuals attended the conference and 140 completed evaluation surveys. 81% of respondents reported knowing an individual with a diagnosis of ASD (11% parents, 28% other family member, 32% friend of family, 29% service provider). 52% of respondents reported knowing an individual whom they thought *might* have an autism diagnosis (8% parents, 23% other family members, 36% friends of family, and 33% service providers).
When asked about ASD resources in the community, the majority of participants endorsed Doctors/Other healthcare providers (80%), followed by the Internet (59%), Autism Research Center (59%), and Books/Newspapers/Magazines (44%) as the most likely places they would seek advice and information if they had concerns about a child's development. Common barriers to accessing services included lack of knowledge about ASD (83%), lack of knowledge about local ASD resources (79%), and concerns about an individual being labeled as having ASD (64%). When asked about what kinds of ASD services would benefit the community, parent-mediated treatment (88%), part-C-funded early intervention (78%), and clinician-mediated intervention (72%) were the most endorsed. Preliminary qualitative analyses of conference discussions indicated several themes, including stigmatization of individuals with ASD, difficulties navigating healthcare/school districts to access services, the receipt of punitive consequences, rather than appropriate intervention, and the lack of ASD research including participants of color.
Conclusions: Community responses showed that most participants knew an individual with autism, suggesting that knowledge of the disorder is reaching the South Los Angeles community, although services may be more difficult to access. Overall, the conference reflected a strong interest in increasing and improving the quality of local ASD resources. The CPPR approach will continue, directly informing the implementation of sustainable intervention research that will better address the needs of under-resourced communities impacted by ASD.

3:16 **117.004** Potential Ethnic Disparities in Special Education Classroom Quality in a Large Urban County

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Background:
Although many evidence-based practices for ASD exist, our understanding of how prepared community-based providers are to deliver high-quality intervention to children with ASD is limited. Additionally, limited data have examined disparities in educational services based on minority populations in ASD specific classrooms. Careful characterization of usual care settings and identification of specific areas of strength and weakness may enhance professional development efforts and increase quality care across populations. This information may help researchers and providers optimally match evidence-based interventions and training programs to community settings based on characteristics of the intervention, student and teacher population, and current community practice, and thereby improve the likelihood of effective implementation.
Objectives:
The purpose of this study is to systematically evaluate special education classroom quality in a large sample of urban classrooms and to compare quality in classrooms across districts serving a high proportion of Hispanic students with those serving a high proportion of White students.
Methods:
Data were collected from 109 special education teachers in a large urban county who participated in

an effectiveness trial for a classroom-based intervention for students with ASD. All teachers had at least one student with ASD in their classroom and represented a wide range of classroom types, teaching experience, and education levels. Trained members of the research team with classroom experience conducted the Professional Development Assessment (PDA), an evaluation for programs serving children with ASD. The PDA includes a 2-hour observation, a 30-min teacher interview and educational records review. PDA outcome scores were averaged across seven domains (Teaming, Classroom Structure, Classroom Environment, Curriculum, Social/Peer Relationships, Management of Challenging Behavior, Instructional Climate) and compared across districts based on majority student ethnicity. Teacher and student demographic data were gathered through self (or parent) report for all participants.

Results:
Overall, classroom quality was high across classrooms except in the domain examining supports for Social/Peer Relationships. The quality of special education classrooms varied by domain and majority student ethnicity (Hispanic or White) across school districts. Significant differences in quality were identified across 5 domains (Classroom Structure, Classroom Environment, Social/Peer Relationships, Management of Challenging Behavior, and Instructional Climate) with classrooms in districts with 50% or more Latino students demonstrating lower overall quality as compared to districts with less than 50% of students reporting ethnicity as Latino.

Conclusions:
Special education classrooms in one urban county have a high level of quality and therefore may represent good environments for the implementation of evidence-based practice. However, differences in quality associated with student ethnicity indicate potential disparities in school-based programs for Latino children with ASD. Methods of adapting training procedures to address disparities will be discussed.

Oral Session
118 - Neural Signatures of Social Perception and Reward Motivation in ASD
1:45 PM - 2:35 PM - Grand Ballroom D

Session Chair: Robert Schultz, *Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA*

1:45 **118.001** Parsing Heterogeneity: Additive Effects of Oxytocin Receptor Gene Polymorphisms on Reward Circuitry in ASD

L. M. Hernandez[1,2,3], S. A. Green[1,2], K. Krasileva[2,4], L. Sherman[2,5], R. McCarron[1,2], C. Ponting[1,2], D. H. Geschwind[1,4], S. Y. Bookheimer[1,6] and M. Dapretto[1,2], (1)Psychiatry and Biobehavioral Sciences, UCLA, Los Angeles, CA, (2)Ahmanson-Lovelace Brain Mapping Center, UCLA, Los Angeles, CA, (3)Interdepartmental Neuroscience Program, UCLA, Los Angeles, CA, (4)Department of Neurology, David Geffen School of Medicine, UCLA, Los Angeles, CA, (5)Department of Psychology, UCLA, Los Angeles, CA, (6)Center for Cognitive Neuroscience, UCLA, Los Angeles, CA

Background: Autism spectrum disorders (ASD) are genetically complex. Single nucleotide polymorphisms (SNPs), which individually confer a small risk for neurodevelopmental disorders, may act additively to significantly increase risk for ASD (Gaugler 2014). A recent meta-analysis of SNPs on the oxytocin receptor gene (OXTR) suggests that multiple loci on OXTR increase the likelihood of developing ASD (LoParo 2014). Animal models have suggested that OXTR risk loci impact biological circuits relevant to ASD symptomatology; presynaptic oxytocin receptors in the nucleus accumbens (NAcc) are required for mice to exhibit a socially conditioned place preference (Dolen 2013). Importantly, neuroimaging research in ASD suggests that the NAcc is hypoactivated during reward processing compared to typically-developing (TD) controls (Dichter 2010; 2011). Together, these studies suggest a link between genetic and biological correlates of the oxytocin receptor, atypical social behavior, and hypoactivity in reward-related brain regions. Here, we explore these links using resting state functional connectivity magnetic resonance imaging (rs-fcMRI).

Objectives: 1) Examine the link between variability in number of OXTR risk polymorphisms across four SNPs and rs-fcMRI of the NAcc. 2) Investigate how altered reward-system connectivity relates to measures of ASD symptomatology.

Methods: DNA was extracted from saliva samples and genotyped for four ASD-associated OXTR SNPs (rs53576, rs237887, rs2254298, rs1042778). Participants were 29 children with ASD and 30 TD children ages 9-17. Children participated in a six-minute eyes-open resting-state fMRI scan. Data were preprocessed using standard methods followed by motion scrubbing (Power 2012). To assess connectivity, rs-fcMRI activity in the bilateral NAcc (defined using the Harvard-Oxford Atlas thresholded at 25% probability) was extracted and correlated with all other brain voxels. Single-subject whole-brain rs-fcMRI maps were combined and compared at the group level, modeling the number of OXTR risk alleles as a covariate of interest. All results were thresholded at z>2.3, corrected for multiple comparisons at p<0.05.

Results: In both ASD and TD participants, the bilateral NAcc showed connectivity with frontal cortex, anterior cingulate, and subcortical regions including caudate, putamen, thalamus, and amygdala. In the TD group greater numbers of OXTR risk alleles were associated with *increased* NAcc connectivity

with the frontal pole and paracingulate gyrus; in contrast, in the ASD group risk status was not associated with increased connectivity. Furthermore, there were no regions in the TD group for which greater numbers of risk alleles were associated with *decreased* NAcc connectivity, whereas in the ASD group greater aggregate risk was associated with decreased connectivity with the insula, anterior cingulate, bilateral caudate, thalamus, pallidum, putamen, and amygdala. This decreased connectivity in the ASD group was associated with ASD greater symptomatology – for example, reduced connectivity between the NAcc and amygdala was correlated with more severe preoccupations and mannerisms scores on the ADI-R.

Conclusions: These findings indicate that multiple OXTR risk polymorphisms have an additive effect on intrinsic reward system connectivity in children with ASD. Furthermore, this modulatory effect of OXTR SNPs on NAcc connectivity was related to ASD behavioral deficits. This work suggests a mechanism by which to parse genetic, neural, and behavioral heterogeneity within ASD.

1:57   **118.002**   Neural Reward Imbalance Between Social Incentives and Circumscribed Interests in Autism Spectrum Disorder

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Background: Neurobiological research in autism spectrum disorders (ASD) has largely focused on the social impairments, with restricted and repetitive behaviors and interests (RRBIs) being much less well studied, particularly with regard to functional neuroimaging. A common notion in the field suggests that the two core symptom clusters share a modest neurobiological overlap. In fact, accumulating evidence indicates an imbalance in the brain's reward system reactivity may contribute to both social deficits and RRBIs (Kohls, Yerys, Schultz 2014, *Biol Psychiatry*).

Objectives: This study's central aim was to determine if preoccupying special interests engage the brain's reward system in a fashion comparable to other incentives (e.g., social reward such as approval), and to compare brain responsivity to these different incentives in youth with ASD vs. typically developing control (TDC) children.

Methods: We conducted a 3T functional magnetic resonance imaging (fMRI) study to investigate the blood-oxygenation-level-dependent (BOLD) effect of social reward vs. personalized interest rewards (based on self-report) in 35 children with ASD relative to 19 TDC. To probe the reward system we used short video clips of actors providing social approval (social reward condition) and movies reflecting personal special interests (interest condition) as incentive stimuli, i.e., rewards. This optimization increases the task's ecologically validity compared to still pictures that are often used in this literature.

Results: There were no group differences with regard to type and number of individual interests, but children with ASD were rated to pursue their interests with greater intensity (according to parent report on the Interest Scale: Cohen's d=1.42). Behavioral task performance on the incentive delay task was similar in both groups with faster responses and better accuracy under reward conditions vs. non-reward. As predicted, however, the imaging data revealed greater reward circuitry activation in children with ASD vs. TDC in response to individual interest rewards. Significant group differences were found in the ventral and dorsal striatum, thalamus, precuneus, dACC, OFC and insula (whole-brain cluster-corrected at p=<0.05). dACC activity was correlated with ASD symptom severity (ADOS: r=0.39, p=0.023). By contrast, amygdala activation was diminished in ASD vs. TDC in response to social reward as revealed by ROI analyses.

Conclusions: The current data corroborate and extend prior findings that the brain's reward circuitry in ASD, particularly frontostriatal areas, selectively overreacts to RRBIs like restricted interests, whereas it underreacts to social rewards. Because ASD may be rooted in the powerful reward circuitries that shape a great deal of behavior, strategically targeting the role of reward mechanisms promises to improve current treatment practices for individuals with ASD and their families.

2:09   **118.003**   Joint Attention and Brain Functional Connectivity in Infants and Toddlers

A. T. Eggebrecht[1], J. Elison[2], E. Feczko[3], J. D. Lewis[4], S. Kandala[5], A. Todorov[6], J. J. Wolff[2], A. Z. Snyder[7], L. McEvoy[8], A. M. Estes[9], L. Zwaigenbaum[10], K. N. Botteron[11], R. C. McKinstry[12], J. N. Constantino[12], A. Evans[13], H. C. Hazlett[14], S. Dager[15], S. J. Paterson[16], R. T. Schultz[17], M. A. Styner[18], G. Gerig[19], S. Das[4], P. Kostopoulos[20], .. The IBIS Network[21], B. L. Schlaggar[12], S. E. Petersen[12], J. Piven[18,22] and J. R. Pruett[12,22], (1)Radiology, Washington University School of Medicine, St Louis, MO, (2)University of Minnesota, Minneapolis, MN, (3)Emory University, Atlanta, GA, (4)McGill University, Montreal, QC, Canada, (5)Psychiatry, Washington University School of Medicine, Saint Louis, MO, (6)Psychiatry, Washington University School of Medicine, St. Louis, MO, (7)Radiology, Washington University School of Medicine, Saint Louis, MO, (8)Washington University School of Medicine, St. Louis, MO, (9)Speech and Hearing Sciences, University of Washington, Seattle, WA, (10)University of Alberta, Edmonton, AB, Canada, (11)Washington University School of Medicine in St. Louis, St. Louis, MO, (12)Washington University School of Medicine, Saint Louis, MO, (13)McConnell Brain Imaging Centre, McGill University, Montreal, QC, Canada, (14)Carolina Institute for Developmental Disabliities and Department of Psychiatry, University of North Carolina, Chapel Hill, NC, (15)University of Washington,

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Background: Autism Spectrum Disorder (ASD) is a common neurodevelopmental disorder defined by impaired social interactions, repetitive behaviors, and altered communication. The Communication and Symbolic Behavior Scale (CSBS) is a semi-structured assessment of social communication, a domain profoundly affected in individuals with ASD.

Objectives: The purpose of this work is to investigate whether particular patterns of correlations between brain regions, as measured with resting state functional connectivity MRI (fcMRI), relate to initiation of joint attention (IJA) as measured with the CSBS.

Methods:

This work focuses on fcMRI and CSBS data collected from N=107 12- and N=94 24- month old (m.o.) children across four sites within IBIS, an NIH ACE Network study.

Cohorts: Children were classified as high risk (HR) if they had a sibling with ASD, or low risk (LR) if they had only siblings without ASD. Groups were assigned by research clinical best estimate using the DSM-IV-TR checklist at 24-m.o. (HR+/HR-/LR-: 12-m.o. n=17/62/28; 24-m.o.: n=22/49/23).

fcMRI data: For each child, fcMRI data were acquired in up to three resting state BOLD runs (130 frames, each TR=2.5 seconds), and processed using standard protocols including motion scrubbing (FD level 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 (Figure 1a) were correlated to yield fc values (Figure 1b), and sorted into one of 15 putative functional networks (Figure 1a) based on Infomap clustering of fcMRI data from the 24-m.o. children.

CSBS data: Question 7 (Q7) of the CSBS provided a dimensional metric of IJA: acts used to direct another's attention to an object, event, or topic (Figure 1c).

Brain-behavior analysis: For each age group, fc values were correlated against CSBS Q7 score (Figure 1d,e). A 2x1 χ^2 test was calculated to determine if the number of strong correlations (uncorrected $p<0.05$, Figure 1e) within each network-pair of the matrix was significantly greater than the number expected by chance (Figure 1f); only a few blocks survived Bonferroni correction (Figure 1g). For each block, a 2-sided t-test was calculated across age groups.

Results: Analyses revealed specific groupings of significant network-pair correlations of fc with IJA (Figure 1d-g) that differ between age groups (Figure 1h), e.g. the Dorsal Attention Network (DAN) and the Supplementary Visual (SV) exhibit strong negative correlations with behavior in 12-m.o. (blue shading in DAN-SV block in Figure 1d, top) and modest correlation magnitudes in 24-m.o. (green shading, Figure 1d, bottom). Age-dependent differences are also apparent between other key network pairs (Figure 1h). Further analyses on the risk and diagnostic groups are forthcoming as we acquire more subjects.

Conclusions: Herein we have shown that IJA correlates with fcMRI, with different specific network-pair interactions in 12-m.o. and 24-m.o. children. Inclusion of the children at high risk for ASD and those with a positive diagnosis provided a unique opportunity to explore a wide range of IJA behavior. Thus we have shown evolving brain-behavior relationships for one affected domain in ASD over the second year of life, when ASD symptoms emerge.

2:21 **118.004** Emotion Processing in Adolescents with ASD: Using Multiple Measures and Varying Intensities

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Background: Adolescents with ASD often have difficulty monitoring facial expressions in daily interactions. Despite these 'real world' deficits, two previous studies reported no differences between children with ASD and control children in experimental measures of facial emotion processing (Hileman et al., 2011; O'Connor, Hamm & Kirk, 2005). One possible explanation for this discrepancy lies in the inconsistency between stimuli used across studies – typically prototypical, exaggerated exemplars of emotion – and the subtle expressions typically encountered in social interactions.

Objectives: To characterize the neural and behavioral response to low- and moderate-intensity facial expressions in adolescents with and without ASD.

Methods: Preliminary analyses include 29 12-year-olds: 15 typically developing (TD) children and 14 with ASD. Children were fitted with a high density EEG/ERP sensor nets and presented with 250 trials of facial expressions of anger, fear and happiness at 20%, 40% and 60% intensity. The component of interest was the face-sensitive N170, measured over the left and right occipito-temporal regions. Participants completed a behavioral sorting task: the child was presented with cards, each showing an expression, and asked to sort them by emotion. Faces included the same emotions at 10% increments of intensity, from neutral to 100%.

Both peak amplitude (in microvolts) and latency (in milliseconds) of the N170 were measured. For the behavioral data, the variables of interest were "threshold" – the intensity at which the participant

identified an emotion in the face (no longer identified the face as 'neutral') – and the number of errors made in emotion identification.

Results: [NOTE: Due to space limitations, only results pertaining to group will be elaborated.] Two 3 (emotion, within-subject) X3 (intensity, within-subject) X2 (region, within-subject) X2 (group, between-subject) repeated-measures ANOVAs were run for N170 latency and peak amplitude. In order to correct for multiple comparisons, the Greenhouse-Geisser test was used. Main effects of emotion (F=5.35, p= .01) and intensity (F=9.04, p=.001) were found; no main effect or interactions of group were found. For peak amplitude, an emotion X group X region interaction was revealed (F=4.32, p=.02). Follow up analyses revealed that the peak amplitude to fear was significantly smaller over the right than left hemisphere, but only for the ASD group (t=2.27, p=.04). No group differences were found in number of behavioral errors made, and although the groups were similar in their thresholds for anger and fear, the ASD group had a higher threshold for happy than the TD group (t=2.34, p=.03).

Conclusions: These results provide a valuable follow-up to previous studies; for the first time, research stimuli have included the low-intensity emotional expressions commonly encountered in daily interactions. These preliminary findings indicate that – even with subtle emotional expressions – response in an experimental task may be remarkably intact, though with some variability across emotion type. This result is encouraging for clinical applications, because it suggests that there may not be a pervasive deficit in the detection of emotional expressions, but rather that the impairment lies in adapting one's social response, an area that is a natural target for intervention.

Oral Session
119 - Relationships between Behavior and Sensorimotor Circuitry in ASD
2:40 PM - 3:30 PM - Grand Ballroom D

Session Chair: Robert Schultz, *Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA*

2:40 **119.001** Cortico-Cerebellar Dysfunctions Associated with Visuomotor Abnormalities in Autism Spectrum Disorder Vary According to the Quality of Visual Feedback

M. W. Mosconi[1], S. P. Coombes[2], L. M. Schmitt[3], G. Magnon[4], D. E. Vaillancourt[2] and J. A. Sweeney[1], (1)Center for Autism and Developmental Disabilities, UT Southwestern Medical Center, Dallas, TX, (2)University of Florida, Gainesville, FL, (3)Center for Autism and Development Disabilities, UT Southwestern Medical Center, Dallas, TX, (4)University of Texas Southwestern Medical Center, Dallas, TX

Background: Sensorimotor impairments are present in the majority of individuals with autism spectrum disorder (ASD). We recently documented increased force variability during visually guided precision gripping in ASD that scaled with the gain of visual feedback. Here, we used functional MRI (fMRI) to characterize the cortical and cerebellar abnormalities underlying visuomotor abnormalities in ASD.

Objectives: To characterize cortico-cerebellar alterations associated with increased visuomotor variability in ASD, and to determine whether brain alterations vary in relation to the gain of visual feedback.

Methods:
Twenty individuals with ASD and 23 healthy controls matched on age, nonverbal IQ and handedness performed an fMRI test of visually guided precision grip force (Figure 1). During the 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 which was set to 15% of each individual's maximum force. Subjects also completed a rest condition in which they viewed the two bars on the screen. Both conditions lasted 26 s and they were alternated 3 times during each run. To assess the impact of changes in visual feedback on force control and brain activation, separate runs were completed at three different visual gains. Visual gain was manipulated by varying the vertical distance the FORCE bar moved per Newton of grip force. Visual gain was increased by moving the FORCE bar a greater distance for every Newton of force generated.

Results:
Subjects with ASD showed increased force variability relative to controls that was most severe at the lowest and highest gain levels compared to the medium gain level. At low visual gain, individuals with ASD showed reduced activation in contralateral primary motor cortex, thalamus, bilateral anterior cerebellum (lobules I-IV) and ipsilateral cerebellar lobules V/VI. At the medium visual gain level, reduced activity in ASD was seen in primary motor cortex, inferior parietal lobule and middle occipital gyrus. Individuals with ASD showed increased activity in lingual gyrus and superior temporal gyrus. When visual gain was high, individuals with ASD showed increased activation in right cuneus and precuneus, supplementary motor area, middle frontal gyri, right superior temporal gyrus, and right superior parietal lobule.

Conclusions:
Our results indicate that increases in force variability at high and low visual gains reflect different

underlying cortico-cerebellar dysfunctions in ASD. At low visual gain, individuals with ASD show reduced activation in parietal cortex, cerebellum, thalamus and primary motor cortex indicating that failure to minimize motor variability may reflect under-responsiveness throughout the visuomotor circuit. When visual gain was high, individuals with ASD showed over-activity of extrastriate and parietal cortices suggesting increases in motor variability may reflect hyperactivity during visual processing. These findings provide new insights into the brain mechanisms underlying sensorimotor abnormalities in ASD, and suggest that multiple distinct cortico-cerebellar systems are involved in the neurodevelopmental alterations that cause this disorder.

2:52 **119.002** Atypical Lateralization of Motor Circuit Connectivity in Children with High-Functioning Autism Is Associated with Motor Deficits

D. L. Floris[1,2], A. D. Barber[2,3], M. B. Nebel[2,3] and S. H. Mostofsky[2,3,4], (1)Autism Research Centre, Cambridge, United Kingdom, (2)Center for Neurodevelopmental and Imaging Research, Kennedy Krieger Institute, Baltimore, MD, (3)Department of Neurology, Johns Hopkins School of Medicine, Baltimore, MD, (4)Department of Psychiatry and Behavioral Sciences, Johns Hopkins School of Medicine, Baltimore, MD

Background:
Atypical lateralization of language-related functions has repeatedly been shown in individuals with autism. No studies have however investigated deviations from typically occurring asymmetry of other lateralized cognitive and behavioural domains such as motor skills. Motor deficits are among the earliest and most prominent symptoms in individuals with autism and precede core social and communicative symptoms.
Objectives:
We have previously shown that leftward lateralization of motor circuit connectivity is associated with better motor performance in typically developing children. Here we aim to investigate whether motor circuit connectivity is (1) atypically lateralized in children with autism and (2) whether this relates to core autistic symptoms and motor performance.
Methods:
Participants comprised 45 right-handed children with high-functioning autism (37 boys; 8 girls) and 87 typically developing children (61 boys; 26 girls) matched for age (8-12), performance IQ and sex. Autistic symptoms were assessed by the ADI-R, ADOS and SRS. Motor performance was assessed by the Physical and Neurological Examination for Subtle Signs (PANESS).
Functional images were slice time and motion corrected, co-registered and normalized to a symmetrical age- and gender matched TPM. Six absolute and six differential motion parameters and nuisance variables (CSF and WM) were removed using CompCor and spatial smoothing (6 mm) and temporal filtering (0.01--0.1 Hz band-pass filter) were performed.
Six-millimeters-radius 3D seeds were generated based on peak coordinates of activations previously identified during right-handed finger sequencing. Homotopic seeds were generated by flipping the left hemisphere seeds along the x-axis. Time series from the seeds were extracted and pairwise correlations were conducted in each hemisphere separately. Laterality indices were calculated with the formula: R-L. Statistical analyses were carried out in SPSS.
Results:
A univariate ANOVA controlling for sex showed a significant difference in laterality of motor circuit connectivity of the left-hemisphere network ($F=5.01$; $p=0.027$) between the two groups. Children with ASD showed rightward lateralization compared to typically developing children. Partial correlations controlling for sex resulted in a significant association between the laterality index and total PANESS Gait scores ($r=0.403$; $p=0.007$) and total PANESS scores ($r=0.45$; $p=0.002$) with stronger rightward lateralization being related to more motor impairment. There were no significant correlations with autistic symptoms.
Conclusions:
Atypical lateralization in autism is not restricted to language functions, but is also present in functional motor circuit connectivity and related to motor deficits. Greater rightward laterality in children with autism may underlie motor deficits. Future studies should investigate whether atypical lateralization is even more pronounced in left-handed individuals with autism and whether these asymmetries are related to atypical lateralization in the language domain, too.

3:04 **119.003** Post-Movement Beta Rebound Is Decreased in Children with ASD

W. C. Gaetz[1], L. Blaskey[2], E. S. Kuschner[2], L. Bloy[2], R. Murray[3], C. Fisk[4], M. Ku[4], D. Chudnovskaya[4], J. W. Dell[5], R. Golembski[4], P. Lam[4], S. E. Levy[6] and T. P. Roberts[2], (1)The Children's Hospital of Philadelphia, Bala Cynwyd, PA, (2)Children's Hospital of Philadelphia, Philadelphia, PA, (3)Radiology, The Children's Hospital of Philadelphia, Philadelphia, PA, (4)The Children's Hospital of Philadelphia, Philadelphia, PA, (5)CHOP MEG Lab, The Children's Hospital of Philadelphia, Philadelphia, PA, (6)Developmental & Behavioral Pediatrics, Children's Hospital of Philadelphia, Philadelphia, PA

Background:
A variety of motor impairments have consistently been associated with ASD, such as low muscle tone, coordination/balance and imitation impairments, dyspraxia and motor stereotypies. However, the neurophysiological mechanisms underlying these motor impairments remain obscure. Movement-

induced cortical rhythms have been investigated recently in ASD during tasks involving motor imitation and observation. These studies indicate a deficiency in beta (15 to 30 Hz) rhythm function associated with the imitation and observation of movement. It remains unclear however, whether these deficiencies are also evident when performing simple motor responses.

Objectives:

To compare movement-related cortical oscillations in TD and ASD children performing a simple button-press task.

Methods:

Neuromagnetic activity was recorded in 12 children with ASD (mean 12.4 years) and 12 TD children (mean 12.2 years), during a task requiring a right index finger response. A visual contrast grating stimulus was presented adjacent to a central fixation cue once every 4 s. Subjects were required to maintain fixation and press a button at the disappearance of the grating stimulus (1.75 s duration; +-0.25 s). 100 responses were collected over a 400 s MEG recording period. Movement related oscillatory changes for beta (15 to 30 Hz) and gamma (60 to 90 Hz) frequency bands were then assessed using beamformer spatial filter analysis. Beta ERD (event-related desynchronization), a decrease in movement-related resting beta band power was assessed at movement onset (active window; -0.3 to 0.2 s, with the button press at time 0 s) compared to a pre-movement baseline (-1.8 to -1.3 s) time period. Following movement, the expected re-synchronization of beta-band power (post-movement beta-rebound; PMBR) was assessed using a 0.5 to 1.0 s active time window compared to the pre-movement baseline (-1.8 to -1.3 s). Movement-related gamma-band synchrony (MRGS) was also assessed at the time of the button-press response using an active window of -0.1 to 0.2 s compared to the pre-movement baseline.

Results:

Right index finger movement was associated with strong contralateral modulations in beta band power as expected. In the contralateral left hemisphere, beta ERD power was observed maximally from primary motor cortex (MI), and was of similar magnitude for both TD and ASD (N.S.). Similarly, MRGS was observed maximally in contralateral MI and was not significantly different for both ASD and TD groups. In contrast, PMBR was significantly reduced or absent in ASD subjects compared to TD control children (p=0.04).

Conclusions:

These results provide physiological evidence for a distinct functional deficit in motor cortical responses for children with autism. These results may be important for interpreting related studies using more complex tasks such as action/observation methods to investigate "mirror-neuron" function from autistic children and adults. PMBR is generally associated with motor deactivation or inhibition and PMBR power has been shown to correlate directly with GABA concentration in TD adults (more GABA results in stronger beta rebound). Reduced PMBR in autism is also interesting in light of a recent study from our group showing decreased GABA level in the motor cortex in ASD.

3:16   **119.004** Praxis-Related Alterations of Cortical Oscillations in Children with Autism: Associations with Symptom Severity, Repetitive Behaviors and Motor Planning

J. B. Ewen[1], B. M. Lakshmanan[2], A. S. Pillai[3], M. Hallett[4], N. E. Crone[5] and S. H. Mostofsky[6], (1)Kennedy Krieger Institute/Johns Hopkins School of Medicine, Baltimore, MD, (2)Kennedy Krieger Institute, Baltimore, MD, (3)Neurology and Developmental Medicine, Kennedy Krieger Institute, Baltimore, MD, (4)Human Motor Control Section, NIH/NINDS, Bethesda, MD, (5)Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, (6)Department of Neurology, Johns Hopkins School of Medicine, Baltimore, MD

Background: The ability to perform praxis gestures--learned, skilled movements--has been linked both theoretically and empirically with the cardinal features of autism spectrum disorders (ASD). Because the praxis network is well characterized, and because motor behaviors are relatively easy to quantify and manipulate, praxis function serves as an excellent model system in ASD. To explore frontal-parietal network function in ASD, subjects performed a praxis task during EEG recording.

Objectives: To assess the specificity of task-related oscillatory differences in ASD as well as their relationship to key behavioral measures.

Methods: 20 children with ASD and 28 controls (typically developing; TD) ages 8-12 years performed a praxis preparation and execution task while EEG was recorded. We assessed broad-band event-related spectral perturbations (ERSP; task-related change in signal power). We specifically examined the premotor (central) and parietal regions known to be related to praxis function. Behavioral assessment included the Autism Diagnostic Observation Schedule (ADOS), the Autism Diagnostic Interview (ADI) and the Postural Knowledge Test (PKT; a "perceptual" test of praxis ability).

Results: Event-related synchronization (ERS; task-related increases in signal power) were seen in the theta band (2-8 Hz), and event-related desynchronization (ERD; task-related decreases in power) were seen in alpha (7-13 Hz) and beta (18-22 Hz) bands in both groups. The groups differed specifically in magnitude of beta ERD in left central channels as well as alpha ERD in left posterior channels. Further, the degree of posterior alpha ERD attenuation was associated with increased autism severity overall as well as impaired performance on a perceptual "praxis" task in the ASD group. The degree of attenuation of central beta ERD was correlated with restricted/repetitive behaviors and interest on both the ADOS and ADI.

Conclusions: Consistent with predictions, the ASD patients had an attenuation of task-related EEG oscillatory responses. The nature of these group differences, however, was quite specific: differences

were only seen on the left, consistent with the known lateralization of the praxis network. Deficits in central beta suppression (ERD) in ASD were associated with degree of restricted/repetitive behavior; this may be due to the putative role of central beta as a mediator of *"status quo"* activity. Deficits of posterior alpha suppression were associated with impairment of "perceptual" or posterior aspects of praxis function as well as overall ASD symptom severity, thus adding to the evidence supporting the role of frontal-parietal networks in motor as well as social/communicative aspects of the autistic phenotype. Further, deficits in oscillatory activity may implicate inhibitory interneurons, whose function is thought to be altered in ASD. The results provide specific evidence that impaired modulation of oscillatory activity may have a direct effect upon autistic symptoms.

Oral Session
120 - Experiencing Autism: First-Hand and Sibling Perspectives
1:45 PM - 2:35 PM - Grand Salon

Session Chair: Alison Singer, *Autism Science Foundation, New York, NY*

1:45   **120.001**   How Should We Describe Autism? Perspectives from the UK Autism Community

L. Kenny[1], C. Hattersley[2,3], B. Molins[3], C. Buckley[4], C. Povey[3] and E. Pellicano[1], (1)Centre for Research in Autism and Education (CRAE), Institute of Education, London, United Kingdom, (2)Providence Row, London, United Kingdom, (3)The National Autistic Society, London, England, United Kingdom, (4)Royal College of General Practitioners, London, United Kingdom

Background: The language used to describe autism has undergone considerable changes since autism was first described. Changes have come from the medical and scientific communities, as diagnostic criteria and understanding of the condition have evolved, and from parent and self-advocacy groups, as the disability rights and neurodiversity movements have gained in prominence. These changes have been brought about partly due to important tensions in what people believe autism to be. Such changes also have important consequences as the way in which people choose to describe autism influences personal and societal perceptions of what the condition entails.
Objectives: We aimed to understand the current views and preferences of community members (autistic adults, parents and professionals) about the terms they use to describe autism, and to determine potential differences, if any, between community groups in the UK.
Methods: 3,808 people (aged 18 years and over), recruited largely through the database of the UK's National Autistic Society, responded to an online survey. These included autistic adults, parents of people with autism, professionals and family members and friends. The survey asked participants (1) to identify, by selecting from a list, which terms they prefer to use when communicating about autism; (2) to identify which terms they would use to describe themselves or the person with autism that they live/work with/know; (3) to rate their preference for a series of terms used to describe autism on a 5-point scale; and (4) to specify, by selecting from a list, which *one* term they would use to describe autism. Finally, in an open question, participants were given an opportunity to provide comments relevant to the issue of describing autism.
Results: Examination of the quantitative data showed that people use many terms to describe autism. The most highly endorsed terms were 'autism' and 'on the autism spectrum', and to a lesser extent, 'autism spectrum disorder (ASD)' for which there was general agreement across community groups. Community members disagreed, however, on the use of several terms. The term 'autistic' was endorsed by a large percentage of autistic adults (61%), family members/friends (54%) and parents (50%) but by considerably fewer professionals (38%). In contrast, 'person with autism' was endorsed by almost 50% of professionals but only by 26% and 22% of autistic adults and parents, respectively. Analysis of the qualitative data provided reasons underlying these preferences, particularly for the lack of unanimity within community groups.
Conclusions: This study demonstrated for the first time that there is no single way of describing autism that is universally accepted and preferred by the UK's autism community. Instead, autism is currently described in a multitude of ways, with little consistency across – and even within – community groups. The context in which language is used is paramount and goes some way to explaining the variety of terms used. These findings have important implications for how we describe autism in research, policy, clinical and colloquial terms.

1:57   **120.002**   "What 'Being on the Spectrum' Means to Me": How Adolescents with Autism Spectrum Disorder Understand and Explain Their Diagnoses

L. Berkovits[1], B. L. Baker[1] and J. Blacher[2], (1)UCLA, Los Angeles, CA, (2)University of California - Riverside, Los Angeles, CA

Background: Although ASD has wide-ranging influences on individuals' lives, little research has been conducted to understand the personal experiences and perceptions of individuals with ASD. Research is particularly lacking during the formative years of adolescence, when one's self-concept undergoes substantial development and changes (Sebastian, Burnett, & Blakemore, 2008). Ruiz Calzada and colleagues (2012) explored both parent and adolescent perceptions, but focused on the impact of the diagnostic label itself, rather than on experiences of the disorder and perceptions of its

influence. Thus, the self-concept of adolescents with ASD and their understanding of their diagnoses remain understudied.

Objectives: To elicit and describe the experiences of adolescents with ASD as collected via semi-structured interviews, in order to understand their perceptions of their diagnosis and what "being on the spectrum" means to them. Specific research questions addressed in this paper include: (1) To what extent do adolescents describe their diagnoses in positive and negative terms? (2) How to adolescents perceive the impact of their diagnoses (e.g., permanency of symptoms and perception of others)? (3) How do adolescent perceptions of their diagnoses relate to autism symptomatology, cognitive abilities, and social functioning?

Methods: This study examined perceptions of ASD in 15-year-old adolescents with ASD (N=48; Mean IQ=92, SD=24), using data obtained from the last time-point of a multi-site longitudinal study. Adolescents were asked a series of questions, using the family's preferred label for the ASD diagnosis (e.g., *"What does [ASD] mean to you?"* and *"Do you think you will always have difficulties associated with [ASD]?"*). Quantitative coding was completed to capture adolescents' responses based on yes/no categories and valence of their perceptions.

Results: In response to the question, "What does [ASD] mean to you?" 32% of adolescents responded with a predominantly negative valence (e.g., "I take things overly literally, it makes conversation harder"), 42% with solely neutral or factual material, 10% with mixed positive and negative valence, and 17% positive valence (e.g., "It helps me feel like an individual and think outside the box"). The sample was mixed regarding the perceived permanency of their difficulties (33% permanent; 38% possibly permanent; 30% not permanent). The sample was also mixed regarding beliefs of how others perceive them (52% differently from their peers; 48% not differently) and the valence of these perceived differences (20% negative; 24% neutral; 40% mixed; 16% positive). Further analyses will relate adolescents' perceptions to other facets of their functioning, including IQ, social skills, and mental health comorbidities.

Conclusions: Adolescents with ASD described a variety of perceptions regarding what it means to for them to have an ASD diagnosis and what impact the disorder has on their current and future functioning. Obtaining a better understanding of these perceptions will inform effective services for adolescents with ASD by highlighting ways in which their perceptions of their diagnoses may influence their current functioning and by targeting services to areas of perceived deficits.

2:09 **120.003** Encouraging Participant-Centered Autism Research: What We Know from Potential Participants

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Background:
Engaging individuals with ASD and their families is critical for subject recruitment; however, there has been little research into the motivators for engagement.

Objectives:
The goal of the study was to understand motivations and research interests in a population of families affected by autism in order to improve the recruitment and retention process in autism research.

Methods:
An anonymous survey (two versions: (i) adults with ASD; (ii) parents of a child of any age with ASD) administered by the Interactive Autism Network, an internet-mediated autism research registry, ran 08/01/2014-08/11/2014. Links to the survey were distributed by e-mail to registry participants and community website subscribers. Links were also posted on the registry's community website and Facebook page.

Results:
141 adults with ASD and 1,122 parents with a child with ASD completed the survey (514 parents of a young child <13 years; 347 parents of a teen aged 13-17 years; and 261 parents of an adult ≥18 years). Exclusions: non-affirmation of ASD diagnosis or indication of age-category of individual with ASD.

53% of adults and 63% of parents had previously participated in research. 98% were willing to participate in future research, depending on the nature and demands of the study.

All groups listed that a "convenient location" was a high/moderate motivator: 88% were prepared to travel 30 minutes each way; 62% one hour; 33% two hours. 21% of adults were prepared to travel more than 3 hours. All groups were prepared to spend a considerable amount of time participating: 77%≤4 hours; 37%≥8 hours.

Respondents across all groups indicated that altruism (helping others, advancing science) and receiving personalized reports were high/moderate motivators (>90%). All groups were very/somewhat likely to participate in studies about genetics (89%) and associated mental health conditions (91%), but less like to join studies that required prescription medication (31%). All groups indicated a willingness to participate in longitudinal studies. Online surveys and paper surveys were preferred to telephone surveys, especially by adults with ASD.

All parents were highly/moderately motivated to learn more about their child (94%) and were

very/somewhat likely to participate in a study on the effects of autism on the family (88%). Parents of adults and teens were especially interested in research on transitioning to more independent living (90% very/somewhat likely). Parents of young children were less willing to travel and more motivated by the availability of child care for their other children while participating; they were especially motivated by research into behavioral therapies, education, and speech/language (all ≥90%). All groups expressed that they were highly/somewhat motivation by reimbursement for time and travel (79%), but indicated less interest in actual dollar amounts or gift codes. Few were motivated by drawings for gifts (<40%). This suggests incentives should be framed in terms of reimbursement for time/travel expenses.

Conclusions:
Research must be designed with participants in mind. Autism research requires consideration of location, convenience, research topic, methodology, and such motivators as altruism and reimbursement. Researchers should be prepared to provide individual feedback, in addition to generalized outcome reporting.

2:21   **120.004** The Sibling Experience: Quality of Life and Adjustment in Siblings of Individuals with Autism Spectrum Disorder in Adolescence

L. L. Green and S. Gavidia-Payne, Health Sciences, RMIT University, Bundoora, Australia

Background:
The sibling bond is the marathon of human connection; it is the longest lasting relationship, enduring from the birth of the youngest sibling to the death of the first to go. It is reasonable to assume the importance of this relationship across the lifespan, but what impact arises when the normal sibling relationship is altered by developmental disability?

ASD is a particularly stressful disability for families (Orsmond & Seltzer, 2009; Quintero & McIntyre, 2010). With the large commitment that family members make to ensure an individual with autism has an environment that caters for their complex needs, it is empirically intuitive to assume that quality of life (QoL) is impacted in these families. This has yet to gain scholarly support, with a lack of research focusing on QoL outcomes in ASD families. In endeavouring to address the gaps in the autism literature pertaining to sibling developmental trajectories, the current study aimed to examine the QoL of autism siblings within the context of a biopsychosocial model of teenage experience.

Objectives:
Siblings of children with ASD have been shown to exhibit higher levels of internalising and externalising disorders (Rodrigue, Geffken, & Morgan, 1993; Ross & Cuskelly, 2006), social and behavioural adjustment problems (Orsmond & Seltzer, 2007), hassles with sibling behaviour (Moyson & Roeyers, 2011), and guilt (Opperman & Alant, 2003). Although this literature is well established, adolescent siblings are afforded less research attention than children and adults. The objective of the present study was to investigate the factors contributing to psychosocial outcomes of young people growing up with a sibling with autism. Specifically, it aimed to examine the profile of psychological adjustment, stress levels, and QoL of 13-14 year old siblings.

Methods:
Two matched groups of participants were recruited: a group of 13-14 year old siblings of individuals with autism and a control group. Each adolescent and their parent completed a survey. The adolescents responded to items regarding: Quality of Life; Daily Hassles, Coping and Accommodations; Internalising and Externalising Disorders; and, Stress and Cognitive Processes. The parents completed questionnaires on: Quality of Life of the Typically-developing Child; Severity of ASD; Family Coping; and, Parent Well-being.

Results:
Data is currently being analysed to determine group differences and predictors of sibling QoL.

Conclusions:
The National Disability Insurance Scheme (NDIS), an Australian funding program for families of people with disabilities, has identified that financial support is critical for siblings of people with disabilities. However, policy makers are yet to devise policies that inform practice in this area. Increased knowledge of the sibling experience will allow policy development to cater for siblings within the family unit in a meaningful way. Identification of at-risk adolescents will allow funding to be appropriately channelled into sibling support programs to address diminished QoL; individual counselling for internalising and externalising disorders; and psychoeducation resources for families. This study is the first of its kind, leading the way for the development of evidence-based autism-specific sibling support interventions.

Oral Session
121 - Social Motivation, Social Reward, and ASD Traits in Clinical and Typical Samples
2:40 PM - 3:30 PM - Grand Salon

Session Chair: Jan Blacher, University of California - Riverside, Los Angeles, CA

2:40   **121.001** Perceived Social Support in Cognitively High Functioning Adults with Autism Spectrum

Disorder

S. Alvarez-Fernandez[1], H. R. Brown[1], J. A. Raithel[1], S. L. Bishop[2], S. B. Kern[1], C. Lord[3] and A. Di Martino[1], (1)Child Psychiatry, NYU Child Study Center, New York, NY, (2)Psychiatry, University of California, San Francisco, San Francisco, CA, (3)Weill Cornell Medical College, White Plains, NY

Background: The observation that perceived social support (PSS) is related to physical and mental well-being in typically developing individuals has motivated investigations of PSS in individuals with Autism Spectrum Disorder (ASD). However, prior efforts have been based on qualitative examinations in small samples without comparison groups of non-ASD adults.
Objectives: To provide quantitative characterization of PSS in adults with ASD we administered the Multidimensional Scale of Perceived Social Support (MSPSS), a self-report 12-item Likert scale examining PSS in three domains: friends, significant-others, and family. Secondary analyses explored the relationships between PSS and self-reported empathy and symptoms of comorbid psychopathology.
Methods: We obtained MSPSS scores from three groups of adults matched for age and IQ, including 41 adults with ASD (Mean age 30.5±11.2; Mean IQ 109±14), 61 with ADHD, and 69 neurotypical controls (NC). There were significantly fewer males in the ADHD group (46% vs. 73% and 73% in ADHD, NC and ASD, respectively). To measure cognitive and affective empathy, as well as comorbidity, participants completed the Interpersonal Reactivity Index (IRI) and the Symptom Checklist-90-Revised (SCL-90-R) questionnaires, respectively. Their scores were related to the MPSSS scores in the two clinical groups.
Results: ANOVA adjusted for sex followed by pairwise group comparisons revealed significantly lower total MSPSS scores in ASD vs. adults with ADHD and NC (F= 3.460, p=0.02). Examinations of MSPSS subscore profiles highlighted that the MSPSS total score difference was primarily driven by the *friend* subscore (F=7.659, p<0.001), as no significant group differences emerged for the *family* and *significant other*subscores. MSPSS total scores were significantly and negatively related to scores on SCL-90-R global indices in adults with ADHD, indicating that lower PSS is related to higher levels of psychopathology in ADHD. This relationship was not significant in adults with ASD. Further, MPSS total scores were significantly and positively related to the empathic concern subscale score of the IRI (indexing affective empathy) in adults with ASD (r=0.545, p<0.001), but not in the ADHD group. No relationships were evident with regards to perspective taking scores indexing cognitive empathy.
Conclusions: Relative to both NC and individuals with ADHD, cognitively high functioning adults with ASD reported significantly lower PSS, primarily as related to friends. This finding, along with the significant correlation between PSS and affective empathy skills in the ASD group only, suggest ASD-specific mechanisms leading to poorer PSS in autism. Findings of a significant relationship between comorbid psychopathology and PSS in the ADHD but not the ASD group were unexpected. These findings need to be interpreted with caution given the exclusive reliance on self-report measures and the relatively selected sample of adults with ASD. They may suggest that the traditional relationships between social support and mental well-being may not apply in the same way to adults with ASD. Future studies with a wider range of measures from multiple informants are needed to confirm the present findings.

2:52 **121.002** Measuring the Value of Social Stimuli in Autism Spectrum Disorders

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Background: An increased preference for non-social over social stimuli is reported in autism Spectrum Disorders (ASD). A recent theory describes this in terms of reduced motivation to engage with others (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). However, there are currently few simple behavioural ways to test this claim or to quantify social motivation in individuals with or without ASD.
Objectives: In this study we aimed to develop a method to measure social motivation and determine if the behavioural preference for social / non-social stimuli differs between people with and without ASD.
Methods: We used a simple behavioural paradigm called Choose-a-movie (CAM) that measures preference for social versus non-social stimuli in adolescents and adults with and without ASD. On each trial, participants chose which of two movies to watch, and must consider their movie preferences against the amount of effort (key-hits) required to see a movie. Three different movie categories were compared: movies of adult actors with direct gaze, adult actors with averted gaze, and non-social movies of object rotating on a table. Each trial presented two movies from these categories.
In experiment one, 40 adolescents with ASD and 40 age/IQ matched typical adolescents completed the CAM paradigm with one set of paired stimuli (i.e. direct gaze versus object movies). In experiment two, 29 adults with ASD and 24 age/IQ matched typical adults completed the CAM paradigm with three sets of paired stimuli: a) direct gaze versus objects, b) averted gaze versus objects, c) direct versus averted gaze movies.
Results: The results from experiment one showed that adolescents with ASD tended to invest more effort to watch object/ non-social movies than to watch direct gaze social movies. In experiment two, adults with ASD showed a significantly reduced preference for direct gaze social movies than matched comparison group. They invested more effort to look at the object/non-social movies than direct or averted gaze social movies. When presented with two social movies (direct versus averted gaze),

typical adults preferred to view direct gaze movies but adults with ASD showed no preference between these categories.

Conclusions: Together, these studies show differences in the value associated with social stimuli between adults and adolescences with and without ASD. Both adults and adolescents with ASD value non-social stimuli more than matched adults and adolescents without ASD. These data provide a precise quantification of social motivation, and advance our understanding of how value of social engagement may differ between those with and without ASD.

3:04   **121.003** Bridging the Gap Between Social Motivation and Empathy: Autistic Traits Modulate Spontaneous Facial Mimicry of Social Rewards in Individuals with ASD

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Background: Individuals with Autism Spectrum Disorders (ASD) typically show deficits in measures related to empathy, including spontaneous facial mimicry. Atypical responsivity to social rewards has been suggested to underlie such deficits (Chevallier et al., 2012). In a previous study we found that typically developing individuals show enhanced spontaneous facial mimicry towards faces associated with high reward value compared to those associate with low reward value (Sims et al., 2012). Importantly, the difference in mimicry for high compared to low reward faces was negatively correlated with autistic traits, suggesting a weakened link between reward and mimicry in individuals high in autistic traits. However, it is unknown how autistic traits modulate this link in individuals with a clinical diagnosis of ASD.

Objectives: We tested the modulation of the reward-mimicry link by autistic traits (as measured by the Autism Spectrum Quotient, AQ) in individuals with a clinical diagnosis of ASD, using a paradigm identical to the one used previously in neurotypicals (Sims et al. 2012).

Methods: 25 adult participants with a DSM-IV/ ICD-10 based diagnosis of Autism/ ASD/ Asperger Syndrome (13 female; age range 19-50 years [$M = 30.63, SD = 11.73$]) took part in an implicit reward conditioning the experiment. Briefly, it involved watching a set of faces in the context of a card game, where different identities were conditioned with different levels of reward (win/lose outcomes: POS faces were associated with wins, NEG faces with losses). Consequently, participants watched short videos of the same faces (as in the conditioning phase) making happy expressions, while facial EMG was recorded. Zygomaticus Major response to happy faces was used as a measure of spontaneous facial mimicry and compared between POS and NEG faces.

Results: In contrast to the finding reported by Sims et al. (2012) in neurotypicals, no increased mimicry for the POS vs NEG faces were noted in the whole sample (t=1.227, p=0.223). However, greater autistic symptoms (as measured by higher AQ scores) were associated with smaller difference in the extent of spontaneous mimicry for POS vs NEG faces (r= -0.457, p=0.016).

Conclusions: We conclude that autistic traits modulate the link between reward and spontaneous facial mimicry, in individuals with ASD. While there was no difference in the spontaneous facial mimicry of POS vs NEG faces in the whole sample, individual scores on autistic traits were strongly associated with the extent to which POS faces were mimicked greater than NEG faces. This further supports the idea that while there may not be a fundamental deficit in the mimicry mechanisms in ASD, an atypical modulation of these mechanisms due to reduced reward responsivity to social stimuli might underlie the previously observed deficits in spontaneous facial mimicry. This observation thus provides a potential bridge between theoretical models of autism that suggest reduced social motivation and those that suggest reduced empathy. The results further underline the importance of studying individual differences within people with a clinical diagnosis of ASD.

3:16   **121.004** Relative Contributions of BAP Subdomains to Social Relationships and Loneliness

J. C. Bush *and D. Kennedy, Psychological and Brain Sciences, Indiana University, Bloomington, IN*

Background: The broader autism phenotype (BAP) is a milder expression of social, nonsocial and language impairments seen in autism spectrum disorder (ASD). Previous research shows that individuals with high BAP scores have greater social cognitive difficulties, including emotion recognition, face processing, and gaze reciprocity, similar to the social difficulties that affect those with ASD. Individuals with BAP exhibit poorer quality of interpersonal relationships and are also generally lonelier. But, how different aspects of the broad autism phenotype contribute to specific aspects of their social relationships remains less unclear.

Objectives: This study aims to elucidate the relationships between BAP characteristics and its subdomains (i.e. social aloofness, pragmatic language difficulties, and rigidity) and various aspects of social relationships and self-reported loneliness in a large sample of non-ASD individuals.

Methods: One thousand six hundred fifty nine neurotypical undergraduate students (1113 female) participated in this study. All participants completed the Broader Autism Phenotype Questionnaire (BAPQ) (Hurley et al., 2007), the Friendship Questionnaire (FQ), which measures the extent to which people enjoy close friendships (Baron-Cohen & Wheelwright, 2003), the UCLA Loneliness Scale (Russell, 1996), and a romantic relationship questionnaire consisting of questions about current relationship status and future marital aspirations.

Results: Total BAP scores were negatively correlated with quality of friendships (FQ; r=-0.37; p<0.001) and positively correlated with loneliness (r=0.59; p<0.001) – i.e., individuals with more BAP characteristics had lower quality friendships and were lonelier. Multiple regression analyses revealed that the different BAP subscales (i.e. aloof, pragmatic language and rigidity) contributed in different ways to both friendship quality and loneliness. High levels of aloofness (β=-0.48, p<0.001) negatively predicted the quality of friendships, while high levels of rigidity was related positively, though weakly (β=0.07, p=0.004). Pragmatic language impairment was unrelated to the quality of friendships (β=0.02, p=0.51). However, pragmatic language impairment was a positive predictor of loneliness (β=0.21, p<0.001) as was aloofness (β=0.47, p<0.001), while rigidity was unrelated (β=0.02, p=0.30). In terms of romantic relationships, participants who were single compared to those in committed relationships reported greater pragmatic language difficulties (t[1434]=2.21, p=0.027) and higher levels of loneliness (t[1490]=2.81, p=0.005). Finally, those participants who reported not having any future thoughts about marriage had higher levels of aloofness (t[1596]=6.77, p<0.001) and exhibited greater pragmatic language difficulties (t[1577]=4.22, p<0.001).

Conclusions: These findings replicate and extend previous research (Jobe & White, 2007; Wainer et al., 2013) suggesting individuals with greater BAP traits show difficulties in interpersonal relationships and higher levels of self-reported loneliness. Additionally, we find that various components of BAP that may be uniquely associated with different aspects of interpersonal relationships. For example, pragmatic language difficulties predicted relationship status and loneliness, but not the quality of friendships, highlighting the role of pragmatic language in initiating these relationships. In contrast, aloofness seemed to have a different role, affecting friendship quality, and loneliness but not one's relationship status. Overall, these results suggest that there may be specific targets of intervention within the triad of difficulties that can help promote the successful formation and maintenance of social relationships in individuals with ASD.

Poster Session
122 - Family Issues and Stakeholder Experiences
5:30 PM - 7:00 PM - Imperial Ballroom

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1   **122.001** Face Processing and the Broad Autism Phenotype

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Background: The Broader Autistic Phenotype (BAP) consists of milder Autistic Spectrum Disorder (ASD) characteristics that occur in some relatives of individuals who have ASD. The core ASD deficits in communication, socialization, and stereotyped/repetitive behavior have been found to manifest themselves separately in the BAP. Due to the strong hereditary nature of ASD, the autistic symptomatology expressed in ASD family members meeting criteria for the BAP can serve as endophenotypes in the study of ASD. Many of the social problems experienced by people with ASD stem from deficits in facial processing. Since the BAP consists of mild socialization impairment, face processing has also been studied in ASD relatives, in particular parents, with mixed results of subclinical similarity and dissimilarity to ASD. Lacking in these face processing studies has been: the examination of typical ASD face processing strategies, as well as measures of both face identity and emotion recognition.

Objectives: The present study sought to explore the effects of Gender and BAP level on face processing deficits in parents and siblings of individuals with ASD. We aimed to assess if gender and BAP levels would each account for differences on face processing tasks, as well as if an interaction effect of gender and BAP level could be found.

Methods: 178 biological parents and siblings, (62 males and 116 females), of individuals with ASD (Mean IQ=109.63) were assessed on: IQ (Wonderlic-WPT-Q), the Let's Face It Skills Battery (LFI), the Broad Autistic Phenotype Questionnaire (BAPQ), and the Social Communication Questionnaire (SCQ). Specifically, the LFI evaluates 10 areas of face processing involving subtests of face discrimination, emotion recognition, and non-face objects. The BAPQ measures an overall BAP level as well as three sub levels of: aloofness, pragmatic language, and rigidity. All assessments were conducted on-line.

Results: Results suggest that relatives of ASD children performed at normal levels of face processing. A 2x2 Manova was conducted with gender and each of the BAP criteria levels. Gender x Total BAPQ: only gender showed a main effect, on discrimination Pillai's Trace V=.094, F (5, 136)=2.81, p<.05, no interaction effect. Gender x Aloofness: the main effect of Gender approached significance, on discrimination Pillai's Trace V=.074, F(5, 136)=2.18, p=.059, no interaction effect. Gender x Pragmatic Language: Gender revealed a main effect, on discrimination Pillai's Trace V=.091, F(5, 136)=2.73, p<.05, no interaction effect. Gender x Rigidity: both Gender, on discrimination Pillai's Trace V=.092, F(5, 136)=2.77, p<.05 and Rigidity showed a main effect, on discrimination Pillai's Trace V=.101, F(5, 136)=3.06, p<.05 and on non-face objects Pillai's Trace V=.070, F(2, 147)=5.50, p<.01, no interaction effect.

Conclusions: Evidence suggests that Gender and BAP level differentially effect ASD family members and may contribute to mild social skill difficulties that mimic those difficulties typically found in biological relatives who have an ASD diagnosis. These findings suggest that effects of BAP level can

be distinguished from gender differences. These results give further insight into the investigation of endophenotypes of ASD as expressed in the BAP, as well as the need to examine the influence of family environment.

2   **122.002**   A First-Hand Account of Raising a Child with ASD

A. Mao, Psychiatry and Behavioral Sciences, Baylor College of Medicine, Houston, TX

Background: Parents raising children with Autism Spectrum Disorder (ASD) face unique stressors and challenges. Among these is a sense of crisis and trauma after receiving an ASD diagnosis, as parents grieve the loss of their "typically developing" child. Despite being at increased risk to experience depressive and anxiety symptoms, especially at times when they contrast their child's development with those of a typically developing child, there are few interventions aimed at supporting parents of children with ASD. Given the complexity and parental frustration with the ASD diagnostic process, the myriad available clinical interventions, and the amount of ongoing research, parents of children with ASD can feel powerless, overwhelmed, and confused at the very time when they are left in charge of a complicated network of professional providers. This has led to a demand for information about how to best support parents of children with ASD.
Objectives**:** Attendees will learn how to:

1. Recognize the importance of providing support and education to parents of children with ASD immediately after diagnosis.
2. Help parents make treatment decisions that optimize the child's independent functioning and improve learning and skills acquisition.
3. Identify unique stressors for the parents/caregivers that occur in each stage of development for the child that may require special intervention.
4. Assist parents in developing a treatment plan for their child with ASD that integrates pharmacological, behavioral and educational interventions.

Methods: Drawing from both personal experience as the parent of a child with ASD and professional experience as a physician, the presenter will discuss the unique challenges facing parents of children with ASD. The discussion will include empirical evidence on caregiver stress for families raising a child with ASD, along with potential barriers for provision of optimal treatment created by denial, lack of resources, or inadequate information. The presentation will also include key points on how to support parents during the diagnostic process, identify parental obstacles to obtaining treatment for ASD, and emphasize the need for early interventions for the parents of children with ASD.
Results: Participants will be able to recognize the emotional and practical obstacles that parents face in accessing appropriate care for their child with ASD. Clinicians will be able to work collaboratively with families to develop a comprehensive multi-modal treatment plan encompassing emotional and educational support for the parents, psychopharmacology interventions for problematic behaviors, and individualized educational/behavioral interventions. In addition, audience members will become more knowledgeable about the nature and magnitude of the task of parenting a child with ASD.
Conclusions: This presentation will address ways that families can best manage challenges experienced during the life of their child with ASD by reviewing evidence-based educational interventions focused on predictable phases that families transition through as they cope with an unanticipated traumatic life change. If prepared to provide support and educational interventions, clinicians can help families accept and adapt to the chronic nature of living with ASD, and develop successful coping strategies throughout the child/family's lifespan.

3   **122.003**   Evidence-Based Treatment and Assessment of Autism Spectrum Disorder

A. S. Weitlauf, Vanderbilt Kennedy Center, Nashville, TN

Background: Although every person on the autism spectrum presents with certain levels of social-communication and behavioral symptoms, the high degree of variability across individuals in symptom profiles can complicate the diagnostic and treatment process. This variability can make it difficult for parents, professionals, and investigators to understand what happens during the diagnostic process, especially for young children, and what evidence-based treatments are available.
Objectives: To provide a summary of the findings from the recently updated Agency for Healthcare Research and Quality (AHRQ) report on Therapies for Children with Autism Spectrum Disorder: Behavioral Interventions Update, and to familiarize participants with common diagnostic tools and criteria.
Methods: Information regarding the strength of evidence for behavioral interventions will be drawn from the most recent (2014) Agency for Healthcare Research and Quality (AHRQ) review of behavioral therapies for children with ASD. This collaborative work comprehensively reviewed existing evidence for behavioral interventions through an exhaustive systematic review framework. Some of the most frequently studied interventions and their effectiveness for improving aspects of children's development will be briefly described. Additional information will be presented on common screening tools and "gold standard" diagnostic instruments, highlighting the core social-communication and behavioral symptoms that define ASD.
Results: The updated AHRQ review documented a substantial increase in available evidence for the positive effects of behavioral interventions for young children (under 12 years) with ASD. The

strongest evidence base was documented for (1) early intensive behavioral intervention with regards to improvements in cognitive and language outcomes and (2) the use of cognitive behavioral therapy for children with ASD and anxiety. Data on parent training, social skills, and relationship-based approaches showed a less substantial evidence base.

Conclusions: The 2014 AHRQ report reflects increases in the number and methodological rigor of studies available. Consistent with the 2011 report, however, important gaps remain in what we know about behavioral interventions for ASD. In particular, more research is needed on why certain treatments seem to benefit some children more robustly than others.

4   **122.004** Parents with Autism of Children with Autism

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Background: Despite the high heredity of autism, relatively little is known about parents with autism of children with autism. There are reasons to expect beneficial effects of an autism diagnosis in parents, as they are more aware of the disorder and likely have access to care and treatment. However, the social communicative problems of autism may also be a burden for parental and child wellbeing.

Objectives: To explore the characteristics and overall quality of life of parents with autism who have one or more children with autism.

Methods: Using data from the Netherlands Autism Register, we analysed 211 parents with autism (135 fathers, 76 mothers), 191 parents of who had one child with autism, and 20 who had 2 children with autism. We analysed their wellbeing and living standard (employment, social relations) as well as their diagnostic and demographic background.

Results: Preliminary findings indicate that parents with autism who have a child with autism generally reported average or above average intelligence and had paid employment in almost half the cases. Their self reported wellbeing and social relations were not markedly high. The interplay of these factors will be analysed further and presented.

Conclusions: While having autism may hinder one's outcomes in life, having a child with autism offers many additional challenges that have not been addressed before in the literature. We will highlight the advantage and the disadvantage of autism in both parent and child, and provide recommendations for future studies on this understudied topic in autism research.

5   **122.005** A Compass for Hope: A Parent Training and Support Program for Children with ASD and Problem Behavior

A. D. Rodgers[1], A. P. Ables[2], J. A. Odom[1], T. M. Belkin[3], G. Mathai Kuravackel[2], R. J. Reese[1] and L. A. Ruble[1], (1)University of Kentucky, Lexington, KY, (2)University of Louisville, Louisville, KY, (3)Indiana University- Purdue University Indianapolis, Indianapolis, IN

Background: Parents of children with ASD are at greater risk for stress and depression than parents of children with other developmental disorders (Montes & Haltherman, 2007). Some explanations come from child and environmental factors, such as severity of child problem behavior (Hayes & Watson, 2013) and the effectiveness of interventions (Baker et al., 2005). Unfortunately, there are limited evidence-based programs available to clinicians in outpatient settings that target parent stress, parent self-efficacy, and child problem behavior. One exception is Stepping Stones Triple P, for which a meta-analysis has shown significant effect sizes for reducing child problem behavior, as well as for parenting satisfaction and efficacy (Tellegen & Sanders, 2013). We aim to develop a new manualized program that can allow for adaptation and customization appropriate for caregivers with limited socioeconomic resources. Building on the ecological-systems framework described by Ruble and Dalrymple (2002) called the Collaborative Model for Promoting Competence and Success (COMPASS), we are currently developing and testing an 8-week parenting intervention program called COMPASS for Hope (C-Hope) using an iterative approach. Additionally, to facilitate access to services from underserved portions of Eastern Kentucky, we will evaluate outcomes from the C-Hope program delivered to parents using videoconferencing technology.

Objectives: The purpose of this study is threefold: (a) to test and adapt the C-Hope program, using an iterative process that includes evaluating each of the sessions and making modifications based on qualitative and quantitative outcomes, including feedback from families, child problem behavior, parent self-efficacy, and parenting stress using a pre-post design; (b) to formally evaluate the efficacy of the modified C-Hope program by randomly assigning families to the intervention or waitlist control condition, and measuring outcomes; and (c) to compare the outcomes based on type of delivery format (videoconferencing vs face-to-face).

Methods: After adaptation of C-Hope, a waitlist control design will be used to compare outcomes. Table 1 describes demographic information of the pilot participants. For the waitlist control condition, two groups (n = 10) are concurrently underway, and two additional groups (n = 13) will begin in January 2015 and end in March 2015 (providing more data for analysis for IMFAR 2015). The program is manualized and includes four, 1-hr, individual sessions and four, 2-hr, group sessions. Outcome measures include the Eyberg Child Behavior Inventory, measuring child problem behavior, as well as the Being a Parent Scale and the Parenting Stress Index, measuring parent self-efficacy and stress.

Results: Visual analysis of preliminary data shows that after the pilot group, parents who participated reported increased self-efficacy and decreased distress, dysfunction, and overall stress. Additionally, children were reported to have decreased externalizing behaviors. Child internalizing behaviors increased slightly, and parental report of having a difficult child remained the same. Mean scores for the pre- and post-measures are shown in Table 2. Additionally, pilot parents reported high satisfaction with the program.

Conclusions: We anticipate that overall findings will show that C-Hope improves outcomes of parents and caregivers of children with ASD.

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6   **122.006** ASD Symptoms As Predictors of Negative Outcomes in Parents and Typically-Developing Siblings

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Background: Literature examining typically-developing (TD) siblings and parents of children with ASD suggests that both may be at risk for negative outcomes due to a variety of factors. However, because many TD siblings and parents adjust appropriately, maladjustment in family members seems to only occur under certain conditions. Research has shown that characteristics of children with ASD may predict adjustment in family members. Due to the heterogeneous nature of ASD symptoms, it follows that family adjustment may differ according to ASD symptom manifestation.

Objectives: This exploratory study investigated how different ASD symptom domains predicted parental stress and psychopathology as well as parent- and self-reported emotional and behavioral maladjustment in TD siblings.

Methods: A total of 113 families participated. Ages of children with ASD ranged from 3-17 years ($M = 11.98$, $SD = 3.29$); ages of TD siblings ranged from 11-17 years ($M = 13.32$, $SD = 1.81$). Parents completed the Strength and Difficulties Questionnaire (SDQ) about the TD sibling (assessed emotional and behavioral functioning) and the Children's Social Behavior Questionnaire (CSBQ) about the child with ASD (assessed ASD symptom severity). Parent also completed the Questionnaire on Resources and Stress – Short Form (assessed parental stress) and Symptom Checklist-10-Revised (assessed parental psychopathology) about themselves. Finally, TD siblings self-reported via the SDQ.

Results: Preliminary correlations (Table 1) showed that general ASD symptoms in children with ASD significantly related to parental stress, ($r = .51$, $p < .001$), parental psychopathology ($r = .33$, $p < .001$), parent-reported maladjustment in TD siblings ($r = .43$, $p < .001$), and self-reported maladjustment in TD siblings ($r = .23$, $p = .01$). To better understand the nature of these relations, four separate regression analyses were conducted to examine which specific ASD symptom domains uniquely predicted the aforementioned criterion variables (if any), while accounting for variance contributed by other symptom domains (Table 2). Parental stress and parental psychopathology scores were separately regressed onto CSBQ subscales scores (i.e., the ASD symptom domains). Stereotyped behavior ($\beta = .27$, $p = .01$) was the only unique predictor of parental stress. The overall model predicting parental psychopathology was significant ($R^2 = .14$, $p = .01$); however, none of the ASD symptom domains emerged as unique predictors. Both parent- and self-reported TD sibling SDQ Total scores were separately regressed onto CSBQ subscale scores. Behavior not appropriate to social situations/aggressive ($\beta = .28$, $p = .01$) and stereotyped behavior ($\beta = .22$, $p = .04$) emerged as significant predictors of parent-reported TD sibling maladjustment, whereas social withdrawal/lack of social interest ($\beta = .28$, $p = .01$) emerged as the only significant predictor of self-reported TD sibling maladjustment.

Conclusions: Results indicate that certain types of ASD symptoms may relate differently to negative outcomes in family members. Additionally, these associations appear to vary for different family members and according to who serves as the reporter (e.g., parent versus typically-developing sibling). These findings can guide further research on predictors of maladjustment among families of a child with ASD and also can inform interventions for these families.

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7   **122.007** Applying Principles of Community-Based Participatory Research in Autism Biomarker Discovery

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Background: Identifying biological markers or *biomarkers* for autism can potentially help to diagnose the condition and reduce overall burden of autism. Some scientific advances in biomedical research have already been integrated in clinical care for autism. However, considering the complex and changing nature of biomedical discoveries in this area, translating such knowledge into clinical applications has been challenging (Walsh et al., 2011). As many families experience challenges in accessing services and navigating treatment options, engaging families could clarify how the impact of putative biomarkers could support the process of identification and access to care.

Various models to engage families in research exist, but few have been used in autism research. One such model is community-based participatory research (CBPR). CBPR is defined by specific key principles, namely involving a unit of identified "community" in an equitable and collaborative way in all stages of research (Israel et al., 1998). While some perceive biomedical research to be at odds with

participatory and community-based approaches, our previous work suggest that several factors influence these perceptions (Elsabbagh et al., 2014).

Objectives: Using a scoping review methodology (Arksey & O'Malley, 2005), we systematically identified studies of stakeholder engagement in biomedical autism research and evaluated the extent to which they are consistent with nine CBPR principles articulated by Israel et al. (1998). These principles include defining a unit of "community", building on strengths and resources within the community, and adapting the principles to different contexts with "flexibility, constant reflection, and critical analysis".

Methods: We identified studies from the following databases: Medline, CINAHL, Ovid, and PubMed. Author lists and references were also cross-referenced for potentially relevant articles. One reviewer retrieved titles and abstracts from these databases and reviewed them for further inclusion. Another reviewer independently retrieved and read included full-text articles and extracted relevant information into a database. They both reviewed the database to evaluate the extent to which CBPR principles are used in autism biomarker discovery research.

Results: A total of 73 full-text articles were assessed from 342 retrieved records. Seven examples of empirical studies were identified. A synthesis of these studies suggests that two CBPR principles are consistent with autism biomarker discovery research. The first is community involvement in setting priorities and research questions through understanding parents' attitudes and expectations towards the application of autism biomarkers in their lives. The second is collaborating with parents in devising experimental protocols. These studies also advocate the need to understand parents' views on ethical issues related to biomarker discovery.

Conclusions: We summarize and attempt to reconcile where CBPR principles are adapted to biomarker discovery in autism research. We raise the challenge of public engagement imposing pressure on the scientific community to produce outputs relevant for society at the risk of undermining scientific integrity. We reconcile this issue by proposing that public engagement is best developed in global priority setting in the process of translation, and protecting a space for scientific discovery.

8   **122.008** Assessment of Transportation and Mobility Adults on the Autism Spectrum in NJ

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Background: Although many advances have been made in other fields related to quality of life improvements for persons with ASD, efforts have been more limited in the realm of transportation planning and policy. Most organizations involved in transportation planning and policy collect travel data for broad population groups such as persons with disabilities instead of collecting data for specific population groups like persons with ASD. As a result, very little is known about the travel patterns, needs, and barriers of persons with ASD. The primary focus of the research is to gain insights about the transportation barriers experienced by the New Jersey adult ASD population. Additionally this research is seeking to identify the characteristics and traits commonly found in adults with ASD and their impacts on transportation choices, which in turn affects employment opportunities, community involvement, and overall quality of life.

Objectives: The broad objective of this study is to demonstrate the specific transportation and mobility needs and barriers of New Jersey adults with ASD so that greater efforts are made by planning agencies and service providers to meet their unmet transportation and mobility needs. Another objective is to educate agencies and officials assisting persons with ASD with work-related skills about the importance of transportation for gainful employment and independence. The research is focused on examining all types of mobility needs and transportation barriers as they relate to pedestrian skills; public transportation including, fixed-route and paratransit services; and driving.

Methods: The research is being conducted utilizing a four-pronged information and data collection approach that includes a review of existing literature, studies and data, followed by 25 structured interviews with a targeted set of experts, then a scientific survey focused on documenting the transportation needs and barriers of adults with ASD, and concluding with a series of focus groups with adults with ASD in New Jersey.

Through conducting 25 key informant interviews with an array of expert stakeholders, the research team was able to document how the characteristics of persons with ASD relates to their travel needs and the barriers they encounter.

Because of the difficulties in identifying adults with ASD for the survey, a convenience sampling methodology was used. The internet survey was disseminated through a variety of agencies including Autism New Jersey, ASPEN, DJFF, and Autism Family Services. The survey allows respondents to complete it on their own or have their guardian/caregiver complete the survey for them.

The focus groups provide a deeper insight and perception about the transportation needs and barriers of adults with ASD. While the analysis of survey data will primarily provide associative results, the focus groups contribute a richer understanding of the observed associations.

Results: The stakeholder interviews resulted in emergence of 8 commons themes including barriers begin with lack of access to public transport services and there are few opportunities in adult services to learn transportation and mobility skills. Currently there is data from over 500 respondents

and preliminary survey analysis will be conducted this winter.
Conclusions: N/A

9   **122.009** Autism Spectrum Disorders- Understanding Parental Pursuit to Access Speech-Language Services in the Indian Context

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Background: An alarming increase in the prevalence rate of Autism Spectrum Disorders (ASD) is a major concern for health care providers. Of foremost concern to Parents of children with ASD (PASD) are communication deficits. Accessing appropriate Speech-Language Services (SLS) for early intervention is the challenge. An average of 350 children with ASD seek SLS at the institute where the current study was undertaken. The intention was to understand the delays in reaching SLS, misperception the PASD hold, other obstacles that come in their way to access SLS. This understanding is of paramount importance to demystify misconceptions and develop professional and public education programs.
Objectives: To examine issues encountered by parents in accessing services of a Speech-Language Pathologist (SLP).
Methods: All children with confirmed ASD (n=65) seen in a span of 2 months were recruited for the current study. PASD were asked to fill a questionnaire that was specifically designed for this study. Some of the areas covered in the questionnaire included, age when parents started becoming concerned about their child (AOC=Age Of Concern), nature of these concerns, Age of Diagnosis (AOD), Age Of first visit to SLP (AOSLP), details of the hearing status, diagnosis and guidelines provided by the medical fraternity.
Results: All families belonged to middle economic status (MES). The mean age (in months) of AOC, AOD and AOSLP was 28.28±7.50, 35.00±15.29 and 43.32±23.26 respectively. The mean time gap (TG in months) between i) AOC-AOD was 7.09±14.06), ii) AOD-AOSLP was 8.32±18.70, indicating an overall delay of about 15 months (15.05±21.99) from AOC to AOSLP. In spite of this long delay in reaching out to Speech Language Therapy (SLT), 72.3% of the children were admitted into a normal school (no special services for a child with ASD) by the age of 48 months, indicating that parents were insistent on the child receiving academic inputs. Some of the common misconceptions and challenges included: 60% of PASD had the notion that speech will develop naturally later in life; 38.5% and 76.9% PASD believed that medicines and TV/mobile apps respectively, would help the child speak. In 44.6% cases the family doctor assured that the child had no significant problems and would improve as the days pass by. Though none of the children had a hearing loss (based on informal screening protocols), 75.4 % underwent an audiological evaluation. Not responding to name call was the single largest reason for referral and evaluation (78.75%). Three major concerns which parents had about their child included, the inability to speak adequately, followed by poor eye-contact and not following commands (75.4%, 29.2%, and 21.5% respectively). Findings are further discussed.
Conclusions: The current study has revealed a definite delay in the child receiving SLT and identified significant misperceptions PASDs hold. Delay in identification and rectifying the misperceptions can be addressed by sensitizing the medical professionals and through public education programs for parents and caregivers.

10   **122.010** Challenges Facing Families with a Child with ASD

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Background:
Priorities for autism research should focus in those areas that make a difference to people's day-to-day lives.
Objectives:
The goal of the current survey was to understand and quantify the greatest challenges facing children with ASD and their families with a view to developing relevant research priorities.
Methods:
An anonymous survey that ran 08/01/2014-08/11/2014 targeted parents of a child of any age with ASD. Parents were asked the following open-ended questions:
(i)   If your *child* could get help for one autism-related challenge, what would it be?
(ii)   If your *family* could get help for one autism-related challenge, what would it be?
The survey was designed and administered by the Interactive Autism Network (IAN), a large, US-based internet-mediated autism-research registry. Links to the survey were distributed by e-mail to registry participants and informational website subscribers. Links were also posted on the registry's informational website and Facebook page.
Results:

There were 888 and 773 responses from parents of a child with ASD to the questions about challenges facing their child and family, respectively. Distribution of child ages for parent responses to both questions: 46% children aged<13 years; 29% teens aged 13-17 years; 25% adult children aged ≥18 years. Responses were coded and categorized into themes and sub-themes. Some responses spanned more than one theme or sub-theme and were coded in multiple categories and, thus, coded responses total more than 100%.

The greatest autism-related challenge that parents said that their children faced were general living skills (58%), most notably communication (19%) and social engagement (15%). The next most challenging category related to behavior (31%), most notably anger, aggressive behaviors, and self-injurious behaviors (19%). The other major challenge related to dealing with psychological comorbidities (14%), especially anxiety.

The greatest autism-related challenges that parents said that their families faced were their child's behavioral issues (20%), especially anger, aggressive behaviors, and self-injurious behaviors (15%). Families were concerned about transition issues and how their child would live independently (19%). Families were also challenged by financial issues (16%) and obtaining the services and help that they needed (18%), including respite care and emotional support, which are challenges that are also reflected in the general stress that families were reporting (18%). Family also reported challenges relating to their child's general living skills (19%).

Conclusions:
Children with ASD and their families face numerous autism-challenges in daily life. Both research and community resource priorities should focus on alleviation of these challenges.

11   **122.011** Compassion Meditation in Parents of Children with ASD and Potential Effects on Stress, Parenting Skills and Children's Outcomes

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Background:
Recent studies suggest that the practice of compassion meditation is associated with stress reduction as well as an increase in the ability to benefit from social support (Cosley et al, 2010). Cognitively-Based Compassion Training (CBCT) is a meditation protocol developed at Emory University that combines mindfulness and analytical meditation techniques that specifically promote compassion toward self and others. Six to eight weeks of CBCT practice on adults without prior experience in meditation shows reduced immune inflammatory and emotional distress responses to psychosocial stressors (Pace et al., 2009) as well as enhancement of empathic accuracy when assigning emotions to other people's faces with changes in the neurobiology supporting it (Mascaro et al., 2013).

Objectives:
The goal of this research is to pilot-test CBCT with typically developing school-aged children, teachers, and parents of children with ASD to promote relational competence in these populations, enhance adult-child interactions, and reduce stress in the parents.

Methods:
Participants in Study I included 53 children (7-10 years, M±SD = 8.77±0.61, 30 girls) at a private school in Atlanta, GA. Participants were randomized to mindfulness training and CBCT over the course of 12 weeks and completed three pre-post measures: the Implicit Association Task as a measure of racial stereotype, the Social Circles Task for friendship networks, and the MacArthur Story Stem Task for moral reasoning. An on-going follow-up study at a second elementary school aims to replicate and expand these findings by involving teacher personnel. In a third ongoing study at the Marcus Autism Center data is being collected on parents of children with autism (n=10). Pre-post measures are being taken on parent stress and acceptance (Parenting Stress Index, Perceived Stress Scale, and Acceptance and Action Questionnaire), empathy and compassion (Interpersonal Reactivity Index), behavioral flexibility (Mindful Attention Awareness Scale and Behavior Rating Inventory of Executive Function), parent-child relationship (Parenting Sense of Competence Scale), and children's symptoms as reported by parents (Aberrant Behavior Checklist).

Results:
In Study I, the proportion of children that included at least one peer in their inner Social Circle was larger post-intervention (92.6%) than pre-intervention (55.6%) for the CBCT group only (Fisher's p=.004, two-tailed). In the MacArthur Story Stem Task, post-intervention overall narrative scores were also higher for CBCT (M±SE= 6.09±.437) relative to mindfulness (M±SE = 4.33±.464) (p=.008) and also in the following subscales: emotionality, compassion, equanimity, and mentalizing (p<.05). Data from Study II, while ongoing, are already suggestive of positive effects of CBCT on prosocial behavior, stereotype, and bullying. Early descriptive and qualitative analyses of results from Study III, also ongoing, show a positive effect of CBCT on parent well-being, parent-child interactions, and parent reported symptoms in their children.

Conclusions:
Taken together, these results suggest that CBCT is a feasible training program for children, teachers, and parents of children with special needs, with benefits for the children regarding prosocial behavior. The potential benefits for teachers and parents in terms of relational competence (prosocial behavior, stress reduction and parenting skills), and the impact of these on the children, warrant further consideration.

12   **122.012** Concerns of Parents and Teachers of Children with Autism in Elementary School

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Background: Numerous conceptual articles attest to the importance of parents and teachers openly communicating about their concerns regarding their children and coming to a consensus on which are the most important to address and how to address them. For children with autism, establishing and maintaining a collaborative partnership between families and schools has been encouraged on theoretical grounds, but rarely operationalized. The limited research in this area suggests that teachers and parents of children with autism may not collaborate to the extent warranted. Barriers to effective partnerships may include a lack of agreement about children's concerns, an inability to communicate about these concerns, or both.
Objectives: The purpose of this study is twofold: 1) to examine whether parents and teachers agree about their concerns for elementary children with autism and 2) to examine whose concern is discussed when these parents and teachers are observed communicating with each other.
Methods: Participants were 39 parent-teacher dyads of children with autism in kindergarten-through-fifth grade autism support classrooms. Each parent and teacher was interviewed separately about their concerns and then observed together in a discussion about the child.
Results: Parents' primary concerns involved deficits in social interaction (28%), problem behavior (26%), and academics (18%). Teachers' primary concerns were about problem behaviors (31%), followed by an equal concern for deficits in social interaction (18%) and restricted, repetitive, and stereotyped behaviors (18%). Parents' secondary concerns involved problem behavior (36%), academics (18%) and social interaction (15%). Teachers had an equal secondary concern for deficits in social interaction (26%) and problem behavior (26%), followed by academics (20%). When given an opportunity to communicate their concerns, 49% of the parent-teacher dyads discussed problems that neither reported as their primary concern, and 59% discussed problems neither reported as their secondary concern.
Conclusions: Our results indicated that parents and teachers generally agreed about their concerns when asked to report on multiple concerns. However, when they talked with each other, parent-teacher dyads discussed concerns that neither reported previously. Our findings are inconsistent with prior investigations that have shown that parents and teachers do not share the same concerns. It is likely that our findings differ from previous research because we asked parents and teachers to report on multiple concerns, whereas prior studies have only focused on one main concern. There are at least three possible reasons why parents and teachers may have discussed neither person's concerns. First, parents and teachers may not have been comfortable with each other because of a potential adversarial relationship. Second, parents and teachers may not know how to effectively negotiate with each other in choosing a topic of concern. It is also possible that parents and teachers do not remember their concerns when they feel pressured, especially when being observed by a researcher. These findings suggest that intervention efforts should focus on targeting parent-teacher communication, rather than agreement, to facilitate home-school collaboration.

13   **122.013** Daily Hassles and Relationship Satisfaction in Parents of Pre-School and School-Aged Children with Autism Spectrum Disorder: The Moderating Role of Spousal/Partner Support

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Background: Few studies have examined relationship satisfaction of parents of children with autism spectrum disorder (ASD). Yet, parents of children with ASD report lower levels of marital/relationship satisfaction and higher divorce rates than parents of children without a disability (Gau, et al., 2010; Hartley et al., 2010). Thus, an important area of study is identifying factors that may impact and protect marital/relationship functioning among parents of children with ASD.
Objectives: The current study examined the relationship between daily hassles associated with children's challenging behaviors, spousal/partner support, and relationship satisfaction among parents of children with ASD. Specifically, it was hypothesized that greater levels of daily hassles would be significantly associated with lower levels of relationship satisfaction. Additionally, spousal/partner support was expected to be positively associated with relationship satisfaction. Furthermore, spousal/partner support was expected to moderate the association between daily hassles and relationship satisfaction.
Methods: The current study consisted of 130 parents (65 dyads) of children with ASD (2.5-10.8 years of age) who participated in a larger study examining the association between child symptomatology and parental well-being and family functioning. Parents were between the ages of 27

– 62 years, and represented a diverse range of ethnicities (54% White/Hispanic, 35% White/Non-Hispanic, 11% Other/Mixed Ethnicity). Parents completed the Parenting Daily Hassles Scale as a measure of every day parenting stress associated with challenging behaviors (Crnic & Greenberg 1990; Crnic & Booth 1991), the Couples Satisfaction Index as a measure of relationship satisfaction (CSI; Funk & Rogge, 2007), and the Informal Social Support scale as a measure of spousal/partner support (Schuster et al., 1990; Whalen & Lachman, 2000).

Results: A hierarchical regression analysis was used to examine links between daily hassles, spousal/partner support, and relationship satisfaction. Results indicated that higher levels of daily hassles was related to lower levels of relationship satisfaction (F (1,128) = 4.217, p <.05) and higher levels of spousal/partner support was related to higher levels of relationship satisfaction (F (2,127)= 93.795, p <.001). Furthermore, spousal/partner support was found to buffer the relationship between daily hassles and relationship satisfaction (F (3,126) = 71.389, p <.001). Post-hoc analyses revealed that when spousal/partner support was low, increased daily hassles was significantly associated with lower relationship satisfaction (t (126) = -2.679, p = .008). When spousal/partner support was high, increased daily hassles was not significantly associated with relationship satisfaction (t(126)= -1.294, p = .198).

Conclusions: Results suggest that parenting stress associated with daily hassles may have adverse effects on marital/relationship functioning. However, spousal/partner support protected against the negative effect of daily stress associated with challenging behaviors. Future interventions should stress the importance of dyadic coping in the face of such challenges, thus strengthening parents' relationship.

14   **122.014**   Development of a Parent Mentor Training Program in Japan

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Background: Parent to parent programs have come to be widely recognized as an effective means of supporting parents of children who have special needs. Similarly in Japan, "parent mentors," parents of individuals with Autism Spectrum Disorders (ASD) and/or other developmental disabilities (ODD), have been engaging in supporting other parents. Parent mentor activities include telephone, one-on-one, and group counseling services. Parent mentors also provide outreach services such as lectures on disabilities and simulation activities. The Ministry of Health, Labor and Welfare indicates the importance of parent mentor activities and training programs in the context of providing family-centered services. The authors have been working with parent mentors by providing support for their activities and developing a Parent Mentor Training Program (PMTP).

Objectives: The objective of this study is to develop a comprehensive PMTP. The purpose of the study is to investigate the effectiveness of the PMTP by conducting a pre- and post-survey on basic and follow-up training programs.

Methods: Participants included a total of 203 parents of individuals with ASD and/or ODD. The two-day basic program included; 1) a lecture on ASD and ODD, 2) a workshop on local resources of social welfare, 3) a lecture on basic counseling techniques, 4) a role-play session on one-on-one counseling. The two–day follow-up program, for those who had received the basic program, included; 1) a lecture with the last updated information on administration and education, 2) a lecture on intermediate counseling techniques, 3) a role-play session on telephone and group counseling. The authors made a questionnaire on 5-point Likert scale, consisting of 20 items and 4 subscales: 1) skills and attitudes, 2) topics of conversation, 3) anxiety and stress, 4) confidence as a parent mentor. Positive scores on this questionnaire indicated high level of aptitude/competence as a parent mentor. The participants answered the questionnaire before and after each program.

Results: As for the basic program, the post-test score of items such as "respect for human rights," "listen carefully," "feel sad and angry (inverted)," and "sense of self-composure," significantly increased, whereas the score on "feel stress when talking with clients" tended to decline. Overall, the scores for the follow-up program were higher than those for the basic program. For the follow-up program, the post-test score of the item "respect for human rights" increased, and the scores on "talk on experience" and "feel stress when talking with clients" declined.

Conclusions: We found that the participants obtained knowledge and skills needed to be a parent mentor through the basic and follow-up programs. We also found that the participants were more likely to feel anxiety and stress after the program. This is partly because they could realize the difficulty to talk with their clients through the programs including the role play sessions. We assume that many parent mentors feel anxious when talking with their clients and have difficulty dealing with the stress. It is necessary to find the way to reduce their anxiety and stress by introducing elements of training in stress management into the PMTP.

15   **122.015**   Early Access to Care in the Province of Quebec: A Policy Analysis Framework

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Background: Prevalence estimates suggest that Autism Spectrum Disorder (ASD) affects 1-2% of children globally (Elsabbagh et al., 2012). There is consensus that early identification and intervention for ASD can improve child functioning and family well-being, thereby reducing costs and burden to society in the long run (Khan et al., 2012). However, serious barriers currently hamper access to care across the world (WHO, 2013). Further investigations are needed to explore how policy and/or implementation barriers contribute to these delays and barriers to care.

Objectives: To identify the congruence between existing policies supporting early identification and intervention for ASD and the actual state of community-based early identification and intervention services in Quebec (QC), Canada.

Methods:
We conducted a scoping review of QC policies related to ASD (Stephenson & Mccoll, 2008) and developed an analysis framework to map existing policies to actual reports of access to care through administrative and family-based sources. Relevant provincial, federal, and international policy documents were identified. Each policy, statement, act, program description or governmental body that was identified as a primary source. Using a snowballing technique, we identified new documents or references from these primary sources. A policy analysis framework (Hill & Bramley 1986; McColl and Jongbloed, 2006) was used to extract the following data: the policy's stated objectives, its desired outcomes, benchmarks and work plans, and mechanisms for policy implementation. A stakeholder focus group of parents, researchers, and health care professionals was held and asked to consider the extent to which identified policies are perceived as effective in achieving their stated objectives.

Results:
The analysis suggested a wealth of articulated policies grounded in international guidelines protecting the rights of children and consistent with medical models for chronic care (life-span, evidence-based, family-centred, and coordinated).
The stated objectives of most policies were to ensure early access to comprehensive care for families and children affected by ASD across the lifespan. The desired outcomes were to optimize access and develop specific mechanisms so that children and families can receive complementary and coordinated services across sectors (e.g. education, health). Very few policy documents described benchmarks or working plans to ensure implementation of their policies considering the systems constraints.
Review of administrative data from a large university health center alongside stakeholder input from a focus group suggested that QC is far from implementing its articulated policies. The following patterns were specifically highlighted as conflicting with these policies: (1) long wait times (up to 2 years) for diagnostic and intervention services, (2) poor care coordination across different levels of service, (3) inadequate support for caregivers, (4) disparities in care access and utilization negatively affecting families from lower socio-economic backgrounds or recent immigrants.

Conclusions: Major disparity exists between articulated policies and their enactment in Quebec. The lack of implementation mechanisms (e.g., an analysis of system's barriers and facilitators) may contribute to gaps in access to care.

16   **122.016** Early Intervention Services and Effects on Parent Stress

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Background:
Parents of children with Autism Spectrum Disorder (ASD) experience greater parenting stress than parents of children who are typically developing and children with other disabilities. A recent meta-analysis of parenting stress literature suggested future research should attempt to *explain*increased parental stress in this population in order to promote parent resilience. Programs that emphasize the quality of parent-child interaction yield the largest effects on child and parent behavior, which could influence parent stress and resilience.

Objectives:
Consistent with these aims, this study investigates the relationship between parenting stress, parent depression, and an early intervention program emphasizing the transactional nature of child development following an initial diagnosis of ASD.

Methods:
Through collaboration between a university based ASD institute and a state department of education, 60 families of young children (ages 18-36 months) are receiving services following a psychologist's diagnosis of ASD or related developmental delay. All families participate in two home-based sessions

involving consultation and training on evidence-based practices for young children with developmental differences. Half of these families (n=30) participate in an additional 12-visit series providing support guided by the Early Start Denver Model (ESDM) curriculum. At pre-test, all primary caregivers complete a Parenting Stress Index, 4[th]edition – Short Form (PSI/SF) and a Center for Epidemiologic Studies Depression Scale (CES-D). All primary caregivers who participate in the two-visit series complete the PSI/SF and CES-D at the end of that series. The primary caregivers who participate in the 12-visit series (n=30) complete the PSI/SF and CES-D after all 14 visits.

When data collection is complete, initial descriptive analyses will be conducted to summarize parenting stress and depression across and within groups. Following descriptive analyses, Pearson Correlation Coefficients will be calculated to investigate the relationship between Parent Stress and Parent Depression. An ANCOVA will be conducted with post-test scores as the primary outcome variables, group status (2-visit versus 12-visit series) as the primary independent variable, and pre-test scores as the covariate.

Results:

Implementation

Consultation implementation at 95% fidelity across both models (Two and 12-visit). Consultants covered 90% of the ESDM curriculum; parents demonstrated 70% of strategies covered. Consultants and caregivers observed minimal-moderate levels of improvement in child behavior after two visits and moderate-significant levels of improvement following 14 visits.

Current Sample (n=20 at pre-test)

PSI-SF at-risk threshold is 85th percentile; clinical threshold is 90[th]percentile.

- 70% indicated an at-risk score; 60% indicated a clinically significant score
- mean %ile=90.45, sd=10.45

CES-D clinical threshold is 16.

- 40% indicated a score above 16
- mean=13.80, sd=8.93

Anticipated Results

Results regarding Pearson Correlation Coefficients and ANCOVA, and any follow-up analyses, will be presented upon completion of data collection.

Conclusions:

Researchers anticipate a difference in perceived parent stress and/or depression across the intervention groups. If analyses reveal a difference, then regression will be used with existing child clinical data to determine which child characteristics are associated with parent stress, parent depression, and parent responsiveness to intervention. Chi-Square may also be conducted to evaluate differences in status on stress and depression according to support series provided.

17 **122.017** Effects of Sensory Sensitivity and Intolerance of Uncertainty on Anxiety in Mothers of Children with Autism Spectrum Disorder

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Background: Parents of individuals with autism spectrum disorders (ASD) consistently report elevated levels of anxiety. Such anxiety may be linked to the stress of managing their child's ASD symptoms, but it is also likely to be influenced by individual characteristics in the parent. Identifying the influence of individual parent factors is important given that anxiety has negative implications for interpersonal relations. In this study we focus on two key individual traits that are associated with anxiety in the general population; intolerance of uncertainty, defined as a "relatively broad construct representing cognitive, emotional, and behavioral reactions to uncertainty in everyday life situations" (Freeston et al., 1994) and sensory sensitivity, a trait that predisposes individuals to be more sensitive to various stimuli from the social and physical environment.

Objectives: This study examined the relations between anxiety in mother and other personal characteristics of sensory sensitivity and intolerance of uncertainty. Given previous research in general population samples, it was predicted that both IU and sensory sensitivity would have a direct effect on maternal anxiety. However, IU and sensory sensitivity might also have an indirect effect on anxiety according to several different models: the relation between IU and anxiety may be mediated by sensory sensitivity (model 1) or the relation between sensory sensitivity and anxiety may be mediated by IU (model 2).

Methods: Fifty mothers of children and adolescents with ASD (mean age of children = 10 years 7 months (10.7), SD= 3.10; mean age of mothers = 44.4; SD= 6.3) completed the Hospital Anxiety and Depression Scale (HSP), the Highly Sensitive person scale and the Intolerance of Uncertainty (IU) Scale. None of the mothers had a diagnosis of ASD.

Results: Almost half (46%) of mothers met the cut-off criterion for clinically significant anxiety; these mothers significantly differed from the non-anxious mothers in terms of their IU (t= 3.01; p= .004; Cohen's d= .85) and HSP total scores (t= 2.22; p= .03; Cohen's d= .63). A three-way interrelationship between sensory sensitivity, IU and anxiety was found. In order to characterize the nature of this interrelationship, two mediation analyses were performed using the serial mediation model in PROCESS (Hayes, 2012) testing two above described models. Mediation analyses showed direct effects between anxiety and both IU and sensory sensitivity but a significant indirect effect was found only in model 2 in which IU mediated between sensory sensitivity and anxiety. Our findings

supported the second mediation model. In other words, the presence of high sensitivity and a susceptibility to being overwhelmed by environmental stimulation, may lead to an experience of the world as highly unpredictable. Such increased unpredictability could make even the most simple situations and events uncertain and difficult, thereby provoking anxiety.
Conclusions: This is the first study to characterize the nature of the interrelation between intolerance of uncertainty and sensory sensitivity in predicting the levels of anxiety.

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18   **122.018** Emotion Regulation and Depression in Parents of Children with Autism Spectrum Disorder
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Background: Research findings prove that parents of children with autism spectrum disorder (ASD) have more depressive symptoms than parents of typically developing (TD) children (Olsson & Hwang, 2001; Davis & Carter, 2008). Experienced stress related to the child difficult behavior and restrictions in personal life imply a higher risk for depression (Olsson & Hwang, 2001). However, studies with TD children also show that children of depressed parents are at risk of developing low emotion regulation (ER) ability (Feng, Shaw, Kovacs, Lane, O'Rourke, & Alarcon, 2008; Hoffman, Crnic, & Baker, 2006). Therefore, it is hypothesized that ER abilities in children with ASD and depressive symptoms in parents are related.
Objectives: Analyze the relationship between depressive symptoms in parents and ER of children with ASD.
Methods: 31 parents answered questionnaires about themselves and their children. Parents were aged 31 to 54 years old and their children 5 to 12 years old. 9 children were diagnosed with ASD accompanied by intellectual and language impairments, 9 were diagnosed with ASD without intellectual and language impairments, and 13 were TD children. The following questionnaires have been applied: the Difficulties in Emotion Regulation Scale for adults (DERS; Gratz & Roemer, 2004), which assesses emotional dysregulation; the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003), which assesses cognitive reappraisal and expressive suppression; the Center for Epidemiologic Studies Depression Scale (CES-D scale; Radloff, 1977), which assesses depressive symptomatology; the Autism Spectrum Quotient Questionnaire for Children (AQ-Child; Auyeung, Baron-Cohen, Wheelwright, & Allison, 2008) which assesses autistic traits; and the Emotion Regulation Checklist of children (ERC; Shields & Cicchetti, 1997) which assesses ER and lability-negativity.
Results: Parents of children with ASD with intellectual and language impairments had a significantly higher score in the DERS ($\chi^2(2)$=7.54, p<.05) and parents of children with ASD without intellectual and language impairment reported using more reappraisal than parents of TD children (U=36, p<.05). Furthermore, a positive correlation was found between the use of reappraisal in parents and the score on the AQ-Child ($r_s(29)$=.38, p<.05). Finally, no relations were found between the parents score on the CES-D and the 3 groups of children ($\chi^2(2)$=2.42, p=.30) or the score on the AQ-child ($r_s(29)$=.19, p=.15). However, parents' score on the CES-D was positively correlated to their score on the DERS ($r_s(29)$=.33, p<.05) and negatively correlated to the children's score on the ER scale of the ERC ($r_s(29)$=-.30, p<.05).
Conclusions: Parents of children with ASD with intellectual and language impairments reported having more ER difficulties. The more the autistic traits appear in children; the more parents used cognitive reappraisal as an ER strategy. Furthermore, parent style of ER and their children ER ability proved to be related to depressive symptoms. However, the causality of this relation is yet to be defined. Parents' depressive symptoms and difficulties in ER might be risk factors for children with ASD developing low ER abilities. On the other hand, children's difficult behavior and difficulties regulating themselves might lead to higher stress levels and depression in parents.

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19   **122.019** Evaluation of a Support Group for Fathers of Children with Autism Spectrum Disorder
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Background: Parenting a child with ASD can present significant challenges for parents, and various supports have been designed to help parents in this task, including support groups, which focus on parents' emotional and psychological concerns and issues. Scant research has examined support group participation and effectiveness, either for parents in general or for parents of children with ASD, and there are a number of methodological flaws (e.g., outcome measures with no psychometric properties). Furthermore, as is the case with other research in field of ASD and special needs, the majority of participants have been mothers. However, qualitative research suggests that fathers would attend such groups if they were available. More research on fathers and their experiences is needed.
Objectives: The purpose of this study was to evaluate the impact of a support group for fathers of children with ASD, using quantitative measures and a measure of social validity to examine participants' psychological experiences.
Methods: Two groups of six fathers (N = 12) attended eight weekly 2-hour sessions that focused on various topics related to parenting a child with ASD. Sample topics included fathers' experiences with the diagnosis, dealing with the education system, and the impact on personal and professional relationships of parenting a child with ASD. Pre- and post-intervention, participants completed the Beck Depression Inventory-II, the Dyadic Adjustment Scale (DAS), the Parenting Stress Index 4th

Edition, the Life Orientation Test-Revised, the Ways of Coping Questionnaire, a demographic form, and a social validity questionnaire. In addition, participants in one group also completed these same measures four months after the support group concluded.

Results: Results of a series of paired samples t-tests indicated no significant changes over time for the groups on any of the measures. However, responses to the social validity measure indicated that all fathers found the groups to be meaningful and helpful, enjoyed listening to and sharing personal experiences with other men in similar circumstances, and strongly recommended a similar group to other fathers of children with ASD. Although no statistically significant improvements in psychological functioning were observed within or between groups, there were a number of changes in individual scores, indicating improvements in well-being.

Conclusions: The vast majority of research conducted with parents of children with ASD still includes mostly mothers as participants. Research on fathers' experiences has increased over time, but more is needed. From an empirical perspective, studying fathers provides important information about their unique experiences and how they differ (or are similar to) those of mothers. Furthermore, it demonstrates respect and appreciation for the unique identity and contributions of fathers. From a clinical perspective, the information gathered via research can be used to develop effective interventions to support and assist fathers to be better parents and partners. In this study, although significant changes were not found on standardized measures of fathers' well-being, the participants reported that the group was valuable and worthwhile and recommended it highly to other fathers, pointing to an important and exciting area for future research and community intervention.

20   **122.020** Examining Changes in Parental Distress, Self-Efficacy, and Children's Problem Behaviors from Admission to 2-Month Follow-up within the Autism Inpatient Collection (AIC) Sample

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Background: Parents of children with Autism Spectrum Disorder (ASD) have reported increased stress, which is associated with lower parental self-efficacy and child behavior problems. There is a lack of research examining changes in parental distress, self-efficacy and children's problem behavior over time, and whether differences in outcome occur based upon children's verbal ability.

Objectives: To analyze preliminary data from the Autism Inpatient Collection (AIC) examining changes in parental distress, parental self-efficacy, and parent's reports of children's problem behaviors from admission, discharge, and 2-month follow-up. Further, to explore potential differences in problem behavior between children with limited verbal ability and fluent speech.

Methods: Children and adolescents aged 4-20 years, with an Autism Diagnostic Observation Schedule-2 (ADOS-2) supported autism diagnosis and admitted to specialized inpatient psychiatry units were prospectively enrolled in a six-site study examining patient phenotypes and behavioral outcomes. Parent measures, including the Parental Stress Index (PSI-SF 4) Parental Distress (PD) subscale, Difficult Behavior Self-efficacy Scale (DBSS), and the Aberrant Behavior Checklist - Irritability subscale (ABC-I), were collected at admission, discharge, and 2-month follow-up. ADOS-2 Modules 1&2 were administered to patients with limited verbal ability, while Modules 3&4 were administered to patients with fluent speech. Repeated measures analysis of variance (RMANOVA) was conducted to examine for changes in scores over time.

Results: Mean age of the first 108 enrolled children was 12.70 years (SD=3.50), 24% female, 77.8% Caucasian and 91.4% Non-Hispanic/Non-Latino. Average length of stay across the six-sites was 25.35 days (SD=23.21, Median=19.0, Range=4-130). Approximately half the sample (56%) was administered ADOS-2 Modules 1&2. Preliminary results are based on complete data from forty-four parents with data from all three time points. The majority of parent report measures came from patients' biological mothers (70.7%), followed by biological father (9.8%), step/foster/adoptive mother (9.8%) or father (2.4%), and grandparent (7.3%). Average age of parent respondents was 44.56 years (SD=10.30), 52% married, with an average annual household income <$35,000. Parents reported a significant decrease in their child's problem behavior between admission, discharge and 2-month follow-up, F=12.75, p<0.001, though this difference did not significantly vary between patients with limited verbal ability and fluent speech, F=0.23, p=0.79 (see Figure 1). Parents also reported a significant decrease in parental distress between admission, discharge and 2-month follow-up, F=6.94, p=0.002. There was no significant difference in parents' report of their confidence in their ability to parent a difficult child (self-efficacy) between admission, discharge and-2 month follow-up, F=0.27, p=0.61. Cronbach's Alpha was >0.70 for all scales at all three time points indicating good scale reliability.

Conclusions: Preliminary data suggests that parents with children in specialized psychiatric inpatient units reported a significant reduction in their own distress and their child's problem behavior from admission to 2-months post-discharge, regardless of the child's verbal ability. There was no change in parents' report of their self-efficacy in managing problem behavior over time. Future research should examine how parent self-efficacy and mindfulness based stress reduction techniques may mediate parental distress and behavioral outcomes in children with autism.

21   **122.021** Factors Influencing Relocation for Military Families with Children with ASD

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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 (in review) interviewed 15 military spouses with children with ASD about their therapeutic experiences. Military spouses reported challenges with relocation, separation, Tricare, and military programs that resulted in negative impacts on their child's autism related services. In order to inform clinical practice for professions, provide evidence for policy, and improve services and outcomes for military families, the experiences and needs of a larger sample of military families with children with ASD should be examined. Military families have specific characteristics that may impact their experiences with services related to autism and; therefore, may have unique service needs. The purpose of the current study was to describe the therapeutic experiences of military families with a child with ASD to determine needs of this population in a larger sample.
Objectives:
The main objectives of this investigation were to determine what factors influence the military spouses' perception of services at different installations, effects of relocation on the child with ASD and family, and factors influencing relocation satisfaction.
Methods:
In order to determine the experiences of a larger sample of military families with children with ASD, a self-administered online survey design was chosen. Surveys allow researchers to collect self-reported data on personal experiences and generalize findings from a small population to a larger one in a time and cost efficient manner (Rea & Parker, 2005). An online mode was chosen because online surveys extend the "reach" of respondents who may live in a number of geographic regions, 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). The questions and response choices in this survey were generated from 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).
Results:
Approximately 200 military spouses with children with ASD completed the online survey. Data analysis is currently on-going, but preliminary results suggest military families with a child with ASD experience challenges related to frequent relocation including provision of therapeutic services, child and family adjustment, and access to supports.
Conclusions:
Data analysis is currently on-going, but conclusions may impact clinical service providers, military programming and providers, and laws and policies.

22   **122.022** Fathers' and Non-Fathers' Physiological Responses to Distress Vocalizations of Infants with Autism Spectrum Disorders

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Background: Children with ASD, even before receiving a formal diagnosis, express atypical patterns of cry (higher fundamental frequency and shorter inter-bout pauses) in response to social and non-social stressors. Cries of children with ASD are also perceived differently from other cries, and these perceptual differences may alter parent-infant interaction.
Objectives: To test multiple physiological responses to atypical distress vocalizations (crying of ASD children) acoustically matched with typical distress vocalizations (crying of typically developing children) and with positive vocalizations (laughter of typically developing children).
Methods: The experimental procedures were designed measure how components of the autonomic nervous system respond to typical and atypical infant distress vocalizations. We employed three convergent methodologies. (i) Emotional arousal was assessed using the Galvanic Skin Response (GSR). (ii) Assessments of excitability were conducted monitoring cardiac dynamics via Inter-Beat Interval (IBI). (iii) Promptness to action was measured as temperature increases of the right hand (Right Hand Temperature Change – RHTC), which is associated with arousal and activation. These physiological assessments were performed on two groups with contrasting caregiving experience: fathers (n=10) and non-fathers (n=10).
Results: Inferential analysis was performed considering two groups (fathers vs non-fathers) and three stimulus types (ASD cry, TYP cry, laughter) for the three measures (GSR, IBI, RHTC). Both fathers and non-fathers showed greater negative response (increased GSR) to ASD cries compared to TYP cries and laughter ($p < .001$). Fathers showed higher IBI compared to non-fathers while hearing both typical and atypical crying ($p < .05$), and for the RHTC fathers showed greater temperature increases

than non-fathers while listening to typical and atypical cries ($p < .05$).
Conclusions: In agreement with behavioral studies that have been conducted mainly in females and mothers, fathers and non-fathers show more emotional arousal mediated by sympathetic activation (measured as increased GSR) while listening to cries of children with ASD. In other terms, it seems that ASD cries are processed as more negative. This result is likely driven by specific characteristics of ASD cries (high frequency and shorter pauses). Fathers were calmer (lower IBI) than non-fathers while listening to cries, perhaps because fathers have more experience in caring for crying infants. Fathers were more prompted to act (increase of the RHTC) than non-fathers while listening to cries. However, we found no differences between fathers and non-fathers in reaction to non-distress vocalizations. Sensitivity to infant cries may be tuned by fathering experience. These findings highlight both similarities and differences in fathers' and non-fathers' physiological responsiveness to crying of children with ASD and can provide information to guide specific intervention programs for parents of children at high-risk of ASD.

23   **122.023** First Concerns Among Latino Parents of Children with Autism Spectrum Disorder

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Background:
Autism spectrum disorders (ASDs) are neurodevelopmental disorders that are estimated to affect 1 in 67 children in the U.S. Typically, diagnosis is made at 3 or 4 years although it is believed that reliable diagnoses can be made as early as 2 years. Unfortunately, studies show that African American and Latino children are under-diagnosed and when diagnosed, receive a later diagnosis than White children. It is believed that earlier recognition and diagnosis leads to improved child outcomes due to enrollment in early intervention services to address speech/language, cognitive, social, and self-help skills. There is some evidence that first concerns expressed by parents about their children are important factors in early diagnosis. However, little is known about the first concerns expressed by Latino parents of children with ASD.
Objectives:
Our research questions for this study are: 1) what are the first concerns of Latino parents of children with ASD and developmental disabilities (DD)?, and 2) how do first concerns differ between Latino parents of children with ASD compared to parents of children with other DDs?
Methods:
We analyzed qualitative responses from 27 Latino parents of children with ASD (n=18) and other DDs (n=9). Each of the authors reviewed the transcripts independently and identified themes in response to our 2 research questions. We then met to agree upon working definitions of themes and proceeded to recode transcripts independently. When saturation was achieved, the authors reviewed the coded transcripts and reached agreement.
Results:
Five categories emerged from our analysis: communication concerns, behavior or temperament concerns, social concerns, concerns about physical milestones, and sensory concerns. The vast majority of parents expressed first concerns about communication or language challenges of their children regardless of whether they had ASD or another DD. However, parents of children with ASD had more concerns about problem behaviors and social development. Surprisingly, the parents of children with other DD had more concerns about sensory issues than the parents of children with ASD in our sample.
Conclusions:
Our findings are consistent with the literature on first concerns (based primarily on White parents of children with ASD). Our results suggest that it is important that pediatricians and health care providers respond appropriately to parent's first concerns about their children's development (i.e., conduct screenings, make referrals for evaluation), particularly when there is a concern about language. Children whose parents also express concerns about social and behavioral issues may especially warrant screening for ASD.

24   **122.024** Implementation of Early Service Interventions and Its Effects on Parent Resilience

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Background:
It is well established that parents of children with autism spectrum disorder (ASD) experience significant stress; however, far less is known about parental characteristics that may promote family resilience, defined as the ability to adapt to stressful life events and changes (Hayes and Watson 2013). A review by Bekhet and colleagues (2012) suggests that parents of children with ASD who possess indicators of resilience are more equipped to handle the stress that often accompanies caring for children with ASD. Specifically, parental self-efficacy – parents' beliefs about their ability to parent successfully – is identified as an important predictor of resilience. Further, research

demonstrates an inverse relation between parental self-efficacy and depression (Kuhn and Carter 2006), highlighting the deleterious effects of depressed mood on parents' sense of competency.
Objectives:
The purpose of this study is to evaluate the impact of early intervention services for parents of children with a recent diagnosis of ASD or a related diagnosis. A primary objective of this investigation is to learn whether the enhancement of parental resilience is an outcome of early intervention services. The relation between parental self-efficacy and parental depression will also be explored.
Methods:
Participants include 60 families with children ages 18-36 months that are receiving support services following an ASD or related diagnosis. All families participate in two home-based sessions that include behavioral consultation and training on evidence-based practices for children with ASD. Half of these families (N = 30) participate in an additional 12-visit series providing education and support from the Early Start Denver Model (ESDM) parent training curriculum. Pre- and post-intervention measures include the Parenting Sense of Competence Scale (PSOC) and the Center for Epidemiologic Studies Depression Scale (CES-D). An Analysis of Covariance (ANCOVA) model will be used in which the post-intervention scores serve as the outcome variable, group (brief consult or ESDM) as the main independent variable, and baseline (pre-intervention) scores as the covariate. Pearson correlation coefficients will be used to determine the relation between self-efficacy and depression.
Results:
Preliminary data suggest that the consultants were able to implement the training model designed for each service with 95% fidelity. Additional data suggest that consultants were able to cover over 90% of the ESDM curriculum across the 12 visit model and that parents were able to demonstrate over 70% of those strategies covered within treatment sessions. Preliminary data indicate heightened levels of parent depressive symptoms pre-intervention (CES-D: M=13.80; SD=8.93) and moderate levels of parental self-efficacy (PSOC: M=74.44; SD=11.5) with an inverse relation between depression and self-efficacy (r = -0.7, p= .001).
Conclusions:
The current study aims to further our understanding of the factors that promote parents' resilience following the significant life event of a child's ASD or related diagnosis. Prior to intervention, parents endorsed elevated levels of depressive symptoms and moderate levels of self-efficacy. Subsequent analyses will examine whether a brief consultation or a longer-term intervention differentially confer benefits to parents' self-efficacy and depressive symptoms. This information will guide future endeavors for enhancing parental well-being.

25 **122.025** Influence of Pre and Post Doctoral Fellowships on Autism Research Career Trajectory
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Background: Investing in the training of junior level researchers at critical points in their academic careers has been an important strategy of public and private funding agencies. This support helps both recruit and cultivate new investigators so that they develop into the next generation of productive autism scientists. However, tracking the short and long term activities of these researchers has not been well documented or published publically.
Objectives: This analysis examined data from 2010 to 2014 from both pre doctoral and postdoctoral research grants awarded from a private funding agency. Diversity of research topics as well as metrics of potential future success as researchers was analyzed and presented
Methods: Trends across time and award type were made and compared. Funding amount and standardized return on investment measures including number of new grants, publications, presentations to scientific and lay audiences, retention in the field of autism and documented collaborations outside the mentor/trainee relationship were recorded and tracked. The last metric has been demonstrated previously as a method for identifying successful scientists within the field of autism (Goldstein et al, 2014).
Results: Data was tracked for 1 year following the end of the award for 14 pre doctoral and 11 post doctoral fellows, who received awards from 2010-2013. During this time period, the 14 predoctoral fellows published 6 articles in books or scientific journals, conducted 41 presentations, and established documented collaborations with 30 scientists who were outside the original pre doctoral training plan. At the time of survey, all were still working in the field of autism. The 11 postdoctoral fellows published 9 articles, made 46 presentations and had established connections with 33 other scientists during their fellowship. More than half had received additional funding for autism research and all were still working in the field of autism research. For predoctoral fellowships, the most popular field of study was molecular and cellular biology (28%); for postdoctoral fellowships it was brain function (30%). Communication and language ranked second for both groups.
Conclusions: These descriptive results demonstrate the critical importance of funding of early career researchers to support the career development of researchers studying ASD. Comparison data from pre doctoral fellows who did not receive specific research and mentorship support, as well as those outside autism research, will be presented at IMFAR. In the future, additional effort should be made to recruit fellows from additional fields of interest for training in autism-specific fields of study.

26 **122.026** Intensity of Parenting Stress, Child Negative Emotionality, and the Interaction of Parent's Self-Regulation Skills
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Background: Parenting a child with autism spectrum disorder (ASD) is often associated with high levels of parenting stress (Steijn, Oerlemans, Aken, Buitelaar, & Rommelse, 2013). Research suggests children's individual characteristics, specifically negative emotionality, also affect parenting stress (Pesonen et al., 2008; Tomanik, Harris & Hawkins, 2004). Additionally, maternal self-regulation has been established as a contributing factor to parenting stress (Bridgett, Burt, Laake, & Oddi, 2013; Evans & Wachs, 2011).
Objectives: Consistent with previous research, we propose self-regulation skills of negative emotions may serve to moderate the effects of children's negative emotionality on parental stress regardless of developmental status.
Methods: Our preliminary sample included 61 children (ages 3:1 to 6:11) and their parents. Thirty-eight children (45% female) were typically developing; 23 children with ASD (17% female). Intensity of parenting stress was measured using the parent-reported Parenting Events Questionnaire (Crnic & Greenberg, 1990), which assesses the frequency and intensity of parenting stress. Negative emotionality was measured by parent ratings of their child's emotional intensity using items adapted from Larsen and Diener's Affective Intensity Measure (1987). Parents' self-regulation skills were coded from audiotaped responses to the Meta-Emotion Interview (MEI; Katz & Gottman, 1986).
Results: Hierarchical regression analysis was utilized to examine the influence of status and negative emotionality (NE) in children with ASD and TD and parent's self-regulation skills (SR) on parenting stress. In our preliminary research, we found that that neither diagnostic status, child NE nor the interaction between status and child NE significantly predicted intensity ratings for parenting stress (t = .537, p = .594; t=.057, p = .295; $F(1,56)$F= 0.691, p= .409, respectively). However parent SR was a significant predictor of parenting stress intensity (t =-2.933, p = .005). In the current study we investigated whether the relation between child NE and stress intensity was moderated by parents' self-regulation. Diagnostic status, parent self-regulation, and child negative emotionality were entered in the first step and predicted significant variance, ΔR^2 = .16, $F(3, 57)$ = 3.70, p = .017. The interaction between child negative emotionality and parent self-regulation skills entered in the second step, accounted for significant variance in parenting stress intensity, ΔR^2 = .23, $F(1, 56)$ = 4.618, p= .036. As can be seen (see Figure 1), parents' strong SR skills appeared to buffer them from high stress intensity even when their child was high in NE. In contrast, the stress of parents with lower SR skills was strongly linked to their child's NE.
Conclusions: Our findings suggest that parenting stress may be related to child characteristics and parent resources. Specifically, our study suggests that parent self-regulation strategies of negative emotions moderate the relation between negative emotionality and parental stress. Furthermore, the findings are significant for children with ASD and TD providing promising evidence for the role of parental self-regulatory techniques for reducing parental stress, especially the intensity of stress. Future research should investigate the different types of parental regulation techniques used with children with ASD and TD to reduce parental stress.

27 **122.027** Keeping up with the Times: Measuring the Stress of Parents of Children with ASD over Email

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Background:
Although increased support has been found to reduce the stress experienced by families of children with an autism spectrum disorder (ASD) (e.g., Weiss et al., 2013) Hall and Graff (2011) found that average parent ratings of support from professional organizations fell between a rating of 1 (not at all helpful) and 2 (somewhat helpful). Autism Ontario (AO) is a charitable organization that provides the leading source of information and referral on ASD in Ontario, Canada. Between 2007 and 2009, 63% of contact initiated by families to family support coordinators (FSCs) of AO occurred through email. It is more difficult to express emotions over email because of the absence of verbal and body language cues present during phone and in-person contact (Byron, 2008; Ekman et al, 2004) and, as a result, there is a greater risk for FSCs to misinterpret family stress over email, when compared to phone and in-person communication. Yet the ability of an organization to determine the stress of families that contact them is an important first step to responding appropriately, in a manner that best serves the family's needs.
Objectives:
This project presents the results of a program to measure the stress of families before and after email contact with AO FSCs.
Methods:
Four equally-spaced time points were selected for data collection throughout the past year. Each of the time points served as a trigger for FSCs to forward the email addresses of families who had contacted them in the preceding week to the AO research team. The researchers then sent these families an online survey that inquired about their overall experiences with email communication with AO that past week, including reporting on how much stress they were experiencing prior to contacting FSCs and how much stress they felt afterwards.
Results:
49 families responded in the round of the email stress survey being reported. The survey responses

indicated that families contacted the AO FSCs for various reasons (see Figure 1). A large number of the respondents considered themselves "very stressed" (35%) (see Table 1) prior to contacting FSCs. 53% of respondents reported a reduction in stress following their correspondence with FSCs while another 41% reported no change. For respondents that indicated a reduction in stress, the mean reduction was 1.77 points on a 5-point rating scale. The majority of the families indicated they were satisfied with their email communication with the FSCs (80%). Reasons families contacted FSCs were not significantly related to their reported stress or their satisfaction with their email communication.
Conclusions:
Online communication is convenient for families as it can be initiated at any time without scheduling limitations, and it has become the most common form of contacting FSCs at AO. Additionally, it allows for anonymity that reduces social stigma associated with seeking help (DuBois, 2004). The findings suggest that, despite the increased possibility of emotional detachment in email correspondence, it is still possible for organizations to measure and help alleviate the stress of families of children with ASD through email communication.

28 **122.028** Many Voices at the Table: Collaboration Between Families and Teachers of Somali Students with Autism

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Background:
Somali refugee children are disproportionately likely to be diagnosed with autism (e.g., Estrem & Zhang, 2010), although autism is virtually unheard of within Somalia itself (McNeil, 2009). Data are inconclusive and several theories have been put forth to explain this pocket of elevated incidence (e.g., vitamin D deficiencies, duplicate vaccinations) (Barnevik-Olsson, Gillberg & Fernell, 2010; Delberto, 2011).
Family participation in the IEP process yields better outcomes for students with autism and other disabilities (e.g., Olvios, Gallagher, & Aguilar, 2010) and yet culturally and linguistically diverse (CLD) families tend to participate in the special education decision-making process at lower rates than their American-born white, English dominant counterparts (Lo, 2012). Certain best practices have been associated with more collaborative IEP meetings in both American-born white families and in majority CLD groups (e.g., African Americans, Asians, Latinos). Little research has examined the effectiveness of IEP practices in the context of a less familiar CLD group (e.g., first generation Somali refugee families).
Objectives:
Participants will learn about important themes related to the collaboration between Somali-American mothers of students with autism and American-born teachers in the IEP development process and how these themes yield practical implications.
Methods:
This qualitative multiple case study (Yin, 2009) examined the IEP process in the context of three Somali-American boys with autism. The student's mother and primary teacher were interviewed before, immediately following, and one month after the students' IEP meetings, using semi-structured interview protocols. Alongside these interviews, the researcher analyzed observations of the educational decision-making dynamics at the IEP meetings and pertinent educational documents from the students' files (e.g., draft and final IEPs, diagnostic reports). Theme analysis drew on both a priori and emergent codes and was informed by the constant comparative approach (Charmaz, 2000). Themes were organized into three phases: before, during, and after the IEP meeting.
Results:
Results of this study corroborate the importance of certain established best practices (e.g., structured agendas to structure IEP meetings, less reliance of special education jargon). However, the present study also extends and challenges previous research, suggesting that an over-emphasis on cultural sensitivity can in fact impede authentic communication between family members and special educators and highlighting the importance of culture in facilitating on-going educator/family member interactions (e.g., impromptu conversations at pick up and drop off) in addition to those related directly to the IEP process.
Conclusions:
A close analysis of the interactions among this very specific group of individuals can lead to important questions about how autism is understood. It is important for educators to understand the variety of beliefs about autism and autism education in order to enhance collaboration with CLD families.

29 **122.029** Maternal Depressive Symptoms and Child Sleep Quality in Young Children with ASD

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Background: Parents of children with ASD are at increased risk for poor psychological well-being (Montes & Haltermann, 2007). Potential sources of maternal depressive symptoms include maternal and child factors especially disrupted child sleep (Hodge et al., 2013). 77.2%-80.9% (Mannion et al.,

2013; Rzepecka et al., 2011) of children with ASD demonstrate comorbid sleep problems. Limited studies have explored links between maternal well-being and child sleep quality.

Objectives: To examine the associations between maternal depressive symptoms and (1) child sleep quality, (2) child adaptive behavior, (3) maternal sleep quality, (4) maternal global self-rated health among mothers of young children with ASD.

Methods: Participants were 72 toddlers with ASD (24-39 months; 75% male) and their mothers (22-53 years; 54% Caucasian). Maternal depressive symptoms were assessed using an adapted version of the Patient Health Questionnaire (PHQ-9; Kroenke & Spitzer, 2002).   Children's sleep quality was assessed using the Children's Sleep Habits Questionnaire (CSHQ; Owens et al., 2000), which consists of seven subscales: (1) bedtime resistance, (2) sleep onset delay, (3) sleep duration, (4) sleep anxiety, (5) night wakings, (6) parasomnias, (7) sleep disordered breathing, and (8) daytime sleepiness. Children's adaptive behavior was measured using the Vineland Adaptive Behavior Scales (Sparrow et al., 2005). Maternal sleep quality was assessed using a single item from the PHQ-9. Maternal global self-rated health was evaluated using a single-item on a four-point scale (Surkan et al., 2009).

Results: Maternal reports of greater depressive symptoms were significantly linked to (1) shorter child sleep onset delay ($r=-.203$, $p=.044$), (2) poorer child sleep duration ($r=.418$, $p<.001$), (3) greater child sleep anxiety ($r=.272$, $p=.011$), (4) greater child night wakings ($r=.372$, $p=.001$), (5) greater child parasomnias ($r=.387$, $p<.001$), (6) greater child daytime sleepiness ($r=.399$, $p<.001$), (7) poorer child adaptive functioning ($r=-.367$, $p=.001$), (8) poorer maternal reports of sleep quality ($r=.600$, $p<.001$), and (9) poorer maternal reports of global self-rated health ($r=-.383$, $p<.001$). A regression analysis was used to examine the variance in maternal depressive symptoms accounted for by child sleep quality, child adaptive functioning, maternal sleep quality, and maternal global self-rated health. The four most strongly related child sleep quality subscales (i.e., sleep duration, night wakings, parasomnias, and daytime sleepiness) were selected for inclusion in the model predicting maternal depressive symptoms because of the limited sample size. The overall model predicted 52% of the variance in maternal depressive symptoms, $F(7,64)=9.95$, $p<.001$. Within the model, only child daytime sleepiness ($\beta=.20$ indicated a small effect) was significantly related to maternal depressive symptoms after adjusting for the other variables in the equation.

Conclusions: This study extends previous work examining the links between maternal well-being and child sleep quality among children with ASD (Hodge et al., 2013). Bivariate analyses indicated significant links between maternal depressive symptoms and child sleep quality; multivariate analyses pointed to toddlers' daytime sleepiness as an important contributor to maternal depressive symptoms. By teasing apart specific child sleep factors that may be important for maternal mental health, targeted priorities for behavioral parent training to address sleep disturbances among children with ASD may be empirically-driven.

30   **122.030** Maternal and Paternal Stress in Parenting Children with ASD

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Background:
Extant literature demonstrates that mothers of children with ASD experience consistently higher levels of stress than mothers of typically developing (TD) children. Child variables such as autism symptom severity, age, behavior problems, and cognitive ability may contribute to this stress, though results vary. Research on paternal stress is limited.

Objectives:
We examined differences in parenting stress and symptoms of psychopathology between parents of children with ASD and parents of TD children. This is one of the first studies to include an equal number of mothers and fathers, which facilitated an examination of how child variables may differentially affect parenting and psychological stress for both mothers and fathers of children with ASD.

Methods:
Participants included the mothers and fathers of 30 cognitively able children with ASD aged between 4.4 and 17.4 years (M=10.50 years, SD=3.97 years) and mothers and fathers of 20 TD children aged between 4.2 and 17.1 years (M=10.58 years, SD=4.95 years). Parenting stress was assessed using the Parenting Stress Index- 4th Edition (PSI-4), and symptoms of anxiety and depression were assessed with the Beck Anxiety Inventory (BAI) and the Beck Depression Inventory-2nd Edition (BDI-II). In the ASD sample, autism symptom severity, behavior problems, and cognitive abilities were assessed with the Social Responsiveness Scale (SRS), the Child Behavior Checklist, and the Differential Abilities Scale-2nd Edition respectively.

Results:
Parents of children with ASD did not differ significantly from parents of TD children on measures of anxiety and depression (BAI and BDI-II). However, parents of children with ASD experienced significantly greater parenting stress (PSI-4) than did parents of TD children. Parenting stress for mothers and fathers of children with ASD did not differ. Externalizing behavior problems and autism symptom severity correlated with magnitude of parenting stress overall. While parenting stress did not differ significantly between mothers and fathers of children with ASD based on the age of the child, the specific factors that contributed to this stress did. Results indicated that externalizing

behaviors were associated with parenting stress for both mothers and fathers of younger (≤11 years) children. For parents of older children, autism symptom severity correlated only with paternal parenting stress.

Conclusions:

Parenting a child with ASD is associated with higher levels of stress than parenting a TD child, but our results illustrated that parents do not experience higher levels of anxiety and depressive symptoms. Importantly, though, since both mothers and fathers of children with ASD experience heightened parenting stress, it is crucial to support both parents when treating children with ASD. Our results suggest that the child variables contributing to parenting stress change throughout child development and may be different for mothers and fathers as children get older. These findings also underscore the importance of addressing comorbid externalizing behaviors when treating younger children with ASD as these behaviors lead to stress for parents.

31 **122.031** Mealtime Structure in Families with Children with ASD

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Background: Feeding challenges are highly prevalent among children with autism spectrum disorders (ASD) with up to 89% reported to have feeding difficulties impacting development, health, and social interactions, specifically parent–child relationships. These feeding difficulties create tension and disruption around mealtimes and have been shown to significantly increase parental stress within and outside feeding experiences.

Objectives: The purpose of this study was to examine how parents of children with ASD structure their mealtime routines using a grounded theory approach.

Methods: Families (n=16), primarily mothers, with a child with ASD, ages 2-8 years, participated in 2-3 semi-structured interviews, each lasting 1 to 2 hours in the home environment. Audio-recorded interviews and field notes were transcribed verbatim and used for data analysis. A grounded theory approach was used, including initial identification of codes and themes to organize data. Axial coding was used to draw connections among the concepts and categories that built on identified themes. Lastly, selective coding was used to describe the central phenomena of the data and develop a theory on family mealtime construction. In-depth interviewing, triangulation, and member-checking (i.e., verifying and clarifying information with participants at follow-up interviews) were used to establish scientific rigor in the qualitative data.

Results: Family construction of mealtimes are a dynamic and adaptive process that involved the interplay of five themes: Values (guiding principles and beliefs shaped by family culture, traditions, religion, and personal experiences), Balancing Demands (what parents prioritize with regards to feeding and mealtime in the context of their busy lives and family schedules), Parent Strategies (strategies individual parents implement with their children in varying mealtimes contexts that are guided by their values and realities of their daily schedules), Mealtime Happenings (actual mealtime process), and Adaptability (interactions and adaptations that occur based on child behaviors and context). Themes were used to construct a grounded theory to describe the process of how parents with children with ASD structure their mealtime routines. Figure 1 shows the relationship and interaction among the themes that describes the elaborate mealtime construction that arises in response to a child's feeding disorder. Many factors influence how parents of children with ASD attempt to structure their mealtime routines and consequently the actuality of the family mealtime experience, including parental values, balancing family demands, and the individual responses of the child to implemented parental strategies. In the described model, parent strategies were often the mediator between how the child behaviorally responded in mealtime contexts and the parent's attempt to balance family demands and values. Due to the complexity of mealtime construction in the presence of having a child with ASD and feeding challenges, parents were required to have constant adaptability to create "successful" family mealtimes.

Conclusions: Five distinct themes were identified and used to create a model of family mealtime construction using a ground theory approach. The explicit identification of mealtime routines will lead to targeted family-centered interventions that can be based on individualized family goals, values, and behaviors that can improve child eating and mealtime behaviors while decreasing parental stress.

32 **122.032** Mental Stress in Parents of Autistic Children: A Pilot Study of the Related Psychological Dimensions

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Background: Parental mental stress is clinically common in families of autistic children and adversely affects the care of the child. Moreover, parents of autistic children frequently experience feelings of guilt, maladaptive coping styles, lack of ability to forgive himself and the partner, and low mindfullness ability. However, is unclear which of these dimensions is predominant in these families and if it their associations are symmetrical in presence of high or low values.

Objectives: The aims of this pilot study are: 1) to evaluate the most predominant dimensions in parents of autistic children and to establish the hierarchy of their relationship; 2) to evaluate if psychological dimensions works in different way when they are high or low; 3) to establish if

psychological dimensions in parents of autistic children are related to the severity of the Autism Spectrum Disorder (ASD).

Methods: Demographic and psychological information about mental stress, feelings of guilt, ability to forgive, mindfullness ability and coping styles were collected through clinical interviews and self-report questionnaires in 28 parents (mean age 43.5 yrs; 22 mothers; 6 fathers) of autistic children (mean age: 12.2 yrs; 3 females; 25 males). Severity of the ASD was assessed through Autism Diagnostic Observation Schedule (ADOS). Artificial Neural Networks (Auto-CM system) were applied to highlight the associations among variables under study. Auto-CM is fourth generation Artificial Neural Network developed at Semeion Research Institute (Rome) and successfully applied in many complex chronic degenerative diseases, able to find out consistent trends and associations among variables creating a semantic connectivity map. The matrix of connections, visualized through minimum spanning tree filter, takes into account nonlinear associations among variables and captures connection schemes among clusters.

Results: Predominant dimensions in parents of autistic children were low feelings of guilt for himself and the partner, high levels of forgiveness of himself and the partner, and low levels of maladaptive coping responses. These three main dimensions are strictly related among themselves. While high parental mental stress was strictly related to high parental distress subscales, high maladaptive coping styles, and low self-forgiveness ability, conversely, low mental stress appeared to be marginal in relation to the other psychological dimensions. This behavior is typical of complex nonlinear systems. The severity of the ASD was not related to parental psychological dimensions. The ADOS scores, both low and high, were in fact marginal in the connectivity map in relation to the other dimensions.

Conclusions: The interplay of psychological factors related to parental stress is complex. Understanding these relationships is the starting point to activate and enhance parental resources essential to the wellbeing of both children and caregivers. Due to the complexity of these relationships and the lack of symmetry between associations of the same dimension when high or low, the approach with advanced neural networks is essential for the analysis of the patterns of relationships.

33 **122.033** Modeling Depressive Symptom Trajectories Among Mothers of Children with ASD from Diagnosis to Age 9

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Background: Elevated levels of depressive symptoms among mothers of children with ASD have been well documented (Davis & Carter, 2008; Montes & Halterman, 2007). However, few studies have examined mothers' depression longitudinally, and most have considered these mothers as a homogeneous group when examining their depressive symptoms. Although several studies suggest some degree of stability in maternal depression over time (e.g., Carter et al., 2009), none have considered the potential heterogeneity of developmental trajectories of maternal depression. Overall sample means and correlations may mask the presence of subgroups of mothers whose depression follows distinct patterns.

Objectives: The purpose of this study was two-fold: 1) to identify subgroups of mothers with different depression trajectories from the time of child diagnosis (between age 2-4) to age 8.5-9, in a large inception cohort of young children with ASD; and 2) to explore the associations between trajectory membership and key parent/family variables.

Methods: Data were drawn from the Canadian Pathways in ASD study and included the mothers of 284 children with ASD. At the time of initial data collection, which occurred within 4 months of diagnosis, the children's mean age was 40.33 months (SD=9.3). Mothers completed the Symptom Checklist-90-R (Derogatis, 1994) to assess their depressive symptoms at four time points: within 4 months of diagnosis, 24 months post-diagnosis, when the children were 7.5-8 years old, and when the children were 8.5-9 years old. In addition, at diagnosis, mothers completed a demographic survey, the General Functioning subscale of the McMaster Family Assessment Device (Byles, Byrne, Boyle, & Offord, 1988), and the Social Support survey (NLSCY, 2008-2009). Severity of children's ASD symptoms was assessed using the Autism Diagnostic Observation Schedule (Gotham, Pickles, & Lord, 2009). A semi-parametric, group-based analytical strategy in SAS, PROC TRAJ (Jones, Nagin, & Roeder, 2001), was used to examine individual differences in developmental trajectories.

Results: Three distinct trajectory groups provided the best fit to the maternal depression data over time. Group 1 (65.2% of the sample) had the lowest mean depression scores at diagnosis and a stable trajectory. Group 2 (27.3%) had moderate mean depression scores at diagnosis and a declining trajectory. Group 3 (7.4%) had the highest mean depression score at diagnosis and an inclining trajectory. Both family social support and family functioning distinguished between the

trajectories of Group 1 (low, stable), and Groups 2 (medium, declining) and 3 (high, inclining). In addition, older child age at the time of diagnosis was significantly associated with membership in Group 2 compared to Group 1.

Conclusions: There is considerable heterogeneity in the trajectories of maternal depressive symptoms. Lower levels of perceived social support, poorer family functioning, and higher child age at the time of diagnosis all appear to be associated with higher depressive symptomatology. While depression improves over time in some mothers, others experience increased symptoms. Additional research is needed to identify other variables contributing to these trajectories and intervention approaches for assisting these families.

34   **122.034** Parent Feeding Practices of Picky-Eating Children with and without Autism Spectrum Disorder

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Background: "Picky eating" children with and without autism spectrum disorders (ASD) often exhibit a variety of eating problems (e.g., sensory sensitivity to the taste, texture, smell, or temperature of food) as well as a variety of mealtime problem behaviors (e.g., food refusal, aggression, and self-injurious behaviors). The feeding practices and parenting stress of parents of children with ASD, feeding disorders, or with typical development are not commonly studied in relation to each other. Several studies have found that parents may vary how they feed their child based on certain characteristics or behaviors of their child. For example, parent feeding practices such as providing specially tailored meals (e.g., pureeing foods, serving semi-liquid foods), providing preferred snack foods, being more controlling and coercive, providing a large variety of fruits and vegetables, using verbal positive persuasion, limiting snacks, or reducing fats were found to vary in relation to certain behaviors or characteristics of the child (e.g., having a texture sensitivity to food, feeding problems, or a diagnosis of ASD). Parents of children with developmental disabilities report helping and supervising during mealtime to be the most stressful parenting task. Further, parents of children with a diagnosis of ASD in combination with a behavior disorder report greater parenting stress than parents of children only diagnosed with an ASD, a behavior disorder, or who are typically developing.
Objectives: There is little research available examining how parent feeding practices may differ based on the interaction between characteristics/behaviors of the child and parenting stress experienced. Therefore, the purpose of the current study was to investigate differences in parent feeding practices based on parenting stress and child characteristics.
Methods: Variables were split into two levels based on respective grand means or clinical significance. Two-way factorial ANOVA's were used to analyze differences in 9 types of parent feeding practices based on interactions between different levels of parenting stress and characteristics of the child.
Results: Parents of children with and without an ASD with high sensory sensitivity to food were more likely to use verbal positive persuasion at mealtime ($p<.05$) compared to parents of children with low sensory sensitivity to food. Parents were more likely to provide many food choices and insist on eating if their child was typically developing compared to having a child with ASD ($p's<.05$). Several interaction effects were significant. For typically developing children, parents were more likely to limit snacks and reduce fats if their child had more mealtime problem behaviors. In contrast, parents of children with ASD were more likely to limit snacks or reduce fats if their child had less mealtime problem behavior ($p's<.05$).
Conclusions: Overall, it appears that parent feeding practices do differ based on level of parenting stress and certain characteristics of their child. Implications will be discussed.

35   **122.035** Parental Disclosure of a Child's Diagnosis of Autism Spectrum Disorder in the Emergency Department

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Background: Children and youth with autism spectrum disorder (ASD) regularly access a variety of medical services, including those in the emergency department (ED). Within the ED, parents are tasked with having to make decisions about if, how, and when to disclose their child's ASD diagnosis to a health care provider (HCP). This disclosure process deserves focus and attention to ensure that HCPs can both communicate and provide effective care to families.
Objectives: This is a sub-study of a larger study focused on examining the experiences of children and youth with ASD, their parents, and their HCPs when accessing, receiving, and providing care in two pediatric ED settings. The objective of this study was to examine the dynamics involved in parents' decisions to disclose a child's ASD diagnosis within the ED. Specifically, we aimed to understand the factors that motivated parents to disclose, those that hindered these decisions, and the perspectives of HCPs as related to disclosure.

Methods: Parents with a child with ASD were recruited for the larger study upon visiting the ED in two paediatric acute healthcare settings. Parents (*n*=29), children (*n*=4), and their HCPs (*n*=22) were interviewed. Parents also completed measures of their child's adaptive functioning and social communication impairments. Participants reported on their experiences in the ED and interview data were analyzed using a grounded theory approach. Reports on the disclosure process were analyzed.
Results: Findings from our qualitative analysis yielded three themes related to parental disclosure of an ASD diagnosis in the ED: (1) the decision to disclose or not disclose, (2) the transmission of the ASD diagnosis throughout the ED system, and (3) suggestions for improving the disclosure process. While all parents in the sample ultimately disclosed, some experienced a significant decision-making process prior to disclosing. Parents who were hesitant to disclose did not want to do it publicly and/or in front of their children; they wanted to avoid negative labels. These parents also described HCPs who lacked an understanding of ASD. Parents identified the desire for expedited service, the need to prepare staff, and the avoidance of unwarranted labels as being reasons for their disclosures. HCPs acknowledged the importance of knowing about a child's ASD diagnosis in the ED, and that discomfort in disclosing in front of their children as well as a fear of stigma could be barriers to disclosure for parents. Parents also reported inconsistent experiences with communication following a disclosure, with some needing to repeat disclosures to multiple HCPs. Finally, to improve the disclosure process, parents suggested using a child's file to alert HCPs to an ASD diagnosis and also encouraging staff to ask questions.
Conclusions: Results from this study reveal that disclosure within an ED setting is both layered and dynamic. Parents and HCPs agreed that disclosure of a child's needs allows for effective preparation and accommodation for families. However, it is clear that conveying this information is not always straightforward for parents. These results have important implications for how HCPs decide to approach the issue of disclosure with parents.

36   **122.036** Parental and Child Characteristics That Contribute to Parental Concerns in Toddlers at High Risk for Autism Spectrum Disorder over Time

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Background: Parents of children with ASD commonly report concerns about their child's behavior or development before their child's second birthday (Baghdadli et al., 2003). These concerns correspond with clinical measures (McMahon et al., 2007), and may help identify children who may benefit from early intervention. However, less is known about the relative contribution of parent and child factors on the presence of concerns at different ages, especially in families who already have one child with ASD.
Objectives: To examine the extent to which parent well-being, child expressive language vocabulary (EL), and child social-communicative skills (SCS) contribute to parent concerns about their high-risk (HR) toddlers within the first 2 years of life.
Methods: Parents and HR toddlers (n=54 dyads) were part of a prospective multi-site study that assessed toddlers at multiple time points from 6-36 months. This study includes data from 18- and 24-month old visits. At both visits, parents completed the Parent Concerns Form, a 7-item questionnaire that probes for concerns in 7 behavioral domains. Scores were dichotomized to reflect "concerns" or "no concerns" at 18 and 24 months. All other measures were collected at the 18-month visit only. Parental well-being was based on aggregated scores from the Parenting Stress Index-Short Form (Abidin, 1990) and the Maternal Self Efficacy Scale (Teti & Gelfand, 1991). Child EL was measured using the "Understands and Says" subscale of the MacArthur Communicative Development Inventories (Fenson et al., 2007). Child SCS were assessed using the total score of the Screening Tool for Autism in Toddlers (Stone et al., 2008).
Results: Overall, 67% of parents expressed concerns about their child's development at 18 months (n=36) and 50% at 24 months (n=27). Logistic regression analyses were used to examine whether 18-month measures of parental well-being, child SCS and child EL increased the likelihood of parent concern measured concurrently (at 18 months) and predictively (at 24 months). Results revealed that parent concerns at 18 months were predicted by lower levels of parental well-being (OR=1.21, p<.01) and lower levels of child EL (OR=.98, p<.05). Parent concerns at 24 months were predicted by lower levels of parental well-being (OR=1.17, p<.01) and lower levels of child SCS (OR=6.02, p<.01).
Conclusions: This study revealed two important findings related to the concerns of parents of HR toddlers. First, parental well-being was found to influence parents' concerns about their child's development both concurrently and predictively. These results emphasize the importance of considering how elevated stress and/or self-perceptions of parenting competence may influence their evaluation of their toddler's development. Second, different aspects of child behavior appeared to influence parent concerns at different ages, with expressive language vocabulary contributing to concerns at 18 months and social-communication behaviors exerting more influence at 24 months. Expressive language may be more salient at younger ages because of the availability of common language milestones. In contrast, more subtle social-communication deficits such as imitation, play and joint attention may be more difficult for parents to recognize or detect until a bit later in development.

37   **122.037** Parenting Teenagers with an Autism Spectrum Disorder before and after the Transition to Secondary School

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Background: In parenting, we can distinguish three main components: parenting behaviours, perceptions and cognitions. There is a growing number of studies investigating parental perception and cognition in parents with a child with an Autism Spectrum Disorder (ASD). However the number of studies investigating parenting behaviour is scarce, particularly for the target group, teenagers.

Objectives: We conducted an exploratory, qualitative study on parenting behaviour in parents raising a teenager with ASD. The first objective of this study was to conceptualise parenting behaviours among these parents. Secondly, we aimed to explore the potential relation between parenting behaviour and parental perception and cognition. Lastly, the influence of the transition to secondary school of the child on parental behaviour was examined.

Methods: Seventeen in-depth, semi-structured interviews were conducted with the mother, father or both parents of teenagers diagnosed with an ASD, within one year before or after the transition from primary to secondary school. A self-constructed interview covering the different components of parenting (parental behaviour, parental perception and parental cognition) was used. The interviews lasted between 70 and 130 minutes.

All interviews were transcribed and double coded. We used a hybrid deductive-inductive approach to analysis. An initial codebook was developed, based on an extensive study of the literature. New codes were inductively generated for findings that could not be classified in the predefined codebook. Constant comparative method was used to guide the analytic process. We conducted a member check to increase the validity of the findings.

Results: The main themes of parenting behaviour were warmth, control, stimulating the development and adapting the environment to the needs of the teenager with ASD. Within the main themes, several categories were discriminated. Categories within parental warmth were positive affect and time spent together. Within parental control, four categories were distinguished: pro-active control, rule setting, reaction on problem behaviour and reaction on positive behaviour. Autonomy-support and stimulating the abilities were categories of stimulating the development. Within adapting the environment, no further categories were discriminated. The reported behaviours within each category were very diverse.

By case-ordering the parents on which parenting behaviour they reported most, three different patterns could be noted. Four parents focused mostly on controlling the teenager, six parents on parental warmth and seven on stimulating the teenager. These patterns were related to the parental perception and cognition, such as reported child characteristics, wishes for the future and parental stress.

Only parents of children in primary school reported control as being the main focus of parenting behaviour. The two other groups included both parents of children in primary and secondary school. This suggests that parental control decreases with increasing child age, while stimulating and warmth are becoming increasingly important.

Conclusions: Using a qualitative design, different patterns of parenting behaviour could be distinguished. These patterns appeared to be related to parental perceptions and cognitions and to the age of the child. Based on the findings of this study, we suggest to further explore the relation between parental behaviours and their perceptions and cognitions using a more controlled design.

38 **122.038** Peer Responses to Mild Social Digressions By College Students Labelled with Autism Spectrum Disorder or Asperger Syndrome

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Background:
The 1990s saw a marked increase in the number of people diagnosed with an Autism Spectrum Disorder (ASD). This group is now reaching the age of going to university, and many people with an ASD express a strong desire to do so. While people with ASD can perform well at university, one impediment to academic and social success for students with ASD is peer attitudes and many people with ASD are reluctant to disclose their disability for fear of negative attitudes from peers. However failure to disclose diagnosis at university prevents potential support being put in place for college students on the autism spectrum. Societal issues such as stigma are under-researched within the ASD literature, although there is some evidence to suggest children are less accepting of a peer with ASD than a typically developing peer. However, for young adults at university, there is evidence that college students have a more positive attitude towards someone performing mild social digressions when the person is labelled 'High Functioning Autism (HFA)' than when they are labelled a typical student.

Objectives:
1) Do college students respond differently to those with a clinical label compared to typical students?
2) Do college students respond differently to an Asperger Syndrome label compared to an Autism Spectrum Disorder label?
3) Does knowledge of ASD impact upon these responses?

Methods:
120 college students (M = 55, F = 65) completed the PANAS assessment of positive and negative

emotional response to two scenarios: one containing a protagonist described as a typical student and one containing a protagonist described as having a clinical diagnosis (order rotated). The clinical diagnoses were either Autism Spectrum Disorder or Asperger Syndrome (or Schizophrenia as a control).

Results:

College students had a significantly more positive and significantly less negative emotional response to examples of mild social digressions when the protagonist was labelled with a clinical diagnosis then when the protagonist was labelled a typical student. This effect was comparable for all clinical labels (Asperger Syndrome or Autism Spectrum disorder or Schizophrenia) and level of prior experience with the autism continuum did not impact upon the results.

Conclusions:

The results suggest that, within a university context, peers are more accepting of those with a diagnostic label from the autistic continuum. This contrasts with research from younger age groups, and this negative experience at a younger age may underpin reluctance to disclose diagnosis at university. However, the findings are consistent with the advice of most university disability services that disclosure of diagnosis is to be encouraged. In addition, the nature of the label did not impact upon the effect, suggesting that an ASD label is not perceived differently from an Asperger Syndrome label (within a University context).

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39 **122.039** Psychosocial Adjustment and Sibling Relationships in Siblings of Children with Autism Spectrum Disorder: Risk and Protective Factors

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Background: Recent research has recognized the variability in outcomes for siblings of children with autism spectrum disorder (ASD). Given this variability, focus has shifted to identifying individual and family factors that may place some siblings at higher risk for experiencing psychosocial difficulties. Several recent studies have found support for a diathesis-stress conceptualization of sibling psychosocial difficulties. In this model, sibling broader autism phenotype (BAP) characteristics interact with family stressors to predict sibling difficulties. However, previous studies have used very small samples and have not examined the impact of these factors on the sibling relationship.

Objectives: This study aimed to investigate demographic factors (e.g., gender, birth order), sibling characteristics (e.g., BAP), and family stressors (maternal depression, child impact on family) in siblings of children with ASD (ASD-Sibs) and siblings of children with typical development (TD-Sibs) to identify risk and protective factors related to sibling behavioral and emotional adjustment and sibling relationship quality.

Methods: Mothers of ASD-Sibs (n=69) and TD-Sibs (n=93) completed online questionnaires about family demographics, sibling behavioral and emotional difficulties, sibling relationship quality, impact of the child on the family, and their own depressive symptoms. Sibling behavioral and emotional difficulties and sibling relationship quality were compared across groups. In addition, a series of MANOVAs and regression analyses were used to examine demographic and family factors that might predict which siblings were at higher risk for behavioral and emotional difficulties or poor sibling relationship quality.

Results: ASD-Sibs and TD-sibs demonstrated similar emotional and behavioral adjustment overall. ASD-Sibs demonstrated higher levels of prosocial behaviors compared to TD-Sibs. However, older brothers of children with ASD were at increased risk for difficulties compared to other groups of siblings. Sibling relationships of ASD-Sibs did not differ in overall level of positive or negative relationship behaviors. However, subscale-level patterns did differ between groups. Sibling relationships in ASD-Sibs involved less aggression, but also less involvement and more avoidance than those of TD-Sibs. Partial support for a diathesis-stress conceptualization of sibling difficulties was found for ASD-Sibs only. For TD-Sibs, broader autism phenotype (BAP) was related to psychosocial difficulties regardless of family stressors. For ASD-Sibs, BAP was related to psychosocial problems only when family stressors were also present.

Conclusions: These findings suggest that overall level of behavioral and emotional problems and sibling relationship quality is similar in ASD-Sibs and TD-Sibs. However, sibling relationship patterns may be qualitatively different in siblings of children with ASD. In addition, older brothers of children with ASD may be at increased risk for psychosocial difficulties. Finally, sibling broader autism phenotype characteristics were related to sibling adjustment and relationship difficulties. However, in the absence of additional family stressors, having a sibling with ASD appeared to confer a protective effect that reduced the negative impact of these BAP characteristics for the siblings. The researchers hypothesize that parents of children with ASD may have developed strategies for effectively coping with these characteristics in siblings due to their experience parenting their child with ASD.

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40 **122.040** Questioning, Directing, and Commenting: Parent-Child Talk in Autism

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Background: Parent-child interactions are an important influence on children's language

development. Several studies have established that parents of children with autism interact with their children differently than parents of typically developing children (Kasari, Sigman, Mundy, & Yirmiya, 1988; Lemanek, Stone, & Fishel, 1993; Doussard-Roosevelt, Joe, Bazhenova, & Porges, 2003). However, there has been less focus on how parents communicate with their children in relation to their child's individual characteristics.

Objectives: The purpose of this study was to examine the association between parent language use and child's baseline characteristics (i.e., receptive and expressive language abilities) in minimally verbal preschoolers diagnosed with ASD.

Methods: This study is a secondary analysis of an ongoing randomized controlled trial targeting social communication in minimally verbal preschoolers (1R01 MH084864, Kasari, et al). The sample consisted of 59 parent-child dyads from the greater Los Angeles area. All children had a diagnosis of ASD and used less than 30 functional words across behavioral assessments. Each parent-child dyad completed a 10-minute free play assessment using a standardized set of toys. These videotaped assessments conducted prior to beginning the randomized controlled intervention study were frequency coded for the following types of parent language: 1) test questions, which have known answers; 2) directives, which are direct instructions to the child, and 3) comments, which include statements that convey information about events or objects within shared attentional focus. Types of parent language were converted to proportions and were then analyzed for correlations with child's baseline language abilities.

Results: Overall, parents used a higher proportion of directives (41%) than comments (28%) and questions (19%). Parent questions were associated with children who had higher baseline language skills from the Mullen Scales of Early Learning (receptive: $r_s = .528$, $p < 0.05$; expressive: $r_s = .623$, $p < 0.05$). Conversely, parent directives were negatively correlated with child expressive language ($r_s = -.337$, $p < 0.05$). Parent comments were not related with child language level; however, they were negatively correlated with parent directives ($r_s = -.673$, $p < 0.05$).

Conclusions: These results suggest that parent language use is related to child's language ability. As language is often an intervention target for minimally verbal children, understanding the baseline relationship between parent and child language may be important especially within the context of parent training. Further research is warranted to determine if parent training will modify the proportions of parent talk and if parent comments will also be related to child language ability when provided with training.

41 **122.041** Raising a Child with Autism: A Developmental Perspective on Parental Adaptation

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Background: While raising a child with an Autism Spectrum Disorder (ASD) is known to produce chronic stress and strain on families, positive family outcomes are also evident. Past research has supported the utility of the Double ABCX model of family adaptation in understanding the experience of parents raising a child with ASD. To date, this model has supported the unique prediction of child related stressors and specific coping strategies on mainly negative maternal outcomes. While the experience of fathers has recently been considered, what remains unclear is the impact of family-related variables on positive as well as negative outcomes in both mothers and fathers within the same family.

Objectives: We sought to provide a coherent understanding of the role of child age and parental gender on family outcomes by charting the trajectory of family stress and coping associated with raising a child with autism. Our objective was to investigate the potential predictors of both maternal and paternal stress and family quality of life in an Australian sample of parents of children with ASD.

Methods: Participants were 196 parents of children aged 3 to 16 years. Using a cross-sectional design, these 98 parental dyads (mother-father matched pairs) of children across four key stages of childhood (preschool, early school years, middle school, early high school) completed questionnaires assessing factors within the Double ABCX model attributed to family adaptation. The questionnaires assessed child behaviour, family functioning, social support, family appraisal and coping strategies including the outcome variables of family quality of life and parental and life stress.

Results: The results revealed that mothers were more stressed than fathers and also reported poorer family quality of life. While parents of older children reported significantly less support from professionals than parents of younger children, no differences were found between parental reports on measures of family outcomes across the four child age cohorts. This was despite a significant increase in child internalizing behaviour between early and middle school years.

Conclusions: The findings support previous research suggesting that time spent caring for a child with ASD has a strong predictive impact on parental stress and coping. They also confirm the negative impact of child externalising behaviours on parent perceptions of FQoL. Importantly, the findings highlight the importance of family sense of coherence on positive parental outcomes. Parents appear to demonstrate stable levels of coping and stress despite fluctuations in child behaviour, indicating that factors other than support and family functioning investigated in the current study (i.e., locus of control) may play an important role in family adaptation. Study implications for future research, including the identification of protective and risk factors for family adaptation, are discussed.

122.042 Rural Parents' Knowledge of Autism and Child Development

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Background:
Literature suggests that children in rural areas and from poorer households receive diagnoses 5 to 8 months later than those in urban and middle class homes (Mandell et al., 2005) and these families have limited to no accessibility to trained professionals specializing in autism (Stahmer, 2007) as well as limited accessibility to reliable information about autism (Peacock et al., 2012). Parents play a critical role in the early identification process by relaying developmental information and concerns to their physician (Woods & Wetherby, 2003). However, very little is known regarding rural parents' general knowledge about autism and child development, which limits the development of appropriate dissemination materials.

Objectives:
To obtain a baseline measure of rural parents' knowledge about autism and child development.

Methods:
Rural primary caregivers of children under 6 years of age who live in a rural area as designated by the 2010 US Census Bureau (under 2,500 people) were invited to complete a 20-question survey via Qualtrics online survey software. Participants are recruited through their local community events such as holiday festivals and school events. Researchers also distributed CDC Learn the Signs-Act Early Alabama program handouts to participants.

Results:
Thus far, 57 surveys have been collected and analyzed. Recruitment is ongoing to achieve a proposed sample size of 500. Theme analysis will be completed on open-ended survey questions such as "What do you think causes autism?". Descriptive data will be presented on multiple choice survey questions. Preliminary analyses on a small sample of questions are presented here. Eighty-nine percent of rural parents felt that early intervention could improve autism symptoms. Eleven percent thought that autism runs in families; 42 percent thought it does not run in families, and the remaining respondents were unsure. Regarding development, eighty-six percent indicated that children could learn language skills through play and 90 percent thought that talking to children helps them learn language. When parents were asked at what age autism can be diagnosed, responses ranged from birth to early school age. When asked whom they should contact with concerns about their child's development, only 44 percent would contact their physician. Other responses included "DHR," "a child development center" and "a friend who is a doctor." Finally, when asked what behaviors were characteristic of autism, only twenty-five percent indicated diagnostic symptoms related to social interaction, communication or repetitive behavior (DSM-V, APA, 2013). Other responses included, "hyper," "get really annoyed," "no emotion," "smart," loner" and "great in math." Additional data collected prior to the 2015 IMFAR annual meeting will also be presented.

Conclusions:
Based on preliminary analysis in this limited sample, parents seem more knowledgeable about certain areas of development (age of first words) and autism (age of diagnosis) than others (symptoms of autism). Yudell et al. (2012) suggested that novel and culturally sensitive materials regarding autism should be developed for underserved communities. This project is an important first step to meeting this need as results could directly inform dissemination research efforts, thereby improving the accessibility and quality of care available to rural families.

122.043 Severity of Child Autistic and Comorbid Symptoms, Parent Mental Health and Parenting Behaviors

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Background: Families with children with developmental disorders face unique challenges. Several studies have reported an association between the severity of autistic symptoms and mental health problems among parents (Kasari & Sigman, 1997; Hastings & Johnson, 2001). Some authors have argued that externalized problems are the most important predictors of parental stress in the context of children with disabilities, including ASD (Baker et al., 2002; Lecavalier, Leone, & Wiltz, 2006). To date, the majority of previous studies on parental stress have been conducted in Western countries. Almost no studies examining the mental health of parents with children who have ASD have been conducted in Asian countries. Furthermore, previous studies have not addressed parental stress as a potential mediator in the relationship between severity of symptoms and parenting behavior.
Objectives: The present study examined the effects of children's autistic (social communication and restricted interests) and comorbid symptoms (inattention/hyperactivity, sensory symptoms, anxiety/depression, and conduct problems) on parent mental health in Japan. In addition, we tested whether or not parental stress mediates the relationship between severity of child symptoms and parenting behavior (positive and negative parenting).
Methods: The participants were the parents of 778 children and adolescents with ASD (572 boys; M age = 10.6, SD = 3.5, range 3-18). The following questionnaire scales were used: the Autism

Spectrum Screening Questionnaire (ASSQ; Ehlers, Gillberg, & Wing, 1999) for ASD symptoms, the ADHD Rating Scale-IV (ADHD-RS-IV; Du Paul et al., 1998) for inattention/hyperactivity, the Sensory Profile (SP; Dunn, 1999) for sensory symptoms, the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) for anxiety/depression and conduct problems, the General Health Questionnaire (GHQ; Goldberg & Williams, 1970) for parent mental health, and the Positive and Negative Parenting Scale (PNPS; Ito, 2014) for parenting behaviors.

Results: Path analysis revealed that parent mental health was significantly predicted by child autistic symptoms, sensory symptoms, and anxiety/depression. Parent mental health, in turn, showed a negative relationship with positive parenting and a positive relationship with negative parenting. Thus, there is evidence that parent mental health serves as a mediating factor between child symptoms and parenting behaviors. In addition, some child symptoms had a direct effect on parenting behavior.

Conclusions:
First, the results suggest that parent mental health is more greatly affected by relatively passive symptoms, such as autistic symptoms, sensory symptoms, and anxiety/depression, in comparison to active symptoms, such as inattention/hyperactivity and conduct problems. This finding is not consistent with those of previous studies in Western countries that found externalized behaviors to be the central factor in the prediction of parental stress. This incongruence may be explained by cultural or ethnic differences. Second, the results provide evidence that parent mental health partially mediates the relationship between child symptoms and parenting behaviors. This may partly explain how negative spirals are created in families with children with ASD.

44   **122.044** Silver Linings: Optimism and Positivity As Buffers of Stress and Lower Well-Being in Mothers of Adolescents with ASD

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Background:
There is considerable evidence that dispositional optimism is beneficial to one's health (Carver et al., 2010; Peterson, 2000) and helps maintain positive parenting and a positive outlook during adverse times (Taylor et al., 2010). Specific to mothers of children with ASD or disabilities, maternal optimism relates to increased positive affect, decreased negative affect, and more adaptive coping strategies (Blacher et al., 2013). However, 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/or a mental disorder.

Objectives:
This paper explores the role of optimism and positive perceptions in mothers of teens: (1) Do mothers' optimism and/or positive perceptions relate to disability status (ASD, intellectual disability (ID) and typical development (TD)? (2) Do optimism and/or positivity buffer the increased stress and psychological difficulties experienced by mothers of youth presenting varying levels of risk?

Methods:
This research is drawn from the Collaborative Family Study, a 15-year longitudinal study of mental disorders in children with or without ID/ASD. We report findings from the age 13 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 problems/mental disorders was the Child Behavior Checklist. Measures included the Family Impact Questionnaire (FIQ) Positive and Negative sub-scales; Symptom Checklist (SCL-36); and Life Orientation Test (LOT). 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. While dispositional optimism is supposed to be independent of what life offers up, here, mothers' optimism was modestly (but significantly, *p*=.04) related to group status, even controlling for SES (TD>ID>ASD). On the other hand, perceived positive impact of the child on the family did not differ significantly by diagnostic group. Moreover, the presence or absence of co-morbid 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, but also were higher for mothers with lower optimism, especially at the high-risk levels. Optimism did not make a difference for at "low-risk" mothers, but at "high-risk" mothers with low optimism (pessimism) reported a greater than 2.5 times increase in psychological symptoms. Similar analyses with other well-being measures will be considered.

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. Perceived positive impact of the child has a similar buffering effect. In short, not all parents are impacted similarly by youth disability and/or problem behaviors. There is a silver lining for those who maintain more positive perceptions.

45   **122.045** Social Support As a Protective Factor for Typically-Developing Siblings in the Presence of

Parental Stress: A Moderated Mediation Model

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Background: Typically-developing (TD) siblings of individuals with ASD may be at greater risk for negative outcomes due to a variety of factors, including symptom severity in siblings with ASD and elevated parental stress (Meadan et al., 2010). However, variability in sibling adjustment suggests that protective factors, such as social support, may improve TD sibling resilience (Armstong et al., 2005). Unfortunately, the ways in which these factors interact to predict TD sibling outcomes remain poorly understood.

Objectives: This study sought to examine social support as a possible buffer against TD sibling maladjustment within a moderated mediation model. It was predicted that the indirect effect of symptom severity in siblings with ASD on maladjustment in TD siblings through parental stress would be moderated by TD sibling perceptions of social support. Finally, exploratory analyses were conducted examining TD sibling maladjustment as predicted by social support subtypes.

Methods: Participants included 113 parents and TD siblings [ages 11 to 17 ($M = 13.34$, $SD = 1.81$)] of a child with ASD [ages 3 to 17 ($M = 12.03$, $SD = 3.28$)]. Parents completed two Strength and Difficulties Questionnaires (SDQ; one on each child) to assess general emotional and behavioral functioning, the Children's Social Behavior Questionnaire about the child with ASD to assess ASD symptom severity, and the Questionnaire on Resources and Stress – Short Form about themselves to assess parental stress. TD siblings self-reported via the SDQ to assess their own functioning and the Child and Adolescent Social Support Scale to assess their perceived social support.

Results: Conditional (based on TD sibling social support) indirect effects of ASD symptom severity on TD sibling maladjustment through parental stress were examined using bootstrapping analytical methods to estimate a bias-corrected asymmetric confidence interval of the indirect effects via "PROCESS," a computational tool for SPSS (Hayes, 2013). The plotted significant interaction between parental stress and TD sibling social support shows that TD sibling social support is a protective factor in the presence of high parental stress (Figure 1). Furthermore, parental stress was more likely to mediate the relation between ASD symptom severity in siblings with ASD and TD sibling maladjustment when TD sibling social support was high, specifically leading to lower maladjustment under the high social support condition (Table 1). Additionally, parent- and self-reported TD sibling maladjustment were separately regressed onto TD sibling social support subtypes as simultaneous predictors after controlling for ASD symptom severity and parental stress. Support from classmates ($\beta = -.35$, $p = .01$) and close friends ($\beta = -.21$, $p = .03$) uniquely predicted parent-reported TD sibling maladjustment, whereas support from parents ($\beta = -.24$, $p = .02$) and classmates ($\beta = -.36$, $p = .01$) uniquely predicted self-reported TD sibling maladjustment.

Conclusions: TD sibling social support moderated the mediational relation among ASD symptom severity, parental stress, and TD sibling maladjustment. Results show the importance of social support in reducing TD sibling maladjustment when ASD symptoms and elevated parental stress are present and underscore the importance of considering multiple raters when assessing social support subtypes.

46 **122.046** Stability and Change of Insightfulness Among Mothers of Children with Autism Spectrum Disorder

ABSTRACT WITHDRAWN

Background: A recent clinical trial of a parent-mediated intervention targeting responsive parental communication (Siller et al., 2013) revealed a conditional treatment effect, suggesting that baseline measures of maternal insightfulness moderate the intervention's efficacy. Mothers who were better able to discuss their child's thoughts and emotions in a complex, nuanced, and accepting way showed larger treatment-related gains in responsive parental behaviors than mothers who were less insightful at baseline.

Objectives: To investigate stability and change across two repeated measures of maternal insightfulness among mothers in the control group of a clinical trial.

Methods: The sample included 34 mothers of children with ASD (chronological age: $M = 56$ months, $SD = 12$; expressive language age: $M = 15$ months, $SD = 8$) enrolled in the control group of a clinical trial (Siller et al., 2013). Participants completed a series of baseline assessments to evaluate child characteristics (e.g., Mullen Scales of Early Learning, ADOS). Measures of maternal insightfulness were administered twice over a period of 5 months ($M = 141$ days, $SD = 43$ days). Maternal insightfulness was evaluated using the Insightfulness Assessment (IA, Oppenheim & Koren-Karie, 2002), a semi-structured interview that asks parents to discuss their child's thoughts and feelings during a previously recorded video vignette. Interviews are coded on ten 9-point rating scales, including insight into the child's motives, flexibility of thought, and complexity in description of the child. Profiles of scores on the ten scales indicate one of three primary classifications: Positively Insightful (PI), One-Sided (OS), or Disengaged (DE). A composite score was calculated by averaging six highly correlated subscales ($r > 0.6$). Inter-rater agreement between two coders was established on the composites ($ICC = 0.77$) and classifications ($kappa = 0.82$) on 12 transcripts.

Results: At time 1, the mean composite scores of mothers classified as PI ($n = 11$), OS ($n = 13$), and DE ($n = 9$) were 6.0 ($SD = 0.7$), 3.5 ($SD = 0.7$) and 2.7 ($SD = .5$), respectively. At time 2, the composite scores of mothers classified as PI ($n = 6$), OS ($n = 12$); and DE ($n = 12$) were 5.3 ($SD = $

1.6), 3.3 (*SD* = .7), and 3.1 (*SD* = 1.5), respectively. To evaluate the stability of individual differences in the insightfulness composite scores, we computed an Intraclass Correlation Coefficient (*ICC* = 0.72, *p* < 0.01). Although the percentage of mothers classified as PI decreased over time (33% and 20% at time 1 and 2), a chi-square test revealed that this change was not statistically significant, $x^2(1)$ = 3.54, ns. Similarly, paired sample t-tests revealed no significant difference in composite scores between time 1 and 2, *t* (25) = .79, ns.

Conclusions: Individual differences in maternal insightfulness appear to be relatively stable, with 72% of the variance in insightfulness composite scores at time 2 being predicted by baseline measures of insightfulness. We found no evidence to support that maternal insightfulness increases over time. There is a need to investigate the potential for responsiveness-based interventions to nurture maternal insightfulness.

47 **122.047** Stakeholder Perspectives on the Inclusion of Secondary Students with Autism Spectrum Disorder: Challenges and Support Needs

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Background: As the prevalence of Autism Spectrum Disorder (ASD) is increasing, some studies have found that the majority of individuals with ASD are without comorbid intellectual disability (ID; CDC, 2014; Kim et al., 2011). This means that high schools are serving a growing number of students with ASD in inclusion classrooms charged with preparing them for the postsecondary environment. Taylor and Seltzer (2011) described this subgroup of students with ASD without ID as "falling through the cracks" as they may not be eligible for the same transition services as their peers with ID who often participate in a more career and life skills focused curriculum. Consequentially many students with ASD are unprepared as they move from high school to the post-school environment (Chiang et al, 2012, Gerhardt & Lanier, 2011). The financial implications, according to a cost analysis for the United States, is $35 billion in direct and indirect costs across the lifespan for individuals with ASD who do not achieve independence (Ganz, 2007). The cost to families and the individuals themselves in terms of quality of life are more difficult to assess.

Objectives: Little is known about the experiences of adolescents with ASD in the inclusion classroom as they prepare for life after high school. Gathering and acknowledging the perspectives of stakeholders involved in the education of high school students with ASD is essential to implementing effective interventions to meet their needs and ultimately to provide more promising outcomes. This study explores stakeholder perspectives of the experiences of high school students with ASD in the inclusion classroom. It is guided by the following research question: How are high schools supporting students with ASD in the inclusion classroom to improve their outcomes?

Methods: This study uses focus group data gathered across multiple stakeholders (i.e. family members, adolescents and young adults with ASD, educators, administrators, community members, and, service providers). A total of 28 focus groups were held in 4 states (North Carolina, Tennessee, Texas, and Wisconsin) and included 152 participants. Parents and teachers represented the largest groups (n=47 and n=45 respectively), and individuals on the spectrum the smallest (n=6). Data was analyzed through a process of coding, categorizing, and theme development using NVivo 10 software.

Results: Three distinct themes emerged from the analysis of the data: (1) the need for whole school autism awareness (e.g. students, teachers, resource officers, bus drivers), (2) better implementation of the Individualized Education Program (IEP) in all classes, and, (3) more attention to the social and communication needs of students with ASD.

Conclusions: The successful transition to adulthood is particularly challenging for students with ASD without ID as they may not receive appropriate transition services during high school. Preparing students with ASD without ID to meet the academic requirements for post-secondary success may not be sufficient to meet all the challenges they will face once they leave high school. It is critical that social-communication needs be addressed not just in IEPs but also actively throughout the day in all classrooms and environments.

48 **122.048** The Cost of Autism Spectrum Disorders

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Background: A diagnosis of an autism spectrum disorders is usually associated with substantial lifetime costs to an individual, their family and the community. However, there remains an elusive factor in any cost-benefit analysis of ASD diagnosis, namely the cost of not obtaining a diagnosis. Given the infeasibility of estimating the costs of a population that, by its nature, is inaccessible.

Objectives: The current study compares expenses between families whose children received a formal ASD diagnosis immediately upon suspecting developmental atypicality and seeking advice, with families that experienced a delay between first suspicion and formal diagnosis.

Methods: A register based questionnaire study covering all families with a child with ASD in Western Australia. Families with one or more children diagnosed with an ASD, totalling 521 children diagnosed with an ASD; 317 records were able to be included in the final analysis.

Results: The median family cost of ASD was estimated to be AUD $34,900 per annum with almost 90% of the sum ($29,200) due to loss of income from employment. For each additional symptom reported, approximately $1,400 cost for the family per annum was added. While there was little direct influence on costs associated with a delay in the diagnosis, the delay was associated with a modest increase in

the number of ASD symptoms, indirectly impacting the cost of ASD.

Conclusions: A delay in diagnosis was associated with an indirect increased financial burden to families. Early and appropriate access to early intervention is known to improve a child's long-term outcomes and reduce lifetime costs to the individual, family and society. Consequently, a per symptom dollar value may assist in allocation of individualised funding amounts for interventions rather than a nominal amount allocated to all children below a certain age, regardless of symptom presentation, as is the case in Western Australia.

49   **122.049** The Impact of Children with and without Developmental Disabilities on Relationship Satisfaction and the Parenting Alliance

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Background: Studies have shown that parents of children with ASD report greater negative impact of the child on family adaptation including financial stability, sibling relationships, and parents' social lives than parents of children with other chronic problems (e.g., Down syndrome, ADHD, ODD). Parents of children with ASD also report increased marital discord and parent stress. Currently there are no studies examining differences in parent perceptions of child impact and how this factor may influence parental relationships, particularly parents' spousal relationships and agreement on co-parenting.

Objectives: One goal was to determine whether there were differences in mothers' report of positive and negative impacts of children with an autism spectrum disorder (ASD), Down syndrome (DS), and Typically Developing (TD) children, as well as differences in parenting agreement and marital satisfaction. An additional goal was to determine whether there were differences between the three diagnostic groups in the relationship between child impact, mothers' marital relationship, and parental alliance.

Methods: The total sample included 157 mothers including, 54 mothers of children with Down syndrome, 56 mothers of children with ASD, and 47 mothers of typically developing children. The children ranged in age from 3-9 years old (DS Mean = 4.87, SD = 1.62; ASD Mean = 6.37, SD = 1.8; TD Mean = 5.31, SD = 1.9); 99 were male and 57 were female. Mothers completed measures online that assessed child impact on the family, marital satisfaction, co-parenting alliance, and child symptom severity. All parents completed the questionnaires online through SurveyMonkey. Only participants who completed 90% or more of the questionnaires received a $20 Amazon.com gift card.

Results: After controlling for child sex and parent education, results showed that mothers of children with ASD reported greater negative impact, lower marital satisfaction, decreased parent alliance, and higher child symptomatology compared to both other groups. Contrary to past research, the DS group did not differ from the TD group on measures of marital satisfaction and parent alliance. Further, child impact negatively predicted marital satisfaction and parent alliance for the ASD group only.

Conclusions: This is the first study to examine differences in parent perceptions of child impact on the family, the marital relationship, and the parenting alliance across parents of children with ASD, DS, and TD children. This study further supports the importance of including parents (and the family) in treatment for children with ASD. Specifically, targeting parents' negative cognitions about their child in family-based interventions may be important for increasing family adaptation and resilience. Treatment considerations also include a focus on improving parenting and marital relationships as well as child behavior in order to improve quality of life for families of children with ASD.

50   **122.050** The Relation Between Parent Stress and Children's Communication Skills Following a Theatre-Based Intervention for Children with Autism Spectrum Disorder

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Background: It is well established that parents of children with autism spectrum disorder experience more stress than those with typically developing children or another disability. Further, previous studies demonstrate an inverse relation between children's adaptive behaviors and parental stress. Impairments in social communication appear particularly stressful. In the current study, parents rated their stress before and after their child participated in a social skills intervention, and likewise also rated their child's adaptive functioning skills pre- and post-intervention.

Objectives: This study evaluates the impact of a theatre-based, social skills intervention for children with ASD. The 10-session program incorporates theatrical approaches, trained typically developing peers, and established behavioral strategies with the aim of increasing children's social functioning. A primary objective of this investigation was to examine the impact of a child-focused intervention on parental stress, and further, whether parental stress is related to their child's functional outcomes.Methods:

Methods: Participants included 30 youth with ASD between 8 to 16 years randomly assigned to the Experimental treatment group (EXP, N = 17) and Wait-list control group (WLC, N = 13). Parent stress was measured using the Parenting Stress Index- Short Form. This version of the PSI is comprised of 36 items divided into 3 subscales: Parental Distress, Parent-Child Dysfunctional Interaction, and Difficult Child. It also includes a total parental stress score. Children's adaptive behavior, including

social, communication, home living, and self-care skills, was measured with the Adaptive Behavior Assessment System-II. Nonparametric, Independent Samples Mann-Whitney U Test was used in which the post-intervention score served as the outcome variable and group (EXP or WLC) as the main independent variable.

Results: Significant differences were observed between the EXP and the WLC groups on the PSI Parent Distress (PD) scale (p = 0.039). Significant differences were also observed between the EXP and WLC groups for the ABAS-II Communication scale (p = 0.039). Pearson correlations indicated a significant relation between parents' post-intervention total stress (PSI Total Score) and children's post-intervention communication skills (ABAS-II Communication), r = -.381, p = .038.

Conclusions: This study extends previous findings about the relation of parent stress to child characteristics of ASD within a novel, theatre-based intervention design. Specifically, the distress parents experienced (in their parental role) was significantly less for the EXP group parents whose children received the theatre-based social skills intervention as compared to the WLC parents. At the same time, children who participated in the intervention demonstrated a significant increase in their adaptive communication skills compared to the wait-list controls. The findings further suggest that stronger child communication skills are related to less parental overall stress. The importance of child-focused interventions for parent well-being is discussed.

51   **122.051** Understanding Student-Teacher Relationships Among Children with Autism: The Role of Parental Involvement and Child Behavior

ABSTRACT WITHDRAWN

Background:
Parents who engage in reinforcing learning activities at home and regularly attend parent child conferences are more likely to have children with favorable school outcomes (e.g., Hoover-Dempsey & Sandler, 1997). However it is not clear whether parent involvement is also related to student-teacher relationships (STRs) which – when warm, close or positive in typically developing (TD) children – are predictive of positive school outcomes (Hamre & Pianta, 2001). This study qualitatively analyzed the STR from the parents', as opposed to the teachers' perspectives, and determined how parental involvement in the child's education may relate to the STR for young children with autism.

Objectives:
(1) To understand how parents describe the student-teacher-relationship (STR); (2) To examine the relationship between parents' involvement in their child's education and the STR; and (3) To understand how child behavior problems and social skills relate to both the parent-teacher relationship (PTR) and the STR.

Methods:
Interviews were conducted with parents (N = 116; 89% mothers) of children with autism (M age = 5.7; M IQ = 87, WPSSI). A subset of 30 interviews were qualitatively analyzed to examine how parents described the STR. Researchers iteratively coded interviews to look for broad codes related to the STR; a confirmatory phase followed. The 30 interviews were coded by two researchers; mean kappa indicated 80% reliability. Correlations among the quantitative Parent Teacher Involvement Scale (PTIS), the Parent Teacher Relationship Scale (PTRS), related child characteristics, and the Student-Teacher Relationship Scale (STRS) were examined.

Results:
Preliminary results indicated that: **Q1:** Qualitative parent reports of poor STRs matched quantitative teacher reports of a poor STRS. Qualitative parent reports of positive and warm student-teacher relationships matched quantitative teacher reports of a warm STRS. **Q2:** Correlation analyses revealed a significant negative correlation between STRS and PTIS scores (r = -.18, p <.05). **Q3:** Higher levels of child internalizing behaviors (CBCL), as reported by parents, were related to less positive STRs (r = -.24, p <.01); lower levels of child social skills were related to less positive PTRs (r = -.20, p <.01). Surprisingly, the PTRS and the STRS were not correlated significantly.

Conclusions:
Qualitative parent reports of the STR mapped onto teacher-ratings: parents and teachers agreed on the level of positivity/warmth in the relationship between the child and his/her teacher. Correlational analyses indicated that more parent involvement related to lower STRS scores. Perhaps parents of children with more behavioral/social problems are in more constant contact with the teacher regarding how to deal with these challenges. Conceivably, these meetings might be contentious (i.e., parents of children with more behavioral challenges and fewer social skills encountered less warm relationships with the child's teacher). Consistent with previous studies (Sutherland et al., 2008) parent reports of children's internalizing behaviors (e.g., anxiety) were significantly related to poorer STRs. Implications for interventions with teachers, parents and early schooling will be discussed.

52   **122.052** Understanding and Reducing Endorsement of Stereotypes of Autism: An Intervention Using Counterstereotypic Exemplars

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Background:
There is currently a paucity of knowledge around societal issues relevant to autism. In particular, stakeholder groups are extremely dissatisfied with the lack of research on improving societal attitudes towards individuals with autism (Pellicano et al., 2014). Examination of media

representations suggests that a negative and inaccurate characterisation of autism is perpetuated (Jones & Harwood, 2009; Huws & Jones, 2011) and this is likely to influence societal stereotypes of individuals with autism. However, before research can evaluate potential interventions for changing public perceptions of autism, a greater understanding of the nature and contents of societal stereotypes of autism is needed.

Objectives:
This research aimed to evaluate (Study 1) and subsequently reduce (Study 2) endorsement of negative stereotypic traits associated with individuals with Autism Spectrum Conditions (ASC) via exposure to video clips of individuals who display characteristics that counter negative aspects of the autism stereotype (i.e., who are counterstereotypic) autism stereotype.

Methods:
Study 1: 298 volunteers completed an online survey; 164 did not have a family member or close friend with ASC, did not have ASC themselves and had lived in the UK for five years or more. Responses of these 164 individuals were analysed.
Study 2: Sixty-six undergraduate and post-graduate students were randomly allocated to either the experimental group or the control group. Participants in the experimental group watched video clips of five individuals who were counterstereotypic on 4-key traits identified in Study 1 – poor social skills, introverted and withdrawn, poor communication, difficult personality or behaviour. Participants in the control group watched video clips of wildlife programmes. Participants then rated their endorsement of the 10 most frequently reported traits associated with ASC identified in Study 1. Demand characteristics were avoided by presenting this phase as an ostensibly separate study, which was validated via a funnel de-brief.

Results:
Study 1: found that the societal stereotype of ASC was predominantly negative. The 10 most frequently reported traits, in order, were poor social skills; being introverted and withdrawn; poor communication; difficult personality or behaviour; poor emotional intelligence; special abilities; high intelligence; awkward; obsessive; low intelligence.
Study 2: found that exposure to counterstereotypic exemplars successfully reduced endorsement of the frequently reported negative stereotypic traits tackled by the intervention compared to participants in the control condition, though stereotype endorsement was not reduced for all stereotypic traits assessed.

Conclusions:
This study reports the content of the societal stereotype of individuals with ASC in the UK. General knowledge of the characteristics of ASD was poor; the only characteristic that could be identified by over half of respondents was poor social skills. We demonstrated that it is possible to tackle endorsement of negative stereotypic traits via exposure to individuals with ASC displaying counterstereotypic behaviour. In future it will be important to tackle endorsement of the entire range of stereotypic characteristics of ASC in order to reduce prejudice and improve attitudes towards group members. This will likely improve the life chances of those with ASC.

53 **122.053** Understanding and Sharing an Autism Spectrum Disorder Diagnosis: Perspectives of Diverse Families Participating in a Family Navigation Program

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Background: Caregivers express a range of responses and experiences following the diagnosis of autism spectrum disorder (ASD) in their child, including relief, stress, and perceived or enacted stigma. Few studies, however, have examined how families from immigrant, racial ethnic minority, or low-income backgrounds understand and disclose their child's diagnosis.
Objectives: The objectives of this analysis were to describe caregivers' understanding of their child's ASD diagnosis and what they told others about their child's difficulties. We explored patterns of understanding and disclosure in families participating in a Family Navigation program and a comparison usual care group, and across immigrant and U.S. born families.
Methods: This qualitative analysis included 155 families enrolled in a longitudinal, randomized controlled study of the impact of Family Navigation (R40 MC 19928-01, Augustyn, PI) on clinical (timeliness and adequacy of treatment received) and psychometric outcome. Participants were parents or legal guardians of the child and self-identified as the child's primary caregiver. Families were eligible if the child was younger than 8 years old and newly diagnosed with an ASD according to DSM-IV or DSM-5 criteria. Participants either received usual care or worked with a Family Navigator for 6 months. Data for this qualitative analysis included participant responses to two open ended questions at baseline and 6-month follow-up to *assess the understanding of the child's diagnosis*: (1) "When family or friends ask you what is the diagnosis your child has, what do you tell them?" and (2) "Can you explain what that word (s) means to you?" Qualitative content analysis using an inductive approach was used to analyze for emerging themes and patterns in the data, using open coding of the narrative responses and then using axial coding to identify patterns and relationships.
Results: Over half of the participant caregivers were immigrants (see Table 1). Across the entire sample, there was an increase in the number of caregivers who could report the clinical diagnosis between baseline and follow-up (65.1% ($n = 84$) vs. 85.3% ($n = 110$), $p < .000$). Among caregivers

born in the U.S., 77% could name their diagnosis at baseline compared to 95% at follow-up. Among caregivers born outside the U.S., 54% could name the diagnosis at baseline compared to 76% at follow-up. Four categories emerged in terms of to whom caregivers shared the ASD diagnosis: (1) Tell no-one, (2) Only close family and friends, (3) Very open to explaining the diagnosis, and (3) Never came up, no-one asks (see Table 2). Patterns of disclosure appeared to differ between immigrant and U.S. born caregivers, but not by participation in the Family Navigation program.
Conclusions: Family Navigator and other support programs at the time of diagnosis could provide training to support caregivers' understanding of the child's diagnosis and assist them with the disclosure process. The findings also have implications for culturally influenced perceptions of stigma in the disclosure process.

54 **122.054** Well-Being of Mothers of Preschoolers with Autism Is Mediated By Their Children's Treatment-Related Improvements in Every-Day Communication

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Background: Numerous studies have indicated that the behavior of children with autism poses unique challenges to parenting. As children's behavior and cognitive functioning are subject to change when suitable early intervention programs are put in place, it is plausible that positive treatment-related changes in the child will have a positive impact on parental well-being. To test this hypothesis we investigated whether maternal well-being is affected by the outcomes of children receiving intervention.
Objectives: Our aim was to evaluate whether treatment-related changes in children with autism (as well as other factors known to be linked to parental well-being) contribute to changes in maternal well-being from pre-intervention (baseline) to post intervention across three indexes – changes in Stress, Anxiety and Depression.
Methods: The participants comprised an Australian sample of 27 mothers (mean age = 36.11 years; SD = 5.65) of children diagnosed with ASD (confirmed with the Autism Diagnostic Observation Schedule; ADOS) who were enrolled at the Victorian Autism Specific Early Learning and Care Centre (ASELCC) in Melbourne, Australia. Mothers were asked to complete a demographic form and three questionnaires at pre- and post-intervention: the Depression Anxiety and Stress Scale to assess their well-being, the Parenting Sense of Competence to determine their satisfaction and self-efficacy in the parenting role and the Vineland Adaptive Behavior Scales II (VABS) to assess their children's adaptive behavior. Children were also administered the ADOS and the Mullen Scales of Early Learning (MSEL) pre- and post-intervention.
Results: We first determined which putative predictors at pre-intervention (VABS communication, daily living and social skills; MSEL verbal and non verbal developmental quotients (DQs); ADOS calibrated severity scores; mothers' age, SES, and parenting satisfaction and efficacy scores) moderate change by using repeated measure ANOVAs. Hierarchical multiple regression analyses were then conducted with the significant predictors to test their unique contribution to T2 well-being (controlling for T1 well-being). Different child and family factors including SES, mother's age, parental satisfaction and efficacy were linked to maternal well-being. However treatment-related changes in children's communication, as assessed on the VABS, contributed to variance in all maternal well-being variables (stress, anxiety and depression) above and beyond the other factors.
Conclusions: The findings highlight that rather than changes in cognitive functioning, it is improvements in everyday adaptive communication skills in children with ASD that impact on mothers' well-being.

55 **122.055** What Constitutes Autism Knowledge? Insights from Adults on the Autism Spectrum

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Background:
Despite growing recognition that autism research is more likely to be useful if autistic people and their family members are empowered participants in the process (e.g. Parsons, 2014; Robertson, 2010), a recent online survey revealed that autistic adults continue to feel that their voices are not heard (Pellicano et al., 2014). A key area wherein autistic people's voices remain unheard is in defining what constitutes "knowledge" about autism. Although "autism knowledge" has been assessed among many different types of people around the world (e.g. Helps et al., 1999; Khatri et al., 2011), it has not previously been purposefully examined among those for whom it is most relevant—autistic people. Discrepancies between needed and received information about autism may contribute to lower Quality of Life (QoL) in autism (Renty and Roeyers, 2006).
Objectives:
(1) Compare knowledge of and stigma toward autism among autistic adults (N=219), their nuclear family members (N=137), and the public (N=115); (2) Examine associations between knowledge,

stigma and QoL; (3) Evaluate potential effects of an online-training on knowledge and stigma.
Methods:
Participants were classified as autistic if they self-identified as autistic *and* exceeded the autism cut-off on the RAADS-14 (Eriksson et al., 2013). The pre-test/post-test included an adapted version of Stone's (1987) Autism Awareness Survey, a social distance scale assessing stigma (Bogardus, 1933), and an opportunity to define ASD. Open-ended definitions of ASD were coded by independent coders after they achieved reliability. Non-parametric tests were used. Except where *p*-values are stated, all reported results are significant at $p \leq .001$.
Results:
Autistic people (*M* = 18.53, *SD* = 4.73) had higher autism knowledge than the public (*M* = 14.88, *SD* = 6.04). Family members exhibited a trend toward heightened knowledge (*M* = 17.45, *SD* = 5.40) relative to the public (*p* = .002). Autistic people were more likely than the public to agree with statements that autistic people show affection and have empathy, and disagree that autistic people do not have attachments, that they can outgrow autism, and that they are violent. Autistic people's definitions of ASD more often were internal, opposed to the medical model and/or described autism as a neutral difference relative to the public's definitions.
Autistic people (*M* = 7.20, *SD* = 2.10) endorsed lower stigma toward autism than the public (*M* = 8.71, *SD* = 3.27). Family members exhibited a trend toward reduced stigma (*M* = 7.47, *SD* = 2.17) relative to the public (*p* = .002). Knowledge about autism correlated negatively with stigma across groups but neither knowledge nor stigma was associated with QoL (which was lowest among autistic participants). Participation in the training was associated with increases in knowledge for all groups.
Conclusions:
This study suggests that autistic people should be considered "autism experts" and be involved as empowered collaborators in the research process. Although knowledge is not yet power for many autistic people, identifying how autistic people view autism is a crucial first step toward developing research that is relevant to the interests/needs of those whom the research is supposed to serve.

Poster Session
123 - Interventions - Non-pharmacologic - Preschool
5:30 PM - 7:00 PM - Imperial Ballroom

56   **123.056** A Telehealth Approach to Parent Coaching in ASD

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Background: Many barriers exist to parents seeking early intervention for their child with ASD, including long waiting lists, costly services, and a shortage of specialist providers. The introduction and development of advanced technologies can provide supplements to current early intervention services. Telehealth is one mechanism that may support parents in their pursuit to help their child learn and access intervention resources sooner from home or other locations at any time of day.
Objectives: The study attempted to identify acceptable components of a telehealth parent coaching delivery model so as to better understand how this resource translates into viable practice for families with ASD. A randomized controlled trial of a telehealth coaching model to treatment-as-usual compared parents' intervention usage, program satisfaction, and online learning patterns. Children in both groups were expected to make gains so that the primary question remained about the feasibility and appropriateness of telehealth delivery to parents.
Methods: Parents received 12 weekly 1.5-hour video conferencing sessions and website access to self-guided learning resources of the parent coaching curriculum of the Early Start Denver Model (P-ESDM). The control group received monthly video conferencing sessions and website access to alternative intervention resources based on treatment-as-usual services. Parent-child interactions were recorded in real time across a six-month period to evaluate parents' fidelity with the P-ESDM, program satisfaction, and website engagement.
Results: Telehealth coaching facilitated greater fidelity gains, program satisfaction, and website usage for parents in the P-ESDM than control group at the end of 12 weeks and three-month follow-up. Increases in children's social-communication skills occurred for both groups.
Conclusions:
Findings suggest the feasibility of a telehealth approach to coaching parents with access to evidence-based intervention resources while waiting for other services to begin. However, not all technology options may be embraced by parents and/or lead to effective change in parent-child behaviors. Additional research must confirm the promise and utility of telehealth for increasing the availability and quality of parent-delivered interventions.

57   **123.057** Bayesian Meta-Analysis of Multiple Interventions and Outcomes for the Treatment of Autism Spectrum Disorder

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Chris Fonnesbeck, Zachary Warren, Amy Weitlauf, Nila Sathe, Melissa McPheeters

Background: Applied early intervention practices for young children with ASD often involve multi-component interventions (*e.g.*, speech-language intervention, developmental preschools, occupational therapies, involvement with ABA programs, etc.). Providers and parents are often required to make recommendations and choices regarding which components of interventions should be included as part of intervention both based on resource availability and scientific understanding of studied interventions. Unfortunately, few studies have directly compared the effects of well-controlled treatment approaches, instead comparing interventions in isolation or to non-specific "treatments as usual." Such comparisons provide insufficient resolution of which components of intervention primarily drive developmental progress, and at what rate.

Objectives: In the current work, we present a novel meta-analytic approach for understanding ASD interventions with the potential for discriminating amongst the components of treatment response across the range of intervention classes. Specifically, we present a network (or mixed treatment comparison) meta-analysis of multicomponent ASD interventions. Network meta-analysis is a generalization of standard meta-analysis to allow for the simultaneous evaluation of a set of treatments, rather than a simple pairwise comparison. By constructing a network of studies, this approach considers both direct evidence from studies that compare the same interventions as well as indirect evidence from studies that have one intervention in common, but not all. Including indirect evidence can improve the precision of meta-estimates relative to using only direct evidence by borrowing strength from the indirect comparisons. Indirect evidence can also serve to mitigate biases that may exist in direct comparisons.

Methods: We implemented a Bayesian mixed-effects model that accounts for multi-component interventions and the reporting of multiple outcomes in a unified framework. Critically, this allows individual studies to contribute partial information, and for missing quantities to be readily imputed or predicted.

Results: The meta-analysis included 19 independent studies (extracted from 2014 AHRQ report on behavioral interventions for ASD) comprising 27 different interventions (classified into 7 multicomponent treatment categories) that reported one or more of three IQ scores (verbal, nonverbal, composite) as outcomes. We estimated the most effective intervention to be high-intensity applied behavior analysis (ABA), with a median posterior effect size of 5.0 (95% Bayesian credible interval = [1.0, 8.8]) points. In contrast, eclectic school programs had a posterior mean effect of -6.0 (95% BCI [-10.5, -1.6]), while the effects of the remaining classes were equivocal.

Conclusions: Our approach is general and flexible enough to provide comparative effectiveness inference on a range of disorders for which there is a heterogeneous mixture of interventions that warrant comparison. This suggests that Bayesian mixed-effects modelling may represent an important methodology for understanding the large and confusing body of ASD intervention research.

58   **123.058** Brief Background of Parent Training in ASD

ABSTRACT WITHDRAWN

Background: Parent Training (PT) is an evidenced-based intervention for children with disruptive behavior uncomplicated by ASD, but it has not been systematically tested in children with ASD.

Objectives: The purpose of this presentation is to illustrate the line of research conducted by our multisite network over the past decade.

Methods: We briefly describe the design and results of our feasibility trials and the randomized trial of medication alone versus medication plus parent training.

Results: PT is acceptable to parents with attrition of 5 /33 (15%), session attendance rate of 88% in the first two feasibility trials. Therapists trained in the intervention for these pilot studies maintained over 90% fidelity to the manual. In a randomized trial of 124 school-age children, we showed that PT in combination with medication was superior to medication alone.

Conclusions: Feasibility trials are prerequisites to large-scale randomized trials to show that the intervention is acceptable to parents and that trained therapists can reliably deliver the intervention.

59   **123.059** Children with Autism Spectrum Disorder Accessing Early Intervention in the Autism and Developmental Disabilities Monitoring (ADDM) Network

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Background: Evidence-based treatments provided by Part C early intervention services, hereafter referred to as "EI," improve IQ, speech, and school performance for children with autism spectrum disorder (ASD). Best outcomes for these children are associated with early initiation of ASD-specific interventions. In the U.S., early ASD identification has been linked to sex, race/ethnicity,

developmental regression, and geographic location; however, little is known about characteristics of children with ASD receiving EI services. The CDC's Early Autism and Developmental Disabilities Monitoring Network (Early ADDM) identifies ASD among 4-year-old children. Two Early ADDM sites (New Jersey and Utah) collect information from EI, providing an opportunity to characterize children with ASD served by EI compared to those not.

Objectives: To describe the socioeconomic/demographic and diagnostic characteristics of children with ASD in two Early ADDM sites, comparing children who did and did not participate in EI services.

Methods: In surveillance year 2010, NJ and UT Early ADDM sites identified 4-year-old children with ASD using validated population-based, multi-source record review methods. Characteristics of children with ASD served by EI were compared with children with ASD not served by EI using chi-square and t-tests. Variables included sex, race/ethnicity, socioeconomic status (SES) indicators (parental ages and education duration at child's birth), presence of co-occurring intellectual disability (ID), attention deficit with hyperactivity disorder (ADHD), or seizures, regression history, previous ASD diagnosis by a qualified professional, and age at first ASD evaluation.

Results: NJ and UT Early ADDM sites identified 484 4-year-olds with ASD; 45% (N=218) participated in EI. A greater proportion of parents of children served by EI were >34 years old and had >13 years of education as compared with parents of children not served by EI (Table 1). Although no significant differences in race/ethnicity were detected between the two groups, a smaller proportion of children served by EI were White, non-Hispanic (36%) than those not served by EI (47%). No differences were detected in the frequency of co-occurring ID, ADHD, or seizures between children accessing and children not accessing EI. Children accessing EI were younger at first ASD evaluation (22.8 vs. 34.1 months, p<0.0001) and diagnosis (30.2 vs. 36.3 months, p<0.0001). Children served in EI were significantly more likely to have a final case status of autism (p<0.001).

Conclusions: Study findings suggest a link between higher SES and EI use; however, there appears to be some indication that the role of race and ethnicity should be further explored. Children accessing EI were not more likely to acquire a community-based ASD diagnosis by age four; however, as expected, they were more likely to have an evaluation and diagnosis at a significantly younger age than children without documented EI access. Toddlers with earlier evaluations and diagnoses have more time to qualify for and participate in birth-to-three EI programs. Although not a perfect severity metric, the co-occurrence of ID, ADHD, or seizures was not associated with EI participation. Additional exploration of the role of SES and other demographic factors in accessing universally-available EI programs for children with ASD is warranted.

60 **123.060** Comparing Two Parent-Implemented Interventions on Direct Observation of Joint Attention and Language of Preschool Children with Autism: A Pilot Study

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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. The efficacy and effectiveness of two popular approaches to autism treatment have not yet been evaluated as parent-implemented treatments. 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. In contrast, an Applied Behavior Analysis 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 on JA and language in children 2-6 year old with ASD in preparation for a larger randomized clinical trial.

Methods: Participants were 12 children diagnosed with autism spectrum disorder (ASD) by community providers and the Autism Diagnostic Observation Schedule-2™. Participants were randomly assigned to parent-implemented RDI or ABA/VB. To control for services received in the community, parents reported weekly on the type and extent of services delivered. The intervention consisted of 16 sessions over 12 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 (PC5) and engaging the child in a conversation about family photographs (PC6). 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.

Results: Post-treatment direct observation assessment revealed that both the parent-implemented RDI and parent-implemented ABA/VB conditions were followed by gains in joint attention and verbal behavior, as well as decreased levels of problem behavior. Although greater improvements as measured by the direct observation coding system were observed in the ABA/VB condition compared to the RDI condition, there was variability in individual response.

Conclusions: Preliminary results from a pilot study comparing parent-implemented RDI and ABA/VB indicated that both interventions are able of producing gains in joint attention and verbal behavior, even though the two interventions differ in primary intervention targets. Further, these results support that parents can serve as effective agents of change in the implementation of empirically supported early interventions for ASD.

61 **123.061** Comparison of a Self-Directed and Therapist-Assisted Telehealth Parent Training Intervention for Children with ASD

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Background: Although there has been growing interest in using telehealth interventions to provide parent training for children with ASD, empirical evaluations of such programs are limited, and little is known regarding the relative benefits of self-directed and therapist-assisted telehealth interventions for ASD. Self-directed programs have far greater dissemination potential as they do not require a trained professional and can typically be administered at a much reduced cost. At the same time, research on telehealth interventions for other disorders have found that therapist-assisted programs lead to better client outcomes than self-directed programs.
Objectives: The goal of this pilot RCT was to compare the effect of a self-directed (SD) and therapist-assisted (TA) telehealth intervention program on parent learning and self-efficacy and child language skills.
Methods: Children were matched with 3 months of expressive language age and then randomly assigned to the SD (n=14) or TA group (n=15). Parents were given up to 6 months to complete the program. Parent outcomes included parent intervention knowledge, parent intervention fidelity during a parent-child interaction in the home, and parent self-efficacy. Child outcomes included parent-report and observational measures of child language skills. In addition, program engagement data was monitored and treatment acceptability was measured at post-treatment.
Results: The program engagement data indicated high rates of program completion and treatment acceptability for both groups. Parents in both groups demonstrated significant improvements in parent knowledge of the intervention and parent self-efficacy from pre- to post treatment. Parents in both groups also demonstrated a significant improvement in parent fidelity; however, parents in the TA group made significantly greater gains in fidelity than parents in the SD group. Children in both groups demonstrated significant gains in expressive vocabulary on the MCDI, communication standard scores on the VABS, and rate of expressive language during a parent-child interaction, with a trend toward greater gains in child expressive language during the parent-child interaction for the TA group. Change in parent fidelity from pre- to post-treatment was significantly associated with improvements in child language during the parent-child interaction.
Conclusions: Both approaches show promise for increasing parents' use of evidence-based intervention techniques to promote their child's language skills. The self-directed program was effective for improving parent knowledge, self-efficacy, and fidelity of implementation. However, therapist assistance via remote coaching provided an added benefit for improving parent fidelity and child language. Additional research that can identify parents who are most likely to need remote coaching would assist in the development of a stepped care model that can increase parent access to evidence-based services in underserved communities.

62 **123.062** Conducting Assessment and Treatment of Problem Behavior for Children with Autism Via Telehealth

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Background: Problem behavior (e.g., aggression toward others, self-injurious behavior, property destruction) is recognized as a significant stressor for caregivers of children with autism. It can also be a barrier to early intervention efforts. Delivering evidence-based treatment for problem behavior via telehealth is a promising method for increasing access to these services, particularly for families who live in rural areas.
Objectives: The purpose of this investigation was to evaluate the efficacy of remotely training and coaching caregivers via telehealth to conduct functional analyses and implement functional communication training to address problem behaviors displayed by young children with an autism spectrum disorder in their homes. In addition to a summary of this project and its impact on problem behavior displayed by children with autism, a discussion of how telehealth was utilized and set up within the home environment will be presented.
Methods: Fifty-one children ages 1-6 were diagnosed with an autism spectrum disorder using the ADOS and the ADI-R; most of these participants continued with the behavior assessment and treatment phases of the study. Functional analyses and functional communication training were conducted by children's caregivers, who received remote training as well as "real time" remote coaching from a behavior therapist who was on average 123 miles from the families' homes. We evaluated these effects on three-levels: individual, group, and caregiver. At the individual level, we

evaluated the effects of functional analyses and functional communication training on problem behavior displayed in session by each child using single-case designs. At the group level, we will evaluate the effects of functional communication training for children participating in a randomized control trial. At the caregiver level, we evaluated changes in caregiver stress and self-efficacy ratings at pre- and post-treatment, as well as six months after treatment ended.

Results: Individual analyses to date show that 83% of children reached at least a 90% reduction in their identified problem behavior. Group results analyzed to date demonstrate that problem behavior decreases by an average of 91% following the implementation of functional communication training. Caregiver results suggest improved functioning following treatment, with caregivers reporting reduced stress and increased self-efficacy over time. The overall costs of providing six months of weekly behavioral services to the children averaged $1,440 per family whereas when the same procedures were conducted in vivo in a previous project, the average cost was $6,984.

Conclusions: Functional analysis and functional communication training can be successfully delivered to children with autism via telehealth. Caregivers are able to conduct the assessment and treatment sessions in their own homes with remote training and coaching from a behavior therapist.

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63 **123.063** Cost-Effectiveness Analysis Comparing Pre-Diagnosis Autism Spectrum Disorder-Targeted Intervention with Ontario's Autism Intervention Program

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Background: Sequential wait times for diagnosis and intervention can negatively impact outcomes in autism spectrum disorder (ASD). New service delivery models propose providing ASD-targeted interventions to young children who show signs of ASD before a diagnosis. One such intervention is the Early Start Denver Model (ESDM), which has shown efficacy in children with ASD as young as 15 months. There are no studies examining the cost-effectiveness of pre-diagnosis ASD-targeted intervention models.

Objectives: We performed a cost-effectiveness analysis comparing the costs and dependency-free life years (DFLYs) generated by comparing pre-diagnosis intensive ESDM (ESDM-I) and pre-diagnosis parent-delivered ESDM (ESDM-PD) to the Ontario Status Quo (SQ).

Methods: The analysis took a time horizon to age 65 using both provincial government and societal perspectives. Published literature was used to derive estimates of effectiveness. The mean expected IQ was determined for each intervention profile. Probabilities of having an IQ in the typical (>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 using the budget of an ESDM pilot project and government publications. A discount rate of 3% was applied to costs and effects occurring more than one year in the future. An incremental cost-effectiveness ratio (ICER) was calculated. One-way and probabilistic sensitivity analyses were performed to assess the impact of uncertainty in the model.

Results: From a provincial perspective, the ESDM-PD resulted in a savings of nearly $9,000 per person to age 65 compared to SQ, and generated 0.17 additional DFLYs. The ICER for ESDM-I compared to SQ was $23,000 per DFLY gained, and the ICER for ESDM-I compared to SQ was $58,000 per DFLY gained. One-way sensitivity analyses showed the model was most sensitive to uncertainty in predicting functional outcomes from IQ. From a societal perspective, the ESDM-I was the dominant strategy, producing more DFLYs for a lower cost than ESDM-PD or SQ. The societal model was most sensitive to uncertainty in predicted functional outcomes and caregiver costs. Probabilistic sensitivity analyses for both provincial and societal models showed considerable uncertainty in the effectiveness estimates of the interventions.

Conclusions: Pre-diagnosis ASD-targeted intervention may be associated with cost savings from both provincial and societal perspectives compared to current Ontario service models; however, predicted gains in independence based on increased IQ remain low with all programs. Caregiver costs were a significant driver in cost-effectiveness estimates. There was a high degree of uncertainty in the effectiveness of pre-diagnosis intervention, suggesting that further study on the effectiveness of these models is necessary to produce more accurate cost-effectiveness estimates.

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64 **123.064** Developmental Trajectories of Response to Treatment for Toddlers with Autism: Findings from the Early Social Interaction Project

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Background: Early intervention for toddlers with ASD is critical, given increasing rates of early diagnosis and the potential for treatment to impact brain development. Early intervention programs have resulted in gains in cognitive, language, and/or social skills at the group level (Dawson et al, 2010; Kasari et al., 2008, 2010). However, these effects are often modest and variable across children, suggesting different patterns of response to treatments. A randomized controlled trial (RCT) of the Early Social Interaction (ESI) Project demonstrated group-level efficacy across measures of

language, social communication, and autism symptoms (Wetherby et al., 2014), but variability in degree of response was also observed. Despite promising findings at the group level, existing studies have not yet determined which children respond best to intervention.

Objectives: To identify patterns of response to intervention in children with ASD enrolled in ESI, using latent class growth analyses (LCGA).

Methods: 82 children diagnosed with ASD were enrolled in the ESI Project at 16-20 months of age. Children were randomly assigned to receive nine months of 1) individual-ESI offered in 2-3 weekly sessions to teach parents to support their child's social communication development or 2) group-ESI offered weekly. Children completed the ADOS and CSBS at baseline, bimonthly, and at the end of treatment, yielding 5-6 time points.

Results: Four LCGA models were conducted for CSBS Social, Speech, and Symbolic composites, and ADOS Social Affect severity scores. Three-trajectory-class solutions provided the best fit for the CSBS Social, Speech, and Symbolic models. For the Speech analyses, Class1 showed the highest scores at baseline and the highest rate of improvement, Class2 showed low baseline scores and significant growth during intervention, and Class3 also showed low baseline scores, but no change during treatment. For the CSBS Social and Symbolic analyses, Class1 showed the highest baseline scores with the highest rate of improvement, Class2 showed moderate baseline scores with significant but lower improvement than Class1, and Class3 had the lowest scores at baseline and no change during treatment. The two-trajectory-class solution provided the best fit for ADOS Social Affect scores: Class1 showed moderate social impairment and significant improvement while Class2 showed severe impairment and no change during treatment. Children in individual-ESI and group-ESI were relatively evenly distributed throughout trajectory classes. Significant predictors of treatment trajectory class membership validate these distinct patterns of response to treatment.

Conclusions: Findings support that group-level analyses, while important for RCTs documenting efficacy, can obscure individual-level variability in response to treatment. Significant variability in baseline skills and rate of improvement were observed and significantly related, with trajectory classes with the highest baseline scores showing the highest rate of improvement. Children in individual-ESI and group-ESI were represented across all trajectory classes, demonstrating that substantial variability in response exists across treatment type/intensity. LCGAs may help researchers identify which children respond best to which treatments, as well as those children who are not showing optimal response to treatment. This may ultimately improve our ability to identify which treatments work for which children and tailor treatments based on early pattern/rate of change.

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65 **123.065** Dosage Effects of an Early and Intense Motor Skill Intervention in Young Children with ASD

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Background: Despite evidence to suggest one of the earliest indicators of an ASD diagnoses is a delay in achieving early motor milestones, there remains very few evidence-based treatments targeting motor behavior as the primary outcome for young children with ASD.

Objectives: Therefore, the primary objective of this study was to investigate the effectiveness of an early and intensive motor skill intervention employing research supported strategies from Classroom Pivotal Response Teaching (CPRT) on motor skills (i.e. locomotor and object control skills) in young children with ASD aged 4-6.

Methods: Twenty young children with ASD aged 4-6 participated in this study. The experimental group (n=9) participated in an intense, 8-week intervention consisting of direct motor skill instruction in a 1:1 ratio for 4-hours/ day, 5-days/ week. The control group (n=11) did not receive the intervention. The environment modeled a youth sports camp, where participants received individual feedback followed by small group gross motor play using CPRT supported strategies. Fundamental motor skills (locomotor and object-control skills) were assessed in both groups using the Test of Gross Motor Development-2 at pre-intervention, post-intervention, and 4-weeks following the intervention (maintenance period). To investigate treatment dosage in the experimental group, bi-weekly assessment of motor outcomes occurred at weeks 2, 4, and 6 of the intervention. A general linear model analysis was conducted to examine differences in each group on motor skill performance. Pairwise t-tests were used to determine treatment dosage.

Results: Linear modeling demonstrated a statistically significant difference in motor performance following the intervention and after a 4-week maintenance period. For locomotor skills in the experimental group, there was a +16.82(SE=1.71) unit gain at post-intervention ($p<0.001$), and a -0.27 unit difference over the maintenance period. For object-control skills, there was a +18.27(SE=1.65) unit difference at post-intervention ($p<0.010$), and a -3.36(SE=1.18) unit difference over the maintenance period ($p<0.05$). The control group did not demonstrate significant gains in motor performance. Non-significant changes in motor skill performance at the post-intervention maintenance period demonstrated a preservation of skills in the absence of directed motor therapy. Pairwise t-tests were used to assess dosage response to the intervention. For locomotor skills, significant gains were observed from weeks 0-2 [$t(1,10)=+3.54, p<0.05$], weeks 2-4 [$t(1,10)=+2.48, p<0.05$], and weeks 6-8 [$t(1,10)=+2.82, p<0.05$], demonstrating continued locomotor gains throughout 8-weeks of intervention. For object-control skills, significant gains were observed from weeks 0-2 [$t(1,10)=+3.59, p<0.05$] and weeks 2-4 [$t(1,10)=+2.16, p<0.05$]. Although significant results continued through 8 weeks when compared to baseline [$t(1,10)=+11.57, p<0.05$], object-control gains plateaued after 4-weeks of intervention.

Conclusions: Following an 8-week motor skill intervention, children with ASD demonstrated and maintained improved motor skill performance. Significant locomotor gains continued throughout the study with minimal plateau. Significant object-control gains continued through 4-weeks of intervention then plateaued thereafter. Dosage response suggests motor performance can be modified in as few as 2-weeks of treatment with continued improvement with treatment duration of 8-weeks for locomotor skills and 4-weeks for object-control skills Findings should inform policy makers to include motor programming as part of the early intervention services delivered to young children with ASD.

66   **123.066**   Effect of Comorbid Psychopathology on Response to Pivotal Response Treatment

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Background: Extant literature on response to behavioral treatments for autism spectrum disorder (ASD) primarily highlights cognitive, social, and adaptive skill gains, with relatively little examination of what predicts these gains. Studies examining predictors of Pivotal Response Treatment (PRT) in particular are few and focus on specific behaviors (i.e., toy play or self-stimulatory behaviors).
Objectives: Our study is one of the first to examine the predictive effects of symptoms of psychopathology on treatment response in young children with ASD.
Methods: Participants were ten 4- to 7-year-old children (2 girls) who participated in a 16-week PRT intervention. Inclusion criteria were a previous ASD diagnosis and full-scale IQ > 70 (measured by the Differential Abilities Scales-2nd Edition). Autism Diagnostic Observation Schedule (ADOS) and Vineland Adaptive Behavior Scales-2nd Edition (VABS-II) assessments were conducted pre- and post-treatment to measure autism symptom severity and adaptive skills. Parents also reported autism symptom severity on the Social Responsiveness Scale (SRS) and comorbid symptoms of psychopathology on the Child Behavior Checklist 1.5-5 or 6-18 (CBCL). Response to treatment was assessed by the change in total ADOS and SRS raw scores and VABS-II Adaptive Behavior Composite standard scores. Linear regression analyses examined the predictive value of pre-treatment CBCL subscale scores on these change scores, controlling for cognitive abilities.
Results: Pre-treatment scores on the aggression (β = -.79, p = .01), oppositional defiant disorder (β = -.64, p = .05), attention (β = -.79, p = .01), and attention deficit hyperactivity disorder (β = -.80, p = .02) CBCL subscales significantly predicted change in total ADOS scores. Scores on the withdrawn, affective, anxiety, and anxious-depressed CBCL subscales were unrelated to ADOS total score change. CBCL subscale scores at pre-treatment were unrelated to SRS and VABS-II change scores.
Conclusions: Our results suggest that externalizing behaviors contribute to the magnitude of effect of PRT on social communication skills, with greater behavioral dysregulation at pre-treatment predicting more improvement in symptom severity as measured by the ADOS. Behaviorally dysregulated children may demonstrate a greater effect from PRT because, in addition to gaining social communication skills, they may also develop a greater capacity for behavioral regulation. Further understanding of the factors impacting treatment response may assist in identifying which treatments work best for which children, towards the goal of individualized treatment design and implementation.

67   **123.067**   Effectiveness of Using a Mobile App Parent Training Program to Increase Language in Children with Autism

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Background: Communication intervention in early life can significantly impact long term outcomes for children with autism spectrum disorder (ASD) (Howlin et al., 2004). Evidence-based practices such as naturalistic approaches (e.g. Koegel et al., 1987; Ingersoll & Schreibman, 2006) are found to be promising in improving communication in children with autism. However, limited resources and high costs have hindered children from receiving prompt and timely intervention. Parents of children with ASD can be vital and important intervention resources and, training them to be therapists can help reduce costs for intervention. The current study aims to evaluate the use of a mobile application as a training medium to disseminate intervention skills of naturalistic language intervention to parents in an effective and efficient way.
Objectives: The primary purpose of this project is to examine the effectiveness of using a mobile application (1) to train parents to implement naturalistic language intervention (Laski, Charlop, & Schreibman, 1988) with their young child with autism; and (2) to increase their child's spontaneous communication and requesting language skills.
Methods: A mobile app was developed with the instructional design of *behavioral modeling training* (BMT) (Bandura, 1976; key components include modeling, retention, behavioral rehearsal, feedback, and transfer of training) to deliver a curriculum of *naturalistic language intervention*. A multiple baseline single case experimental design was conducted across 3 parent-child dyads (i.e., children with ASD aged 2 to 5 years) to evaluate the impact of using iPad to teach parents on naturalistic

language intervention. Video recordings on parent's intervention with the child were collected via a one-push button on iPad and the network. Behaviors of both parents (10 parent behaviors) and children (5 child behaviors) were measured in 5 phases: *baseline, parent training, post-training intervention, generalizations and 1 month follow up*. Interrater reliability on target parent behaviors and child behaviors were collected for at least 33% of total sessions and an average agreement of over 85% was achieved. Procedural integrity of parents' intervention techniques were above 80% on average during post training intervention. Parents' acceptability of the mobile app and program satisfaction ratings were administered with survey forms.

Results: The current results indicate that (a) parents achieved an increase in knowledge on the principles of naturalistic language intervention via the mobile application during the course of parent training, (b) parents showed an increase in the application of intervention techniques in naturalistic settings, and (c) their respective children showed an increase in spontaneous word use.

Conclusions: The results show that mobile applications are a promising means for improving efficiency and effectiveness in disseminating evidence-based practices for autism intervention. Mobile platforms will close the research-practice gap, multiply intervention resources in both developed and developing countries for individuals with autism, and provide prompt intervention without delays. Further research on generalizations of the current intervention is expected to be completed by 2014 to assess parent and child behavioral gains in different home and community contexts.

68   **123.068** Effects of School-Based Interactive Book Reading on the Vocabulary and Emergent Literacy of Preschoolers with ASD

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Background:
Little is known about effective methods for preparing children with ASD to be competent readers. 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). Without both of these aspects, comprehension is limited. How these elements develop in young children with ASD is not well-understood.

This proposal presents preliminary findings from year 1 of a four-year project to examine the emergent literacy of preschoolers with ASD and the effectiveness of two school-based interventions. The intervention in year 1 was Dialogic Reading (DR), hypothesized to increase expressive and receptive vocabulary. Children build their emergent literacy skills and knowledge through interactions with print and literate behaviors from a young age. One common experience during this time is shared book reading which provides experiences with oral language, narrative structure, and conventions of print (Anderson et al., 1985). One method of providing good interactive storybook reading is DR (Whitehurst et al., 1988).

Objectives:
One of the project aims is to determine the immediate effects of school-based interventions for preschool children with ASD. Our Yr. 1 research question is: For which outcomes do children who received DR intervention significantly outperform their non-tutored peers?

Methods:
42 children diagnosed with ASD were randomly assigned to DR treatment (n = 21) or BAU control group (n=21). The inclusion criteria were (a) either a medical diagnosis of autism or an educational identification, (b) an active IEP and receive services for ASD, (c) be 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. Children were in 24 classrooms across 13 schools.
 Children in the treatment condition had 1:1 interactive book reading sessions using DR methods 3-4 times per week, for 15-20 weeks in the children's preschool classrooms. Measures are outlined in the table of results and were pre-tested in November and post-tested in May.

Results:
Three-level Hierarchical Models were conducted. There were no group differences on pretests. Significant teacher and school variance was detected; therefore 3-Level models were retained. Raw score gain scores were computed to test treatment impact. All children made significant gains on all measures regardless of condition. As well, a significant treatment effect on EOWPVT was found along with a trend for treatment effects on PPVT and WJ Oral Communication. No other significant or trend differences were found. See the table for all of the results and treatment fidelity information.

Conclusions:
Improvements were found for the treatment group on the measures hypothesized to be affected. This finding is important given the applied nature of the research. School-based research is critical to learn what types of intervention are effective with this population given the specific ecological context. Due to the small sample size, there may be a lack of power. Given that the project has additional treatment groups in years 2 and 3, this will be avoided with the full sample.

69   **123.069** Enhancing the Social Interactions of Preschool Children with Autism: The Effectiveness of a Peer-Mediated Intervention

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Background: Deficits in social interactions are a defining feature of autism spectrum disorders (ASD) and a powerful predictor of individual outcomes (e.g., Carter, Davis, Klin, & Volkmar, 2005). Although a wide variety of methods for improving social skills has been examined, it is still unclear which approaches are most effective with very young children. Some of the techniques that have empirical support include ABA, peer training, and video modeling. However, each strategy has its limitations, especially when used in isolation (e.g., Ferraioli & Harris, 2011; Reichow & Volkmar, 2010).
Objectives: This pilot study examined the efficacy of a new manualized social skills treatment package for preschool children with ASD that combines several techniques with demonstrated efficacy in order to enhance intervention effects.
Methods: The participants were 19 children with ASD who were enrolled in an early intervention preschool program that also served typically developing peers. Children with ASD were assigned to either the treatment group (n = 11, M = 4.9 years, SD = 0.7) or the waitlist control group (n = 8, M = 4.6 years, SD = 1.1). Ten typically developing peers participated in 8 training sessions that consisted of explanations of strategies, modeling, role play, and reinforcement. The intervention itself was delivered across 10 weeks in natural social environments, including recess and classroom playtime. Each participant in the treatment group received approximately fifteen intervention sessions targeting parallel play, social initiation, imitation, shared positive affect, and turn taking. In addition to verbal and visual prompts, some sessions also included video modeling of targeted social skills. Participants and peers received immediate social praise and small tangible rewards for their efforts throughout treatment. Data were collected at three time points: pre-intervention, post-intervention, and at a ten week follow-up assessment. Parents and teachers completed the Autism Spectrum Rating Scale (ASRS) which produced Social/Communication and Unusual Behavior composite scores. Clinicians, who were blind to group assignment, rated participant's social and play skills using subscales of the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP). Group differences post-intervention and at the 10-week follow-up were examined using univariate ANCOVAs.
Results: After adjusting for pre-intervention scores, parents reported that children in the treatment group demonstrated significantly fewer deficits in Social/Communication skills post-intervention compared to those in the control group, $F(1,16)$ = 4.64, p < .05, Cohen's d = -1.06. At the 10-week follow-up there were no significant group differences in parent reported Social/Communication skills, $F(1,16)$ = 1.51, p > .05, Cohen's d = -0.62. Results of clinician ratings revealed that at the 10-week follow-up, children in the treatment group demonstrated significantly more appropriate play skills compared to the control group, $F(1,16)$ = 4.69, p < .05, Cohen's d = 0.82.
Conclusions: Integrating evidence-based intervention techniques (e.g., ABA, peer training, video modeling) in a natural social environment may improve the social and play skills of preschoolers with ASD. Further examination of this intervention, potentially using more sensitive outcome measures and a larger, more diverse sample, is warranted.

70 **123.070** Evaluation of the PEERS Play Intervention for Preschoolers with Autism Spectrum Disorder (ASD)

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Background:
Children with ASD have documented impairments in social communication skills that are related to concurrent language and predictive of later language abilities, adaptive functioning, and academic performance (Toth, Munson, Meltzoff, and Dawson, 2006; McGovern and Sigman, 2005; Sigman and Ruskin, 1999). Even before impairments in social interaction and communication are evident, however, parents of infants who later receive an autism diagnosis often describe their children as having difficulty controlling their attention, affect, and behavior (Dawson, 2008). Difficulties with self regulation in children with ASD can persist into adulthood, impacting relationships, attention, problem solving, and communication (Bradley & Isaacs, 2006; White, Oswald, Ollendick, & Scahill, 2009). Most of the interventions targeting social skills in children with ASD have focused on short term treatments (e.g., 8-12 weeks) and children older than 5 years (Ozonoff & Miller, 1995; Taras, Matson, & Leary, 1998). To our knowledge, only one published study has examined a social skills intervention for preschool aged children with ASD delivered in a group vs. one-to-one setting (Dykstra et al., 2012). Further, self regulation skills have not been the primary focus in prior studies of social skills group interventions for young children with ASD.
Objectives:
To evaluate the effectiveness of the PEERS Play intervention, assess change in self regulation skills and social functioning, and manualize the PEERS Play curriculum.
Methods:
The PEERS Play intervention targets social and self regulation skills in preschool aged children with ASD. The curriculum is based on extensive experience with this population, age, principles of applied behavior analysis, and self regulation techniques drawn from The Alert Program. The intervention follows a weekly group format consisting of structured (e.g., circle time, art) and unstructured (e.g., free play, choice time with a peer) activities. Pilot data were collected on 6 children with ASD ages 3 and 4 years. Pre-treatment baseline assessment included standardized cognitive and adaptive measures; parent, teacher, and clinician ratings; and videotaped behavioral observations. The

intervention phase consisted of 6 months of videotaped, weekly, 60-minute social groups using the PEERS Play curriculum. Post-treatment assessment duplicated the pre-treatment battery.
Results:
Two analytic plans are underway: 1) A multiple time point, single case design analyzing weekly behavioral codes from videotape across multiple domains (social initiation, joint attention, play level, cooperative play and emotion regulation); and 2) pre- and post-treatment parent, teacher, and clinician ratings on a variety of measures. Results from analytic plan 2, using paired difference t-tests, indicated significant positive change on measures of parent rating of social skills (t=2.755, p=0.04), teacher rating of social skills (t=4.284, p=0.05), and parent ratings on the Temperament and Atypical Behavior Scale (TABS; t=2.86, p=0.035), a measure of atypical self-regulatory behavior intended for use with infants and young children. Additionally, on the BRIEF-P, most children showed positive change on most domains.
Conclusions:
The present findings indicate that the PEERS Play intervention can effect change in multiple domains including self regulation in preschool age children with autism. Future research will include an RCT design and a parent-mediated adjunct to this intervention.

71   **123.071** Family Implemented Teacch for Toddlers (FITT) Reduces Parent Stress and Improves Toddler Social-Communication Skills: Results from a Small, Randomized Controlled Trial

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Background: FITT was designed using core TEACCH principles of Structured TEACCHing and evidence based practices for toddlers with ASD. One core principle of TEACCH is the inclusion of parents as co-therapists, but the effects of this component on parent well-being have not yet been studied. In addition, there is limited research examining the effects of structured teaching on toddler skills.
Objectives: The objectives of this study were to examine the effects of FITT on child and parent factors, including child social-communication and developmental skills and parent stress.
Methods: Forty-nine toddlers with ASD (ages 17 mos – 35 mo at baseline) enrolled in a 6-month RCT comparing FITT (n = 32) to community services as usual (SAU; n = 15). Approximately 50% of participants lived in rural communities. A majority of the sample (88%) demonstrated moderate to high autism symptoms on the ADOS and 72% scored below 70 on the Mullen ELC, with 28% scoring at the floor (Early Learning Composite = 49). There were no baseline differences between FITT and SAU for key demographic variables. FITT included 20 90-minute in-home parent coaching sessions and 4 parent group sessions over 6 months. Child outcome measures included the Mullen Scales of Early Learning and Parent Interview for Autism-Clinical Version. Parent stress was measured using the Parental Stress Index-Short Form.
Results: Attrition was greater in the SAU group than the FITT group. The final sample included 42 participants (FITT n =30; SAU n = 12). To produce an ITT estimate of treatment effects for child and parent outcomes, we used ANCOVA models where the outcome at Time 2 was modeled as a function of the Time 1 pre-test, treatment status, gender, and age at Time 1. Treatment status, pre-tests, age, and gender were centered at zero before analysis so that the intercept of each model reflects the sample average performance on the modeled outcome at Time 2. Children in the FITT group had higher PIA Total scores at Time 2 than children in the SAU group (B =.26, p < .05). Parents in the FITT group had lower Total Stress scores at Time 2 than parents in the SAU group (B = -13.20, p = .05). While parent stress increased over time in the SAU group, it decreased over time for the FITT group (see Figure 1). There were no statistically significant treatment effects on Mullen Early Learning Composite.
Conclusions: Results supported the use of FITT for toddlers with ASD and their parents, with treatment effects found for social communication skills and parent stress. Treatment effects were not detected for developmental skills as measured by the Mullen ELC. The severity of the ASD symptoms and developmental delays in a majority of the sample may have contributed to these findings. The low intensity of the parent coaching intervention may have also played a role. The significant decrease in parent stress for these families new to a diagnosis of ASD was encouraging given that stress increased for SAU parents during this time.

72   **123.072** Gesture in Toddlers with Autism Spectrum Disorder: Before and after Intervention

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Background: Young children with autism spectrum disorders (ASD) exhibit impaired gesture development (APA, 2013; Landa, 2007). Gesture is an essential component of social interaction. Also, gesture can be used to compensate for spoken language limitations (e.g., typically-developing toddlers, and children with language delay; Capone & McGregor, 2004) and can index and facilitate learning (Goldin-Meadow, 2009). For these reasons, gesture is an important aspect of communication

to target in early interventions for ASD.

Objectives: We investigated gesture production in toddlers who participated in a previously reported intervention for ASD (Landa et al., 2011). We predicted that across the entire sample gesture production would increase from pre-test to post-test. However, gains in mature gesture use, including pointing gestures, would only be observed for the treatment group.

Methods: Toddlers (mean age=31.06 months, SD=6.08) with ASD participated in a six-month randomized-controlled-trial targeting social and communication skills. In both groups, caregivers were coached in the implementation of evidence-based child-responsive strategies. In only one condition, however, this intervention was supplemented with nursery school classroom-based instruction (class) treatment condition where they received an interpersonal synchrony curriculum and instruction fostered peer-to-peer engagement. Here, we report on nine children in each condition. There were no significant differences between groups for age (p=.69), general developmental level on the Mullen Scales of Early Learning (MSEL) (p=.79), MSEL Expressive Language (p=.730), nor on any of our outcome measures (p's>.63) at baseline. The Autism Diagnostic Observation Schedule (ADOS, Lord et al., 2000) was administered to all children before and after the intervention. Coders blind to condition coded communicative gesture production during the sections of the ADOS that are included in the modules used here (T, 1, 2) (e.g., free-play). We derived three measures of gesture based on developmental maturity and importance in ASD (Iverson, et al., 1994; Kita, 2003, Wetherby et al., 2004). Measures included: (1) number of developmentally mature gestures produced (e.g., pointing gestures, waving goodbye, holding an object up to show to someone); (2) number of developmentally immature gestures produced (e.g., extending an object for someone to take); and (3) number of pointing gestures. Measures (1) and (2) are mutually-exclusive. Due to small sample size, we used non-parametric tests when possible, although results are unchanged when using parametric alternatives.

Results: We found significant increases in mature gestures (p=.016) and pointing gestures (p=.049), but not immature gestures (p=.399) from pre- to post-test in both groups (Figure 1). However, consistent with our predictions, effects varied with condition. Two-factor repeated-measure ANOVAs revealed a significant interaction between session (pre-test, post-test) and condition for mature gestures (F=5.36, p=.038) and pointing gestures (F=4.77, p=.048), but not immature gestures. At post-test, children in the treatment group produced more mature gestures and more pointing gestures than the control group (p=.024 and p=.019, respectively). In contrast, the control group produced relatively more immature gestures (p=.050) (Figure 2).

Conclusions: Intervention is associated with increased frequency and maturity of communicative gesture in toddlers with ASD. These effects may have cascading consequences for positively impacting and enriching social interactions for children with ASD.

73   **123.073** Impact of Parent Training on Parental Competence and Parental Stress
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Background: We propose that serious behavioral problems in children with ASD erode parental confidence and increases parental stress. Thus, reducing disruptive behavior through PT should restore parental competence and decrease parental stress.

Objectives: This presentation reports on the measures of self-perceived parental competence and parental stress before and after six months of PT compared to six months of PEP.

Methods: The 17-item Parental Sense of Competence (PSC) asks parents to report on self-efficacy in the parenting role. Parental stress was measured by the 36-item Parent Stress Index (PSI) and the 21-item Caregiver Strain Questionnaire (CSQ). These measures were collected at baseline and endpoint (6 months).

Results: At baseline, mean PSI and CSQ total scores were elevated in the study sample as a whole (PSI = 104.5; CGS = 32.0). PSC total score was low (62.4 of possible 102). These results suggest that parenting a child with ASD and disruptive behavior is a major challenge. Compared to PEP, PT significantly reduced scores on the CSQ and increased scores on PSC (effect sizes 0.50; p < 0.5 for both). PSI scores improved in both PT and PEP groups (effect size 0.27 in favor of PT; p not significant). Within the PT-treated group, we had complete data on the CGI-I and parent measures for 80 of 89 subjects. Children rated as *much improved* or *very much improved* (n=61) on the CGI-I had significant reductions in parental stress on the PSI and CSQ when compared to children rated as non-responders (n=19) (effect sizes 0.63; p values 0.004 and 0.02, respectively). Parents of positive responders showed an increase on the PSC compared to non-responders (effect size 0.4; p value 0.06). Results of exploratory analyses on the correlations of the PSC and parental stress measures at baseline and endpoint will also be presented.

Conclusions: These results suggest that PT reduces parental stress and enhances self-perceived parental competence.

74   **123.074** Implementation and Impact of Focused Early Intervention Services
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Background:
Quality early intervention programs emphasize the role of the caregiver in supporting the child at home. However, support and education programs are often difficult to access. In an effort to better equip caregivers with the knowledge base and tools necessary to adequately address the needs of children with Autism Spectrum Disorder (ASD), a university-based institute on ASD and state department of education have collaborated to develop and implement two model early intervention programs for families of young children with ASD and related developmental delays.
Objectives:
This program evaluation study investigates the feasibility of implementing two different parent education-focused service models with fidelity. In addition, this study assessed parent satisfaction with each service as well as the impact of services on child functioning as perceived by both caregivers and clinicians.
Methods:
Approximately 60 families will be provided with services following participation in a psychological evaluation for ASD. All participating families receive 2 home-based evaluation support sessions which include an opportunity to discuss the evaluation report as well as focused consultation and training on evidence-based practices for children with ASD. Approximately half of these families will participate in a parent education series that includes 12 additional sessions guided by the Early Start Denver Model (ESDM). Professionals in the fields of early intervention and applied behavior analysis conduct all visits within both models of service. Procedural fidelity data, satisfaction ratings, and Clinician Global Impression ratings are collected on both services in an effort to evaluate program effectiveness.
Results:
Preliminary data on families that have completed each service at this time (N = 34; N = 8) suggest that clinicians were able to apply the training model with over 95% fidelity across families with varying needs. Additional data collected on the application of the ESDM curriculum suggest that clinicians were able to cover over 90% of the ESDM curriculum across the 12 visit model and that parents were able to demonstrate over 70% of those strategies covered within sessions. Preliminary data using a Clinician Global Impressions rating of improvement suggest that both clinicians and caregivers observed improvement following completion of the brief evaluation support service with average ratings of 3.2 and 2.4 respectively on a scale of 1 to 7 with 1 equaling "very much improved" and 4 equaling "no change". Caregivers and clinicians also observed improvement following completion of the extended parent education service with ratings of 2.1 and 2.4 respectively. In addition, caregivers assigned high ratings to their overall satisfaction with services as well as their own competence in implementing the strategies with overall ratings averaging 3.8 on a scale of 1 to 4.
Conclusions:
The preliminary results of this study suggest that early intervention programs emphasizing caregiver support and education can be implemented with high levels of fidelity. Additionally, the results suggest that even brief intervention services focused on providing caregivers with immediate support and education may result in improvements in child functioning and caregiver confidence in supporting their child.

75   **123.075** Improved Parent Interaction Style Associated with Improved Child-Parent Joint Engagement 3-Months after a Low-Cost, Group, Parent-Training Workshop

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Background:
Parent-implemented interventions for young children with ASD have been found to be associated with improvements in child social engagement (e.g. Casenhiser and Shanker. 2011; Kasari et al.2010; Patterson, Elder, Gulsrud and Kasari, 2013) language (Coolican et al. 2010; Vismara et al. 2009), imitation (Ingersoll and Gergans, 2007), and play (Gillett and LeBlanc 2007). In countries with relatively few trained autism professionals, such as Argentina, parent-implemented interventions may be the only services available for young children with ASD. However, traditional parent training models emphasizing individual coaching sessions are not scalable in countries such as Argentina and very little research has focused on group parent training which has the potential to make training more accessible to families (Minjarez, Williams, Mercier and Hardan, 2011; Ingersoll and Dvortcsak, 2007). This study is a 3-month follow-up to a parent-training program delivered in Buenos Aires, Argentina.
Objectives:
To investigate the relationship between change in parental interaction style following a weekend, group parent-training workshop and changes in parent-child joint engagement 3 months post-training.
Methods:
The parent-training program was originally developed for a multi-cultural, low-income, group in the Bronx, NY (Houghton, 2012) then delivered to 24 families in Buenos Aires, Argentina (Hougthon et al, 2013). It teaches parents research-based techniques for encouraging joint engagement embedded in everyday activities at home. 22 families participated in the training program. Video of parent-child free play sessions were taking pre-training, post-training and 3-months post-training. Parent

interaction style was coded along the dimensions of Responsivity and Directiveness (Mahoney and Perales, 2003) and parent-child joint engagement coded following Baekman and Adamson (1984) and Kasari et al. (2010).

Results:

Results show a relationship between parent interaction style post-training and at 3-month follow up and between parent interaction style and parent-child joint engagement at 3-months.

Conclusions:

A brief, low-cost group parent-training program was shown to improve parent interaction style which was then associated with improved parent-child joint engagement at 3-month follow-up without further training.

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76 **123.076** Joint Attention during an ABA Intervention Session Can Predict Progress of Preschoolers with Autism Spectrum Disorder

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Background: Although the positive effect of ABA has repeatedly been demonstrated, it remains unclear how variations in techniques affect the results. Moreover it is poorly understood why a substantial subgroup of children with ASD does not improve with ABA. Possibly features of the interaction between therapist and child during intervention account for part of the variability in outcome.

Objectives: This study performed a descriptive analysis of the variability in the joint attention interaction sequences between therapists and children. Second, the study focused on the extent to which these observational data predicted the progress which children made during 6 months of intervention.

Methods: 16 children with ASD participated. They were between 30 and 75 months old. The children received an ABA intervention. They were followed-up during a period of 6 months and their joint attention and language skills were tested both before and after this period. After three months we videotaped one intervention session of each child. Both the imperative and declarative joint attention behaviours of the children, as well as their antecedents (prompts) and consequences (rewards) provided by the therapist were coded. We calculated the frequency of imperative and declarative joint attention bids that were either prompted or spontaneous and rewarded or unrewarded.

Results: Children who showed more spontaneous imperative than declarative joint attention were 1.93 times more rewarded for imperative than declarative joint attention, while children who mainly showed spontaneous declarative joint attention were 1.62 times more rewarded for declarative compared to imperative joint attention The majority of the children showed more or less the same amount of prompted and spontaneous imperative joint attention.

We conducted four backward stepwise regression analyses with the joint attention interaction sequences as predictors and progress in imperative joint attention, declarative joint attention, receptive and expressive language as dependent variables. The first regression analysis showed that the progress in imperative joint attention could be predicted by the number of rewarded declarative joint attention bids, $\beta = .59$, $t(15) = 2.36$, $p = .04$. over and above the number of imperative joint attention bids and the number of unrewarded declarative joint attention bids. Progress in declarative joint attention on the other hand, was negatively related to the number of prompted unrewarded imperative joint attention bids, $\beta = -.55$, $t(15) = -2.43$, $p = .03$, which was the only significant predictor. Progress in receptive language was predicted by a model with spontaneous unrewarded declarative joint attention, $\beta = .54$, $t(15) = 2.84$, $p = .01$ and prompted rewarded imperative joint attention, $\beta = .48$, $t(15) = 2.52$, $p = .03$. Progress in expressive language could only be predicted by the number of spontaneous declarative joint attention bids, $\beta = .73$, $t(15) = 3.99$, $p = .001$.

Conclusions: Joint attention behaviours that are rewarded seem to occur more frequently, even within one session. Moreover the interaction between therapist and child within this session after three months of intervention can predict the amount of progress children make in a period of 6 months on joint attention and language.

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77 **123.077** Lasting Effects of a 12-Week Group Parent Education Model for Pivotal Response Treatment

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Background: Preliminary studies of Pivotal Response Treatment (PRT) have shown that parents can successfully learn and implement PRT with high fidelity, indicating that parent-delivered treatment could be an efficacious treatment modality. While a recent randomized controlled trial of a 12-week parent education group treatment showed an increase in children's functional utterances and adaptive communication skills (Hardan et al., 2014), the lasting effects of a short-term parent-delivered PRT group intervention have not yet been sufficiently researched.

Objectives: The objective of this study was to assess maintenance of treatment effects, following a 12-week PRT parent education intervention at the follow-up assessment at 24-week. The primary goal was to measure improvement in children's language development between baseline, week 12 (treatment end), and week 24 (follow-up assessment), as well as changes in developmental functioning over this 6-month period.

Methods: Families who were randomized to the active treatment group and participated in the full 12-week PRT parent education group training (n=23; mean age=3.9 years, SD= 1.04) were followed over the course of 6 months with parent questionnaires and structured laboratory observations. At follow-up, participants were re-assessed for changes in communication, cognitive, adaptive, and social skills.

Results: Preliminary results from baseline, week 12 and week 24 measures suggest that a 12-week group-delivered parent education treatment model has enduring effects on language. Mean total number of child functional utterances during a 10-minute structured laboratory observation suggests a significant improvement from pre to post-treatment, with maintenance at 24 week follow-up (Baseline: 45.7 ± 23.1; Week 12: 64.5 ± 28.9; Week 24: 55.1 ± 23.2; F: 5.9, p=.009). Children also made significant gains on the Vineland Communication Domain Standard Score that continued to improve over time (Baseline: 69.9 ± 16.3; Week 12: 78.9 ± 18.9; Week 24: 83.1 ± 17.8; F:11.74, p=.001). In order to assess the effects of parent-implemented PRT on early developmental/cognitive skills, standard scores from week 24 on the Mullen Scales of Early Learning (MSEL) were compared with baseline levels. The MSEL early learning composite score was calculated and showed significant improvements beyond expected developmental gains (F= 5.43, p=.03).

Conclusions: Children randomized to PRT showed evidence that treatment gains were maintained 12 weeks after the active treatment ended. Overall improvements were noted on child communication measures, at post-treatment, as well as 12 weeks after that (24-week follow-up), indicating maintenance of treatment effects. Interestingly, gains in total number of child utterances appeared to decline after active treatment. Nevertheless, at 6 months, the children were still using significantly more functional utterances than at baseline. The preliminary results of this study suggest that a brief PRT parent group intervention can facilitate improvements in language skills and cognitive functioning that are maintained 12 weeks post treatment. These findings will be discussed in terms of the need for effective and efficient treatments that can be easily disseminated. Future research should continue to address questions about the maintenance of developmental gains from short-term parent education interventions.

78   **123.078** Long-Term Outcomes of Early Intervention in 6-Year-Old Children with Autism

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Background: There is a lack of long-term outcomes studies for comprehensive autism interventions conducted with very young children. The only long-term outcome study of comprehensive autism intervention of which we are aware was published over 20 years ago (McEachin et al., 1993) and this seminal study was conducted with older children. The Early Start Denver Model (ESDM) intervention, conducted for 2 years at 15 hours per week, begun when children were 18-30 months of age, showed evidence of efficacy immediately post-treatment in a randomized controlled trial (Dawson et al., 2010, 2012). The ESDM group significantly surpassed the community-intervention comparison group in IQ gain, adaptive behavior, and diagnostic changes. Furthermore, an EEG study revealed normalized patterns in the ESDM group involving stronger responses to social than nonsocial stimuli, a pattern opposite that of the comparison group.

Objectives: We prospectively examine evidence for the sustained effects of early autism intervention, begun at 18-30 months of age, when children are 6 years of age. We also examine patterns of group differences in the ESDM group as compared with the Community-intervention group at 6 years of age.

Methods: Forty-five children completed the original outcome study. Thirty-nine children were available for follow-up at 6 years of age (3 lost per group). During the two-year follow-up period the study no longer provided intervention to either group, so parents selected varying types and intensities of community-based interventions. Measures of IQ (Mullen, DAS), adaptive behavior (Vineland), autism symptoms (ADOS), and challenging behaviors (ABC) were gathered immediately post-intervention (age 4) and after the 2-year follow-up period (age 6). Peer relations were assessed at age 6 (ADI-R, selected items.)

Results: The ESDM group, on average, maintained or increased improvements during the follow-up period in intellectual ability, adaptive behavior, symptom severity, and challenging behavior. At follow-up the ESDM group demonstrated improved core autism symptoms compared with the Community group. In contrast, no significant differences in core autism symptoms as assessed by the ADOS were found immediately post-treatment (see Dawson et al., 2010.) In addition, the ESDM group had improved adaptive behavior and peer relations compared with the Community group at follow-up. The two groups did not differ in terms of intellectual functioning at age 6 follow-up.

Conclusions: These results indicate sustained and, in some domains, enhanced long-term effects of early ASD intervention. This is the first study to examine the role of early ESDM behavioral intervention initiated below 30 months of age in altering the longer term developmental course of autism.

79 **123.079** Parent-Mediated Intervention for Hispanic Families of Young Children with Autism

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Background: The US Hispanic population has grown rapidly over the past decade (Humes, Jones, & Ramirez, 2012) and has experienced one of the largest increases in ASD prevalence when compared to other populations (MMWR, 2014). A support system needs to be in place for this population, one that includes accessible, high-quality intervention. Unfortunately, US Hispanic families have poor access to ASD services (Harstad, Huntington, Bacic, & Barbaresi, 2013), diminished treatment quality (Magaña, Parish, Rose, Timberlake, & Swaine, 2012), and poorer outcomes when compared to White, non-Hispanic families (Fountain, Winter, & Bearman, 2012). Based on their negative experiences, Hispanic families report losing trust in the healthcare system (Zuckerman et al., 2014). These findings emphasize the importance of establishing supportive early interventions for Hispanic families of children with ASD. To date, however, no studies have examined early parent-mediated interventions for Hispanic families of children with ASD. To address this need, this study investigated a parent-mediated intervention called "Adapted Responsive Teaching" (ART; Wakeford et al., under revision) in primarily Spanish-speaking families.

Objectives: The purpose of the study was twofold: (1) to examine how ART impacts the social-communication skills of children with ASD from Hispanic families; and (2) to explore the acceptability & feasibility of ART among these families.

Methods: This study used a multiple baseline across participants and behaviors design. Three Hispanic children diagnosed with ASD participated in an initial assessment (age range in years;months was 2;9 – 4;4). Baseline data were collected on selected social-communication behaviors for each child. During the ART intervention, parents were taught responsiveness strategies, which were intended to improve the social-communication skills of their children. Measures of parent responsiveness and parent fidelity of implementation were also taken. At the conclusion of the intervention, caregivers participated in qualitative interviews about their perspectives of the ART intervention.

Results: Treatment effects were demonstrated in four out of seven opportunities, providing moderate evidence for the ART intervention's effectiveness at improving social-communication skills in Hispanic children with ASD. Two out of three children demonstrated improvements in social-interaction and requesting. For the two children who showed treatment effects, their parents also showed high levels of parent responsiveness and fidelity to intervention; the third parent demonstrated inconsistent responsiveness and fidelity to intervention. According to the interviews, parents perceived that the ART intervention was feasible and acceptable for their families overall, and felt that it would also be applicable to other Hispanic families of children with ASD. Families reported that they would continue implementing ART strategies after the program ended, but also provided suggestions for modifications.

Conclusions: ART appears to be a promising intervention option for US Hispanic, primarily-Spanish speaking families, particularly for families and children who share similar characteristics as the participants in this study. Explanations for the differences in parent and child outcomes are explored, providing guidance to professionals and families who are making decisions about early interventions, as well as to early intervention researchers conducting future studies with this population.

80 **123.080** Pilot Randomized Controlled Trial of the Effects of Reciprocal Imitation Training on Children with Autism

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Background: Children with autism exhibit pervasive social and communication difficulties, including particular deficits and delays in social imitation skills. Reciprocal Imitation Training (RIT) is a play-based behavioural intervention focused on increasing imitation skills and gesture use in individuals with autism. Previous research has demonstrated RIT to be effective for increasing spontaneous object and gesture-based imitation. However, a limitation in existing literature includes independent replication of effectiveness of intervention outside the parent lab.

Objectives: The current study is an attempted replication of the previous behavioural effects, as well as an examination of electroencephalographic (EEG) measures of brain activity as potential biomarkers for intervention effects.

Methods: Participants to date in this on-going Randomized Controlled Trial are 17 children with autism aged 2- to 6-years. Participants in the intervention group receive 20 sessions of RIT over a period of 12 weeks, relative to a Wait-List control group. Stratified randomization is conducted utilizing pre-defined chronological age and verbal ability criteria at intake. Pre- and post-intervention assessments include the verbal portion of the Mullen Scales of Early Learning, Autism Diagnostic Observation Schedule, and two experimental-behavioural change measures: Unstructured Imitation Assessment (UIA) and Structured Imitation Assessment (SIA), administered by experimenters who are blinded to intervention status. EEG assessments of auditory and visual human versus non-human action processing are also recorded at pre- and post-training.

Results: To date, we have analyzed data from the Unstructured Imitation Assessment. The effect of

the intervention was evaluated using repeated-measures ANOVA including Condition (Immediate Intervention, Wait-List) as a between-subjects factor and Time (Pre, Post) as a within-subjects factor. A significant Condition by Time interaction showed that children in the Immediate Intervention group (N = 9; pre-intervention M = 5.4, S.E. = 2.1; post-intervention M = 13.6, S.E. = 3.6) made significantly more gains in spontaneous imitation compared with children in the Wait-List group (N = 8; pre-intervention M = 7.9, S.E. = 3.1; post wait-list M = 6.8, S.E. = 3.8), F (1,15) = 8.47, p = .01, η_p^2 = .36. Follow-up t-tests on the intervention group data also supported this finding, where a significant difference between pre-intervention scores and post-intervention imitation was observed, t (9) = 3.73, p <.01. Preliminary results from an event-related potentials assessment of human versus non-human action sound processing will also be presented.

Conclusions: The current results suggest that children who received RIT showed significant improvements in spontaneous imitation during play with an unfamiliar adult, compared with children who were in a wait-list control group. Because reciprocal imitation of the actions of others in unstructured contexts is considered to be a core deficit that impacts negatively upon socialization and learning in this population, the results of this study are very encouraging. Although this study is on-going and the results preliminary at this point, these findings provide further support for RIT as an effective intervention for teaching critical social imitation skills to this population. Preliminary results from the ERP assessments of this study will provide an initial assessment of potential biomarkers for the observed intervention effects.

81 **123.081** Pivotal Response Treatment Alters Brain Function in Children with Autism
ABSTRACT WITHDRAWN

Background:
Autism Spectrum Disorder (ASD) is characterized by severe deficits in social information processing (Levy, Mandell, & Schultz, 2009), which are most visible in natural social settings (Volkmar et al., 2004). Pivotal response treatment (PRT) is a naturalistic behavioral intervention that promotes social communication development in children with ASD. Although PRT is an empirically validated treatment, the neural and behavioral mechanisms by which PRT is efficient are lacking.
Objectives:
We aim at identifying neural and behavioral mechanisms of PRT related improvements in the social functioning of children with ASD using well-validated eye-tracking and fMRI paradigms.
Methods:
We are randomly assigned 4- to 6-year-old children with ASD (N=20) to either a waitlist control group (WTC, n=10) or the PRT group (n=10). Additionally, we include typically developing children (TD, n=20, matched for age, sex and IQ) as a point of reference for the interpretation of changes in brain function and visual scan paths. All children are assessed twice, at time 1 (T1) and time 2 (T2) separated by a four-month interval, during which the PRT group receives treatment.
Results:
Preliminary eye-tracking data from 8 children with ASD (6 males) pre and post PRT indicates that at T2, the proportion of fixations on the mouth region significantly increases, relative to T1. FMRI analysis including 10 children with ASD (9 male) at T1 yields activity of the right fusiform gyrus, and the bilateral lateral occipital cortex for faces vs. houses. Analysis of treatment effects (T2 > T1) reveals significant increases in activity in the medial prefrontal cortex (MPFC) for social stimuli (faces vs. houses) in PRT (n=5) vs. WTC (n=5) group.
Conclusions:
Preliminary analyses of PRT-related effects indicate that the treatment modulates behavior and brain function. In particular, the MPFC has been closely linked to consciously engaging in social cognition (e.g., taking another's perspective into account (Amodio & Frith, 2006)). Increased activity in the MPFC after treatment might underlie the positive effects of PRT on social behavior.

82 **123.082** Pivotal Response Treatment Improves Neural Efficiency for Social Perception in Children with Autism Spectrum Disorder

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Background:
Individuals with autism spectrum disorder (ASD) demonstrate reduced social motivation, resulting in diminished attention to people and consequent dysfunction in the specialization of neural mechanisms associated with social behavior. This dysfunction has been reliably associated with a deficit in the neural response to face stimuli, indexed both functional neuroimaging and electrophysiological techniques. Pivotal Response Treatment (PRT) is an empirically validated behavioral treatment for ASD that focuses on improving key social and communication abilities by enhancing social motivation. Prior research from our group demonstrated that a 16-week PRT intervention results in meaningful improvements in pragmatic language, social engagement, and adaptive functioning (Ventola et al., 2014), with accompanying changes in regional brain activation (Voos et al., 2012). Effects of treatment on neural efficiency have not yet been studied. The current study utilizes electroencephalography (EEG), an imaging method with excellent temporal resolution,

to examine the temporal dynamics of brain responses associated with positive response to intervention.

Objectives:

To identify temporal changes in neural mechanisms associated with social perception following PRT treatment.

Methods:

Seven children with ASD between ages 4 and 6 years received PRT for 8 hours per week (child: 6 hours; parent: 2 hours) for 16 consecutive weeks. Participants completed an EEG session, recorded with a 128-channel Hydrocel Geodesic sensor net, both pre- and post-treatment. A waitlist control sample completed an EEG session 16 weeks prior to starting treatment to differentiate effects of treatment from those resulting from developmental changes over a four-month period. During the EEG sessions, participants viewed 73 distinct, computer-generated faces displaying neutral and fearful expressions. Data were segmented to onset of face stimuli and event-related potentials (ERPs) were extracted over the right occipitotemporal region. Changes in the amplitude and latency of early feature detection and face-sensitive ERP components (P100 and N170, respectively) were examined.

Results:

Results revealed a main effect of treatment [$F(1,6) = 11.34$, $p = .015$], indicating a change in the efficiency of face processing, indexed by N170 latency. Post-hoc paired samples t-tests revealed that the reduction in N170 latency was significant for both neutral ($p = .027$) and fearful ($p = .029$) face stimuli from pre-treatment to post-treatment assessments. There were no significant changes in N170 amplitude or in either P100 latency or amplitude ($p > .05$). There was no significant change in N170 latency across the 4-month period prior to treatment when participants were enrolled as waitlist controls [$F(1,2) = 2.45$, $p = .26$].

Conclusions:

A 4-month course of PRT for young children with ASD was associated with improved efficiency of neural indicators of social behavior. Effects of treatment were reflected in brain responses associated with social perception (N170), rather than low-level sensory processes (P100), suggesting focal treatment effects on social processing mechanisms. Preliminary data also revealed that a 4-month period of development without intervention does not result in similar changes in neural efficiency, indicating specific effects of treatment. These findings provide the first evidence of increased processing efficiency for social information resulting from PRT.

83   **123.083** Predicting Growth of Communication Skills of Preschoolers with Autism Spectrum Disorder during Treatment in a Community-Based Pivotal Response Treatment Program

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Background: Understanding the variable responses of children with ASD to current early intervention (EI) programs is a research priority (Vivanti et al., 2014). Attempts to understand this variability have examined global factors (e.g., IQ and age) and their relations to particular outcomes (e.g., IQ changes; Howlin et al., 2009). Increasingly, researchers are attempting to move beyond these immutable factors to examine empirically and theoretically informed predictors (baseline child characteristics). Such research aims to elucidate mechanisms of change, and ultimately to match interventions to individual profiles. A set of variables that together predicted response to Pivotal Response Treatment (PRT; Koegel & Koegel, 2006), in single-case design research (Scherer & Schreibman, 2005; Schreibman et al., 2009) were baseline levels of appropriate toy contact (ATC), social approach, social avoidance, stereotyped and repetitive vocalizations (SRV) and non-verbal behaviours. These variable have not yet been examined as group-level predictors of outcome among children with ASD. An additional variable, baseline positive child affect, is also of interest, given its role in early communication (Kasari et al., 1990) and negative association with emerging ASD (Garon et al., 2009).

Objectives: To determine whether variables identified by Scherer & Schreibman (2005), and child affect, predicted expressive language (EL) outcomes in an unselected sample of preschoolers with ASD in a PRT program.

Methods: Preschoolers with ASD (n=57) participated; mean baseline chronological age (CA) of 48.81 mo (SD = 8.97), mean baseline ratio IQ scores of 53.38 (SD = 20.35), and mean baseline severity of ASD symptoms (SRS T score) of 77.40 (SD = 9.99). Children were enrolled in a one-year community-based EI program (Bryson et al., 2007). The dependent variable, EL, was assessed by research examiners at baseline and after 12 months of EI, using the Preschool Language Scales, 4th ed. (Zimmerman, Steiner & Pond, 2002). Independent variables (i.e., ATC, Avoidance, SRV and affect) were coded blindly from baseline videos of children interacting with a therapist or a research examiner.

Relations between putative predictors and EL outcomes were examined using hierarchical linear regression. Baseline EL was entered as a predictor with IQ and chronological age. Based on the patterns of bivariate correlations, ATC, Avoidance, SRV and Affect were entered in a second step.

Results: The first step accounted for 84% ($p = .000$) of variability in 12-month EL outcomes. Higher baseline EL and IQ scores significantly predicted greater 12-month EL. Step two accounted for an additional 4% ($p = .005$) of outcome variability. Baseline EL remained a significant predictor. More

positive baseline child affect predicted greater 12-month EL outcomes; lower baseline ATC (p = .061) and avoidance (p = .056) were strong trends.
Conclusions: Positive affect emerged as a predictor of EL outcome in a PRT-based program for preschoolers with ASD, contributing variance in addition to that accounted for by previously established predictors such as baseline language and IQ. The predictor profile described by Sherer & Schreibman (2005) was not observed in this sample.

84 **123.084** Predictors of Successful Parent Training in Pivotal Response Treatment during the Jumpstart Program: Parent Mental Health and Self-Efficacy

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Background: Many behavioral treatment models for autism spectrum disorder (ASD) include a parent training component. Theoretically, this allows the caregiver to implement intervention consistently and in multiple environments without the presence of a professional behavioral interventionist (Steiner et al., 2012). Many parents are able to successfully implement pivotal response treatment (PRT), a naturalistic therapy based on the principles of applied behavior analysis, with fidelity; however, there is considerable variability in parent fidelity of implementation (FOI) and the amount of time necessary for parents to learn how to implement PRT with acceptable FOI (Coolican et al., 2010). Little is known about parent characteristics associated with successful parent implementation of PRT. Parent mental health and parenting self-efficacy (SE) have been identified as potential correlates (Guimond et al., 2008; Steiner et al., 2012). JumpStart is a 20-hour education and empowerment program for parents of children recently diagnosed with ASD. JumpStart meets twice a week for four weeks, and parents receive 11.25 hours of PRT training (didactic, observation, and in-vivo coaching).
Objectives: To examine: (1) changes in depression, parenting SE, parent FOI, and child responsivity among families who completed the JumpStart program, and (2) whether initial levels of depression and parenting SE predict changes in parent FOI and child responsivity.
Methods: Participants were 65 parents (46 mothers; age M = 35.15 years, SD = 5.84) of 49 children (42 males; age M = 40.25 months, SD= 11.73) with a clinical diagnosis of ASD or an at-risk classification. Families were predominantly Caucasian and middle- to upper-middle class. Parents completed the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977) and the Early Intervention Parenting Self-Efficacy Scales (EIPSES; Guimond et al., 2008) pre- and post-JumpStart participation. Videotaped 10-minute probes pre- and post-JumpStart were coded for overall parent FOI and child responsivity.
Results: There were significant decreases in depression symptoms (F(1, 46) = 9.74, p = .003, h^2 = .18) and increases in parenting SE (F (1, 49) = 20.73, p < .001, h^2 = .30), FOI (F (1, 46) = 77.90, p < .001, h^2 = .63), and child responsivity (F (1, 46) = 36.38, p < .001, h^2 = .44) pre- to post- JumpStart participation. These effects did not differ between mothers and fathers. Time 1 depression levels were not associated with pre-post changes in FOI (ρ = -.20, p= .19) or child responsivity (ρ = -.03, p = .87); nor were parent age, level of education, or household income. Time 1 parenting SE was positively associated with pre-post change in FOI and child responsivity (Table 1).
Conclusions: Findings indicate that participation in JumpStart reduces depression symptoms and increases parenting SE. From a family systems perspective, improvements in these domains may translate to improved outcomes and quality of life for children with ASD. Initial parenting SE predicted positive change in parent FOI and child responsivity. Thus, it may be useful to implement interventions targeting parenting SE prior to parent training in PRT in order to maximize parent FOI and improve child outcomes.

85 **123.085** Prevalence and Correlates of Use of Complementary and Alternative Medicine in Children with Autism Spectrum Disorder in Europe

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Background: Complementary and alternative medicine (CAM) comprises diverse health care systems, practices, and products not considered to be part of conventional medicine, including potentially unsafe or definitively disproven approaches. Children with ASD are treated with CAM at higher rates than the general population. In US samples, high parental educational level, lower level of functioning and high levels of use of conventional treatment increase the likelihood of CAM use.
Objectives: To report on prevalence and correlates of use of different categories of CAM among a sample of young children with ASD in Europe. Specifically, the following characteristics in relation to the likelihood of CAM use were examined: child's age, gender, verbal ability, use of prescription medication, level of use of conventional treatment, parental educational level.
Methods: Parents of children with ASD < 7 years completed an online survey on use of conventional, pharmacological and CAM treatments. The survey, translated in 19 languages, was distributed via national support associations in 20 countries.
Results: The survey yielded 1,680 responses. Forty seven percent of parents reported having used

one or more CAM approaches in the past 6 months; for these, the total number of different CAM approaches used ranged from 1 to 12 with a mean of 2.15 (SD=1.55; IQR: 1-3). Diets and other supplements were used by 25% of the sample, mind and body practices by 24% and other unconventional approaches by 25%. A minority of parents reported having tried an invasive or potentially harmful approach (2%). Children over 5 years and children with lower verbal ability were more likely to have used CAM. Use of any prescription medication was associated with using any CAM, particularly diets and supplements (two-fold increase). Concurrent high levels of use of conventional psychosocial interventions were associated with a three-fold increase in use of any CAM; the effect was four-fold for mind-and-body practices. Higher parental educational level also increased the likelihood of CAM use; both of diets and supplements and mind-body practices.
Conclusions: This was the first study to report on factors associated to use of CAM in a large sample of young children with autism in Europe. The study replicates the findings of high prevalence of CAM use among young children with ASD in non-EU samples. Use of CAM was positively associated with concurrent use of high number of conventional treatment, which is an indication that parents need to be supported in the choice of appropriate treatments early on in the assessment and diagnostic process.

86 **123.086** Receipt of Early Childhood Special Education and Therapeutic Services Prior to Autism Diagnostic Evaluations in Children Referred to a Regional Autism Clinic

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Background: The estimated lifetime cost to care for all individuals in the US with autism spectrum disorder (ASD) is $35 billion or $3.2 million per person. However, when early interventions are implemented, studies have shown potential savings of up to $208,500 per child across 18 years of education. Increasing recognition of ASD behaviors by families and primary pediatric health care providers has led to long wait lists at tertiary ASD diagnostic clinics and delays in formal ASD diagnoses. Whether such wait lists for ASD diagnostic evaluations delay referral to early interventions has not been previously investigated.
Objectives: To determine the prevalence of receipt of early intervention and therapeutic services in children prior to their diagnostic ASD evaluations and whether prior receipt of such services predicts an ASD diagnosis.
Methods: The electronic medical records of all children ≤ 5 years of age evaluated at a single regional ASD clinic between September 2012 and June 2014 were reviewed. Information regarding type of services, clinical diagnoses, and demographic information was abstracted for each patient.
Results: 561 children (mean age = 44 months [SD 10 months]; 80% [N=450] male; 20% [N=111] female) completed a diagnostic ASD evaluation. Of these children, 498 (89%) were already receiving early intervention services and only 63 (11%) were not receiving any services. Receipt of services did not vary based on race, ethnicity, insurance type, or primary language. Children who were already receiving services were more likely to receive an ASD diagnosis (67% [N=333]) than those not receiving services (43% [N=27]; p = .0002).
Conclusions: Despite concerns that long wait lists for diagnostic ASD evaluations may delay initiation of critical early interventions, our data indicate that a majority of children are receiving early intervention services prior to their diagnostic ASD evaluations, particularly if an ASD diagnosis is confirmed. This may be attributable to increased awareness among primary care providers and families of the importance of early interventions. Further investigation into access to more intensive and costly interventions (such as Applied Behavioral Analysis) once an ASD diagnosis is established is warranted.

87 **123.087** Reliability of Retrospective Parent Report: Hours and Type of Intervention

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Background: Research on ASD frequently relies on retrospective parent report to gather information about the child's behavioral profile as well as any interventions employed. Many intervention studies have utilized retrospective report to detail the type and intensity of interventions used by children in early development. Previous research has called into question the reliability of retrospective report in general; therefore it is important to understand whether we can rely on retrospective parent report to inform intervention practices.
Objectives:
The current study examines the agreement between parent's report of intervention at the time the child was receiving those services, and their retrospective report of those same services 5 years later.
Methods:
In a longitudinal study, 24 parents reported on the services their child had received during the past year when the child was approximately 4 years of age (M = 52.33, SD = 9.83; Time 1). The child returned for a follow-up evaluation at 9 years of age (M = 116.76, SD = 9.91; Time 2) and parents

were asked to recall the services their child received from 3-4 years of age.
Results:
Children most frequently received occupational therapy, speech therapy or ABA therapy. Correlation coefficients between therapy hours recalled at Time 1 and Time 2 were significant for all three types of therapy (OT: r = 0.46, p = .02; ST: r = 0.74, p < .001; ABA: r = 0.90, p < .001). Reliability between Time 1 and Time 2 reports was calculated using Cronbach's alpha and demonstrated good agreement across therapies: OT, α = 0.61; ST, α = 0.85; ABA, α = 0.94. Further types of interventions will be discussed.
Conclusions:
Although there was not perfect agreement between intervention hours reported at Time 1 and Time 2, the agreement between current and retrospective report was significant. The current study supports the validity of parent retrospective report to examine the effects of types and intensity of interventions on child outcomes.

88   **123.088** Sensory Treatment for Autism to Alleviate Tactile Abnormalities Reduces Severity of Autism and Improves Self-Regulation: A Randomized Controlled Trial in 100 Pre-School Children

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Background:
Two recent studies in pre-school children with autism showed the universal prevalence of tactile/oral abnormalities (pain and numbness) suggestive of tactile impairment. Severity of tactile abnormalities was linearly associated with self-regulatory delay and severity of autism. Concurrently, two small randomized controlled trials (n=47, n=46) evaluating treatment of tactile abnormalities showed a mean 25% decrease in severity of autism, providing initial evidence that tactile abnormalities may be a contributing cause of autism. Treatment was with a Chinese medicine-based massage protocol for autism given daily by parents and weekly by therapists for five-months. Treatment was effective in low and high-functioning children. This was important as there are currently few treatment options for low-functioning children.
Objectives: To replicate and extend earlier studies with a larger controlled study and determine whether sensory treatment for autism directed at tactile abnormalities decreases severity of autism.
Methods: 104 pre-school children with ASD were recruited, underwent confirmation of autism diagnosis by DSMIV criteria, and were randomly assigned to treatment and wait-list control groups. Pre-testing was accomplished by experienced autism examiners who were blind to group, and parents. The treatment group received 5 months of treatment, and post-testing was accomplished with the same examiners. Treatment was given at multiple sites by multiple trained therapists. No additional research-based autism treatments were initiated during the study period. Autism severity was measured by the CARS and Autism Behavior Checklist; sensory and self-regulatory abnormalities were measured with the Sense and Self-Regulation Checklist; language was measured with the PLS-5; parenting stress was measured with the Autism Parenting Stress Index.
Results: Repeat-measure multivariate analyses showed medium-to-large effect size on improvement of severity of autism (F(2,81)=5.71, p=.008, Partial η2=.113); large effect size on improvement tactile/oral and self-regulation abnormalities (F(3,80)=6.74, p<.0001, Partial η2=.202); and medium effect size on improvement of receptive language (F(1,83)=4.81, p=.031, Partial η2=.055). Univariate analysis showed large effect size on reduction of parenting stress (F(1,82)=15.69, p<.0001, Partial η2=.161). Treatment was effective in low and high functioning groups, indicating that language was not required for treatment to be effective.

Conclusions: Five months of sensory treatment for autism was effective in reducing tactile/oral and self-regulatory abnormalities, as well as in considerably reducing the severity of autism. With parent training and support, the program was readily implemented in the home. This treatment is the first to be effective in reducing severity of autism in low and high-functioning children, and can be helpful to families at the time of autism diagnosis. More improvement can be expected with longer-term treatment, and additional treatment and evaluation is underway.

89   **123.089** Student Change in Response to Early Achievements Intervention Translated for Public Preschool Classrooms

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Background: The substantial increase in students with autism spectrum disorder (ASD), combined with a decline in educational funding, makes the availability of cost-effective, evidence-based classroom intervention options vital to both student outcomes and special education costs. However, there is a troubling research-to-practice gap in educational settings for young children with ASD. Empirically-proven interventions for young students with ASD are often too complex, costly, or impractical for use in authentic educational settings. With these barriers in mind, intervention researchers must take into account the needs and characteristics of educators, their classrooms, and their students with ASD when developing and evaluating potential interventions.
Funded by an Institute for Education Science (IES) Goal 2 Development and Innovation grant, this

ongoing study's overall aims are to translate an existing evidence-based intervention (i.e., the Early Achievements model) for implementation in public preschool classrooms, thereby improving the outcomes of preschoolers with ASD. This presentation reports on data reflecting student change in response to the translated intervention, collected across the first two years of the study. These data are vital in guiding the final year of the study, which involves a small efficacy trial of the intervention and its associated professional development model.

Objectives: The objectives of this presentation are: (1) to describe the translated Early Achievements model and the associated professional development program provided to educators in participating classrooms; and (2) to share pilot data evidencing the promise of the intervention through reporting of student change.

Methods: The pilot data presented herein were obtained through a quasi-experimental pre-post design (treatment group only) with data captured at the start and end of the school year. Results across two years of study are presented. Demographic and baseline information will also be presented to describe the sample of students, their families, and the participating educators.

Results: Combined data across two years of pre-post comparisons of preschool student participants' (n=49) standardized assessment results showed a significant decrease in their *Autism Diagnostic Observation Schedule-2* calibrated severity scores ($p=.004$), significant gains in their *Mullen Scales of Early Learning* age equivalent scores across all subtests (p<.001 for all), and significant gains in their *Peabody Picture Vocabulary Test* standard scores ($p=.019$) and age equivalent scores ($p=.003$). Logistic regression results showed *Mullen* expressive language gains of 5 or more months from pre- to post-test were predicted by *Mullen* visual reception age equivalent scores at pre-test, as well as by sex of the participants.

Conclusions: This study's intent is to assess the promise and impact of an evidence-based clinical intervention program specifically translated for use in public preschool classrooms serving children with ASD. Results showing educators' successful uptake of the intervention were presented previously. Student gains presented here add to those results as further evidence of the effectiveness of both the professional development *and* intervention models. Language and visual reception gains indicate parallel gains in student attention and learning based on educators' increased understanding of development and increased use of strategies to enhance engagement. Further implications, discussion of regression results, and future directions will be included.

90 **123.090** Telehealth Delivery of Cognitive-Behavioral Intervention for Anxiety in Youth with ASD: Perspectives of Parents in Rural Communities

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Background: A comparative effectiveness review by AHRQ (2014) determined that there is now a "strong body of evidence" supporting cognitive-behavioral interventions targeting anxiety and mood symptoms in youth with ASD who are verbally fluent. For families living in rural communities, access to specialists who have been trained to deliver evidence-based treatments, such as CBT, is severely limited. Telehealth delivery of evidence-based interventions has the potential to improve access to services for rural families.   However, little is known about how to modify evidence-based protocols for delivery of psychosocial interventions through telehealth in a manner that is acceptable and feasible for families.

Objectives: To examine parent perceptions of credibility, feasibility and impact of a short-term telehealth intervention designed to reduce interference and severity of anxiety symptoms in youth with ASD. Results will inform revisions of the model in planning for a large, multi-site trial.

 Methods: Twenty-six parents participated in a pilot study of telehealth delivery of Facing Your Fears (FYF; Reaven et al., 2011), which is an empirically supported, manualized, multi-family group CBT for anxiety for youth with ASD. Parents completed several questionnaires focused on acceptability and feasibility of delivering mental health interventions directly to youth with ASD through videoconferencing before and after engaging in the intervention. Parents also completed a structured exit interview that probed for feedback regarding intervention content, delivery and impact. Efficacy data (published elsewhere) will be reviewed briefly and long-term follow-up measures of anxiety symptoms are being collected to assess sustainability of effects.

Results: Credibility and acceptability ratings by parents were consistently high before, during and after the intervention. Qualitative data from the exit interviews are being analyzed through Atlas, a software program that identifies emerging themes and associations amongst themes. Thus far, the majority of parents perceive telehealth as a viable option for improving access to specialty mental health care. Many cite the ease of engaging their son or daughter in a treatment session that occurs via the home computer as a benefit and several reported knowing of no local alternative to the services provided through this telehealth program. Few parents expressed any concerns about risks to confidentiality. The majority of families identified the need for ongoing support from project therapists, suggesting the importance of long-term sustainability.

Conclusions:

Parents who participated in a short-term, multi-family CBT intervention with their son/daughter with ASD via telehealth report that the approach is credible, acceptable and feasible. Analysis of their feedback regarding ways to improve the program are ongoing. Many parents have expressed interest in building sustainable models wherein clinicians can be accessed as needed by project

91   **123.091** The Effect of an Outdoor Adventure Program on Functioning of Children with Autism Spectrum Disorder

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Background:
Challenge in the outdoors is important for people with and without disabilities. The outdoor environment intensifies group interaction and development. Individuals with cognitive and/or motor disabilities benefit from participation in outdoor adventure programs and show increased outdoor recreation skills, enhanced self-concept, self-esteem, social adjustment, positive behavior changes, increased interpersonal relationships, and sensitivity to the needs of others. The effect of outdoor adventure programs (OAP) on the functioning of children with autism spectrum disorder (ASD) has not yet been examined.
Objectives:
The aim of the current study was to examine the effect of OAP for children with ASD on autism severity, adaptive skills, and the kindergarten (KG) teacher's perception of the child's 'future competence'.
Methods:
Fifty-one participants recruited from seven special education KGs for ASD using the same educational curriculum in Tel Aviv, with an age range of 3:4-7:4 years (M=5:4, SD=.9) were enrolled in this study. Four KGs including 31 participants were randomly selected to participate in an OAP (research group). The other three KGs included 20 participants who did not participate in this program (the control group). The groups did not differ in age and sex. The OAP included 13 weekly sessions of 30 minutes each provided by professional recreation specialists from "ETGARIM", a non-profit organization. Activities included: climbing and descending a ladder; a rope elevator requiring group collaboration by pulling a child tied to a harness; walking on ropes tied to trees requiring a request for the instructors' help, and swinging on a hanging hammock. Pre-and post-evaluation of autism severity (Social Responsiveness Scale-SRS), adaptive skills (Vineland Adaptive Behavior Scales- VABS) and perception of the KG teacher on 'future competence' (a questionnaire based on several sources and modified by the authors) were conducted.
Results:
Outcome in autism severity revealed a significant TimeXGroup interaction. At post-intervention time, the research group showed a significant reduction in autism severity on the SRS composite and specific subdomains (cognition, motivation and repetitive behaviors scores), while the control group showed an increase in autism severity in these measures. Further analyzing the differences between the groups using T tests revealed that only the research group showed significant improvements in SRS communication, $p<0.05$) and motivation ($p<0.05$) subdomains. At post-intervention time, only the control group had more severe SRS composite, $p<0.05$) and repetitive behaviors ($p<0.05$) scores. The two groups showed significant improvements over time in VABS communication and daily living skills scores. No significant TimeXGroup interaction was found for VABS scores nor for the 'future competence' questionnaire scores. Dividing the groups at baseline into two autism severity subgroups based on the SRS scores revealed that only the low autism severity subgroup that received intervention showed significant improvements on the VABS DLS scores ($p<0.05$) and on 'future competence' questionnaire scores ($p<0.05$).
Conclusions:
Outdoor adventure programs for children with ASD improve measures of autism severity and prevent deterioration in socio-communication skills and repetitive behaviors. Children with less severe autism symptoms benefit from this program and improve in adaptive skills. Including an outdoor adventure program in the intervention plan in ASD is recommended.

92   **123.092** The Effects of Teacher Perceptions on Fostering Engagement during Dyadic Play Interactions with Students with ASD

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Background: Children with an autism spectrum disorder (ASD) are less likely to be jointly engaged with a play partner than typically developing children (Adamson, Bakeman, Deckner, & Romski 2009). Being in a joint engaged state during play provides educators an optimal environment to target social communication skills, such as joint attention. It is especially important then for teachers to use strategies that promote engagement for students with ASD.
Objectives: The aim of this study was to investigate how teachers' perceptions about their students with ASD influenced their use of strategies to engage with their students during dyadic play interactions. Specifically, we examined how teachers perceived their students' ability to control of

their ASD related behaviors, and how this perception relates to strategies that foster engagement.
Methods:
Participants: We included preschool aged students with ASD (mean = 48 months), 82% male, and from diverse ethnic backgrounds (12.1% African American, 30.3% Caucasian, 18.2% Latino, 15.2% Asian, and 18.2% other). Twelve teachers from six ASD preschool classrooms (two teachers from each class) located around the greater Los Angeles area participated.
Measures: Teachers completed questionnaires rating their students' ability to control behaviors associated with ASD: social interaction, non-verbal communication, repetitive interests/behaviors, and sensory seeking behavior. For these four domains, teachers were given a brief description of behaviors associated with ASD, and asked to rate each child on their ability to control those behaviors. Scores across all four domains were totaled to create a composite score representing teachers' perceptions of each student's ability to control ASD related behaviors. Teachers and students were filmed during a ten minute dyadic play interaction in the classroom. Videotapes were scored for teachers' appropriate use of strategies to promote engagement during the play interaction, resulting in an overall teacher strategies score. Strategies included appropriate matching of affect, response to dysregulation, providing opportunities for students to initiate play, responding to student initiation of play and communication, and modeling language matched to verbal ability. Students were administered the Mullen Scales for Early Learning (Mullen, 1989) to assess expressive language.
Results: Multiple regression analysis revealed that teachers' perceptions of a student's ability to control ASD behavior predicted overall teacher strategies scores during dyadic play interactions, while accounting for students' expressive language ability ($\beta = .015$, $p < .05$). Teachers' perceptions of a student's ability to control ASD behavior accounted for an additional 14% of variance in teacher strategies scores ($DR^2 = .147$). Correlation analysis of specific strategies showed that teachers' perception was positively correlated with appropriate responding to child initiated social communication ($r(45) = .35$, $p < .05$) and appropriate language strategies ($r(45) = .31$, $p < .05$).
Conclusions: These findings indicate that teachers' perception of students' ability to control ASD behavior is associated with strategies used during play interactions. Teachers tended to more appropriately use strategies promoting engagement when students were perceived to be better able to control their ASD behavior. Specifically, teachers scored better in actively responding to the student's initiations and using language that matches the student's abilities.

93 **123.093** Toddlers and Families Together: Caregiver Implementation and Perceptions of Strategies to Facilitate Joint Engagement

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Background:
Research on early intervention programs targeting toddlers with or at risk for autism spectrum disorder (ASD) primarily involve individual sessions with the caregiver and child in the home which may be isolating or impractical for some families. In Toddlers and Families Together (*Together*), toddlers and their families participate in eight weekly group sessions that take place during the weekend and focus on increasing joint engagement with their child. Specifically, families have an opportunity to practice strategies and receive feedback within a context of everyday routines and activities for toddlers (e.g., play, snack, art, gross motor, music) within 3-hour long group sessions that also include a family education/support segment to learn and discuss strategies with a facilitator and other caregivers while the toddlers are engaged in various learning activities.
Objectives:
With an overarching goal of promoting joint engagement for children with ASD through the *Together* program, the specific questions of this study include:

1. Does participation in the program result in changes in caregiver implementation of strategies to facilitate joint engagement with their children?
2. After participating, what are caregiver perceptions of the strategies and the program?

Methods:
The study utilized a multiple baseline design across four toddlers (24-31 months) with or at risk for ASD and their families that included an initial baseline period (of 4, 6, 8, or 10 weeks) followed by participation in the 8-week *Together* program. The weekly sessions included a 10-minutes video-recorded interaction between the child and the primary caregiver that was rated on eight items that were scored on a three-point Likert scale for implementation of strategies to promote joint engagement. In addition, at the end of treatment, caregivers completed a brief questionnaire reporting their ability (e.g., time, comfort, confidence) to implement and perceptions (acceptability) of the treatment strategies. Families also participated in a semi-structured interview to provide their opinions about the intervention.
Results:
Results show increased caregiver implementation of strategies during intervention and demonstrated family acceptability of the intervention. Visual analysis indicates a functional relationship between the intervention and caregiver implementation of the strategies with increased level changes observed

during the intervention phases for all caregivers. Furthermore caregiver responses to the questionnaire and interview indicated overall acceptability of the strategies and program. Most family members felt comfortable and confident with the strategies but did note that it did take a little effort and time to implement the strategies. They also reported that the family support/education sessions were the most helpful aspect of the intervention.

Conclusions:
The results from this SCD provide preliminary efficacy and social validity data supporting the *Together* program. However, further study needs to test the program with a larger sample of children and families in randomized controlled trial. Furthermore, additional analysis is required to examine caregiver outcomes of stress and coping as well as child outcomes of joint engagement. Overall, it may be beneficial to both toddlers and families to use a group-based model of intervention for families of young children with or at risk for ASD.

94 **123.094** Using EEG to Target GABA-a for the Treatment of Social Disability in Young Adults with Autism Spectrum Disorders

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Background:
Identification of biological targets could represent opportunities to intervene and ameliorate core pathophysiology in ASD. Changes in resting and activated neuronal network oscillatory activity across various frequency bands are evident in ASD. To this end, NIMH Fast Fail Trial in AS Network evaluated one compound, AZ7325 (a $GABA_{a2/a3}$ partial agonist), by examining its target engagement, safety and tolerability, and preliminary efficacy indices. The GABA system shows strong evidence of disruption in ASD and EEG has been investigated as translational biomarkers for examining putative decreased GABA signaling. Most models of temporally organized oscillatory activity interpret the activity as the output of network interactions between interconnected glutamatergic pyramidal cells and GABAergic inhibitory interneurons (Bartos et al 2007), wherein GABAA signaling mediates phasic inhibitory control of excitatory pyramidal firing, the source of the EEG signal.

Objectives:
Our hypothesis is that administration of a selective $GABA_{a2/a3}$ receptor partial agonist in an adult ASD sample is expected to result in specific EEG signatures of drug action consistent with selective target engagement.

Methods:
In Phase 1 (EEG Biomarker Validation): a battery of 4 EEG paradigms consisting of resting state, face perception, sensory perception, and frontal functioning were developed. Pilot data were collected on 39 controls and 12 adults with ASD from 3 sites. All data were collected using high density EEG under standardized settings. Each data file was artifact detected using Independent Component Analysis, and key features included the presence of posterior alpha activity in eyes closed and a N170 component to face stimuli. Analyses compared the ASD and Controls for identification of a biomarker that differentiated group functioning. In Phase 2 (Double Blind Placebo Control Study), 24 adults with ASD from 3 sites were screened on the EEG paradigm and assessed for inclusion based on the identified biomarker.

Results:
Although there were few significant differences between ASD and Controls on a specific variable (e.g., non significant delta, theta, alpha ps>.10), a linear discriminant analysis consisting of 3 metrics (from resting state eyes closed and faces) were combined to provide a sensitivity of .8 and specificity of .7 for separation between groups. Using this combined marker as an inclusion criteria, we are currently completing Phase 2. Upon completion in Dec, the blind will be broken and analysis of baseline vs week 4 and week 6 EEG will be conducted for the active vs. placebo group.

Conclusions:
Fast Fail AS is the first trial to develop a targeted EEG biomarker for use in investigating a GABA deficit in ASD. This study of AZD7325 may provide insight into the relevance of GABAergic medications in ASD and the role of EEG as a marker of treatment response.

95 **123.095** Why High-Risk Families Decline Early Treatment: Barriers to Treating at-Risk Siblings

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Background: Prospective studies of infant siblings that later develop autism show the emergence of symptoms within the first year of life (Ozonoff, et al., 2010, Macari et al., 2012). A small body of literature explores the treatment of very young children at high risk for ASD (Bradshaw et al., 2014).

The subset of studies that examine the feasibility of intervention for very young infants, 12 months of age or younger, have small sample sizes suggesting parents may decline these types of services. Little research has been conducted on the factors that influence parents' decisions to enroll their infant, who does not yet have a clinical diagnosis, in very early intervention.

Objectives: The purpose of this study was to examine factors influencing decision making of high risk families to participate in early social communicative treatments for their at-risk infant.

Methods: Twenty eight participants, 12-18 months, were evaluated from a prospective study examining infant siblings at risk for developing ASD. Infants exhibiting delays in social communication were invited to participate in a 12-week adapted Pivotal Response Treatment (PRT). Questionnaires measuring degree of parental concern for their infant's development were collected. An interview was conducted with families who declined participation or discontinued treatment.

Results: Of the 28 HR infants who were evaluated, 17 (61%) met inclusion criteria. Twelve families (71%) declined participation. Five families (29%) elected to enroll in treatment. Of these five, three (60%) discontinued participation within the first four sessions. The following factors were reported by the 15 families (88%) who declined participation or discontinued treatment. Five families (33%) reported more than one factor impeding participation.

Factor 1: Distance to the Clinic. Seven families (47%) reported distance as a factor. All of these families lived >50 miles round trip from the Clinic.

Factor 2: Early Intervention. Two families (11%) enrolled in state provided home based early intervention instead of our clinic-based treatment.

Factor 3: Family Commitments. Three families (13%) reported significant commitments at home related to the older siblings with Autism and other disabilities.

Factor 4: Parental Concern. Five families (33%) reported little to no concern regarding their child's development despite clinicians concerns.

Factor 5: Unknown. Three families (20%) did not provide a reason for declining treatment.

Conclusions: Results from this pilot study indicated that few families expressed interest in treatment. Although many families reported distance to the clinic as a barrier, for others, home based intervention was more practical. Others declined treatment because of family commitments involving older siblings with disabilities in the home. A proportion of families did not express the same level of concern for their child's development as the clinicians. One interpretation of this mismatch is that parents may be comparing the development of their younger child with the older sibling who has autism, often minimizing the developmental concerns of the younger child. While treating high risk infants who demonstrate developmental delays may seem intuitive, this preliminary study suggests continued research is needed regarding the feasibility of these types of very early treatments.

96 **123.096** Efficacy of Adapted Responsive Teaching in a Community Sample of One-Year-Olds at-Risk for ASD

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Background: Contemporary theories emphasize the transactional influences of biology and environment on neurodevelopment (Beauchaine et al. 2008). Infants at-risk for ASD are vulnerable to disrupted neural connectivity (e.g., Dinstein et al., 2011; Righi et al., 2014); thus, introducing behavioral intervention soon after the first birthday, when neural shaping processes become prevalent (Webb et al., 2001), may be key timing to promote more typical neural development and, subsequently, more typical child-environment transactions. The efficacy of interventions for infants at-risk for ASD before all ASD diagnostic symptoms emerge has been examined previously only in small samples.

Objectives: To determine whether (1) a parent-mediated intervention, Adapted Responsive Teaching (ART; adapted from Mahoney & MacDonald 2007) impacts expressive communication (ExpCom) outcomes of one-year-olds at-risk for ASD; (2) ART is differentially efficacious as a function of parental stress or infant nonverbal cognitive skills at pretest; (3) ART impacts caregiver interaction styles.

Methods: 87 infants scoring at-risk for ASD on the First Year Inventory (Baranek et al., 2003) were enrolled in a randomized controlled trial at 13 to 15 months, along with a primary caregiver of each. Staff provided all families with information about community early intervention services, and monitored participants through monthly phone calls. Families randomized to the control group received no further services from project staff. Families randomized to ART participated in a manualized intervention entailing ~30 one-hour home sessions over 6 to 8 months. ART uses a variety of responsive strategies to promote pivotal behaviors in the social-communication and sensory-regulatory domains, with planned individualization. The interventionist provides caregivers with a rationale for each session's focus, demonstrates and coaches new responsive strategies, and discusses caregivers' observations of their infants' behaviors and responses. Assessors, blind to group assignment, completed assessments with the infants and caregivers immediately before and

after the intervention phase.

Results: Analyses are preliminary. All models covaried for child gender and caregiver education, as well as the pretest scores corresponding to posttest outcomes. There were no significant group differences on posttest ExpCom. Parental Stress Scale (Berry & Jones, 1995) scores did not moderate the effects of ART. However, pretest Visual Reception (VR) T-scores (Mullen, 1995) interacted with treatment group in that infants with low VR scores assigned to ART showed fewer gains on ExpCom than infants in the control group, whereas infants with high VR scores assigned to ART showed greater gains, $t = 2.57$, $p = .012$ (Figure 1). No group effect was apparent on the Maternal Behavior Responsiveness Scale (Mahoney et al. 1986) for Responsiveness, Achievement or Directiveness, but parents in the ART group had higher posttest ratings on Affect, Cohen's $d = .71$, $p < .01$.

Conclusions: The moderating effect of VR on ExpCom outcomes of infants assigned to ART reinforces the importance of determining how to best fit interventions to child and family characteristics. The impact of ART on parent affect raises the possibility of more distal effects on child outcomes due to changes in parent interaction style. Future research should be directed at both issues.

Poster Session
124 - Early Development (<48 months)
5:30 PM - 7:00 PM - Imperial Ballroom

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97   **124.097** 18-Month Predictors of Later Outcomes in Younger Siblings of Children with Autism Spectrum Disorder: A Bsrc Study

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Background: Younger siblings of children with Autism Spectrum Disorder (ASD) are at high risk (HR) for developing ASD, as well as features of the broader autism phenotype. While this complicates early diagnostic considerations in this cohort, it also provides an opportunity to examine patterns of behavior associated specifically with ASD as compared to other developmental outcomes.

Objectives: We examined (1) combinations of behavioral features at 18 months that are associated with ASD diagnosis at 3 years, and (2) the factors that affect accurate identification at 18 months of HR siblings who receive a diagnosis of ASD at 3 years of age.

Methods: We applied a nonparametric decision-tree learning algorithm, Classification and Regression Trees (CART) analysis, to individual items of the Module 1 Autism Diagnostic Observation Schedule in 719 HR siblings to identify behavioral features at 18 months that are predictive of diagnostic outcomes at 36 months. CART analysis allows for selection of the most predictive features from a multiplicity of behavioral symptoms *and* their interactions, resulting in a parsimonious mapping of different sets of predictors of later outcomes.

Results: Three combinations of features at 18 months were predictive of ASD outcome: 1) poor eye contact and lack of communicative gestures and giving; 2) poor eye contact and a lack of imitative or spontaneous imaginative play; and 3) lack of giving and presence of repetitive stereotyped behaviors despite intact eye contact (**Figure 1**). These behavioral profiles predicted ASD versus non-ASD status at 36 months with 82.7% accuracy in the initial test sample and 77.3% accuracy in a validation sample. Clinical features at age 3 years among children with ASD varied as a function of their 18-month symptom profiles (**Figure 2**). Cases with ASD who were missed at 18 months were higher functioning and their autism symptoms increased over time.

Conclusions: A large minority of HR siblings with ASD display marked symptoms at 18 months, whereas in others, symptoms become pronounced after 18 months, suggesting at least two windows of opportunity for identification of the affected cases in clinical settings. Several combinations of clinical features at 18 months were predictive of ASD outcome, each associated with a different developmental course and clinical profile by the 3 years of age. Combined, these findings suggest the presence of different developmental pathways to the common diagnostic ASD outcome, pathways characterized by distinct combinations of early markers, reinforcing the need for repeated screening in the first three years of life to identify individual cases of ASD as their behavioral symptoms appear.

124.098 A Comparison of Live Versus Video Modalities for Measurement of Eye Contact in Infants at Age 6 Months As 'Red Flags' for ASD

*A. Townsend[1], J. A. Chevallier[2], **P. A. Filipek[1]**, C. Laufer[1], M. M. Abdullah[3], P. Horner[3], J. T. Phan[3], K. Pham[3], K. Jung[1] and J. M. Williams[1], (1)University of Texas Health Science Center at Houston, Houston, TX, (2)UT Houston, Houston, TX, (3)University of California, Irvine, Irvine, CA*

Background: Considerable research in infants-at-risk for ASD (IAR) has focused on eye-tracking devices to measure the degree of eye contact, with variable results at age 6-months (mos). Many studies of eye fixation show abnormalities developing between 6- to 12-mos of age, often reporting no differences from typical infants at 6-mos but significant differences in eye gaze patterns by 12-mos. However, Jones and Klin showed that at-risk infants had a mean decline in eye fixations from 2- to 6-mos that continued to decline to ~50% of typical infants by 24-mos, while object fixations nearly doubled.[1] By 6-mos, Chawarska *et al.* showed that IAR spend more time engaged in abstract stimuli and disengaged from pertinent social stimuli, and gaze less at the inner features of the face compared to low risk infants.[2,3] These findings suggest that IAR already do not attend to the salient facial features necessary for social communication in very early infancy.[4]

Objectives: To compare two eye gaze modalities in 6-month-old infants who were later classified as either ADOS-Toddler Module (ADOS-T) positive (ASD+) or Non-Spectrum (N/S) as toddlers: conventional eye-tracking with caregiver's face presented on a monitor (FTM) *versus* face-to-face (FTF).

Methods: Twenty-three 6-mos old infants interacted with their caregiver during traditional Still-Face (SF) paradigms while eye contact was recorded under two conditions:

- with a conventional Tobii eye-tracking device (FTM), and
- FTF recorded with a fiber-optic eyeglass camera.

Each infant had psychometric testing including the ADOS-T in the second year of life. ADOS-T classification was used to divide the subjects *post-hoc* into ASD+ (n=10) and N/S (n=13) groups. Trained blinded researchers coded eye contact data using Tobii 1.73 and Noldus X10. Fixation length (FL), fixation count (FC), and mean duration (MD) of eye contact were subjected to ANOVAs to compare the two groups; only effect sizes greater than 0.5 were considered to be meaningful differences between the two groups.

Results:

- Both groups generally had higher FL and MD of eye contact in FTF-SF than in FTM-SF interactions.
- However, during FTF-SF, the ASD+ group had significantly lower FL and MD of eye contact than the N/S group (p≤ 0.001).
- The ASD+ group also surprisingly had a longer FL in FTF than FTM interactions, but had a greater FC in FTM than FTF interactions.

Conclusions: As noted by several other studies, ASD+ infants displayed eye contact behaviors similar to that of N/S infants during FTM video interactions at 6-mos. In contrast, in FTF interactions ASD+ infants had fewer fixations with shorter durations than did the N/S infants. Live social interactions may be a more sensitive experimental tool than computerized eye-tracking technology in detecting anomalous eye contact in ASD+ infants as young as 6-mos.

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2. Chawarska K, Shic F. *JADD* 2009;39:1663-1672.
3. Chawarska K, Macari S, Shic F. *Biol Psychiatry* 2013;74:195-203.
4**.** Hunnius S, Geuze RH. *Infant Behav Dev* 2004;27:397-416.

124.099 A Computational Approach to Eye-Tracking Analysis Reveals Slower Orienting to Movements in Social Scenes in Toddlers with ASD

***Q. Wang**, S. Macari, K. Chawarska and F. Shic, Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Complex, naturalistic, dynamic scenes are becoming increasingly prevalent in eye-tracking research on autism spectrum disorder (ASD). However, conventional analyses with predefined Areas of Interests (AOI) have limitations: they are created subjectively, are hard to apply to dynamic stimuli, and have a binary definition ("in" or "out"). Computational approaches may provide alternative analytical quantitative frameworks that are more automated, less arbitrary, and that highlight more nuanced features of atypical scanning strategies in ASD.

Objectives: To develop a framework for examining motion-driven visual scanning during observation of naturalistic scenes. We use this framework to compare the visual scanning patterns of toddlers with ASD and typically developing (TD) controls.

Methods: Participants included 20 month-old toddlers with ASD (n=99), developmental delays (DD, n=56), and TD (n=111). Toddlers freely viewed a dynamic 3-minute scene with four probes (Dyadic Speech, Sandwich-Making, Joint Attention, and Animated Toys), which was broken down into contiguous 100 ms segments for analysis. We first conducted a Cohesion Analysis of TD scanning

patterns (Shic et al., 2012). We used three-fold cross validation to compute a 'cohesive score,' calculated by the sum of the inverse distances between each participants' gaze position and that of a subset of TD toddlers for each segment. Next, we computed the optical flow (Horn and Schunck, 1981; Sun et al., 2010), i.e. the relative motion at pixel level between frames in scene. We conducted a Latency Analysis to find the temporal lag between gaze orienting and motion in scene that maximized the average optical flow indexed by the participant's gaze orienting positions (Maximal Optical Flow). Correlations were computed between cohesive scores, maximal optical flow magnitudes, and behavioral characteristics of toddlers with ASD.

Results: Cohesion Analysis: ASD scanning patterns deviated from both DD and TD groups on cohesive scores (p< .01, p<.001) in all four probes, with no significant differences between DD and TD groups. Latency Analysis: The ASD group responded more slowly to motion than the TD group (p<.05), but not the DD group. This effect was driven by the Joint Attention (p<.05) and Sandwich-Making (p<.05) probes. Maximal Optical Flow: On average, toddlers with ASD looked less at motion than TD and DD groups (p<.05, p<.05), particularly in the Sandwich-Making probe (p<.001, p<.001). Correlations: Strong correlations between cohesion and the optical flow magnitude for all groups (r>.76, p<.001) suggest that motion has a strong organizing influence on looking behavior. Toddlers with ASD with higher cohesion scores presented with higher verbal (r=.21, p<0.05) and non-verbal (r=.22, p<0.05) DQ and lower ADOS autism severity (r=-.21, p<.05); those with longer lags had higher ADOS autism severity (r=.22, p<.05).

Conclusions: Our results suggest that, as a group, toddlers with ASD react slower toward movement in social scenes, and that this behavior is associated with developmental level and social deficits. These techniques may help characterize the nature of atypical scanning patterns in ASD and lead to new, automated instruments for identifying early symptoms of ASD.

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100 **124.100** A Dynamic Eye-Tracking Paradigm: Eye Gaze Patterns in Typically Developing and Infants at-Risk for Autism

C. Parikh and A. M. Mastergeorge, Family Studies and Human Development, University of Arizona, Tucson, AZ

Background: The ability to follow the gaze of others is an essential advancement in the development of social attention. Eye gaze sets the foundation for the initiation of joint visual attention and understanding the intentions, mental states, and goals of others (Gredeback et al., 2008; Jones & Klin, 2013). Deficits in eye contact and gaze have been hallmarks of autism spectrum disorders (ASD; Chawarska et al., 2012; Swanson et al., 2013). A recent focus on comparisons between typical (TD) and at-risk development of visual fixation patterns using eye-tracking paradigms may be a proxy for early indicators of gaze discontinuity and may classify the phenotypic behaviors of infants' visual attention patterns for early identification and intervention purposes (Frank et al., 2014; Merin et al., 2007).

Objectives: To examine preliminary individual differences in eye gaze patterns in TD and infants at-risk for autism.

Methods: Participants include 37 males and 31 females consisting of ($N = 60$) TD and ($N = 8$) infants at-risk for autism with chronological ages ranging from 3 to 12 months ($M = 7.59$, $SD = 3.35$). Participants were considered to be at-risk if they had an older sibling diagnosed with ASD. A Tobii Studio eye-tracking model captured the visual fixation patterns during a dynamic clip of *Peter Pan*. The total on-screen area was divided into areas of interests (AOIs) including eyes of the characters, mouth and chin region, and a salient object (ball) region. Gaze fixation counts and duration were calculated by measuring the frequency and duration of each individual fixation made within an AOI.

Results: Table 1 displays results of a 2-way ANOVA that examined the effect of developmental status (TD or at-risk) and age (3, 6, 9, and 12 months) on total gaze fixation. There was a significant effect of developmental status on total gaze fixation counts within the AOIs, $F(1, 60) = 5.57$, $p < 0.05$, $\omega = 0.13$. There was a non-significant effect of age ($p = 0.32$) and an interaction term between age and developmental status ($p = 0.67$). Independent samples T-tests were conducted to compare average gaze duration within AOIs (eyes, mouth, and object) in TD and at-risk groups. There was a significant difference in gaze duration towards the mouth between TD ($M = 5.46$, $SD = 5.38$) and at-risk groups ($M = 1.94$, $SD = 2.12$); $t(66) = 1.82$, $p < 0.05$. A significant difference was also found for gaze duration on the eyes between TD ($M = 6.80$, $SD = 6.16$) and at-risk groups ($M = 2.44$, $SD = 1.62$); $t(66) = 1.98$, $p< 0.01$ (see Figure 1).

Conclusions: This study was designed to understand the differences that exist in TD and infants at-risk for ASD for gaze patterns as they relate to social attention within the first year of life. Few studies focus on eye gaze trajectories during dynamic social paradigms in young infants. This study contributes to understanding early neurodevelopmental and endophenotypic mechanisms that could inform later atypical development.

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101 **124.101** A Novel Parent Report Questionnaire of Early Behavioral Signs Between 6 and 24 Months of Age: The Autism Parent Screen for Infants

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Background: Identifying early impairments in children who will subsequently be diagnosed with Autism Spectrum Disorder (ASD) is crucial to ensure that they gain timely access to interventions that will improve functional outcomes. Although prospective studies of high-risk infants have increasingly focused on direct observation of infants' behavior during interactive assessments, prospective parent reports may provide valuable and complementary information. Parents are familiar with the infant's naturally occurring behaviors across varied contexts. This study reports on a novel parent-report questionnaire, the 'Autism Parent Screen for Infants' (APSI), which was developed as a parent-report analogue of the Autism Observation Scale for Infants (AOSI), an observational assessment designed to elicit ASD-related behaviors (Bryson et al., 2008).

Objectives: Our primary objective was to examine whether APSI scores distinguish high-risk infants ('HR'; older sibling diagnosed with ASD) who were diagnosed with ASD at 36 months from other HR and low-risk infants ('LR'; no family history of ASD) on repeat assessments from ages 6 to 24 months.

Methods: *Participants*: Three groups of children: (1) HR siblings who did not receive an ASD diagnosis at 36 months (HR-N; n = 138), (2) HR siblings who did receive a diagnosis of ASD at 36 months (HR-ASD; n = 66), and (3) infants without a family history of ASD (LR; n = 79). ASD diagnoses were based on an independent expert clinical assessment using the ADOS and ADI-R.

Parent Report Questionnaire: The APSI is a 26-item forced-choice questionnaire modeled in content from the AOSI (Bryson et al., 2008), thus including items enquiring about atypical patterns of eye contact, visual tracking, responding to name, imitation, language, social development, joint attention, gestures, play, visual examination of objects, and emotional regulation. Parents of LR and HR infants completed the APSI at 6, 9, 12, 15, 18 and 24 months.

Statistical Analyses: Performance on the APSI was compared using linear mixed modeling with Group (HR-ASD, HR-N, LR) and Age as Independent measures and APSI scores as the Dependent measure. Total scale score and groupings of questions by developmental domain (social-communication, sensory stimulation, temperament, and motor skills) were compared and group by age interactions were explored using Benjamini & Hochberg (1995) corrections.

Results: Total score on the APSI differentiated the HR-ASD group from HR-N and LR beginning at 6 months and at each subsequent age ($q < .036$). Subgroupings of questions also differentiated the HR-ASD group from the other two groups; social-communication at each time-point between 6 and 24 months ($q < .039$), temperament/reactivity from 12 to 24 months ($q < .025$), and sensory stimulation and motor skills from 9 to 24 months ($q < .031$; $q < .025$. respectively). Estimates of sensitivity and specificity at 12 months were 0.61 and 0.70, respectively.

Conclusions: The APSI shows promise as a simple, low-cost parent-report monitoring tool, which may lead to earlier identification of risk and implementation of interventions to remediate problematic behavior in children at-risk for ASD.

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102 **124.102** A Preliminary Investigation of Child, Caregiver and Sociocultural Factors Influencing Caregiver-Reported Autistic Trait Scores on the Quantitative – Checklist for Autism in Toddlers (Q-CHAT) in an Unselected Sample of Asian Toddlers

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Background: There is increasing research evidence that individuals with a diagnosis of ASD lie at the extreme end of a continuum of quantifiable autistic traits and that there is moderate to high heritability of these traits in child, adolescent and adult community samples. Given this shift towards a dimensional conceptualization of ASD, a range of measures have been developed to dimensionally measure and quantify autistic traits, but to our knowledge only the Q-CHAT is available to measure autistic traits and related symptoms in toddlers. Autistic traits research has largely, if not exclusively, relied on informant report of sub-threshold symptoms, without considering whether other individual, informant or sociocultural factors may affect the reporting of autistic traits.

Objectives: This study aimed to explore the relationship between caregiver-reported autistic traits and a range of individual child (gender, IQ, birth order, verbal skills), maternal and socio-cultural

variables (maternal age, education, depressive symptoms and ethnicity). Specifically, the relationship of these variables with Q-CHAT Total as well as Factor scores (social/ communication; repetitive behavior; and language/ speech subscales derived following exploratory factor analysis) was examined.

Methods: Participants were 396 2-year old toddlers (205 males) from a sample of caregivers and their children recruited into an ongoing large longitudinal birth cohort study in Singapore (GUSTO – Growing Up in Singapore Towards Healthy Outcomes) who had completed the Q-CHAT at the 2-year old follow-up of this study. Demographic information was collected in earlier stages of the study and mothers also completed a measure of depressive symptoms at various time-points throughout the study.

Results: In preliminary regression analyses, children's higher verbal/ language scores predicted lower (i.e. less severe) Q-CHAT total, social-communicative factor and language factor scores. Increased maternal depressive symptoms also predicted higher Q-CHAT total and factor scores. When all child and maternal characteristics were considered together, maternal education, maternal depressive symptoms, children's birth order and verbal/ language scores were significant predictors of Q-CHAT total and behavioural trait scores. Child gender and IQ and ethnicity were not predictive of any autistic trait scores.

Conclusions: The findings from this study are discussed in relation to existing literature examining the potential influence of child and caregiver characteristics in reporting autistic traits and symptoms. The potential limitations of relying exclusively on informant-based measures of autistic traits for research examining autistic traits and the broader autism phenotype in unselected samples or families of individuals with ASD respectively is also discussed.

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103   **124.103** Acoustic Properties of Affective Vocalizations Produced By Six-Month-Old High- and Low-Risk Infants

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Background:
Intonation emerges in infancy, at approximately six months, in response to physiological changes to the vocal tract, perceptual biases and linguistic influences within the infant's environment (Stark et al., 1993). While nuclear intonation provides linguistic information, affective intonation conveys emotion (Cruttenden, 1997). Atypical cry intonation may emerge as young as six months in high-risk infants and may be a precursor of later affective intonation deficits associated with ASD (Sheinkopf et al., 2012). Despite recent literature regarding the vocalizations of high-risk infants, little is known about the acoustic properties of affective vocalizations in this population.
Objectives:
To examine the acoustic properties of affective vocalizations produced by six-month-old high- and low-risk infants.
Methods:
Thirty high-risk (HR) and twenty low-risk (LR) six-month-old infants were recruited from a larger study examining ASD symptoms in the first three years of life**.** A subset of the sample was coded for this abstract ($n = 7$), including four high-risk and three low-risk infants. At age three, all HR infants in this subset received an ASD diagnosis, and all LR infants were typically developing (TD). Five-minute speech samples were collected during quasi-naturalistic parent-child interactions (Paul et al., 2010). A research assistant blind to risk status acousticaly coded vocalizations for pitch range and mean fundamental frequency using Praat (Boersma, 2014). Vocalizations were also assigned a perceptual rating of either affective (i.e. positive or negative) or neutral (not conveying affect). Volubility of vocalizations was computed.
Results:
Both groups produced similar proportions of affective ($M_{hr} = 0.69$, $M_{lr} = 0.58$) and neutral ($M_{hr} = 0.31$, $M_{lr} = 0.42$) vocalizations. Independent t-tests revealed no significant effect of risk status on volubility for affective ($t(5) = -1.35$, $p = 0.24$) or neutral ($t(5) = -1.06$, $p = 0.34$) vocalizations. A linear mixed model analysis showed a main effect of affect ($F(1, 173.93) = 6.38$, $p < 0.05$; affective > neutral) and a trend toward an effect of risk status ($F(1,5.88) = 4.13$, $p = 0.09$; HR > LR) on pitch range. Planned comparisons also suggested trends toward between-group differences in pitch range for affective vocalizations ($F(1, 7.45) = 4.67$, $p = 0.07$; $HR_{affective} > LR_{affective}$). An additional linear mixed model revealed a main effect of affect ($F(1,158.23) = 19.38$, $p < 0.001$; affective > neutral) and a trend toward an effect of risk status ($F(1,5.22) = 3.09$, $p = 0.14$; HR > LR) on mean fundamental frequency.
Conclusions:
These preliminary results reveal intonation trends in the affective vocalizations produced by six-month-old HR infants later diagnosed with ASD. In this subset, HR infants produced higher- and more variably-pitched affective vocalizations. Analyses of the total sample will ascertain whether the observed trends translate into reliable effects. If so, as early as six months, HR infants' vocalizations may be shown to exhibit acoustic differences that are not evident perceptually (Paul et al., 2010). Ongoing full-sample analyses will include comparisons between 1) affective categories (positive and negative) and 2) diagnostic groups (HR-ASD, HR-BAP (broader autism phenotype), and LR-TD). We will

present the full sample at IMFAR.

104 **124.104** Adaptive Behavior Profiles in Toddlers with Autism Spectrum Disorders

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Background: Efforts have been made to lower the age at which ASD is first diagnosed. Additional diagnostic information, such as cognitive and adaptive behavior testing, can supplement results from an autism assessment to help improve clinical decision making. Several studies have explored the differences in adaptive behavior between children with autism spectrum disorder (ASD) and other developmental disabilities. An "autism profile" of adaptive behavior has been identified that ranks Vineland Adaptive Behavior Scale domain scores, from highest to lowest, as motor, daily living, communication, and socialization scales. Perry, Flanagan, Geier, et al. (2009) confirmed this profile in a large sample of children under 6 years, finding that children with ASD scored lower than children with ID on communication and socialization scores. Of interest is whether the same adaptive behavior profile is also found in toddlers aged 12 to 36 months since the introduction of the Vineland – II (VABS-II), the DSM-5 revised diagnostic criteria, and tools allowing for the earlier identification of ASD, such as the ADOS-Toddler Module.
Objectives: To identify and compare adaptive behavior profiles of toddlers diagnosed with ASD versus global developmental delay (GDD) based on DSM-5 criteria in a sample of toddlers referred to the developmental assessment center of a pediatric hospital.
Methods: A retrospective chart review was conducted to review clinical assessment records of children presenting for a diagnostic evaluation at the developmental disabilities clinic of a large Midwestern pediatric hospital. Children who presented with concerns of ASD or a developmental delay were evaluated using DSM-5 criteria, cognitive assessments, the VABS-II, and the appropriate ADOS module (Toddler, 1, or 2 few to no words) if concerns of ASD were presented. A final sample of toddlers with ASD (n=54) and global developmental delay (n=54) was used.
Results: VABS-II communication and daily living skills scores were significantly correlated with Mullen Early Learning Composite scores for toddlers with ASD. For the ASD sample administered with ADOS-Toddler module, a moderate negative correlation was found between VABS-II communication, socialization, and daily living skills scores and ADOS scores. VABS-II subdomain scores confirmed a pattern similar to that found by other studies of the "autism profile" in toddlers diagnosed with ASD using DSM-5 criteria. Additionally, toddlers with ASD were found to have comparable scores on the daily living and motor scales to toddlers with global developmental delay. Toddlers with ASD had significantly lower communication and socialization scores than toddlers with global developmental delay.
Conclusions: The "autism profile" of adaptive behavior is relevant for toddlers aged 12-36 months, and remains relevant for use with newer assessment tools and systems, specifically the VABS-II, and the DSM-5 criteria for ASD. This profile should be considered to supplement clinical decision making when required to make a differential diagnosis between ASD and another disorder in toddlers.
References: Perry, A., Flanagan, H. E., Geier, J. D., & Freeman, N. L. (2009). Brief Report: The Vineland Adaptive Behavior Scales in Young Children with Autism Spectrum Disorders at Different Cognitive Levels. Journal of Autism and Developmental Disorders, 39(7), 1066–1078.

105 **124.105** An Autism Screening Tool for Underserved Young Children: Preliminary Findings

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Background: Significant disparities have been identified among poor and minority children in the identification and treatment of ASD. Late diagnosis leads to later enrollment in intervention and potentially poorer outcomes. Multiple barriers to early diagnosis of underserved children may include reduced utility of existing ASD screening tools which require reading comprehension and parental recognition of behaviors that may be red flags for ASD.
Objectives: The objective of this study is to improve the identification of young children with ASD from traditionally underserved populations by refining and testing the utility of a new, visual ASD screening tool, the Developmental Check- In (DCI).
Methods: Items for the DCI were selected based on behaviors or skills noted to have the highest item discrimination on the ADOS and other measures, as well as based on clinical experience. Both photographs and line drawings were created to depict each item. In order to determine if the visual images were identified by parents from underserved populations as depicting the behavior or skill intended, cognitive interviews were conducted with parents of children with ASD or typically developing children from low income, racial or ethnic minorities or those with Spanish as the primary language.   Parents were also questioned regarding preference for line drawings or photographs.
  The target population of this study was children at risk for ASD between the ages of 24-60 months from minority groups, and/or with Medicaid as insurance, and/or whose parents speak Spanish as a primary language. 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 DCI, M-CHAT-R, Social Communication Questionnaire, 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. Hypothesis: The DCI will more accurately predict ASD diagnosis in this underserved population in comparison to MCHAT-R or SCQ.

Results: Photographs of the DCI items were better accepted and understood than were line drawings. For several of the items, direct translation of item labels into Spanish was confusing to parents who required more descriptive labels in order to adequately identify intent of the visual depiction. To date,   87 subjects have been evaluated with approximately 280 subjects expected by time of presentation.   Demographic data to date confirms representation of an underserved population with 55% of subjects reporting Hispanic/Latino ethnicity, 43% had a primary language other English and 97% of subjects had Medicaid coverage. Further analyses including comparison of the DCI to other ASD screening tools will be conducted by the time of presentation.

Conclusions: The results of this study will provide important information about the utility of a pictorial screening tool in a population in which English comprehension and literacy preclude the use of more text intensive screening strategies.

106   **124.106** Anogenital Distance (AGD): A Novel Biomarker of Elevated Fetal Androgen Activity in Toddlers with Autism?

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Background: During a critical period of prenatal brain development, fetal steroid hormones, particularly fetal testosterone (fT), may contribute to the etiology of autism, as fT is elevated in children who go on to develop autism spectrum conditions (ASC) and is positively correlated to autistic traits in typically developing (TD) children. Direct measure of fetal steroids is only possible in convenience samples of women undergoing amniocentesis. Thus, a robust biomarker of fT exposure is needed to assess the contribution of fT to the autism phenotype in wider studies. Right hand 2nd digit to 4th digit (R2D:4D) ratio, a biomarker of fT activity, has been previously shown to be masculinized in ASC. However, R2D:4D is also influenced by postnatal steroid levels, and the effect size of sex upon fT is weak, especially in early development, limiting its utility as a biomarker of fT activity. Anogenital distance (AGD), which is determined by fT in the prenatal male programming window (gestational weeks 8-14), has been suggested as a superior biomarker of fT activity.

Objectives: To test whether toddlers with ASC have increased AGD, indicative of increased fetal androgen activity, compared to controls.

Methods: Anopenile distance was measured in male toddlers with ASC (n=29) and in male controls (n=24) using electronic callipers. Groups were frequency matched on age and BMI (ASC n=28, control n=12).

Results: Groups did not differ on age or BMI (p>0.05). Males with ASC had a longer AGD than controls. (Mean ± SD; ASC 80.6 ± 7.4, CTR 74.8 ± 8.9, p = 0.017, Cohen's d=0.71).

Conclusions: Consistent with the predicted role of fT in the development of autism, children with ASC had significantly greater AGD, indicating increased fT activity during gestational weeks 8-14. With further research, AGD may be a useful biomarker, measurable at birth, for risk of ASC linked to elevated prenatal testosterone activity in autism.

107   **124.107** Associations Between Behavior Problems and Dopaminergic Variants in High- and Low-Risk Siblings

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Background: Children with autism spectrum disorder (ASD), as well as their younger siblings (high-risk siblings), exhibit substantial heterogeneity in behaviors. Children's behavior problems have important implications both for children with ASD and their families. High levels of internalizing and externalizing behavior problems have been reported in both children with ASD (Mahan & Matson, 2011; Maskey, Warnell, Parr, Couteur, & McConachie, 2013) and in their high-risk siblings (Fisman et al., 1996; Rodrigue, Geffken, & Morgan, 1993; Verte, Roeyers, & Buysse, 2003). In children with ASD, behavior problems are also associated with the severity of ASD symptomatology (Pearson et al., 2006), as well as broader family factors such parent stress and depression (Davis & Carter, 2008; Ekas & Whitman, 2010). In typically developing children and children with ASD, dopaminergic variants have been associated with behavioral difficulties. As behavior problems may be particularly relevant to ASD symptomatology and family emotional factors in high-risk siblings, identifying common genetic variants

associated with behavior problems would enable potential early identification of behavioral targets for early intervention.

Objectives: Examine the role of dopaminergic variants associated with behavior problems, *DRD4* and *DRD2*, in externalizing and internalizing problems at three years in siblings at high and low risk for ASD.

Methods: High-risk (*n*=37) and low-risk (*n*=27) siblings were genotyped for *DRD4* and *DRD2*. A dopamine gene score was created for each child, ranging from 0-2, indicating the number of alleles associated with lower dopaminergic functioning (7-repeat allele of *DRD4* and A allele of *DRD2*). At 36 months, parents reported behavior problems (Externalizing and Internalizing Problems) using the Child Behavior Checklist (CBCL).

Results: Regression models were constructed for CBCL Externalizing and Internalizing Problems to assess effects of the dopamine score, risk group status, and their interaction. For Externalizing Problems (see **Figure 1**), neither status, b=-0.55, *t*=-1.37, *p*=.89, nor dopamine score, b=-3.95, *t*=-1.20, *p*=.24, were significant predictors. There was a dopamine score*status interaction effect, b=8.97, *t*=2.06, *p*=.045, suggesting a moderating role for status. For Internalizing Problems (see **Figure 2**), neither status, b=-2.71, *t*=-0.79, *p*=.43, nor dopamine score, b=-4.35, *t*=-1.55, *p*=.13, were significant predictors. There was a dopamine score*status interaction effect, b=11.73, *t*=3.17, *p*=.003, again suggesting a moderating role for status.

Conclusions: Associations between dopaminergic functioning and behavior problems were moderated by risk group. Lower dopaminergic functioning (indexed by higher dopamine gene scores) was associated with higher levels of behavior problems (externalizing and internalizing) at three years in high-risk siblings. Low-risk siblings exhibited the opposite pattern, suggesting differential susceptibility. In the presence of familial risk for ASD, lower dopaminergic function was associated with increased behavior problems. Knowledge of common genetic variants associated with ASD-relevant behaviors may aid in identifying those high-risk siblings at greatest risk for difficulties relevant to ASD-related outcomes and family functioning. Those high-risk siblings at greatest genetic risk represent an appropriate target for prophylactic early intervention.

108 **124.108** Attention Shifting from Emotional Faces in High-Risk Infants and Relations with Later Social-Communicative Behavior

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Background: Studies with individuals with ASD and their first-degree relatives have found difficulties in face processing as well as more general atypicalities in visual attention. Prospective studies of infants at high-risk for autism (HRA; defined as having an older sibling with ASD) allow researchers to examine the origins of these difficulties to help understand how these domains could be linked to later developmental difficulties.

Objectives: The present study examined attention disengagement from emotional faces in HRA and low-risk control (LRC) infants. Attention shifting was then analyzed alongside prospective social-communicative behavior with the aim of using early visual attention to predict later development within the broader autism phenotype.

Methods: Attention disengagement in HRA and LRC was tested in 6- (HRA: 30; LRC: 34), 9- (HRA: 34; LRC: 25), and 12-month-olds (HRA: 29; LRC: 28). Infants receiving a subsequent clinical judgment of ASD were not included in the present sample. Each trial presented one of three emotional faces (happy, fearful, neutral) in the center of the screen for 1s, then the face remained present while a distracter appeared on the left or right. A Tobii T60 eye-tracker recorded gaze, and for each emotion, latency to shift from face to distracter and percentage of no-shift trials were calculated. Parents completed the Communication and Symbolic Behavior Scales (CSBS) at 18 months.

Results: For latency to shift from faces, infants showed a main effect of emotion ($p = .012$), with slower shifting from fearful as compared with happy and neutral faces ($ps < .015$). A significant age*group interaction was also found ($p = .025$), with LRC showing decreasing shift latency with age, while HRA show the opposite pattern (Figure 1). Analysis of no-shift percentage revealed a main effect of emotion ($p < .001$), with a greater percentage of no-shifts found for fearful faces compared with happy and neutral ($ps < .05$), and happy greater than neutral ($p = .027$). A significant age*group interaction ($p = .033$) revealed that HRA show increasing no-shift percentage with age, while LRC show no age-related differences. Correlations were run at each age between eye-tracking measures and CSBS 18-month social and total scores. At 6 months, HRA showed a positive association between disengagement latency from fearful faces and CSBS total scores ($p = .044$; Figure 2). At 9 months, HRA showed a positive association between no-shift percentage to fearful faces and CSBS social scores ($p = .05$). No other correlations were significant.

Conclusions: Similar to past work, we found slower shifting and increased no-shifts for fearful faces, and this emotion-specific pattern was comparable for LRC and HRA. HRA infants with more normative responses to fearful faces also showed better social-communicative outcomes. Across emotions, our results show diverging trajectories of increasing and decreasing disengagement efficiency during the first year of life in low-risk and high-risk infants, respectively. These findings are representative of the broader autism phenotype, as this sample excluded infants with an ASD diagnosis. Future work will examine whether infants later diagnosed with ASD differ on these emotion and attentional measures.

124.109 Attention and Proximity to Threat Among Toddlers with Autism Spectrum Disorders

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Background: Among children with autism spectrum disorders (ASD), comorbidity with anxiety disorders later in life is common, affecting up to 40% of youth with ASD (van Steensel, Bogels, & Perrin, 2011). In non-ASD populations, social inhibition and anxiety have been linked to individual differences in attention and proximity to a threatening stimulus during early childhood (Crockenberg & Leerkes, 2004, 2006). Little is known about proximity and attention to threat or their relationship to negative affectivity, a precursor to later anxiety, among toddlers with ASD.
Objectives: The first goal was to investigate differences between toddlers with ASD and TD in terms of attention and proximity to threat. The second goal was to investigate the associations between these variables and parent-reported negative affectivity.
Methods: Participants were 20 toddlers from 13.9 to 28.3 months of age (M=20.6 months) with ASD (n=12) and typical development (TD; n=8). Behavioral samples were taken from the Spider Episode portion of the Laboratory Temperament Assessment Battery (LabTAB; Goldsmith, et al., 1987), during which children sat next to their parents as a large, realistic remote-controlled spider crawled toward them. Proximity variables included proportion of the episode the participant spent approaching the spider, staying in place/not moving, or escaping. Attention was measured using the proportion of the episode spent looking at or away from the spider. Negative Affectivity was derived from the Early Childhood Behavior Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006) with subscales including Fear, Discomfort, Frustration, Motor Activation, Perceptual Sensitivity, Sadness, Shyness, and Soothability.
Results: Groups differed in proximity to the spider, with toddlers with ASD approaching for a larger proportion of the episode compared to toddlers with TD, $t(18) = -2.01$, $p = .06$. The TD group stayed in place for a larger proportion compared to the group with ASD, $t(18) = 2.18$, $p = .04$. Effect sizes were large: approach, $d = .95$; staying in place, $d = 1.03$. Groups did not differ in the time spent escaping from, looking at, or looking away from the spider. Within both groups, the Negative Affectivity composite was moderately positively correlated with proportion of time spent escaping ($r = .38$, $p = .12$).
Conclusions: Our findings show that toddlers with ASD are more likely to approach a threatening stimulus than toddlers with TD, who are more likely to stay in place compared to the ASD group. Higher levels of approach suggest an atypical response to threat in very young children with ASD. Additionally, longer escape behavior was observed in those toddlers with greater parent-reported negative affectivity, highlighting the relationship between a fear response (escape) and a precursor of anxiety (negative affectivity). By May, we expect to have results for approximately 35 children in each group (N= 70). With these greater numbers we will be able to evaluate correlations within both the ASD and TD groups.

124.110 Attention to Conspecific Auditory Information in Infants at-Risk for Autism

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Background: In typical development, infants demonstrate perceptual biases that direct their attention to socially relevant, conspecific information (e.g., voices and faces of the same species; Johnson, Dziurawiec, Ellis, & Morton, 1991; Vouloumanos & Werker, 2004, 2007), which may facilitate infants' ability to become competent linguistic and social beings (e.g., Tomasello, 2008; Werker & Curtin, 2005). For example, 3-month-olds prefer looking at human faces over gorilla and monkey faces (Heron-Delaney, Wirth, & Pascalis, 2011) and they prefer listening to human speech over nonspeech and rhesus monkey vocalizations (Shultz & Vouloumanos, 2010, Vouloumanos, et al., 2010). However, children diagnosed with Autism Spectrum Disorder (ASD) process auditory and visual information from conspecifics differently (Kuhl, et al., 2005; Chawarska, Volkmar, & Klin, 2010). Differences in these early biases could have cascading effects in development, suggesting that atypical conspecific biases in infancy may form the basis of the social communication difficulties characteristic of ASD (Surian & Siegal, 2008; Volkmar, Chawarska, & Klin, 2005).
Objectives: To examine whether 7 to 9-month-old infant siblings of children diagnosed with ASD (SIBS-A) attend to auditory conspecific information in the same way as infant siblings of typically developing children (SIBS-TD). Approximately 19% of SIBS-A will also be diagnosed with ASD by 3 years of age, thus representing a high-risk population of interest to researchers examining the early development of ASD (Ozonoff, et al., 2011).
Methods: Infants were tested using the Infant-controlled Sequential Looking Preference Procedure (*see* Cooper & Aslin, 1990, 1994). The infants viewed 6 test trials consisting of 3 human speech ('keev', 'ploo', 'boola', etc.) and 3 monkey call (coos, girneys, warbles) trials paired with the static image of a bullseye on a monitor. Stimulus presentation was contingent on infants looking toward the monitor. We hypothesized that SIBS-TD would look longer to the human speech test trials and that SIBS-A would not differentially attend to either trial type.
Results: We found a significant interaction between risk group status and attention to the human speech versus monkey calls, $F(1, 63) = 4.16$, $p = .046$. Follow-up comparisons revealed that SIBS-TD

($n = 41$) looked significantly longer during the monkey call trials ($M = 19.75$s, $SD = 9.01$) versus the human speech trials ($M = 16.49$s, $SD = 9.16$; $t(1, 40)=2.77$, $p = .009$); whereas SIBS-A ($n = 24$) did not demonstrate a clear preference for either stimulus (human: $M = 17.71$s, $SD = 9.01$; monkey: $M = 17.27$s, $SD = 8.45$; $p = .729$).

Conclusions: Our hypothesis was partially supported in that SIBS-A did not demonstrate a clear preference for either trial type, whereas SIBS-TD preferred the monkey calls. Stimulus preferences may shift during development such that younger infants prefer familiarity whereas older infants prefer novelty (Hunter & Ames, 1988). Compared with younger infants who prefer human speech over monkey calls (Vouloumanos et al., 2010), our results suggest a possible shift toward preferences for novelty by 7 to 9 months in TD infants in favour of monkey calls. These findings may have implications for the development of social communication.

111   **124.111** Attentional Protective Factors in Typically-Developing 6-Month-Old Girls at High-Risk for Autism

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Attentional Protective Factors in Typically-Developing 6-month-old Girls at High-Risk for Autism

Background: Recent studies have highlighted potential neuroprotective factors against the development of ASD that are associated with being of female gender (Robinson et al., 2013). Prospective longitudinal studies of the infant siblings of children with ASD offer the possibility of examining how these gender-specific neuroprotective factors manifest developmentally in those siblings who go on to show typical development. Given recent evidence that infant siblings who go on to develop ASD show atypical patterns of visual scanning of social scenes in the first year of life (Chawarksa et al., 2013; Klin et al., 2013; Shic et al., 2014), it is possible that gender differences in visual exploration may manifest early in development in the attentional patterns in unaffected siblings.

Objectives: To use eye tracking to examine gender differences in looking patterns towards social scenes in the first two years of life in high-risk (HR) infant siblings who receive a later diagnosis of typical development.

Methods: Participants were high- and low-risk (LR) infant siblings of children with ASD enrolled in a prospective, longitudinal study of social attention and who were judged by a multidisciplinary diagnostic team to have typically developing (TYP) outcomes at 24 or 36 months of age: HR-TYP F (n=23), HR-TYP M (n=25), LR-TYP F (n=30), LR-TYP M (n=29). All groups were comparable and in the typical range for: chronological age, verbal and nonverbal ability, and presence of autism symptoms. Participants were presented with videos of an actress emulating a bid for dyadic engagement (Spontaneous Social Monitoring Task; Chawarska et al., 2013,2014) at 6, 12, 18, and 24 months of age while their scanning patterns were recording using eye tracking. Outcome measures included longitudinal changes percentage of time looking at the scene (%Valid), the actress (%Person), and her mouth (%Mouth).

Results: Longitudinal mixed effects modeling with quadratic effects of age and fixed effect of group showed increasing %Valid and %Mouth with age in all groups (p<.05). In the LR-TYP group no gender effects were observed at any time point on any outcome measure. Relative to the LR group, the HR-TYP boys showed diminished %Valid at 12 and 18 months (p<.05) and trends for diminished %Mouth before from 6 to 18 months (p~.10). The HR-TYP girls showed increased %Valid relative to HR-TYP boys and LR-TYP girls (p<.05), and greater %Person and %Mouth compared to all other groups (p<.05).

Conclusions: High-risk infant sibling girls who develop typically show heightened attentional responses to social and communicative information early in development relative to both high-risk typically developing boys and low-risk infants. These results contrast with observed viewing strategies in high-risk TD boys, who show some evidence of residual scanning strategies more similar to HR-boys who develop ASD. Given positive predictive relationships between mouth looking and later language acquisition, and the importance of attending to people in social motivation frameworks of ASD, our results are consistent with increased risk in HR boys and attentional protective factors in HR girls.

112   **124.112** Can ASD and ADHD Symptoms in Children with Autism Predict Early Attentional Disengagement in Their Infant Siblings?

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Background: Studies with infants with older siblings with autism spectrum disorder (ASD) (probands) suggest that difficulties in visual disengagement may be one of the earliest emerging features of ASD (Zwaigenbaum et al., 2005; Elsabbagh et al., 2009; Elsabbagh et al., 2013). At 9-10 months, infant siblings of children with ASD took significantly longer to disengage from a central fixation and orient to peripheral stimuli compared to low-risk controls (Elsabbagh et al, 2009). To date, no studies have investigated whether ASD or attention-deficit/hyperactivity disorder (ADHD) symptoms in the proband predict attentional disengagement in their infant siblings. As ASD co-occurs frequently with ADHD, a

condition in part characterized by attentional difficulties, there is a need to consider the role of ADHD symptoms in early attentional markers of ASD.

Objectives: To examine the relation between ASD and ADHD symptoms in probands and attentional disengagement in their infant siblings at 8 and 14 months.

Methods: A cohort of 108 infants with an older sibling with ASD completed the gap-overlap task (Elsabbagh et al, 2009) at 8 months and 14 months. In a series of trials, infants were presented with a central stimulus (CS) followed by a peripheral stimulus (PS); reaction time (RT) to saccade to the PS was measured using eye-tracking technology. There were three conditions: Baseline (CS disappeared as PS onset), Gap (CS disappeared 200ms prior to PS onset) and Overlap (CS and PS on screen at the same time). Key dependent variables at 8 month and 14 months were the number of trials in which the infant failed to saccade to the PS within 1.2 seconds of onset, and mean RT in the Overlap condition. Proband ASD symptoms were measured with the Social Communication Questionnaire (SCQ), and ADHD symptoms with the hyperactivity and inattention symptom subscale of the Strengths and Difficulties Questionnaire (SDQ) reported by the parents on the children with ASD (mean age = 7.05 years, S.D.=2.46; 91% male).

Results: More severe proband ASD symptoms predicted more frequent disengagement failure (rho = 0.29, p<0.01), and slower disengagement times at 8 months (t=-2.61, p=0.01); but not at 14 months (rho = 0.03, p=0.73; t=-0.58, p=0.56; respectively). Proband ADHD symptoms did not relate to disengagement failure in infant siblings at either time points (all ps>0.30). However, more severe proband ADHD symptoms significantly predicted faster disengagement speed in the infant siblings at 8 months (t=-2.61, p=0.01) but not at 14 months (t=-0.58, p=0.56).

Conclusions: Proband ASD and ADHD symptoms predicted infant sibling attentional disengagement at 8 months, but this effect was not observed at 14 months. While greater levels of ASD symptoms in probands related to greater difficulty with disengaging from the central stimulus, proband ADHD symptoms predicted faster orienting in overlap conditions. Our findings highlight the importance of taking into account ADHD symptoms when studying infants with familial risks for ASD.

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113   **124.113**   Catching up Vs. Falling behind: Longitudinal Investigation of Developmental and Adaptive Skills in Toddlers with ASD

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Background: Previous research has demonstrated deficits in adaptive skills in toddlers with ASD, particularly socialization skills (Ventola et al., 2014). Likewise, high-risk samples have characterized various trajectories of developmental skills in ASD between infancy and toddlerhood, with a recent study identifying stable-average and declining trajectories as those most common (Brian et al., 2014). However, the trajectory of adaptive skills and their relation to overall development in early toddlerhood (i.e., age 3 and earlier) is less clear.

Objectives: This study seeks to examine longitudinal changes in developmental and adaptive skills among toddlers with ASD.

Methods: Participants included 24 toddlers (20 males) from a community-referred sample whose families expressed developmental concerns and enrolled in a longitudinal study on social engagement. Two separate visits spanned an average of 15 months (mean age in months at initial visit = 22.89, SD = 4.38), and first-time ASD diagnoses were provided by a multidisciplinary team. Families were offered recommendations regarding interventions that they might choose to pursue (87.5% of families reported subsequent involvement in intervention, with speech therapy, occupational therapy, and special education most commonly endorsed). In addition to the Autism Diagnostic Observation Schedule, Second Edition, toddlers completed a developmental assessment (Mullen Scales of Early Learning) and parents completed an interview on their child's adaptive behavior (Vineland Adaptive Behavior Scales, Second Edition) at both visits. Analyses compared standardized scores across time points.

Results: Paired-samples t-tests indicated that Mullen t-scores improved significantly between the two visits on the scales of Receptive Language, $t(23)$ = -3.86, p < .01, and Expressive Language, $t(23)$ = -2.35, p = .03, with a trend in the direction of scores on Visual Reception having improved significantly, $t(23)$ = -1.98, p = .06 (Table 1). However, Fine Motor t-scores became significantly worse between visits, $t(23)$ = 2.47, p = .02. Paired-samples t-tests with Vineland Standard Scores indicated that Communication skills improved significantly between visits, $t(23)$ = -2.72, p = .01, while Daily Living Skills remained statistically unchanged, $t(23)$ = 1.56, p = .13. However, adaptive skills of both Socialization, $t(23)$ = 2.86, p = .01, and Motor Skills, $t(23)$ = 2.90, p = .01, became significantly worse.

Conclusions: Across most scales/domains of the Mullen and Vineland, community-referred toddlers with ASD evidenced developmental progress between their second year of life and approximately age three, as represented by significantly improved standard scores (Receptive Language, Expressive Language, Communication), or standard scores that remained comparable across time points (Visual Reception, Daily Living Skills). Standard scores in the area of Motor Skills became significantly worse on both measures. Interestingly, despite improved scores in the areas of Receptive and Expressive Language, and also Communication, toddlers evidenced significantly worse Vineland scores in the domain of Socialization. Results highlight the need for interventions that target not only increasing speech/communication, but also improving social interaction, play, and motor skills, which in spite of

treatment continue to fall rapidly behind relative to peers. Future research should seek to identify interventions that embed socially-oriented goals into all treatments for young children with ASD.

114 **124.114** Cerebellum Enlargement in 4-6-Month-Old Infants at High Familial Risk of Autism Spectrum Disorders

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Background: Imaging studies of typical brain development highlight that the first two years of life are a time of dynamic growth. However, very little is known about early brain development in infants at high familial risk of autism spectrum disorder (ASD), prior to the age of two. At present, only two other groups have studied high-risk infants at 6-months of age, with one group finding no significant differences in intracranial, cerebrum, cerebellum or lateral ventricular volume (Hazlett et al., 2012), and the other finding significant enlargements in total brain volume and extra-axial fluid (Shen et al., 2013).

Objectives: In this study, magnetic resonance imaging (MRI) was used to investigate the differences in regional brain volumes from a sample of 4-6-month-old infants at high-risk of ASD, relative to a group of infants at low-risk. Infants were considered to be at 'high-risk' if they had an older sibling with a diagnosis of ASD, and at 'low-risk' if they had an older sibling who was typically-developing.

Methods: 31 (n=22 'high-risk', n=9 'low-risk') infants were scanned in natural sleep at 4-6-months of age on a 1.5T scanner. T2-weighted structural MRI images were acquired. The images were volumetrically segmented following an in-house automated protocol, which was based on the intensity distributions of the regions of interest, and made use of a probabilistic atlas. Following this, manual editing was carried out 'blind' to participant group. The intracranial, subcortical grey, total cerebrospinal fluid, cerebellum, midbrain, and lateral ventricular volumes were compared between groups, using a General Linear Model. The analysis was conducted on SPSS v.21, and the model controlled for age and gender.

Results: We found a significant group difference in the cerebellar volume [$F_{(1,23)}=4.420$, $p=0.047$], with the infants at high-risk of ASD showing a significantly greater volume than those at low-risk. In addition, we also found a significant group by age interaction [$F_{(1,23)}=4.307$, $p=0.049$], which was explained by a distinct relationship between age and cerebellar volume in infants at high-risk of ASD ($r=0.807$, $p=0.0001$), relative to those at low-risk ($r=0.771$, $p=0.015$). Between the ages of 120-150 days, infants at high-risk of ASD show larger cerebellar volumes that those at low-risk. However, by the age of 160 days, this pattern seems to be reversed (Figure 1). No other significant results were found.

Conclusions: We emphasize that these results are preliminary and that data acquisition is still in progress. Nevertheless, this data suggests that within the first 6 months of life there are differences in the trajectory of cerebellar growth in infants at high-risk of ASD, relative to those at low-risk. Besides continuing with data acquisition, we are following up our participants until at least 3-4 years of age. We hope, eventually, to identify patterns of brain development before 6 months of age which signpost the future diagnosis of ASD in those infants at high familial risk.

115 **124.115** Characterising 'other Developmental Concerns (ODC)' at 36 Months in Infants at Familial High-Risk for Autism Spectrum Disorder: A Bsrc Study

ABSTRACT WITHDRAWN

Background: Approximately 20% of HR infant siblings are diagnosed with ASD at 36 months of age and a further 20% show other sub-optimal developmental profiles (Messinger et al., 2013). However, the pattern of these ODC and whether they are associated with early development or sex has not been determined.

Objectives: N/A

Methods: 1,931 infant siblings (1,330 HR; 601 LR) from 15 different BSRC sites were recruited. The N=330 siblings with an ASD diagnosis at 36m were excluded (321 HR, 9 LR) leaving 1,601 siblings (1,009 HR, 592 LR). 36 month outcomes were defined as: Broader Autism Phenotype (BAP): ADOS severity score > 4 regardless of Mullen scores; Subthreshold ASD (Sub): ADOS severity score = 3 no Mullen subtest t score < 30 and at most 1 Mullen subtest t score < 35; Developmental Delay (DD): ADOS severity score < 3 combined with 2 or more Mullen subtest t scores < 35 or 1 or more subtest t scores < 30; or Typical Development (TD).

Results:
Multinomial logistic regression was used to test whether risk status (HR vs. LR) and sex (male vs.

female) was associated with ODC outcome group (Table 1). Compared to TD children those categorised as BAP were more likely to be HR (relative risk ratio (RRR): 1.84 (95% CIs: 1.33 to 2.53), p<.001) and male (RRR: 1.52 (1.13 to 2.04), p<.01). Those who were categorised as Sub were more likely to be HR (RRR: 2.52 (1.51 to 4.18), p<.001) and those who were DD were more likely to be HR (RRR: 3.03 (1.55 to 5.90), p=.001) and male (RRR: 3.43 (1.86 to 6.32), p<.001).

In order to examine whether developmental abilities at earlier timepoints (6, 12, 18, 24 months) was associated with ODC outcomes the Mullen ELC was added to the model (Figure 1). Lower ELC at 6m was marginally associated with an increased likelihood of being in the BAP group (RRR: 0.99 (0.97 to 1.00), p=.06). Lower ELC at 12m was significantly associated with an increased likelihood of being in the DD group (RRR: 0.97 (0.95 to 0.99), p<.01). Lower ELC at 18m was associated with an increased likelihood of being in the BAP group (RRR: 0.98 (0.96 to 1.00, p<.05) and the DD outcome category (RRR: 0.96 (0.93 to 0.99), p<.01). Lower 24m ELC was associated with being in the DD group (RRR: 0.93 (0.91 to 0.95), p<.001).

Conclusions: One quarter of HR siblings fell into one of the ODC groups. Each of these outcomes was also seen in the LR siblings, albeit at around half the rate. Boys were more likely than girls to be in these ODC groups. Earlier developmental abilities only weakly predicted outcomes, with the exception of DD where Mullen scores were low from 6 months onwards. Further analysis will explore the clinical utility of these outcome groupings to help establish if they should be used when reporting HR infant sibling studies.

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116   **124.116** Clinical Correlates of Social Affect in Early Infancy: Implications for Early Identification of Autism Spectrum Disorder

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Background: Earlier intervention for infants and toddlers with autism spectrum disorder (ASD) enhances developmental gains (Rogers, et al. 2012) and necessitates ascertainment of early, reliable indicators of ASD. Diminished positive social affect, also termed social smiling, has been among the leading hypothesized risk factors for ASD in the prelinguistic period, between 6-12 months of age. However, research has resulted in mixed findings for the predictive value of social engagement in 6-9-month-old infants for the development of ASD. If abnormalities in infant social affect contribute to the early phenotypic expression of ASD, it is important to determine whether diminished social affect is a unique construct associated exclusively with social impairments or if it is, alternatively, an expression of normal variation in individual development better explained by temperamental style.

Objectives: The current study sought to enhance the understanding of atypical social development in early infancy by investigating individual differences in social engagement. Positive social affect exhibited by 6-8-month-old infants during naturalistic parent-infant interactions was correlated with four dimensions of behavior relevant to early identification of ASD: social-communication, vocal production, and autism symptomology. Temperament was included as a control measure of individual behavioral style, often considered to be independent of developmental psychopathology.

Methods: Participants included 33 dyads of 6-8-month-old infants and their mother. Each dyad participated in a videotaped semi-structured face-to-face interaction that was later coded for infant expression of directed positive affect. Positive social affect was coded in ten-second intervals using a previously developed affect rating scale (Koegel et al., 2014). Time spent engaging in positive social affect was then correlated with clinical measures of social-communication (CSBS Social Composite and Mullen Receptive Language), vocal production (CSBS Speech Composite), autism symptomology (Autism Observation Scale for Infants), and temperament (Infant Behavior Questionnaire).

Results: Overall, the proportion of time infants spent exhibiting positive social affect ranged from .00 to .60 with an overall mean of .32 (SD=.18). Analyses revealed a positive association between positive social affect and receptive language (r=.428, p=.007). No significant relations were observed between positive social affect and other clinical measures, including vocal production (r=-.118, ns), autism symptomology (r=-.166, ns), or the three dimensions of temperament (Surgency: r=.042; Negative Affect: r=.098; Effortful Control: r=-.125). Age and gender were not significantly associated with the primary measure of positive social affect. Further, overall attention the caregiver's face regardless of affect revealed no significant associations with clinical measures.

Conclusions: These results suggest that positive social affect in early infancy may be a uniquely meaningful indicator of social responsivity and perhaps social motivation. The lack of association between positive social affect and other clinical measures, including temperament, may suggest that this is a specific behavioral marker for low social responsivity and possibly ASD. Additionally, the lack of relation between total time looking to the caregiver's face and clinical measures suggests that overall social attention at this age is not indicative of social-communicative skills. Further research is needed to understand how diminished positive social affect in early infancy may impact later developmental outcomes, including development of ASD.

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117   **124.117** Cognitive and Adaptive Functioning of Children Who Lose Their ASD Diagnosis

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Background:
Emerging literature has indicated that a subset of children with a documented Autism Spectrum Disorder (ASD) lose their diagnosis and function in the average range of cognition and behavior. Following an early ASD diagnosis, these children experience significant improvements in ASD symptoms, cognitive abilities and adaptive skills during their toddler years. Children who lose an ASD diagnosis might be expected to display residual difficulties in social or language functioning. This study aims to characterize children who lose the diagnosis at an early age.
Objectives:
To compare the cognitive and adaptive functioning of toddlers who demonstrate highly positive outcomes from an early ASD diagnosis to peers with high functioning autism and to typically developing (TD) peers.
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. At approximately 50 months, children were re-evaluated. The current study utilizes three groups of children (Optimal Progress (OP), HFA, TD). The OP group includes children who initially met criteria for an ASD, no longer meet criteria for any ASD, and demonstrate functioning in the average range (within 1.5SD of the mean) on standardized measures of cognition, language, social and communicative skills. Children in the HFA group met criteria for an ASD at both evaluations and are functioning within 1.5SD of the mean on cognitive measures. Children in the TD group did not meet criteria for any clinical diagnosis and are functioning within 1.5SD of the mean on cognitive and adaptive measures.
Results:
Children in the OP group (N=19) were matched to HFA (N=19) and TD peers (N=19) on gender and age at re-evaluation. The groups did not differ in median household income (p=.870) or ethnicity (p=.203). ANOVAs were utilized to compare the cognitive and adaptive functioning of the groups at re-evaluation (mean age = 50.92 months). No group differences were found in visual receptive, fine motor or receptive language abilities. In the domain of expressive language, the OP group demonstrated weaker skills than their TD peers (p=.031) and comparable skills to their HFA peers (p=.937). In terms of adaptive abilities, the OP group demonstrated stronger skills than their peers with HFA across domains (Communication, p=.008; Daily Living, p=.003; Motor, p=.006; Socialization, p<.001), and comparable skills to their TD peers (p>.05 across domains).
Conclusions:
By age four, children who demonstrate Optimal Progress from an early ASD diagnosis are functioning comparably to TD peers cognitively and adaptively. These children continue to demonstrate weakness in expressive language skills. This supports existing research with older children with Optimal Outcomes who continue to show mild deficits in pragmatic language. In sum, in addition to losing the symptoms associated with ASD, children who demonstrate Optimal Progress in their toddler years are largely indistinguishable from TD peers in the areas of cognitive and adaptive skills.

118   **124.118** Contingent Maternal Vocal Responses to 9-Month-Old Infant Siblings of Children with Autism

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Background: As a group, infant siblings of children with autism demonstrate difficulties in language and communication that appear towards the end of the first year of life (Mitchell et al., 2006; Ozonoff et al., 2014; Paul, Fuerst, Ramsay, Chawarska, & Klin, 2011). These difficulties are presumed to reflect an increased familial risk, but the extent to which this familial risk includes environmental influences remains poorly understood. An extensive literature documenting the role of maternal input in shaping the language development of typically developing infants and toddlers, toddlers with autism, and other high risk infant populations (e.g. infants of depressed mothers), but no studies have examined maternal linguistic input to infant siblings of children with autism in the first year of life.
Objectives: The goal of the current study was to investigate the linguistic input provided to high risk infants by their mothers during the first year of life.
Methods: The vowel (VV) and consonant-vowel (CV) production of 30 infant siblings of children with autism and 30 low risk infants were scored from video diaries filmed in the home when infants were 9 months of age. Maternal contingent responses to these early vocalizations were also scored and classified as either language promoting or non-promoting responses.
Results: A 3 (Diagnostic Group) by 2 (Vocalization Type) repeated measures ANOVA revealed no significant main effects of Group or a Vocalization Type x Group Interaction. There was a significant main effect of Vocalization Type, $F(1, 57) = 62.11$, p <.001, indicating that infants in all groups produced significantly more Vowel than Consonant-Vowel Vocalizations.
A 2 (Infant Vocalization Type) x 2 (Maternal Response Type) x 2 (Group) repeated measures ANOVA revealed significant main effects of both infant vocalization type, $F(1,44) = 9.61$, p < .01 and maternal response type, $F(1,44) = 61.51$, p < .01, with infants overall producing more Vowel than Consonant-Vowel utterances, and mothers overall producing more Language Promoting that Non-Promoting

Responses. These main effects were modulated by a significant Infant Vocal Type X Maternal Response Type interaction, $F(1,44) = 22.45$, $p < .01$. There were no significant main or interaction effects involving group. Simple main effects analyses conducted to determine the source of this significant interaction revealed that Language Promoting responses occurred significantly more frequently in response to Consonant-Vowel than Vowel vocalizations ($F (1, 46) = 21.57$, $p = .000$), while the opposite pattern was observed for Non-Promoting responses, which occurred significantly more in response to Vowels than Consonant-Vowels ($F (1,46) = 10.43$, $p = .002$).

Conclusions: These results indicate that as a group, mothers of high risk infants provide equally high quality linguistic input to their infants in the first year of life and suggest that impoverished maternal linguistic input does not contribute to high risk infants' initial language difficulties. Implications for intervention strategies will be discussed.

119 **124.119** Contingent Smiling Behavior in 2-to 5-Month-Old Infants with and without ASD during Dyadic Interactions

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Background: Social smiling, smiling that is closely linked to vocalizations and affective changes in one's communicative partner, is one of the most visible forms of early social engagement, emerging by the second month of life in typical development. By contrast, individuals with autism spectrum disorders (ASD) have impaired social interaction abilities, displaying reduced social smiling relative to their TD peers (e.g., Zwaigenbaum et al., 2005). In typical development, the emergence of social smiling marks a pivotal milestone, as early success in reciprocal social interaction likely plays a role in shaping social and communicative outcomes. In ASD, reduced social smiling in later life may reflect the cascading impact of disruptions in reciprocal social interaction from the first months of life. Consequently, examining early smiling behavior may provide an early diagnostic marker of ASD and inform how deviation from the normative course of development impacts the unfolding of social deficits characteristic of ASD.

Objectives: Investigate whether infants at low-risk for ASD with typical outcomes (LR-TD), and infants at high-risk for ASD with and without later diagnoses of ASD (HR-ASD and HR-unaffected) differ in: (1) frequency of smiles; and (2) whether their smiles are time-locked to the behavior of their communicative partner.

Methods: Two-to-five-month-old LR-TD (n = 25; mean age = 4.06 months), HR-unaffected (n = 5 ; mean age = 3.6 months), and HR-ASD (n=9; mean age = 4.36 months) infants were recorded monthly during 30-second face-to-face interactions with their caregivers. Infant facial expressions (including smiling) and gaze direction, and caregiver facial expressions and vocalizations were coded as in Lavelli & Fogel (2005).

Results: One-way ANOVAs revealed no differences in frequency of smiling between LR-TD, HR-ASD, and HR-unaffected infants (p's > .05). Infants also displayed similar levels of looking towards versus away from their caregiver, and caregivers showed no between-group differences in frequency of infant-directed behaviors (all p's > .05). Peristimulus time histograms were created to examine the temporal relationship between infant smiling and specific caregiver behaviors. LR-TD infants showed a significant *decrease* in smiling rate when caregivers displayed neutral expressions, both with and without vocalization (74.46% and 67.39%, respectively; p's < .05), but showed a significant *increase* in smiling rate when caregivers were smiling, both with and without vocalization (37.68% and 29.31%, respectively; p's < .05). Smiling rate of HR-unaffected infants was only time-locked to moments when caregivers were vocalizing while smiling, increasing by 24.05%. Finally, smiling in HR-ASD infants was not modulated in relation to any caregiver behavior (p's > .05).

Conclusions: The temporal relationship between infant smiles and caregiver behaviors differed significantly between LR-TD, HR-unaffected, and HR-ASD groups, though infants in all groups displayed comparable frequency of smiling. While LR-TD infants showed changes in smiling rate that were time-locked to affective changes in their caregivers, smiling in HR-ASD infants was not contingent upon caregiver behavior. These results highlight a very early disruption to social smiling and sensitivity to social contingencies in ASD, skills that serve as an essential means of pre-verbal communication and social learning in typical development.

120 **124.120** Decreased Neural Response to Touch As a Marker of Autism Risk Across the First Year of Life

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Background:
Touch is an important means of social communication between parents and infants and facilitates social interactions throughout the lifespan. Neuroimaging studies have revealed that slow (affective) touch selectively activates areas of the brain also involved in social perception of visual stimuli (e.g., posterior superior temporal sulcus, medial prefrontal cortex); the level of activation in these areas

negatively correlates with levels of autistic traits in typical adults. Additionally, individuals with autism spectrum disorder (ASD) and infants at risk for ASD show diminished responses in these brain regions during visual social perception tasks. It is not clear whether similar deficits are apparent in the neural responses to tactile social perception tasks in infants who are at elevated risk for ASD.
Objectives:
To investigate neural responses to affective (slow) versus non-affective (fast) touch using functional near infrared spectroscopy (fNIRS) in infants at high- and normal-risk for ASD across the first year of life.
Methods:
Participants were 40 infants at high-risk (*n*=17) or normal-risk (*n*=23) for ASD. High-risk children had at least one older sibling with ASD, while normal-risk children had no known family history of the disorder. Infants visited the laboratory with their parent at approximately 3 (n=13), 6 (n=9), 9 (n=8) or 12 (n=10) months of age. Prior to the experimental procedures, infants were outfitted with the fNIRS optode headgear and were seated on their parent's lap. The tactile perception task consisted of 8 periods each of slower (0.5 Hz) and faster-paced (2.5 Hz) brushing to the skin of the infant's leg, which alternated with periods of no tactile contact. Both oxygenated and deoxygenated hemoglobin responses were recorded with a Hitachi ETG4000 fNIRS transcranial optical topography system.
Results:
Epochs of fNIRS data were extracted from each optode around the stimulus presentation (-1 sec – 7 sec) and averaged by brushing type (fast, slow) for each participant. At optode sites over left superior temporal cortex, high-risk infants, in comparison to normal-risk infants, showed decreased responses to fast brushing 1-5 seconds after the beginning of the stimulation. This response was seen in infants at 3, 6, and 12 months of age. No consistent differences were seen in response to slow brushing across the first year of life.
Conclusions:
This is the first known study to examine neural responses to a tactile social perception task in infants at-risk for ASD across the first year of life. We found that infants at high- and normal-risk of developing ASD have differential sensitivity to tactile stimuli. Our results suggest that (1) areas of the temporal cortex (superior temporal cortex), which is known to respond to visual social cues, also play a role in the processing of tactile social information. (2) Differences in response to tactile stimulation evident in the first year of life are a potential biomarker for elevated risk of ASD.

121 **124.121** Developmental Plateaus in Gaze Following in 24-Month-Old Toddlers with ASD: An Eye-Tracking Study

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Background:
Recent work has highlighted eye tracking's potential to catalogue a range of critical social and communication skills in individuals with ASD (Guillon et al., 2014). Gaze-following skills are particularly interesting given their fundamental connection to joint attention and social monitoring. Although recent eye-tracking studies have examined gaze following in older children and adolescents (Freeth et al., 2010; Swanson & Siller, 2013), no reports have used eye tracking to analyze the developmental processes underlying gaze following in toddlers with ASD.
Objectives:
To use eye tracking to examine developmental changes in gaze following during emulated joint attention in toddlers with ASD between the ages of 18- and 24-months.
Methods:
Participants included 18- and 24-month-old toddlers with ASD (ASD-18, *n*=77, Age: M=19.3 (SD=1.5) months; ASD-24, *n*=80, Age: 24.0 (0.9) months), non-ASD developmental delays (DD-18, *n*=11, Age: 18.4 (1.1) months; DD-24, *n*=12, Age: 23.5 (1.3) months), and typical development (TD-18, *n*=87, Age: 18.3 (0.9) months; TD-24, *n*=89, Age: 23.9 (1.0) months). Participants were administered an eye-tracking task testing spontaneous social attention to discrete probes, including a Joint Attention (JA) probe, in which an actress repeatedly looked at the camera and then at one of four toys (see Chawarksa et al., 2012). Outcome variables included percentages of valid scene-viewing time spent attending to the actress's head (%Head), any toy (%Toys), and the toy at which the actress looked (%Target). Looking patterns within a circuit of targets, including Toys-cued (TargetRatio), Toys-not-cued (DistractorRatio), and the actress's head (HeadRatio), were also calculated.
Results:
Linear mixed effects modeling was employed to examine the fixed effects of diagnostic group, age group, and their interaction. Effects for %Head were not significant. %Toys revealed an age x diagnosis interaction ($p<.05$; toy-looking increased with age in the TD ($p<.001$) and DD (trend; $p=.10$) groups but not the ASD group ($p=.73$)). For %Target, a diagnosis effect (ASD<DD,TD: $p=.06$, $p<.001$; DD=TD: $p=.94$) and an age effect ($p<.01$; target-looking increased with age) were observed. Circuit analyses confirmed conversion of attentional focus from the actress's head to the cued toy in the transition between 18- and 24-months in the TD (increasing TargetRatio, $p<.01$; decreasing HeadRatio, $p<.05$) and DD (increasing TargetRatio, $p=.09$) groups but not in the ASD group. For the ASD-24 group, %Toy correlated with Mullen verbal age equivalent scores ($r=.31$, $p<.05$), and DistractorRatio correlated with ADOS severity scores ($r=.31$, $p<.05$).

Conclusions:
Our results reveal developmental gains in gaze following from 18- to 24-months of age in non-ASD toddlers but not in toddlers with ASD. Although time spent attending to the cued toy increased for all groups over time, toddlers with ASD consistently attended less to the cued toy and did not demonstrate developmental improvement in gaze following. This, combined with relationships between gaze following and characterization variables in ASD, suggests that scanning patterns in response to JA probes may provide clinically meaningful indices of social ability. More broadly, these results indicate that eye tracking may help quantify atypical social information processing in toddlers with ASD and monitor changes due to development or intervention.

122 **124.122** Differences in Means-End Exploration Between Infants at Risk for Autism and Typically Developing Infants in the First 15 Months of Life

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Background: Means-end exploration has been well studied in typically developing infants between the first and second year of life. Infants are able to efficiently retrieve small toys from nested boxes through the use of advanced strategies that reflect improved bilateral hand use (transition from unilateral to bilateral hand use) as well as motor planning (the ability to perform movement sequences) (Goubet et al., 2006). Infants who later develop autism often show fine and gross motor delays within the first few years of life (Landa & Garrett-Mayer, 2005; Bhat et al., 2012). However, there has been no research to date that has examined means-end exploration tasks as early tools to determine autism-risk.
Objectives: Therefore, the purpose of this study was to compare the means-end exploration abilities of infants at-risk (AR) for autism and typically developing (TD) infants between 9 and 15 months of age.
Methods: 16 AR infants and 16 TD infants were observed during a means-end exploration task at 9, 12, and 15 months with developmental follow-up and autism screening at 18 and 24 months. During each visit we collected video data on three tasks that involved retrieving a small toy sheep by – a) opening an opaque box, b) opening a transparent box, and c) opening two nested boxes. Dependent variables included time taken to complete each task, bilateral hand use, the number and variety of strategies used, number of attempts made, the amount of tester assistance provided, and the number of prompts provided.
Results: Our preliminary findings from a subset of infants suggest that TD infants dramatically reduced the amount of time taken to complete the task between 9 and 15 months. They also reduced the amount of assistance and prompts required to complete the task. They showed greater asymmetrical hand use and more advanced strategies to retrieve the toy. In contrast, AR infants showed greater task failure, longer times to complete the task, and immature exploration strategies such as greater unilateral hand use.
Conclusions: Our results suggest that means-end exploration tasks provide a window into the bilateral coordination and motor planning abilities of young infants, including those at-risk for autism. These contexts may provide an early marker for future risk of ASDs by the end of the first year of life. Moreover, these early bilateral coordination and motor planning delays may contribute to the social communication and cognitive delays of infants at risk for ASDs, specifically, in gestural communication, functional play, and problem solving abilities. Facilitating early means-end exploration would be an important learning context for infants at risk for ASDs.

123 **124.123** Does Functional Gaze Following of Children with an Autism Spectrum Disorder Really Rely on Gaze Direction? an Eye-Tracking Study

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Background:
Children with autism spectrum disorders (ASD) show abnormalities in functional gaze following. Although their gaze shifts towards attended objects are accurate, the duration of their first fixation at these objects is shorter suggesting weaker initial processing bias for attended objects (Falck-Yttter, Thorup, & Bölte, 2014). However, it is not clear whether they rely exclusively on other's gaze direction or use other's head direction to govern functional gaze following.
Objectives:
The experimental manipulation in this eye tracking study is whether or not an adult could see the objects by using an open and closed eyes paradigm (Brooks & Meltzoff, 2002) while objects were present or absent (Caron, Butler, & Brooks, 2001).
Methods:
Seven children with ASD (mean chronological age of 64 months; mean mental age of 36 months) and 7 mental age-matched typically developing younger children (TD) were involved in this study. Children saw video clips of an adult turning her head to the right or left in 2 different conditions (eyes open or

closed) and with 2 different stimuli (with or without objects). This resulted in four different situations: open-eyes with object, open-eyes without object, closed-eyes with object, closed-eyes without object. Gaze was measured with a Tobii T120. The outcome parameters were the accuracy (amount of congruent gaze shifts minus amount of incongruent gaze shifts) and the duration of the first fixation to the attended target.
Results:
A three-way ANOVA (2groups*2conditions*2stimuli) revealed no significant effect for the accuracy (F=1.07; p=.32) whereas a significant effect was present for the duration of the first fixation to the attended target (F=11.64; p=.005). Post hoc testing showed that TD demonstrate a longer first fixation duration to the attended target in the open compared to the closed eyes conditions if objects were present (p=.04) in contrast to children with ASD (p=0.10).
Conclusions:
Consistent with Falck-Ytter et al. (2014), children with ASD followed the adult's gaze in terms of accuracy as much as mental aged-matched younger children but showed an aberrant pattern of first fixation duration to the attended target. In line with findings of Brooks and Meltzoff (2002), gaze following of TD seems to be influenced by the open or closed status of the eyes, directing a higher initial object processing to the attended object when the eyes of the adult are open. In contrast, children with ASD showed no difference in initial object processing between open and closed eyes conditions. Findings suggest that gaze following of children with ASD may rely on the adult's moving head and less on the status of the adult's eyes. Since in naturalistic settings gaze shifts towards an object may indicate an upcoming goal-directed action with an object, an altered gaze following pattern and initial object processing can interfere with action understanding. To investigate action understanding in children with ASD the above mentioned aberrant gaze following pattern should be taken in account.

124 **124.124** Early Gross and Fine Motor Abilities in Infants at Heightened Vs. Low Risk for ASD: A Bsrc Study

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Background: A growing body of research has pointed to the presence of early-appearing delays in gross motor (GM) and fine motor (FM) development in infants at heightened risk (HR) for ASD (e.g., Libertus et al., 2014; Nickel et al., 2013). In addition, relative to HR infants who are not later diagnosed with ASD and to infants with low ASD risk (LR), HR infants later diagnosed with ASD exhibit poorer gross and fine motor skills by 6 months of age (e.g., Leonard et al., 2013). However, much of this work has involved comparison of overall scores on standardized assessments and relatively small sample sizes.
Objectives: To examine GM and FM skills at an item level at 6 months in relation to outcome classification at 36 months in a large sample of HR and LR infants.
Methods: This study utilized data from the GM and FM subscales of the Mullen Scales of Early Learning (MSEL) administered at 6 months of age at 7 Baby Siblings Research Consortium (BSRC) sites. The total sample included 530 infants (363 HR, 167 LR). Thirty-six month outcome classification followed procedures outlined by Chawarska et al. (2014), with HR infants categorized as ASD, Atypically-Developing (ATYP), or Typically-Developing (HR-TD). A comparison sample of typically-developing low risk infants (LR-TD) was also included.
Results:
General linear mixed model logistic regressions with outcome classification and item as fixed effects and random intercepts for participants were carried out separately on the GM and FM subscale data (Figure 1). Results were generally similar across subscales, with group item performance for GM: (ASD=ATYP)<LR-TD (p<.01) and (ASD=ATYP)<HR-TD(p~.06); and for FM (ASD=ATYP)<LR-TD

(p<.05,.01) and HR-TD<LR-TD (p<.01).

To examine motor milestones specific to age 6 months, we focused on subsets of 4 items on each subscale tapping sitting and grasping skills respectively and identified infants who were low performers (≥3 items failed; Figure 2).

For sitting items, significantly more ASD and ATYP infants were low performers relative to both the HR-TD and LR-TD groups, who did not differ from one another. A similar pattern of differences was evident for grasping items, but in addition, significantly more HR-TD infants fell into the low performing group relative to the LR-TD group (all ps < .05). Within the ASD group, significantly more females (44%) than males (22%) failed 3 or more grasping items (p = .04).

Conclusions: Delays in gross and fine motor development were evident among ASD infants at 6 months of age, but similar delays were also apparent among HR-ATYP infants. In addition, HR-TD infants also demonstrated delays relative to LR-TD infants in fine motor skills. These findings have implications for early identification and intervention efforts and for the understanding of the pathways from genetic risk for ASD to social and cognitive impairments associated with ASD and the broader autism phenotype.

125 **124.125** Early Social Communication Predictors of Clinical Diagnosis from 18 to 24 Months

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Background: Social communication deficits are often the first noticeable 'red flags' of autism spectrum disorder (ASD), as typically developing (TD) children demonstrate robust intentional modes of social communication (i.e., to engage another person in their requesting and expressing interest) by one year of age. Previous studies have identified differences in social communication in children with ASD (Chawarska et al., 2014; Clifford et al., 2007; Wetherby et al., 2007), but some of these studies have not had the power to detect potential differences between children with ASD and developmental delay (DD). Given the average age of diagnosis at 4-5 years (CDC, 2014), it is important to identify early indicators that can reliably differentiate TD, DD, and ASD. Since communication delays are usually present by the second year of life and may be more readily identified by parents and professionals than other red flags (e.g., repetitive behaviors), these social communication skills represent an important measure for early screening.

Objectives: (1) Examine differences in social communication at 18-24 months between children diagnosed with ASD, DD, and TD and (2) Identify significant predictors of diagnosis of ASD compared to DD or TD.

Methods: Children participated in the FIRST WORDS® Project at Florida State University and were administered the Communication and Symbolic Behavior Scales (CSBS; Wetherby & Prizant, 2002) Behavior Sample between 18-24 months. They also received a concurrent diagnostic battery to determine best-estimate diagnosis of ASD (n=275), DD (n=93), or TD (n=99).

Results: An ANCOVA, controlling for age and nonverbal skills, revealed that the ASD group had lower CSBS Cluster scores, which measure seven distinct dimensions of social communication, than the TD group (p<.001). All Cluster scores were significantly lower in ASD than DD (p<.05), except for Word Use. Logistic regressions examined z-scored CSBS Clusters to identify significant predictors of clinical diagnosis. In comparing ASD and TD, four significant predictors emerged (p<.05): Emotion & Eye Gaze (*odds ratio* [*OR*]=.30), Gestures (*OR*=.38), Sounds (*OR*=.40), and Understanding (*OR*=.57). Overall, 88% of children were accurately classified as either ASD or TD (sensitivity: 93%, specificity: 77%). In the model comparing ASD and DD, Emotion & Eye Gaze (*OR*=.32) and Gestures (*OR*=.55) were significant predictors (p<.05) of clinical diagnosis. In total, 80% of the children were accurately classified as either ASD or DD (sensitivity: 92%, specificity: 53%).

Conclusions: Results indicate that social communication deficits measured by the CSBS discriminate children with ASD from both DD and TD. Four of the seven clusters differentiated ASD from TD, resulting in 88% correct classification. Impressively, just two clusters (Emotion & Eye Gaze and Gestures) resulted in 80% correct classification of ASD and DD. This suggests that screening should focus on gaze, facial expressions, and gestures to most efficiently identify children with ASD. Given the high sensitivity rates found, the CSBS may serve as a useful ASD screening tool to identify children in need of ASD-specific testing. Higher specificity in the TD than DD analyses suggests that many "false positives for ASD" may indicate non-ASD delays requiring intervention services.

126 **124.126** Early Social Development in Preschoolers with Autism Spectrum Disorders: A Comparison of DSM-5 Profiles

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Background: The new diagnostic criteria for autism spectrum disorders (ASD) in the 5th edition of the Diagnostic and Statistical Manual (DSM-5; American Psychiatric Association, 2013) represent an attempt to capture the heterogeneity of symptoms and impairment among children with ASD in a dimensional manner. In DSM-5, associated clinical specifiers describe co-morbid developmental challenges experienced by children with ASD, including structural language impairment (LI) and intellectual disability (ID). Children with ASD plus LI (ASD/LI) and ASD plus ID (ASD/ID) may be at greater risk of adverse social-developmental outcomes than those with ASD alone (ASD/alone).

Objectives: We aimed to compare the trajectories of social competence in young children recently diagnosed with ASD/alone, ASD/LI and ASD/ID.

Methods: Data were provided by 332 children and their families participating in the Canadian *Pathways in ASD* study, a multi-site longitudinal inception cohort study of children aged 2-4 years with a recent DSM-IV diagnosis of ASD (278 boys, 54 girls). Children who scored below 70 standard score (SS) points on the Merrill-Palmer-Revised Developmental Index (MPR-DI) were described as ASD/ID (n=249, 75.0% of sample). Among those with baseline MPR-DI scores above 70 SS points, children who scored 1.5 standard deviations below population mean scores on the Preschool Language Scale-4 (PLS-4; Auditory Comprehension or Expressive Communication subscales) were classified as language impaired (ASD/LI; n=32, 9.64%). Children in the ASD/alone subgroup (n=51, 15.36%) scored in the unimpaired range on language and cognitive testing. Participants were assessed at baseline (within 4 months of diagnosis) and 6 and 12 months later. We examined latent growth curve trajectories of early social competence (as measured by the Vineland Adaptive Behavior Scales-II [VABS-II Socialization domain]), and compared parameters of growth (intercept and slopes) of social competence trajectories between the ASD/alone, ASD/LI and ASD/ID subgroups.

Results: Twelve months after diagnosis, 74% of children in the ASD/LI group no longer met criteria for language impairment; however, by contrast 69% of the ASD/ID group continued to score as impaired on cognitive testing. On average, children with ASD made significant gains in social competence over 12 months (slope = 7.15 raw points [SE=0.36, p<0.01], equivalent to 3 SS points on VABS-II). There was significant variability within the group with respect to initial levels (intercepts) and rates of change (slopes). Growth parameters were significantly associated with family income (intercept) and child age at diagnosis (intercept and slope), but not child sex or years of primary caregiver education. Children with ASD/LI were significantly more socially impaired at baseline than the ASD/alone subgroup, and less impaired than those with ASD/ID. Rates of change in social competence did not differ between the ASD/alone and ASD/LI subgroups, however children with ASD/ID made significantly fewer social gains during the year after diagnosis.

Conclusions: Clinicians should describe DSM-5 diagnoses of ASD/LI as provisional when assessing preschoolers, given the significant language gains made by many children. The ASD/ID classification appeared to be more stable in the first year after diagnosis. Children with ASD/ID were most severely impaired and lagged further behind in their early social development.

127   **124.127** Effects of Race, Ethnicity, and Maternal Education on Reported Regression in Children with Autism Spectrum Disorder (ASD)

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Background: According to parent report, about one-quarter to one-third of children with ASD experience developmental regression. Previous studies have noted that gender and socioeconomic status have no associations with reported regression among children with ASD. However, information about the effects of race, ethnicity, and maternal education on the prevalence of regression in children with ASD is limited.

Objectives: To determine the effects of race, ethnicity, and maternal education on reported regression in children with ASD in the Simons Simplex Collection (SSC) and Autism Genetic Resource Exchange (AGRE) databases.

Methods: Data were analyzed for children with ASD in the SSC (N=2695; mean age at study participation=9.0 years (SD = 3.6); 87% male). Regression status was ascertained via the *Autism Diagnostic Interview-Revised* (ADI-R) and operationalized for this study as any loss of language and/or social engagement at or before 36 months of age. Logistic regression was used to explore possible associations with regression by race/ethnicity, maternal education, annual household income, and age at first concern.

Results: The overall prevalence of language and/or social regression in the SSC sample was 28%. Prevalence of regression by race/ethnicity was: non-Hispanic white 26%, non-Hispanic black 42%, Hispanic 37%, and non-Hispanic other 30% (p<0.001). In unadjusted analyses, regression was associated with race/ethnicity (p<0.001), age at first concern (p<0.001), and maternal education (p=0.013), but not annual household income (p=0.818). When controlling for age at first concern and maternal education, race/ethnicity was significantly associated with language and/or social regression (p=0.0002). Non-Hispanic black children were twice as likely to experience regression than non-Hispanic white children (95% CI 1.1, 3.5; p=0.011). Hispanic children were 1.6 times more likely to

experience regression than non-Hispanic white children (95% CI 1.1, 2.2; p=0.004). When controlling for age at first concern and race/ethnicity, children with mothers with an associate's degree or higher were 20% less likely to reportedly experience regression (p=0.019), although the difference in reported regression between maternal education groups was small (32% for mothers with no degree and 27% for mothers with a degree). Comparable analyses in the AGRE dataset are currently underway.

Conclusions: In the SSC sample, non-Hispanic black and Hispanic children with ASD were at increased risk of parent-reported regression compared to non-Hispanic white children, when controlling for maternal education and age at first concern. Further studies are needed to evaluate whether these differences in race/ethnicity among children with ASD and regression are related to cultural and/or genetic differences possibly resulting in different phenotypes of ASD.

128   **124.128** Emotional Reactivity in Toddlers with ASD: Diminished Response to Threatening Stimuli during the Laboratory Temperament Assessment Battery (Lab-TAB)

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Background:
Temperament, biologically-based aspects of behavior in the domains of emotional reactivity, attention, and regulation (Rothbart, 1981), is relatively unexplored in very young children with ASD. Existing research in this population focuses largely on parent questionnaires (del Rosario et al., 2014, Clifford, 2013; Garon, 2009) but laboratory-based methods hold additional promise. The Laboratory Temperament Assessment Battery (Lab-TAB) is an in-vivo behavioral assessment for infants and toddlers that examines temperamental characteristics based on standardized naturalistic probes (Goldsmith & Rothbart, 1999). The Lab-TAB has been used extensively to study temperament in typically-developing children (Gagne et al., 2011), but little is known about emotional reactivity in very young children with ASD in response to a range of challenges.

Objectives:
To examine emotional reactivity in very young children with ASD compared to their non-ASD peers in response to behavioral probes aimed at eliciting fear, joy, and anger.

Methods:
We adapted the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith & Rothbart, 1999) for use with toddlers with developmental disabilities, including a period of extensive piloting and reliability coding (across 5 coders, ICC>0.85). Nine episodes of the Lab-TAB were administered to toddlers with ASD (n=15) and age-matched peers without ASD (Non-ASD (n=10); 6 with typical development and 4 with non-ASD developmental delays) at age 20 months (SD=2.5). Three episodes per emotion were administered: Fear (Spider, Masks, Dinosaur); Anger (Carseat, End of the Line, Restraint); and Joy (Bubbles, Puppet Show, and Penguin Race). Each episode consisted of three to four trials lasting 10 seconds each. Videotaped sessions were coded offline by blinded coders for intensity of emotional responses during each trial on a four-to-six-point Likert scale. Responses were averaged across trials, and composites computed for Negative Affect (facial fear, facial sadness, distress vocalizations, escape, bodily fear); Joy (facial joy, positive vocalizations, bodily joy); and Anger (facial anger, distress vocalizations, bodily struggle).

Results:
A linear mixed models analysis examining group, episode type and their interaction indicated that toddlers with ASD exhibited less intense Negative Affect only during the Fear episodes ($F(1, 23)=9.42$, $p<.01$) than Non-ASD peers ($p<.01$, $d =1.17$). Joy and Anger were expressed at similar levels of intensity during the Joy and Anger episodes ($p=.51$, $p=.25$, respectively) across both groups of toddlers.

Conclusions: Preliminary findings suggest that 20-month-old toddlers with ASD exhibited less intense observable negative affect than their non-ASD peers in response to novel and potentially frightening stimuli. Diminished affect was specific to the Fear probe, as both groups responded similarly to joy- and anger-inducing situations. The factors underlying diminished emotional reactivity in threatening situations in ASD, including basic attentional, physiological, affective, and cognitive processes require further examination. Deficits in emotion processing are likely to impair the use of affective communication channels to form social bonds, develop empathy, and learn about the world. Data collection is ongoing and further analysis with a larger sample will enable examination of the specificity of these findings to the ASD group.

129   **124.129** Empathy Emerges: Attention and Affective Responses to Maternal and Experimenter Distress in Infants at Risk for Autism at 12- and 15-Months

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Background:
Emerging at 12 months, empathy appears to be relatively stable over time, consistent across contexts, and predictive of prosocial behaviors. Empathy consists of both attending to a person in distress (attention) and displaying concern (affect; Knafo et al., 2008). High-risk infants (by virtue of

having a sibling with ASD; HR) later diagnosed with autism spectrum disorder (ASD) were less attentive and displayed fewer affective responses to an experimenter in distress than non-ASD infants (Hutman et al., 2010). Interestingly, infants may be more responsive to mother's distress versus a stranger's (Young et al, 1999), but when these differences emerge and if such differences occur in HR infants have yet to be explored.

Objectives:
Identify changes in attention and affect: (1) toward other's distress between 12 and 15 months across risk groups, and (2) toward experimenter versus maternal distress within risk groups.

Methods:
Nineteen HR infants and 21 low-risk (LR) infants were administered a standard empathy paradigm by both an experimenter and their mother at 12 and 15 months. Attention and affective response to distress were coded from video using an existing coding scheme (Hutman et al., 2010). Linear mixed-effects (LME) models were conducted separately for attention and affect scores as outcome variables, with age and risk as the independent variables for (1) maternal distress (MomDistress) and (2) experimenter distress (ExpDistress; Table 1). Additional LME models were conducted separately for each risk group, with age and condition (MomDistress/ExpDistress) as the independent variables (Table 2).

Results:
Affect was significantly different between risk groups, such that the HR group displayed less affect in both conditions. Additionally, there was a significant increase in affect over time for ExpDistress, but not for MomDistress. Within the HR group, no significant main effects of age or condition were found. In contrast, within the LR group, there was a significant age by condition interaction, such that affect increased over time for ExpDistress. Attention toward ExpDistress was significantly different between risk groups, such that the HR group paid less attention. For MomDistress, there was a significant age by condition interaction, which indicated attention decreased over time for the HR group and increased for the LR group. Within the LR group, there was a significant difference in their attention between conditions, such that they attended less to MomDistress.

Conclusions:
Results of this study suggest differences in empathic responses to others' distress are present as early as 12 and 15 months, when comparing HR and LR infants. The HR infants displayed weaker affect and attended less to others' distress than their LR peers. Furthermore, while LR infants' affect increased between 12 and 15 months, HR infants' affect did not change (ExpDistress) or decreased (MomDistress). The HR infants also did not differ in their affect and attention to experimenter versus maternal distress, while their LR peers showed increased affect to experimenter distress and increased attention responses to maternal distress over time. These deficits may be an early marker of social cognitive impairment and may be an important target for early intervention.

130 **124.130** Examining the Structure of Temperament Traits in Toddlers with and without ASD

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Background: Temperament is defined as constitutionally based individual differences in reactivity and regulation (Rothbart & Bates, 2006). Research has highlighted the importance of this construct to social and behavioral outcomes in typically developing (TD) children. One important measurement of temperament is the Toddler Behavior Questionnaire-Supplemental (TBAQ-S; Goldsmith, 1996). The TBAQ-S includes 13 subscales subsumed by three composites: Attention (including Perceptual Sensitivity, Attention Focusing, Attention Shifting, Inhibitory Control, and Low Intensity Pleasure), Negative Emotionality (consisting of Discomfort, Sadness, Soothability (negatively), Anger, and Social Fear), and Surgency (comprising Social Fear (negatively), High Intensity Pleasure, Activity Level, and Approach/Positive Anticipation; Becken-Jones, Gartstein, Rothbart, & Chasman, 1999). Now scholars have turned to examining temperament in children with autism spectrum disorder (ASD). The TBAQ-S was only validated for use in TD populations, and no study to date has explored the composite trait structure of this measure in toddlers with ASD. Improving our understanding of temperament in special populations may elucidate the relationship between temperamental characteristics and later outcomes and help us identify subgroups of ASD for diagnostic and treatment purposes.

Objectives: To examine the structure of temperament traits as measured by the TBAQ-S in toddlers with ASD compared to their TD peers.

Methods: Participants included 146 toddlers with a diagnosis of ASD, derived from a clinically-referred sample (Mean age = 26.01 months) and a control group of TD toddlers ($n = 118$; Mean age = 24.16 months). All participants underwent a comprehensive developmental and clinical assessment to confirm diagnostic status. Measures included the Mullen Scales of Early Learning and ADOS-G. Parents completed the TBAQ-S prior to developmental testing. An exploratory factor analysis (EFA) was performed for both groups using principal axis factoring with direct oblimin rotation. Factor scores in ASD were correlated with Mullen and ADOS scores.

Results: EFA revealed three-factor models for both groups. The TD model appeared similar to Becken-Jones and colleagues' (1999). Loadings were also similar in the ASD model, but some notable exceptions emerged. Perceptual Sensitivity loaded on Negative Emotionality, and Social Fear only loaded on this factor. In addition, Activity Level, High Intensity Pleasure, and Approach/Positive

Anticipation loaded together negatively, resulting in an Introversion factor. The Introversion composite was positively correlated with ADOS Severity ($r = .289$, $p < .001$) and negatively correlated with nonverbal DQ ($r = -.208$, $p < .05$).

Conclusions: The traits measured by the TBAQ-S in toddlers with ASD appear slightly different from those in TD toddlers. Perceptual Sensitivity and Social Fear are both more associated with Negative Emotionality in ASD. Additionally, the most socially relevant scales loaded negatively, suggesting that they represent a more withdrawn pattern of behavior in ASD. This Introversion factor is associated with greater ASD severity and poorer nonverbal functioning. These results suggest that temperament may be organized differently in toddlers with ASD, and these differences may be related to autism symptomatology. Future work should explore how this trait structure may improve our characterization of children with ASD, identify possible subpopulations, and identify other ASD outcomes that may be influenced by temperament.

131 **124.131** Exploring the Relationships Between Visual Preference for Biological Motion, Joint Attention Behaviors and Language Development in Young Children with Autism Spectrum Disorders

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Background:
According to the social motivation theory in autism (reviewed in Chevallier et al., 2012), social-communication deficits observable in autism are partly explained by a lack of social orienting. Eye-tracking studies show promise to quantify social orienting, with reduced preference for biological motion being already observed in toddlers with autism from 14 months of age (Pierce et al., 2011). It is typically assumed that reduced social orienting reduces opportunity for learning. For instance, decreased attention to people is thought to impair joint attention behaviors, and may represent a barrier to further language development (e.g. Charman et al., 2003). The formal relationship between social orienting, following joint attention behaviors and language skills have however not been extensively examined to date.

Objectives:
We sought to explore the relationship between lack on biological motion in ASD, joint attention behaviors and language development in young children with autism.

Methods:
We recruited 25 children with ASD (mean age= 3.2 ± 1.2 years old), and 20 typically developing children (TD, mean age= 3.0 ± 1.5 years old). Measures of initiation and response to joint attention were collected using the Early Social Communication Scale (ESCS, Mundy et al., 2003). Language development was quantified using the Psychoeducational Profile, 3rd version (PEP-3, Lansing et al., 2010) and the Vineland Adaptive Behavior Scales, Second Edition (Vineland-II, Sparrow et al., 2005). Finally, we quantified social orienting using an eye-tracking paradigm inspired from the one by Pierce and colleagues (2011), using a split screen with simultaneous biological motion and geometrical motion.

Results:
Replicating results by Pierce et al, we found that, as a group, children with autism orient less on biological motion compared to TD (t=3.48, p=0.0012). Important heterogeneity was however observed in the ASD group. Part of this variance related with social communication. Indeed, orientation on biological motion in ASD correlated with initiation and response of joint attention behaviors in the ESCS (R=0.508, p=0.022; R=0.438, p=0.04). Response to joint attention further correlated with expressive language standard scores at the PEP-3 and at the Vineland-II (R=0.501, p=0.009; R=0.452, p=0.012).

Conclusions:
Our results support the view that reduced orientation on biological motion has consequences on joint attention behaviors in children with ASD. The correlation between lack of response to joint attention and language outcome in children with ASD confirms the crucial role of joint attention in the development of communication in children with ASD. Future longitudinal studies are required to further understand whether social orienting and joint attention behaviors can serve as predictor of social and clinical outcome in autism.

132 **124.132** Frequencies of Vaccine Uptake in Children with Autism Spectrum Disorder and Type of Onset Described By Parents

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Background: A highly controversial theory for ASD is that regressive-onset ASD is triggered by vaccines. If vaccines are associated specifically with developmental regression in ASD, then it follows that vaccination rates should be significantly higher among children with ASD plus regression. Two studies conducted outside the U.S. found no association between the MMR vaccine and regression in ASD; however, these works only focused on one type of vaccine and did not examine ASD onset more broadly. The current study extended this line of work to examine potential associations between different types of ASD onset—not just regression—and a variety of vaccines that children routinely receive between birth and age 3 years. Focus was on both proportion of vaccine uptake and proportion of non-delay (i.e., accepting the vaccine at the time it was offered) for each vaccine.
Objectives: To examine whether vaccine-uptake and non-delay rates were equivalent among in a large sample of children with confirmed ASD diagnoses who had different types of autism onset (early onset, plateau, delays + regression, regression).
Methods: Data were analyzed for children with ASD (N = 2755; 86.4% male; M age = 9 years, SD = 3.6 years, range = 4—17.9 years; 78.5% White, 88.8% non-Hispanic) who participated in the Simons Simplex Collection (SSC). Onset categories for ASD were created using various combinations of responses to select items from the *Autism Diagnostic Interview—Revised* (ADI-R) to group children into one of the following four ASD-onset types: early onset, plateau, delay + regression, or regression. Vaccination history was obtained as part of an extensive Medical History Interview (MHI) conducted with children's parents; families were permitted to send in shot records for these data. Focus was on the following vaccines queried during the MHI: DPT/DTaP, HepB, HiB, poliovirus oral/injected, MMR, chicken pox/varicella. Equivalence for uptake and non-delay for each type of vaccine was assessed by deriving the risk difference of the percentage of vaccine uptake between all pairwise comparisons for ASD-onset groups using a two-sided 90% confidence interval.
Results: Proportions of children in each ASD-onset group were 33.5% for early onset, 36.5% for plateau, 10% for delay + regression, and 20% for regression. Vaccine-uptake rates ranged from 79% to 99%; non-delay rates ranged from 92% to 98%. All pairwise group comparisons for vaccine uptake and non-delayed administration were statistically significantly equivalent (adj p < .05), with the exception of varicella, for which the early onset/delay + regression comparison and the delay + regression/regression comparison were not equivalent for uptake (adj p = .07). The early-onset (85%) and regression (83%) groups each had higher rates of uptake than the delay + regression group (79%).
Conclusions: Equivalence was demonstrated between all ASD-onset types for each vaccine except varicella; however, differences between groups were not considered clinically meaningful (4—6% difference). Moreover, uptake proportions for early-onset and regression were equivalent. This, in conjunction with equivalent uptake across onset groups for all other vaccines, does not support the theory of an association between vaccines and regressive-onset ASD.

133 **124.133** Gaze Following in Infants at Risk for Autism: The Role of Eye Information, Head Turns and Salient Objects

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Background: The ability to follow other people's gaze is a key component of joint attention (JA), and Autism Spectrum Disorders (ASD) are associated with poor JA skills. Surprisingly, a recent eye-tracking study (Bedford et. al., 2012) found that infants with later emerging ASD were as accurate in gaze following as control children. In contrast, Elsabbagh et. al. (2012) found different ERP responses to dynamic gaze shifts in infants who were later diagnosed with an ASD as compared to typically developing infants. Thus, despite processing eye-related information differently, infants with later autism seem to be able to follow gaze. No study of infants at risk has investigated the tendency to follow eye direction alone, without an accompanying head turn.
Objectives: The aim of the present study was to investigate gaze following in 10-month olds at risk for autism (due to having an older sibling with ASD), with and without head turns.
Methods: The study included a group of children at high risk (HR) for ASD (n=24) as well as a group of children at low risk (LR, n=11). Using live eye tracking technology, we recorded the infants' gaze patterns when they observed a model who gazed at one of two objects in front of her. The primary measure was a difference score (DS) with the number of incongruent gaze shifts subtracted from the number of congruent gaze shifts made by the child, aggregated over several trials. The design included three conditions; one in which the model turned his/her head towards the toys (eyes and head condition), one in which the model shifted his/her gaze towards the toys without turning the head (eyes only condition) and one where the model turned his/her head towards empty spaces with no objects present (empty condition).
Results: The analysis revealed a group x condition interaction (p < 0.05). The HR group showed significantly higher gaze following accuracy in the eyes and head condition than in the eyes only and empty conditions (p:s < 0.05, bonferroni corrected). The gaze following accuracy in the LR group did not differ between conditions. The effect could not be explained by a general group difference in number of gaze shifts. Both groups were able to follow gaze accurately (DS > 0) in the eyes and head and empty conditions, but only the LR group followed gaze accurately in the eyes only condition.

Conclusions: While performance was modulated by condition in the HR group, no such modulation was found in the controls. This could suggest that infants in the HR group rely more on features such as head turns towards target objects, and fail to follow gaze when such cues are absent (i.e. in the eyes only condition). Lack of modulation in the LR group could indicate that these infants are more sensitive to the communicative meaning of the gaze cue, and less reliant on salient features such as head turns and objects.

134 **124.134** Growth Trajectories in Initiating Joint Attention during the First Three Years of Life in Siblings of Children with Autism Spectrum Disorder

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Background: Since initiating joint attention (IJA) is impaired in children with autism spectrum disorder (ASD), many researchers are currently studying the development of IJA and its relations to outcome in children who have an older sibling with ASD. This could lead to insight into differential pathways in the early development of these children: younger siblings who also have ASD themselves, siblings on the broader autism phenotype, and non-affected siblings.
Objectives: To explore differences in growth trajectories in IJA: a) between siblings of children with ASD compared to typically developing children and b) within the group of siblings according to their autism symptomatology at 36 months and their diagnostic outcome.
Methods: The Early Social Communication Scales (ESCS) were administered to siblings of children with ASD (SIBS; $n = 36$) and to typically developing children (TD; $n = 32$) at 9, 12, 18, 24, and 36 months of age. Rates per minute were calculated for IJA bids. The proportion of higher level IJA bids (i.e., pointing or showing) to the total number of IJA bids was used as a measure of the quality of nonverbal IJA bids. In addition, the Dutch version of the MacArthur-Bates Communication Development Inventories (N-CDI's) was administered at the ages of 18 and 24 months to assess the acquisition of spoken words. Finally, the Autism Diagnostic Observation Schedule (ADOS) was administered at 36 months as a measure of ASD symptomatology by means of the ASD severity scores (see Gotham, Pickles, & Lord, 2009). Currently, all children are being contacted to collect information about community clinical diagnosis. The Autism Diagnostic Interview-Revised (ADI-R) will be administered to children with a community clinical diagnosis and to children who scored above the ASD cut-off on the ADOS at 36 months. A clinical best estimate diagnosis will be given by a team of licensed clinical psychologists.
Results: At the conference, results of hierarchical linear modeling (HLM) will be presented to examine initial status of IJA at 9 months and growth in IJA between 9 and 36 months in relation to language acquisition between 18 and 24 months, autism symptom severity at 36 months, and diagnostic outcome. Since data collection on diagnostic outcome is still ongoing, only preliminary results comparing TD children and SIBS are summarized here. A decline was noted in the total frequency of IJA for TD children between 12 and 18 months, whereas in SIBS this was observed between 18 and 24 months. SIBS show an increase in the proportion of higher level IJA bids until 18 months, whereas TD show a growth until 24 months (see Figures). Also, the total frequency of IJA at 18 months was related to autism symptom severity at 36 months in both groups.
Conclusions: Differences in IJA trajectories between SIBS and TD children were most apparent between 18 and 24 months. Further analysis with HLM and complete outcome data will be presented and considered in the light of possible relations between these IJA trajectories, concurrent language acquisition, and autism symptom severity at a later age.

135 **124.135** Infants and the Emerging Autism Phenotype

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Background:
While ASDs can reliably be diagnosed in children starting around 18-24 months of age, symptoms present much earlier. Converging evidence has pointed to a constellation of developmental differences in infants as young as 12 months, including limited eye contact, imitation, social smiling, receptive language, and affective sharing. This study enrolled infants and toddlers between the ages of 12 and 22 months who were exhibiting early behavioral features consistent with a diagnosis of ASD.
Objectives:
This study aimed to characterize symptoms of ASD emerging in infants evaluated as a part of a larger randomized control trial. Specifically, we aimed to understand whether chronological age and sibling status would predict differences in standardized measures of functioning and diagnosis.
Methods:
36 infants (M=17.81 months old, 83% male) were asked to participate in a series of assessments including the ADOS- Toddler Module, Mullen Scales of Early Learning and the clinician's best estimate of diagnosis. Overall, infants demonstrated significant developmental delays with an average Mullen Early Learning Composite standard score of 67.58 (SD=13.36). Four scored "mild to moderate risk" classification on the ADOS- Toddler, with the remainder scoring with "moderate to severe risk". The clinicians also rated their certainty that the infant met DSM criteria for ASD using the Diagnosis Data

Form (Adapted from Cathy Lord, Personal Communication). A score of 15 reflects the highest score and the most diagnostic certainty. The scores of this sample ranged from 6-15 with an average score of 12.28 (SD=2.8).

Results:

Of the 36 infants who participated, 16 were first born and 20 had older siblings, 7 of whom had a diagnosis of ASD. Therefore, 19% of the total sample was infant siblings of children with ASD who were also showing early signs of the disorder. The child's chronological age was not a significant predictor of overall developmental quotient score, ADOS total algorithm score or clinician's diagnostic certainty. Infants with an older sibling with a diagnosis of ASD had significantly higher cognitive scores (M=77.86, SD=16.10) than children without a sibling (M=66.50, SD=11.63) with a diagnosis; t(33)=-2.33, p=.026). There were also trends toward infants with older siblings with confirmed diagnoses having lower ADOS total algorithm scores (M=15.57, SD=4.93) than those without (M=18.93, SD=4.29). Clinicians reported having more diagnostic certainty in those infants who did not have an affected older sibling (M=12.68, SD=2.28) compared to those who did (M=10.57, SD=4.28).

Conclusions:

This study examined the age related and sibling status differences in development amongst those children with the earliest signs of ASD. Although chronological age did not relate to the developmental or diagnostic outcomes, it may be that sibling status does play a role although larger samples are needed. Infants who belonged to the high risk group of infant siblings presented with less significant developmental delays, lower scores on the ADOS and clinicians rated less certainty in their overall diagnosis. These findings suggest that this subset of children may present with subtle delays early on but due to their sibling status parents may be more vigilant about monitoring these behaviors.

136 **124.136** Inhibited Toddlers and ASD Screening

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Background: A child's inhibited temperament greatly influences social engagement and exploration particularly in unfamiliar situations. Hence, inhibition can be confused with social-communication delays. Inhibition, defined by shyness, withdrawal, and under-activity, is rarely considered a mediator of ASD screening results.

Objectives: (1) Examine reliability and validity of inhibition observation. (2) Describe early ASD markers unique to those who were inhibited at one-year of age. (3) Determine whether inhibition increases false clinical referral for a developmental evaluation.

Methods: Parents of 84 12-month-old toddlers completed the First Year Inventory (FYI) an ASD screener. At 13 months toddlers participated in an in-home assessment including the Autism Observation Schedule for Infant (AOSI) and Mullen Scales of Early Learning (MSEL). The AOSI includes a reactivity item that captures both under- and over-reactivity. At 30 months parents completed the Infant Toddler Social Emotional Assessment (ITSEA) and toddlers participated in an in-home assessment including the MSEL and Autism Diagnostic Observation Schedule – Generic (ADOS-G). At 13 and 30 months toddlers were referred for a diagnostic evaluation if warranted by assessment results (n=18, 16, respectively). Inhibition was rated during the AOSI by experienced clinicians blind to the child's risk status. Five children were excluded from the non-inhibited group due to their rating as over-active.

Results: Twelve infants were rated as inhibited, 7 of which were also captured by the AOSI reactivity item. Inter-rater agreement for inhibition observation was significant, *PABAK* = 0.79. Parents of all infants in this group stated that the toddler behaved as usual during the observation. Inhibited infants received a significantly higher risk on the FYI social-communication score but not on the sensory-regulatory score; 58.3% met FYI risk cutoff versus 10.4% in the non-inhibited group. Inhibited infants showed significantly higher risk rates on the following five AOSI items: visual tracking, social babbling, response to name, reciprocal social smile, and social interest and shared affect. The inhibited versus control group had significantly lower early learning composite scores at 13 months, and marginally lower at 30 months. At 30 months this group had a significantly higher clinical referral rate of 54.5% versus the non-inhibited children (16.7%). However, there was no difference in rates of false (positive or negative) referrals at 13 versus 30 months referral; or based on risk on the FYI relative to 13 month referral. At 30 months, the inhibited versus the non-inhibited group had significantly ($p < .05$) higher rates of meeting ITSEA 90th percentile for inhibition to novelty (45.5%, 15.5% respectively) and depression/withdrawal scores (36.4%, 8.5% respectively).

Conclusions: Inhibition was reliably measured and persisted over time for about half of the children. An inhibited, withdrawn and difficult to engage infant has a higher likelihood of falling at risk on both parent and clinician based ASD screening measures. Nonetheless, inhibition did not inflate false screening results.

137 **124.137** Jealousy and Social Engagement in Very Young Children with Autism Spectrum Disorders

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Background: Jealousy is expereinced in a triadic context, where a potential threat exists that a valued relationship will be lost to a rival. Thus, expression of jealousy requires children to intersubjectively share with others. Intersubjective sharing is a core deficits in ASD—leading to speculation concerning

their ability to express jealousy. Recent data presented evidence of jealousy indices in some high-functioning preadolescents and preschoolers with ASD (IQ>75) (Bauinger, 2004; Bauminger, Chomsky-Smolkin, Orbach-Caspi, Zachor, & Levy-Shiff, 2008), and in half of low-functioning preschoolers with autism (IQ<75) (Bauminger et al., 2008), but no data was presented yet regarding children with ASD who are younger than three years. Also the link between jelaousy and social engagement was not yet examined.

Objectives: In an attempt to illuminate the nature of autism's affective deficit, the present study aimed to conduct assessment of jealousy in very young children with ASD (personal–mother and nonpersonal–stranger) and to identify jealousy's linkage with experimenter-child's social egngagement.

Methods: Participants included 19 toddlers with ASD (*CA*=23.16, months). To provok jealousy we manipulated two triadic conditions (personal mother-child-baby doll scenario and nonpersonal stranger-child-baby doll scenario), consisting of the mother/stranger putting a "life-like newborn-baby doll" on her lap, and cuddling the newborn-baby doll (e.g., Hart, Aaron, Jones, & Field, 2003). Social engagament was tested through 3 interactive social tasks based on the ADOS (Lord et al., 2000) including bubble play; peek-a-boo and playing with a Balloon.

Results: Repeated measure ANOVA conducted to examine differences in protest behaviors between the two situations (personal/non-personal) revealed a significant main effect for situation**,** $F(1,18) = 7.30$, $p < .05$, η2 = .29. Young children with ASD showed more protest behaviors in the jealousy personal situation (mother-holding the baby-doll) versus the non-personal situation (stranger holding the baby-doll). Furthermore, eye gazes, physical proximity behaviors and verbal gestures were directed more towards the mother in both the personal and non-personal situations versus the stranger. Higher levels of social engagement were linked with more eye gazes, physical proximity behaviors and verbal gestures in the jealousy personal situation.

Conclusions: The fact that jealousy expressions were higher in the personal-mother condition than the nonpersonal - stranger situation and the link between jealousy and social engagement in very young children with ASD holds significant implications for understanding ASD children's intersubjective capabilities.

138   **124.138** Joint Attention and Language Development in Infants at Risk for Autism

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Background:
Few studies have prospectively examined joint attention and language development in infants with an older sibling with ASD (Sibs-ASD), who have a higher risk of ASD and/or language delay than infants with an older sibling without ASD (Sibs-TD; see Rogers, 2009). We hypothesized that Sibs-ASD would have lower RJA, receptive language, and expressive language scores than Sibs-TD. We also expected to replicate the findings of Hudry and colleagues (2013) that Sibs-ASD would have a smaller gap between receptive and expressive language scores than Sibs-TD. Moreover, we expected RJA at 9, 12, or 15 months of age would positively predict 24-month language scores across groups.

Objectives: This study examined associations between joint attention across 9, 12, and 15 months and multiple measures of language development across 9, 12, 15, 21, and 24 months in Sibs-TD versus Sibs-ASD.

Methods:
Twenty-one Sibs-TD (11 female; 10 male), 20 Sibs-ASD (10 female; 10 male), and their mothers participated as part of a larger longitudinal study of Sibs-ASD. The Early Social Communication Scales were administered to infants, and later coded for Initiating and Responding to Joint Attention (IJA and RJA; Mundy et al., 2003). We assessed infants' receptive and expressive language using the MacArthur Communication Development Inventories (MCDI; Fenson et al., 1993), Vineland Adaptive Behavior Scales (Vineland-II, Sparrow et al., 2005), and the Bayley Scales of Infant Development (Bayley-III, 2006). See Table 1.

Results:
A one-way ANOVA between groups revealed that Sibs-ASD had significantly less growth in IJA from 9 to 15 months compared to the Sibs-TD ($F(1, 30) = 10.107$, $p = .004$). However, there were no significant differences in RJA scores between groups. Sibs-ASD had significantly lower receptive vocabulary at 15 months on the MCDI ($F(1, 30) = 7.25$, $p = .011$) and 21 months on the Vineland ($F(1, 30) = 4.310$, $p = .047$). Sibs-ASD also had significantly lower Bayley expressive language scores than Sibs-TD at 12 months ($F(1, 30) = 4.079$, $p = .053$). Also, the advantage of receptive over expressive language skills on the MCDI at 15 months was significantly lower in Sibs-ASD than Sibs-TD ($F(1, 30) = 11.64$, $p = .002$). Across groups, 15-month RJA was positively correlated with 15-month MCDI expressive ($r = .476$, $p = .004$) and 24-month MCDI expressive scores ($r = .456$, $p= .022$).

Conclusions:
These findings suggest that Sibs-ASD, as a broader group, may not exhibit joint attention deficits when compared to Sibs-TD at one time point. However, Sibs-ASD did exhibit less growth in IJA than Sibs-TD. Our results also indicated that Sibs-ASD appear to have (a) significantly lower receptive language abilities at 15 and 21 months and (b) a significantly lower receptive over expressive language advantage at 15 months compared to Sibs-TD. Across groups, RJA at 15 months predicted expressive language at 15 and 24 months. One key implication of this study is that given the link

between early RJA and language development, facilitation of the early ability to respond to joint attention bids could mediate language deficits in Sibs-ASD.

139   **124.139**   Latency to Share Interest at 12 Months Is Associated with Joint Attention Trajectories in Infants at High and Low Risk for ASD
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Background: Low-level initiation of joint attention (IJA-low; looking to the examiner and alternating gaze between toy and examiner) does not differ between 12-month olds who are later diagnosed with ASD and those who develop typically. However, IJA is impaired in older children with ASD. We explored individual differences in time to orient to an examiner after viewing an interesting event in 12-month olds at high (HR) and low risk (LR) for ASD to examine reaction time or speed to convert a solitary experience into a shared social experience. We hypothesized that social motivation would be greater and therefore latencies would be shorter in LR infants than in HR infants later diagnosed with ASD. There is limited research on social reaction time in ASD, but older children with ASD do not differ from neurotypical controls in inspection time on computerized nonsocial tasks. Investigation of skills that are intact in infancy but impaired in childhood is expected to reveal useful targets for early intervention.
Objectives: (1) Evaluate latency to share interest in HR and LR 12-month olds; (2) Evaluate relations between latency to orient and frequency of IJA concurrently and longitudinally.
Methods: Participants were 105 infants at high and low risk for ASD. Evaluations at 36 months indicate that 50 were developing typically (TD); 30 showed signs of social and/or language delays; and 25 met criteria for ASD. We administered the Early Social Communication Scales (ESCS; Mundy et al., 2003) at 12 and 18 months. During the wind-up toy portion of the ESCS, the time between presentation of the wind-up toy and first look to the examiner was measured. Latency times were averaged across trials for each participant. IJA-low at 12 and 18 months was coded according to the ESCS manual.
Results: Preliminary results show no difference in average latency time between groups (Mean (Standard Deviation) in seconds: ASD = 6.4 (5.3); Atypical outcome = 6.3 (4.3); TD = 7.9 (5.7)). However, latency to orient across groups was negatively correlated with frequency of IJA-low (r=-.59, p<.01). Additionally, the relation between latency to orient at 12 months and growth in IJA-low from 12 to 18 months was moderated by outcome classification (F(3,52)=5.41, p<.01): the TD group showed a positive relation between latency and IJA growth, and the ASD group showed a negative relation.
Conclusions: Latency to convert one's own enjoyment of an event to a shared social experience did not differ between 12-month olds later diagnosed with ASD and those with other atypical or TD outcomes. Longer latency to disengage from the non-social stimulus and orient toward the examiner appears beneficial among TD infants whereas infants who take longer to orient to the examiner and who are later diagnosed with ASD show decreases in IJA-low from 12-18 months. Social orienting is present in all outcome groups and occurs at comparable speeds. Mechanisms of experience-sharing are evident but function differently among groups, arguing for interventions that focus on transforming social glances into opportunities for shared enjoyment in infants at heightened risk for ASD.

140   **124.140**   Longitudinal Development of Preferential Attention to Biological Motion in Infants at Low and High Risk for Developing ASD
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Background: Preferential attention to biological motion is typically present in human infants shortly after birth and plays a key role in facilitating filial attachment and guiding social interaction (Simion et al., 2007). In contrast, absence of preferential attention to biological motion in 24-month-olds with ASD (Klin et al., 2009) suggests a disruption of normative social engagement. Little is known, however, about the longitudinal development of preferential attention to biological motion in either TD or ASD populations. Knowledge thereof would be critical in understanding *when* deviations are first observed in ASD and what their developmental consequences may be.
Objectives: To measure the development of preferential attention to biological motion from 2-24 months in infants at high-risk (HR) and low-risk (LR) for ASD.
Methods: 88 LR (49 male) and 95 HR (67 male, 50%>12 months) infants were shown point-light biological motion animations as in Klin et al. (2009). An upright point-light animation was presented on one half of the screen, with the inverted version playing on the other half in reverse order. Piloting revealed that trials lasting <30sec failed to elicit interstimulus shifting in young infants; as a result, we increased trial time by playing two unique animations in succession (referred to as part 1 and part 2). Eye-tracking data, collected at months 2, 3, 4, 5, 9, 15, and 24, were used to calculate percentage of fixation time during the whole trial, part 1, and part 2.

Results: Analyses of percent fixation during the whole trial revealed that at 15 months both LR (M(SD) = 55.8(9.4)%, $t(16) = 2.55$, $p<0.05$) and HR infants (M(SD) = 58.2(9.2)%, $t(24) = 4.52$, $p<0.05$) have a preference for the upright figure that increases at 24 months, (M(SD) = 63.0(9.5)%, $t(28) = 7.33$, $p<0.05$) (M(SD) = 62.6(7.4)%, $t(22) = 7.96$ $p<0.05$). Analyses of percent fixation during part 2 of the trial revealed that LR and HR infants have a preference for the upright figure beginning at 3 months (M(SD) = 57.9(19.4)%, $t(31)= 2.32$, $p<0.05$) (M(SD) = 57.6(19.5)%, $t(34) = 2.32$, $p<0.05$), an effect that remains robust at 4, 5, 9, 15, and 24 months (all p's <0.05) in TD infants. An absence of preferential attention to biological motion was observed at 2 months in LR and HR infants. Conclusions: Our results replicate earlier findings of preferential attention to biological motion in 24-month-old TD infants and map the trajectory of this preference during the first two years of life. The absence of preferential attention to biological motion at 2 months, followed by preference at 3 months and thereafter, matches the existing literature regarding preferential attention to faces, which is present at birth but declines at 4-6 weeks of age before re-emerging at 2-3 months. The current findings provide evidence of a similar transition in orienting to biological motion, and highlight this developmental period as a critical focus for future research into the unfolding of social disability in ASD (Klin, Shultz, Jones, 2014). Future analyses will examine early departures from normative trajectories in infants later diagnosed ASD.

141 **124.141** M-CHAT-R with Follow-up Phone Interview (M-CHAT-R/F): Analysis of Changed Responses

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Background:
The M-CHAT-R is a screening instrument developed for the detection of autism spectrum disorder (ASD) in children ranging from 16 to 30 months of age. It is a parent-completed measure consisting of 20 yes/no items. When a child screens positive on the M-CHAT-R, a more comprehensive follow-up phone interview can be conducted to confirm a parent's answers and rule out potential false positives. A recent validation study suggests that the completion of the follow-up phone interview is most critical for children who fall in a medium risk category, failing between three and seven items on the M-CHAT-R. Despite the importance of the follow-up phone interview, the performance of individual items has not yet been examined. As the American Academy of Pediatrics recommends screening for ASD at 18- and 24-month well-child visits, the current study proposes to compare item performance on the follow-up phone interview (PI) for children who screen positive on the M-CHAT-R at 18- and 24-months.
Objectives:
To examine item performance on the M-CHAT-R Follow-up phone interview at 18 and 24 months.
Methods:
Parents completed the M-CHAT-R at their child's 18- or 24- month well-child visit. The parents of children who screened positive on the M-CHAT-R were contacted, and PIs were conducted. The demographics of the 18-month (n = 400) and 24-month (n = 213) samples that screened positive on the M-CHAT-R were compared using Chi Square or t-tests, as appropriate. The percentage of times each item was asked on the PI (i.e., failed on the M-CHAT-R) was compared between the 18- and 24-month samples using Chi Square. The percentage of answers changed when each item was asked (i.e., fail on M-CHAT-R to pass on PI) was also compared using Chi Square.
Results:
Although samples differed on gender, they did not differ on ethnicity or informant characteristics, such as relationship to child and maternal education. PIs were conducted with over 80% of each sample, and were completed approximately a month and a half after the M-CHAT-R, on average. Items reflecting early development, such as imitation, were asked more often in the 18- than 24-month sample. Responses to twelve of twenty items changed (i.e., Fail to Pass) more than 60% of the time when asked on the PI. The most frequently changed items included encouraging parents to watch him/her, making unusual finger movements, and engaging in pretend play. Three items, pointing to direct attention, interest in peers, and response to name, were significantly more likely to change in the 24- than 18-month sample.
Conclusions:
Results suggest that the performance of individual M-CHAT-R and PI items may differ depending upon the age at completion. High frequency of change in response for more than half of the items reinforces the importance of the PI in the screening process. Parents may be cued to look for certain behaviors after completing M-CHAT-R leading to changed responses on the PI. Alternatively, parents may not understand the question as intended. Further research examining the predictive nature of change in item response for diagnosis is warranted.

142 **124.142** Measuring the Importance of Fyi Screener Items in Predicting Adost Totals at 12 and 18 Months: A Machine Learning Approach

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Background: The First-Year Inventory (FYI) parent questionnaire is designed to screen for autism

(Reznick et al., 2007). Given the potential benefits of early intervention (Filipek et al., 1999), it is important to identify those active ingredients most informative of later outcome.

Objectives: To identify FYI items from 12 months that predict levels of autism symptoms at 12 and 18 months measured by the ADOST algorithmic total, among high-risk (HR) infant siblings.

Methods: Parents of HR siblings (N=76) completed the FYI at 12 months. Those children received ADOST evaluations at 12 and 18 months. We used random forest machine learning (#trees=500, #tries=35; similar to Wu et al. 2003) to measure the importance of individual FYI items, predicting ADOST algorithm totals at 12 and 18 months. Random forests measure the importance of each training variable in terms of resultant change in sample variance when moving that training item's position within the step-wise predictive model. Items with larger changes are more important. We selected as important those variables whose scores affected variance at a higher rate.

Results: Random forest variable selection isolated three FYI questions, important in predicting ADOST totals at both 12 and 18 months: Q37 (restricted interest in parts of toys, Sensory-Regulatory Functions—SRF—domain), Q49 (social interactive play, social communication—SC—domain), and Q24 (vocal imitation, SC). Two items were important for predicting 18 but not 12 month ADOST totals: Q57 (reactivity, SRF) and Q12 (attention to others, SC). Six items were important for predicting 12 but not 18 month ADOST totals: Q43 (stuck postures, SRF), Q48 (fixated interest in certain toys, SRF), Q6 (avoiding eye contact, SRF), Q11 (isolated play, SRF), Q45 (kicking, SRF), Q41 (feeding, SRF).

Conclusions: We have applied machine learning to identify early screening questions that are most predictive of later autism symptom levels. In predicting ADOST total scores, the importance of an FYI item may reflect three properties: [1] prevalence of the behavior at 12 months, [2] good operationalization in the FYI and ease of evaluation of the behavior by parents, and [3] developmental stability of the behavior. Items that were important in either prediction may be prevalent and easily detectable at 12 months. Items Q37, Q49, and Q24 were important for predicting both 12 and 18 month ADOST totals, suggesting developmental stability, especially because these are closely related to core symptoms of ASD. Items Q57 and Q12 were important for predicting 18- but not 12-month ADOST totals, possibly indicating association with the development of more refined and advanced social communication behaviors (Q12), and with impairments in sensory-regulatory functions (Q57), that emerge between 12 and 18 months. These items may represent early, recognizable precursors of greater impairments that develop between 12 and 18 months. The six items that were important for predicting ADOST totals at 12 but not 18 months all fall within the sensory-regulatory function domain. These may be easier for parents to evaluate at 12 months than social communication behaviors. Their decline in importance at 18 months may reflect the specificity of those behaviors to an earlier developmental epoch.

143 **124.143** Motor Development, Autism Symptoms, and Emerging Executive Functioning in Infants and Toddlers at High and Low Risk for ASD

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Background: The A-not-B task, developed by Piaget, is one of the classic tests of human cognitive development and has been used widely in developmental research. This task is based on the theory of object permanence and is purported to measure working memory, response inhibition, and goal-directed behavior. Ability to perform the A-not-B task requires acquisition of specific motor milestones (e.g., reaching and grasping). Furthermore, research suggests that motor abilities and executive functioning are associated. However, relationships between abnormal early motor ability, impaired performance on the A-not-B task, and later development of autism symptoms in a high-risk (HR) sample having an affected older sibling are not well understood.

Objectives: To assess whether performance on the A-not-B task at 12 and 24months is associated with motor development and autism symptoms. We hypothesize that 1) better motor skills will be associated with better performance on the A-not-B at both 12 and 24months and 2) toddlers who develop autism symptoms at 24months (HR-ASD-Positive) will perform worse on the A-not-B at 12 and 24months than those without autism symptoms (HR-ASD-Negative, LR-ASD-Negative).

Methods: Participants are part of a multi-site, longitudinal study of brain and behavioral development in infants at high-risk (HR) and low-risk (LR) for ASD followed from 6months and assessed for autism symptoms at 24 months (HR-ASD-Positive, n=34; HR-ASD-Negative, n=133; LR-ASD-Negative, n=69). A-not-B data was collected at 12months (n=291) and 24months (n=226). In the A-not-B task, the infant watched as a toy was hidden to the left or right of midline. The infant was encouraged to find the toy after a delay of either 5s or 12s. Once the infant found the hidden toy on two consecutive trials, the side of hiding was switched. A maximum of 24 trials were administered. Performance was measured by the percentage of accurate reaches/errors at each delay interval. Motor skills were assessed with the Mullen Scales and Vineland. Autism symptoms were assessed using the ADOS and DSM at 24months.

Results: Preliminary results revealed that nearly one-third of HR and LR 12-month-olds had unusable

A-not-B data and one-quarter had unusable data at 24months. These children had lower fine motor skills at 12 months and lower fine and gross motor skills at 24 months as compared with children with useable A-not-B data. The groups (HR-ASD-Positive, HR-ASD-Negative, LR-ASD-Negative) did not differ on A-not-B performance at 12 months. At 24months, the HR-ASD-Positive group demonstrated significantly lower total percent correct than the LR-ASD-Negative group. The HR-ASD-Negative group demonstrated significantly decreased performance (percent correct reversal at 5s, total reversal errors, and total percent correct) as compared with the LR-ASD-Negative group. Further analyses will investigate the interaction between group, motor ability, and A-not-B performance and the role of overall cognitive ability in A-not-B performance.

Conclusions: Preliminary evidence suggests that difficulties on the A-not-B task at 12 and 24months may be associated with motor ability at 12 and 24 months, with autism symptoms at 24months, and with autism risk status. Future studies should evaluate possible causal pathways between early motor deficits and later outcomes in ASD.

144 **124.144** Online Queries of Parents Suspecting Their Child Has ASD: A Clinician Mediated Machine Learning Prediction of ASD Risk

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Background: The increasing rates of autism spectrum disorders (ASD) and the growing awareness of them lead more parents to suspect ASD in their child. These early concerns can precede their referal of a professional by months. Parents are increasingly approaching online communities for information about their child's development expecting to verify/dispute their concerns by a largely non-professional community. Online queries are a testimony to the signs alarming parents. Machine learning tools may offer a way to facilitate an estimate of the degree of ASD risk of the child in an online query.

Objectives: (1) Identify signs that differentiate online queries of children with low, medium, versus high ASD risk as rated by clinicians; (2) Test the efficacy of machine learning tools in classifying a child for ASD risk.

Methods: Yahoo Answers, a social question and answering site, was mined for queries of parents asking the community whether their child has ASD. The 194 questions from the resulting corpus were sampled for this study (Mean age = 39.59 months; 72% < 3 years; 86.32% boys). Domain expert clinicians performed a content analysis of the types of signs described in the question. The child's risk level for ASD in the question was rated as low, medium, and high by a different clinician. Machine learning tools were applied for predicting risk from text or coded signs.

Results: Of the 194 questions, 31 were rated as low risk, 55 medium risk, and 108 high risk. There was no difference in gender distribution between risk groups. Chi square tests showed that questions rated as high risk contained a significantly ($p < .05$) higher rate of social, communication, language, and cognitive problems as well as repetitive and restricted behaviors in text. Of the 55% of parents that mentioned a language problem there was a 95.3% chance of high or medium risk compared to 70.4% for the rest of the sample. 20.6% of the sample did not mention language problems and no repetitive and restricted behaviors. For them the chance of high or medium risk was 55%. 24.7% of parents did not report language problems but reported repetitive and restricted behaviors. For them the chance of high or medium risk was 83.3%. When predicting if a question was medium or high risk using the text of the question, an automatic classifier (decision tree) reached an Area Under the Curve (AUC) of 0.63, compared to 0.78 when the classifier used coded signs.

Conclusions: Most children for which parents suspect they have ASD are judged by a clinician as in need for a clinical evaluation. Parents report signs in all core ASD diagnostic domains as well as concerns related to cognitive functioning. Accurately predicting ASD risk from a question requires a mediating step of classifying text into symptom domains. Findings support the need for a computerized tool to assist parents in tagging their concerns in order to obtain a risk estimate.

145 **124.145** Optimizing Stimulus Selection for Early Detection of ASD Based on Preferential Attention to Audiovisual Synchrony in Toddlers

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Background: Our previous studies of two-year-olds with ASD demonstrated increased orientation to physical contingencies relative to social contingencies in a preferential looking paradigm when physical contingencies were defined by audiovisual synchrony between sound and light while social contingencies contrasted faces and voices with moving objects. Typically developing (TD) toddlers preferentially attended to social contingencies. We previously demonstrated a likelihood-ratio-based classifier discriminating between ASD and TD toddlers using eye-tracking measures of behavioral response to social and physical contingencies based on a variety of stimulus types but did not test for the effect of clip type.

Objectives: This study uses a permutation-based stimulus selection technique to optimize the

performance of eye-tracking measures of behavioral responses to social and physical contingencies to discriminate between ASD and TD toddlers.

Methods: Using a preferential looking task, TD and ASD toddlers (Table 1) were presented with videos of audiovisual stimuli that paired faces and geometric shapes with tones or speech. A second cohort of TD and ASD toddlers were presented with naturalistic videos of a caregiver paired with one of four toys – rocking horse, light-up toy, mobile, or train – exhibiting different types of motion synchronized with the caregiver's speech. Using eye-tracking measures of fixation on regions of interest, the optimal classifier for discriminating ASD from TD participants was created using a likelihood ratio test. Receiver Operating Characteristics with leave-one-out cross-validation (LOOCV) evaluated the performance of the classifier. To optimize the stimulus set for maximizing the classifier performance, each possible permutation of the stimulus clips was used to train the classifier and the corresponding area under the curve (AUC) was used to identify the combination of clips with the best classification performance.

Results: We obtained a maximum AUC = 0.968 and sensitivity and specificity of 91% using the classifier to distinguish between TD and ASD toddlers for the preferential looking task. The top ten clip combinations had an AUC value centered on 0.967 ± 0.0001. After LOOCV, the best clip combination yielded an AUC = 0.967 ± 0.004, sensitivity = $90.8 \pm 0.9\%$, and specificity = $90.4 \pm 0.9\%$. Using the naturalistic stimuli, we obtained a maximum AUC = 0.944 with sensitivity and specificity of 88% (Figure 1). Furthermore, the mobile toy clip comprised 50% of the clips in the best clip combination with the highest AUC indicating that the rotational motion of the mobile toy exhibited the greatest difference in perceptual salience between ASD and TD groups.

Conclusions: Unlike traditional strategies of pooling stimuli for classification analysis, this study used a permutation based stimulus selection strategy to select the video clips that maximized the AUC. This significantly improved the discrimination between ASD and TD toddlers and inherently sorted the stimuli based on clip features. In addition to maximizing classifier performance, the permutation based clip selection also revealed which type of toy motion showed the greatest difference in salience between groups.

146 **124.146** Parent Education Level and Developmental Progress in Toddlers with ASD

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Background: Given disparities regarding age of diagnosis and access to services amongst underserved populations, (Liptak et al., 2008) it is vital to examine factors associated with developmental gains in toddlers with ASD. Previous research has demonstrated an association between parental education level and earlier diagnosis as well as family's income level and risk for ASD (Fountain et al., 2010; Rai et al., 2012). Additionally, maternal education level has shown to predict developmental gains following intervention (Ben Itzchak et al., 2011). Impact of paternal education in relation to developmental gains in early toddlerhood is less clear.

Objectives: The purpose of this study is to examine whether parent education level is associated with developmental progress in toddlers with ASD.

Methods: The current sample included 24 community-referred toddlers with ASD (20 males) who participated in a longitudinal study on social engagement. The study consisted of two separate visits (about 15 months apart), both of which included the Autism Diagnostic Observation Schedule, Second Edition, and Mullen Scales of Early Learning (Mullen). Families received ASD diagnoses and recommendations from a multidisciplinary team. In order to consider developmental progress on the Mullen between visits (mean age Time 1 (T1)=22.89 months; mean age Time 2 (T2)=38.30 months), a ratio was computed for each scale [(T2 age equivalent–T1 age equivalent)/(T2 chronological age–T1 chronological age)]. A ratio of greater than 1 indicated that for the given scale, the participant gained more in age equivalent (months) than he or she aged chronologically. Parents self-reported on educational attainment; this was coded into two categories: below bachelor's degree (47.83% of mothers, 52.17% of fathers) and bachelor's degree or beyond. Analyses considered toddlers' developmental progress by determining whether parental education level was associated with aforementioned Mullen ratios.

Results: Given that Mullen Fine Motor scores decreased significantly between visits, $t(23)=2.47$, $p=.02$, toddlers' developmental progress was considered in terms of the remaining three Mullen scales (Visual Reception, Receptive Language, Expressive Language). One subgroup of participants consisted of those who made gains in all three areas, ("more progress"; 48.7% of participants). The other subgroup consisted of those with gains on two or fewer scales ("less progress"; 58.3% of participants). Fisher's exact tests (rather than chi-square tests of independence, due to low expected cell counts) were conducted to examine the association between developmental progress and maternal/paternal education level. The association between maternal education and developmental progress was not significant, Fisher's exact test $p=.68$. Conversely, there was a significant association between paternal education and developmental progress, Fisher's exact test $p=.01$, whereby higher paternal education (i.e., bachelor's degree or beyond) was associated with "more progress."

Conclusions: When analyzing toddler outcomes between visits in three areas on the Mullen (Visual Reception, Expressive and Receptive Language), there was a significant association between paternal education level and developmental progress. There was no significant association with maternal education. Future research should examine the relevance of socioeconomic status and

parental education level to ASD prognosis as well as how interventions can be adapted to better address needs of families from varying backgrounds.

147 **124.147** Parent Prediction of ASD in Infants at Risk

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Background: Infants with older siblings with ASD are at biological risk for ASD or the broader phenotype. Early identification could lead to earlier treatment and prevention.
Objectives: This study compared three groups of 1 to 36 month children ($N = 108$) at-risk (because they had an older biological sibling with ASD) on the Parent Observation of Early Markers Scale (POEMS, Feldman et al., 2012). The POEMS has 61 items completed prospectively by parents. Parents rate each item as 1 (no problem) to 4 (severe problem) with ½ scores allowed; scores range from 61-244. Elevated items are those with scores of 3, 3.5 or 4.
Methods: The groups were: (1) 13 children who were eventually diagnosed with ASD by 13 years; (2) 5 children who lost their ASD diagnosis by 6 years; and (3) 89 children never diagnosed. A mixed ANOVA determined the differences between the three groups on the POEMS total scores and elevated items.
Results: Using all available POEMS scores at 9, 12, 18, 24 and 36 months, total POEMS scores differed between groups, $F(2, 69) = 11.78$, $p < .001$, partial eta-squared (h^2) = .025, and group X age was significant, $F(8, 276) = 3.76$, $p < .001$, (h^2) = .098. Post hoc comparisons using the Tukey HSD test showed that the diagnosed group ($M = 87.76$, $SD = 28.68$) had significantly higher scores than the undiagnosed group ($M = 67.83$, $SD = 8.33$). The lost diagnosis group ($M = 74.70$, $SD = 8.63$) did not differ significantly from the diagnosed and undiagnosed groups. The groups differed on the number of elevated items, $F (2, 70) = 9.34$, $p < .001$, $h^2 = .21$, and group X age was significant, $F (8, 280) = 3.16$, $p < .001$, (h^2) = .083. Post hoc comparisons using the Tukey HSD test showed that the diagnosed group ($M = 7.3$ $SD = 9.78$) had significantly more elevated items than the undiagnosed group ($M = 1.10$, $SD = 2.34$), but not the lost diagnosis group ($M = 1.93$, $SD = 1.64$) that also did not differ from the undiagnosed group. (3) Repeated measures analyses revealed a significant age effect as the children got older on total POEMS scores $F (4, 276) = 4.55$, $p < .001$, $h^2 = .062$, but not for elevated items $F (4, 280) = 2.28$, $p = .061$, $h^2 = .032$. Significant differences in total scores and elevated items between the undiagnosed and diagnosed groups began emerging as early as 12 months. Across ages, imitation, verbal communication, pointing in response to a question, tolerance for waiting and acceptance of food most differentiated the at risk infants eventually diagnosed from those who had not been diagnosed by age 13 years.
Conclusions: The findings suggest that by completing the POEMS prospectively, parents of at-risk infants may be able to predict which infants will or not be diagnosed, or lose their ASD diagnosis, as early as 12 months of age, with prediction increasing the closer the child is to 36 months.

148 **124.148** Parental Concerns and Their Relation to Early Intervention and Social-Communicative Functioning within the First Two Years of Life

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Background:
Parental concerns about a toddler's development may serve as a catalyst for seeking guidance, diagnostic evaluations, and/or early intervention services. For children diagnosed with ASD, on average, parents report becoming concerned about their child's development by 18 months. However, little is known about how these concerns develop, whether they prompt parents to seek early intervention services for their toddlers, and the extent to which they predict toddlers' later social-communicative functioning. The current study examined the presence of parental concerns in infants at risk for ASD with an ASD diagnosis (Sibs-HR/ASD), at risk but without an ASD diagnosis (Sibs-HR/ND), and low risk controls (Sibs-LR).
Objectives:
Examine: 1) change in parental concerns between 12 and 18 months, 2) the extent to which parental concerns at 18 months increase the likelihood that toddlers are enrolled in intervention services at 18 months, and 3) the extent to which parental concerns at 18 months predict childrens' language and social-communication at 24 months.
Methods:
Sibs-HR/ASD ($n=21$), Sibs-HR/ND ($n=39$), and LR-sibs ($n=41$) were examined at 12, 15, 18, and 24 months. At 12-18 months, parental concerns were calculated by summing parent's responses indicating level of concern (i.e., 0=no, 1=a little, 2=yes) across the 7 items on the Parent Concern Form, which focuses on motor, language, and social behaviors. At 18 months, toddlers were identified as receiving early intervention; 12 Sibs-HR/ASD, 4 Sibs-HR/ND, and 3 LR-sibs were receiving services

per the Child Treatment Questionnaire. At 24 months, expressive and receptive language were measured via T-scores on the Mullen, and social-communication was measured via Vineland standardized Communication and Socialization scores.
Results:
For parental concerns, a repeated-measures ANOVA yielded significant main effects for Age and Diagnostic Group, and their interaction, $ps<.01$ (see Table 1). Post-hoc analyses indicated that: (1) at 12 months, parental concerns were significantly higher for Sibs-HR/ASD and Sibs-HR/ND than Sibs-LR, $ps<.03$; (2) at 15 and 18 months, parental concerns were significantly higher for Sibs-HR/ASD than Sibs-HR/ND and Sibs-LR, $ps<.01$; and (3) for Sibs-HR/ASD only, parental concerns significantly increased between 12 and 18 months, $p<.02$. A logistic regression indicated that, across all toddlers, higher levels of parental concerns at 18 months increased the likelihood that early intervention services were being received, $OR=1.51$, $p<.01$.
For Sibs-HR/ASD, higher levels of parental concerns at 18 months predicted lower levels of receptive language ($r=-.49$), communication ($r=-.65$), and socialization ($r=-.59$) at 24 months. For Sibs-LR, higher levels of parental concerns at 18 months predicted lower levels of expressive language, $r=-.31$.
Conclusions:
At 1 year of age, parents of Sibs-HR were more concerned about their infant's development than Sibs-LR parents; however, concerns significantly increased over the following 6 months only for those Sibs-HR who received an ASD diagnosis at age 2. The presence of concerns increased the likelihood that toddlers would be receiving intervention by 18 months. While parental concerns predicted lower levels of expressive language for Sibs-LR, they predicted both language and *social* outcomes for HR-sibs/ASD, suggesting that early developmental concerns may map on more closely to later ASD-specific deficits for these toddlers.

149 **124.149** Patterns of Repetitive Behavior with Objects in Infants Developing ASD

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Background: Prior studies examining early manifestations of ASD have largely focused on social communication. However, it is increasingly recognized that repetitive behaviors also emerge early. Studies of infant siblings indicate that, at 12 months of age, infants who later developed ASD showed significantly more repetitive behaviors with objects (Ozonoff et al., 2008) and stereotyped motor mannerisms (Elison et al., 2014). However, it is unknown whether such behaviors are evident prior to the first birthday nor how they develop over the first years of life.
Objectives: We evaluated infant behaviors with objects from 9 through 36 months to determine whether infants later diagnosed with ASD show distinct early patterns.
Methods: Infant siblings of children with ASD (high-risk) or typical development (low-risk) were administered a task designed to elicit repetitive object use (Ozonoff et al., 2008) at 9, 12, 15, 18, 24, and 36 months of age. Of 151 infants, 59 were classified as low-risk typically developing (LR-TD), 76 as high-risk non-ASD (HR-Non-ASD), and 16 as high-risk ASD (ASD) at 36 months. Behavior was coded using seven codes, four of which were hypothesized to be developmentally typical (bang, drop/throw, shake, functional/symbolic play), and three hypothesized to be atypical (spin, rotate, unusual visual inspection). Employing a Generalized Estimating Equations approach using a negative binomial distribution with log link, we evaluated group differences in repetitive behavior frequencies between 9 and 36 months.
Results: The interaction between type of repetitive behavior, visit, and outcome was significant (Wald $\chi^2=308.29$, $df=60$, $p<.001$). The groups showed few persistent differences in typical behaviors (Figure 1). The ASD and HR-Non-ASD groups displayed significantly less shaking at 9 months and more banging at 12 months relative to the LR-TD group, and the ASD group displayed significantly less dropping/throwing at 24 months relative to the LR-TD group. From 12-18 months, the LR-TD and HR-Non-ASD groups engaged in significantly more functional/symbolic play than the ASD group. Regarding atypical behaviors (Figure 2), at 9 months, the ASD group engaged in significantly more unusual visual inspection than the LR-TD and HR-Non-ASD groups, persisting through 36 months. The ASD group also engaged in significantly less spinning than the LR-TD and HR-Non-ASD groups at 9 months. There were no differences in rotating, although trends for the ASD group being higher were evident at 15 and 18 months.
Conclusions: Unusual visual inspection of objects is present and stable as early as 9 months of age in infants developing ASD. This replicates and extends, in an independent sample, prior findings from 12-month-olds developing ASD (Ozonoff et al., 2008), demonstrating that unusual visual inspection is present earlier than previously thought and is one of the earliest behavioral predictors of ASD outcome yet documented. The groups showed few persistent differences in developmentally typical repetitive behaviors, suggesting that those developing ASD are not broadly repetitive overall, but display specific atypical repetitive behaviors with objects. These results suggest that close monitoring of unusual visual inspection may be an important aspect of early detection efforts and could be incorporated into screening and diagnostic tools.

124.150 Perception of Biological Motion and Integration of Audio-Visual Stimuli in Infants at Risk for Autism

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Background: Biological motion (BM) perception and multisensory integration (audio-visual synchrony; AVS) are critical processes in typical development that are implicated as potential mechanisms of dysfunction in ASD. In typical development, preferential attention to biological motion and successful detection of temporal contingency between auditory and visual events develop early in life and facilitate interpersonal interactions. Behavioral research indicates that these abilities are impaired in toddlers diagnosed with autism spectrum disorder (ASD). However, the developmental emergence and neural underpinnings of these abilities are poorly understood.

Objectives: Neural responses to BM and AVS were compared in infants at high-risk (HR; having an older sibling with ASD) and infants at normal risk (NR; no family history of ASD) for ASD. Through investigation of electrophysiological markers of BM and AVS, we aimed to (a) compare sensitivity to BM, (b) evaluate the degree of neural facilitation when processing multisensory stimuli, and (c) track the emergence of BM sensitivity and AVS facilitation to define typical vs. atypical trajectories.

Methods: Through a longitudinal design, HR (n=36), and NR (n= 42) infants were assessed at three-month intervals between three and twenty-four months. EEG was recorded with a 128-channel Hydrocel Geodesic Sensor net while infants viewed point-light displays illustrating BM and scrambled motion (SM; Experiment 1) or unimodal/bimodal auditory (tone) and visual (blue circle) stimuli (Experiment 2). In Experiment 1, two event-related potentials (ERPs) indexing BM perception (N200, negative deflection over right occipitotemporal scalp between 200-300ms; PSW, late anterior positive slow wave between 900-1500ms) were examined. In Experiment 2, two ERPs indexing multisensory integration (N100, negative deflection over fronto-central scalp between 90-145ms; N200, negative deflection over occipitotemporal scalp between 150-200ms) were assessed.

Results: Preliminary analyses from Experiment 1 found that neither HR nor NR infants exhibited significant differentiation between BM and SM (p>.05) at the six and nine-month time points. Descriptively, both groups exhibited attenuated N200 to BM, relative to SM, at six months, but this differentiation did not reach significance. NR infants, but not HR infants, continued to demonstrate this N200 attenuation to BM at nine months. In Experiment 2, 9 to 12 month NR infants exhibited a significantly enhanced N200 in response to AVS, (p=.01), whereas HR infants did not.

Conclusions: HR and NR infants elicited differential neural responses to BM at six months of age, and 9-12 month old HR infants exhibited neural atypicalities for AVS. These characteristic changes in neural response to BM and AVS over the first two years of life have the potential to serve as early indicators of ASD and to guide development of individually-tailored early interventions.

124.151 Predictors of Functioning in Preschool and School Age Children with ASD

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Background:
Many longitudinal studies thus have examined the stability of the ASD diagnosis over time, yet occurred at a 1 to 2 year period, at preschool age, when the symptomology is most prototypical (Thurm, Lord, Lee & Newschaffer 2006). There is a need for longitudinal research on the trajectories of development and predictors of functioning for school age children that explore the core developmental factors involved. Smaller studies have looked at measured outcome for three time points (Charmen, 2005); however, most have focused on outcome rather than level of functioning across time.

Objectives:
To examine what degree measures of early communication, language, cognitive and social competence predict later outcomes in nonverbal functioning and autism severity in a cohort of children with ASD.

Methods:
Participants included 74 children with ASD who were initially derived from a sample of children who were evaluated at ages two (toddler), and four (preschool), as part of participation in the NAAR/CPEA and STAART funded Yale projects. These participants were seen again at age eight (school age) as part of their participation in the NICHD funded study on the Developmental Processes, Trajectories, and Predictors of Outcome in a Longitudinal Cohort. The assessments at ages two and four included measures of autism, adaptive, cognitive and language functioning and were used to examine the predictability across time of autism severity and nonverbal functioningfor this cohort.

Results:
Pearson's correlations were conducted to assess the cross-time association between a variety measures. All characterization measures demonstrated strong correlations from 1st to 2nd visits and from 2nd to 3rd visits. Multiple linear stepwise regressions were further run to identify significant

relationships over time among autism severity and cognitive development with measures of language, social, adaptive and cognitive functioning.

Preliminary results show a shift in predictors based on point of assessment. 30% of the variance in ADOS calibrated severity score (CSS) measured at age four was predicted by the CSS at age two (R^2=.296, $F(1,67)$=28.11, p<.000) whereas a shift to 38% of the variance in calibrated severity scores at age eight was predicted by socialization and functional communication (Vineland) in combination with CSS at age four (R^2=.381, $F(3,57)$=11.68, p<.000).

47% of the variance in nonverbal performance at age four was predicted by, non-verbal developmental quotient (Mullen), functional communication (Vineland), and autism severity (CSS) at age two (R^2=.473, $F(3,63)$=18.82, p<.000). By age eight, however, VDQ (Mullen) is most strongly predictive of nonverbal performance with 57% of the variance. (R^2=.570, $F(1,64)$=84.82, p<.000).

Conclusions:

The combinations of multiple source of information including direct assessment and parent interview lead to more stable prediction of functioning, particularly in the transition from preschool to school age. The identification of early mediators will also inform research on the predictive power of various measures and may contribute to establishing goals for early intervention services.

152   **124.152**   Reduced Attention to Fearful Faces in 10 Month Old Infants at Risk for Autism

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Background: Autism spectrum disorder (ASD) is associated with atypical face perception. Studies with children and adults have found that people with ASD are less sensitive to configural information in faces than controls. ASD is also commonly associated with impaired attention to emotional faces. These impairments may be most pronounced for negative and threat related emotions such as fear. Although atypical face scanning patterns may be one of the earliest signs of ASD in infants, little is known about the underlying mechanisms.

Objectives: Here we assessed sensitivity to emotional expression and configural information in infants with typical development and infants at risk for ASD (HR-siblings) HR-siblings have an increased risk of developing ASD compared to the general population. Given the high risk for ASD and related developmental concerns in HR-siblings, we predicted that they would show reduced attention to fearful faces than typically developed infants. Secondly, we predicted HR-infants to be less sensitive to spatial inversion of faces, which disrupts configural processing.

Methods: 26 HR-infants (22 female) and 12 Low-risk infants (LR-infants; 6 female) were included in the final sample. The infants were 10 month old (M=10.23 months; sd = 0.45). There were no group differences in age or verbal and nonverbal cognitive development as measured with the Mullen Scales of early learning (MSEL), (all *ps* >.05). Gaze data was recorded using a corneal reflection eye tracker. The dependent variable was looking time to the whole face. 4 static images of happy or fearful adult faces were presented one at a time in random order (5 seconds duration). Faces were presented either upright or inverted. All trials were preceded by a central moving animation in order to attract the infant's attention. Trials were included if the infant looked at the center of the screen at trial onset.

Results: A group (HR/LR) x Emotion (Fearful/Happy) interaction effect was found (*p* < .05). Follow up comparisons revealed that this was driven by longer looking time to fearful faces in the LR- as compared to the HR-group (*p* <.05). The LR-group looked longer at fearful than happy faces (*p* <.05) whereas the HR-group did not differentiate reliably between emotions. No main or interaction effect of orientation was found

Conclusions: We found evidence of reduced attention towards fearful faces in infants at risk for ASD. Moreover, LR- but not HR- infants looked longer at fearful than at happy faces. These results are consistent with the theory that altered processing of fearful faces is an early marker of the ASD phenotype. These results are consistent with studies in older populations with ASD. Follow up of the infants studied here will determine if the performance of the HR-siblings as a group is particularly pronounced among those later being diagnosed with ASD. In contrast, no effect of spatial orientation was found. This means that no evidence of configural face processing was found in any of the groups

153   **124.153**   Referral Patterns and Early Signs of Possible ASD Among Children Referred for Generic Developmental Early Intervention

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Background: Early identification of autism spectrum disorders (ASD) is essential to providing intervention during a time when neural plasticity allows for optimal social learning. Few studies have

looked at the early signs of ASD in high-risk community samples, such as children referred to generic developmental early intervention (EI) programs.

Objectives: The objective of this study was to describe a developmentally high-risk, community-based cohort of children referred to EI with regard to their demographic characteristics, reasons for referral, source of referral, as well as the prevalence of early signs of ASD in this population. An additional aim was to assess the implications of these findings for EI intake processes and service delivery for children showing early signs of ASD.

Methods: A retrospective chart review was conducted using EI electronic records from York Region, an urban regional municipality in the Greater Toronto Area, Ontario, Canada. All referrals and intake interviews conducted between January 2014 and April 2014 were screened for inclusion. Children with conditions that would automatically generate a referral were excluded (those referred through prematurity pathways, ASD-sibling monitoring pathways and those with established diagnoses that generate referrals, such as Trisomy 21). Data were extracted from the referral form and from the intake interview conducted by York Region EI staff. Descriptive statistics were calculated for referral data and early signs of ASD. ANOVA was used to evaluate the differences in the referral ages based on the referral source.

Results: During the four month period, there were 759 referrals to York Region EI, of which 81 were excluded due to being automatically generated referrals. The remaining 678 referrals were included in the analysis. The mean age at referral to EI was 27 months (95% confidence interval 12 to 47 months). The source of referral was available for 559 charts. Caregivers were the source of referral in the majority of cases (54%, n=302), compared with physicians (33%, n=185) and others (13%, n=72). There was a significant difference in the age at referral between the three sources, with physicians making the earliest referrals (F=3.5, p=0.015). Screening tools were noted in only 20% of referrals. Delayed domains of development were indicated in 126 cases. Speech and language delays were identified in 86% of these cases, and social/emotional delays (which may be indicative of ASD) were identified in 44%. In the intake interviews, the proportion of the sample showing specific early signs of ASD varied from 1-59%.

Conclusions: Our results were disappointing in both the age at referral to EI and the reported use of developmental screening tools, given recent local efforts to implement routine eighteen month developmental screening. The number of children with potential early signs of ASD varied greatly, and further characterization of ASD risk in this population was limited by the lack of standardization in the intake process. The inclusion of validated, standardized developmental screening tools in the intake process, including screening tools for ASD, would provide better information on the early signs of ASD at a population level.

154 **124.154** Response to Name: Increasing the Sensitivity of This Very Specific Sign of ASD

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Background: Response to name (or rather, the failure to respond to one's name) is one of the most consistently documented behaviors that distinguishes autism at a young age. However, despite its very high specificity to ASD, and its clinical relevance, it has not yet been a useful measure of autism, severity, or response to treatment. This is likely because we have misconceptualized it as a dichotomous variable; as if children either always respond or always fail to respond, when a closer look at the evidence suggests that children with autism show a decrease in, not an absence of, responding. Measured as a quantitative variable, or as a *rate* of responding rather than a dichotomous summary judgment, response to name may be a powerful indicator of ASD and perhaps a clinical measure that could be sensitive to change.

Objectives: To characterize and measure both the child's behavior and adult's behavior around Response to Name, including determining the different kinds of "bids" adults use during a clinical interaction, and the child's rate of responding to each type of bid. Secondary objectives were to compare results to the more categorical measures of Response to Name currently used (ADOS, ADI-R, M-CHAT, ITC, Mullen, and Vineland).

Methods: We rated children's responses to their own name during 20 minutes of free play and structured activities (two 10-minutes segments from the ADOS). Participants (11 with ASD; 12 with speech or other delays, and 11 typically developing controls) included children who had been screened as part of a highly comprehensive screening study within a large community practice, and thus are highly representative of the types of children presenting to pediatricians for screening. Ratings were conducted by two blind raters, and percent exact agreement was 90%.

Results:

Adults used three types of name calls (Name, Name with Command, and Name within a social game). Children who responded less than 50% of the time were considered to show weak responding. In the ASD group, 63% of children showed weak responding to Name, compared to 25% of children with delays, and 36% of typically developing children. In contrast, only 18% of children with ASD were weak responders to Name with Command, with 8% and 0% weak responders in the other groups (respectively). Our quantitative measures showed almost no correspondence with ADOS, ADI-R or questionnaire items completed by parents. On questionnaires and interviews, parents virtually always rated their children as good responders. On the ADOS, only 36% of children with ASD obtained a

score of 2 or 3 on the Response to Name activity, and of those, half were good responders otherwise.
Conclusions:
Among children screened in pediatric practice, actual rates of responding to name showed little correspondence to current clinical and research measures. As a simple behavior with high specificity to ASD and high ecological validity, Response to Name may have more clinical and research utility as a quantitative variable, rather than a categorical judgment.

155   **124.155** Sensory Responsiveness in Infants at-Risk for Autism Spectrum Disorders within the First Two Years of Life

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Background: Autism Spectrum Disorders (ASDs) are multisystem neurological disorders with primary impairments in the social communication skills as well as the presence of stereotyped/repetitive behaviors (American Psychiatric Association, 2013). Additional comorbidities such as sensory processing dysfunction are reported in more than 90% of the children diagnosed with ASDs (Tomcheck & Dunn, 2007). Parents of infants later diagnosed with ASDs reported early atypicalities in sensory responsiveness to auditory, tactile, and visual stimuli as well as excessive oral exploration of objects (Hoshino et al., 1982; Baranek, 1999; Tomcheck & Dunn, 2007). Early identification of sensory processing issues in infants at-risk for ASDs could help in developing appropriate early interventions. However, few studies have prospectively examined the presence of sensory processing deficits in the at-risk infants.
Objectives: The current project examined the sensory processing abilities of infant siblings of children diagnosed with ASDs (AU sibs) within the first 2 years of life by using a parent questionnaire, the Infant/Toddler Sensory Profile (ITSP).
Methods: This study was part of a larger ongoing longitudinal study comparing the development of AU sibs and typically developing infants within the first 2 years of life. Parents of 13 AU sibs were asked to complete the ITSP at 6,9,12,15,18, and 24 months of age. ITSP assesses the sensory processing abilities from birth to 3 years and its effects on the infant's daily performance (Dunn, 2002). ITSP scoring was done for 2 sections: (i) response to various sensations, i.e. auditory, visual, tactile, vestibular, and oral sensation and (ii) the neurological threshold of the infant for various sensory behavior such as sensation threshold, seeking behaviors, sensitivity, and avoidance.
Results: 8-54% of the AU sibs showed atypical response - over or under responsiveness to various sensations as well as atypical neurological thresholds between 6 to 24 months. Specifically, 30-50% of the AU sibs showed auditory, oral, and tactile processing deficits early on at 9 months whereas vestibular and visual processing deficits were evident from 12 and 15 months respectively in 30-38% of the group. In terms of neurological thresholds, 50% of AU sibs showed atypical low threshold behaviors early on at 6 months whereas sensation seeking and sensory sensitivity were seen at 12 months and sensation avoiding at 9 months. Currently, we are relating infancy performance to future outcomes and conducting individual item analyses to better understand the sensory processing issues of the AU sibs.
Conclusions: Parent questionnaires such as the ITSP are a quick and easy tool for evaluating the sensory processing issues of infants at-risk for ASDs. Our study suggested that almost half of the at-risk infants showed sensory difficulties. However, the incidence is lower than that reported in the previous literature indicating that some of the parents might have over or under estimated the performance of their infants.

156   **124.156** Sex Differences Do Not Distinguish High-Risk ASD, High-Risk No ASD, and Low-Risk Children through Three Years: A Bsrc Study

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Background: Autism spectrum disorders are more common in males than females, but the relative risk of ASD among high-risk siblings (younger siblings of ASD probands) requires large-scale characterization. It is also currently not clear whether there are sex differences in symptom presentation and cognitive functioning among children with ASD; nor is it clear whether potential sex

differences are unique to ASD or characterize high-risk siblings without ASD and low-risk children. Finally, there has been little opportunity to investigate the longitudinal development of symptom presentation and cognitive functioning for children with and without ASD.

Objectives:
Obj1. Compare the relative risk of ASD outcomes for males and female high-risk siblings.
Obj2. Examine sex differences in the longitudinal development of ASD symptom presentation and cognitive functioning among high-risk siblings with and without an ASD outcome and among low-risk children.

Methods: Participants were 1,830 infants (1,241 high-risk siblings, 583 low-risk) from 15 consortium-contributing sites who were recruited prior to 18 months of age (M=7.28, SD=3.36) with outcome diagnosis at 33 months or older. ASD at outcome involved both outcome diagnosis and meeting ASD cut-off criteria on the ADOS. Hierarchical generalized linear models (HGLM) in which site was included as a random variable were used to determine factors affecting ASD incidence among high-risk siblings (**Obj 1**) and factors affecting Mullen Scales of Early Learning (MSEL) subtest and ADOS domain scores longitudinally among high-risk ASD, high-risk non-ASD, and low-risk children (**Obj 2**).

Results:
Obj. 1.
Of 1,241 high-risk siblings, 252 had ASD outcomes. The sex effect was significant ($X2$=55.35, df=1, p<.001) with a 3.18 odds ratio (95% CI = 2.31 to 4.39) of male to female recurrence. Male recurrence was 26.7% and female recurrence 10.3%.

Obj. 2.
MSEL (see **Figure 1**). All main and interaction effects of Group (High-risk ASD, High-Risk Non-ASD, Low-Risk Non-ASD), Age (18, 24, & 36 months) and MSEL Subtest (a repeated measure: Expressive & Receptive, Fine Motor, Visual Reception) on MSEL scores were significant (*p<.001).* There was no main effect of Sex (p=.20) and Sex did not interact with Group either alone (*p*=.23) or in combination with other variables (*p*>.69). There was a Sex by Subtest interaction (*p<.001).*
ADOS (see **Figure 2**). Group (High-risk ASD, High-Risk Non-ASD, Low-Risk Non-ASD), Domain (Restricted & Repetitive Behaviors, RRB, and Social Affect, SA) and their interaction were significant (*p<.001*). Age (24, & 36 months) was not significant (p=.41). Sex was not significant (p=.41), nor were its interactions with any variables (*p>.07),* except Domain (p<.05).

Conclusions: In prospectively followed high-risk siblings, males had a 3.18-fold greater chance of ASD outcomes. However, we found no ASD-specific sex differences in symptoms and cognitive functioning. Sex differences in repetitive behaviors and social affect were apparent in children with ASD, but also in high-risk and low-risk children without ASD,. Likewise, sex differences in particular areas of cognitive performance (e.g., language and visual reception) characterized the total sample and were not unique to ASD. Sex differences that appear in children with ASD may not be ASD-specific.

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157   **124.157**   Sex Differences in Adaptive Skill Trajectories from 12 to 36 Months in Infants at High and Low Risk for ASD

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Background: Children with ASD appear to have a distinct profile of adaptive behaviors even when compared to children with non-ASD developmental delays. ASD-specific trajectories of adaptive skills have been reported with cross-sectional differences evident as early as 12 months. Here we investigate ASD-specific sex differences in trajectories of adaptive skill development. This study seeks to determine whether parent report regarding adaptive behaviors may provide insight into the apparent discrepancy between the high male:female diagnostic ratio in ASD and null results with respect to ASD-specific sex differences on measures of ASD symptomatology (ADOS) and cognitive development (Mullen).

Objectives: To evaluate ASD-specific sex differences in trajectories of adaptive skill development among high- and low-risk infants from 12-36 months of age.

Methods: Parents completed the Vineland Adaptive Behavior Scales (VABS) interview or questionnaire when their infants/toddlers at high and low risk for ASD were 12, 18, 24, and 36 months of age. Diagnostic classifications were made at 36 months. Children with atypical non-ASD outcomes were excluded from these analyses. 42 children were diagnosed with ASD (gender ratio 5:1). 200 children were judged to be developing typically (gender ratio 1.2:1). Hierarchical linear models evaluated trajectories of each VABS subscale using age equivalencies. Predictors were sex, diagnostic outcome (ASD or TD), and sex*diagnosis. A second set of models included baseline verbal mental age based on observed sex differences in that measure and its association with the development of adaptive skills.

Results: Linear, but not quadratic, effects of time were observed for the Communication (Com), Daily Living (DLS), Socialization (Soc), and Motor (Mot) scales of the VABS (ps<.001). Significant sex-by-diagnosis interactions were observed with respect to growth in Com (p=.007), DLS (p=.034), and Soc (p<.001), but not Mot (p=.85). Parent ratings of adaptive skills in boys and girls with ASD were similar at 12 months and skills of girls with ASD improved more rapidly than skills of boys with ASD between 24-36 months. Main effects of sex were observed with respect to COM, DLS, and SOC. Main effects of ASD were observed with respect to DLS and SOC, but not COM. Baseline language skills were associated with trajectories of Com, DLS, and Soc. When language skills were included in models, a

robust sex-by-diagnosis interaction was observed on Com and Soc, but not DLS.

Conclusions: Parent-reported adaptive behavior trajectories during the time frame when overt symptoms of ASD first emerge indicate that girls differ from boys within the group of toddlers who are diagnosed with ASD and between diagnostic groups. Developmental trajectories reflect an improvement of adaptive behaviors among girls with ASD relative to boys with ASD across infant-toddler development. Further investigation is necessary to confirm that infant siblings are representative of non-familial autism phenotypes. Viewed longitudinally, these results are not consistent with the Carter Effect, which suggests that in conditions with uneven sex ratios, genetic loading should be significantly greater in the sex with lower prevalence. Other factors that may contribute to parents' differential reporting about ASD-related behavioral trajectories between girls and boys will be discussed.

158   **124.158**   Sex Differences in Visual Attention to the Mouth in Infancy: Implications for Language Development and ASD

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Background: Development of pre-linguistic communication skills, like gesture, predicts acquisition of language in typically developing infants and toddlers (Iverson & Goldin-Meadow, 2005). Prior to, and concurrent with, such communicative development, infants are attuned to social auditory and visual input, such that their visual behavior serves to index interest in, and predict later proficiency with, social-cognitive abilities (Jones & Klin, 2013). Analysis of social-visual engagement in infants suggests that the degree to which infants visually fixate on eyes of others successfully differentiates between typically-developing (TD) infants and infants subsequently diagnosed with Autism Spectrum Disorder (ASD; Jones & Klin, 2013). Irrespective of diagnosis, a global increase is evident in the second year of life in visual attention to the mouth (mouth-fixation), immediately preceding a period of known vocabulary growth, and a sex difference is evident in the chronology of this increase. The present study suggests mouth-fixation as potentially facilitative of language acquisition, delay of which is a hallmark of ASD.

Objectives: The current study seeks to elucidate the importance of increased mouth-fixation for language development, and to explore apparent sex differences among TD infants for their importance to the male-bias in ASD diagnosis. In keeping with these goals, this study tests the extent to which increased mouth-fixation correlates with increases in communicative abilities and in specific indices of language acquisition.

Methods: Eye-tracking data were collected longitudinally at 10 time-points from 2 to 24 months of life in TD-infants (26 male, 24 female), and high-risk infants later diagnosed with ASD (13 male). The Mullen Scales of Early Learning (Mullen) and the MacArthur-Bates Communicative Development Inventory (CDI) were administered longitudinally, assessing cognitive and communicative functioning.

Results: Results indicate a phase-shift in mouth-fixation, from increasing with age to decreasing with age, early in the second year of life. The mouth-fixation shift is evident in TD-females at 13.5 months of age, in TD-males at 15 months, and in ASD-males between 15 and 16 months. Concurrent sex differences in trajectories of scores on clinical measures of expressive vocabulary ($F_{(2,47)}=7.214$, $p<0.01$), gesture ($F_{(2,47)}=5.230$, $p<0.01$), and language-related cognitive abilities ($F_{(3,46)}=9.452$, $p<0.01$), indicate that TD-females are precocious in these areas, and support a relationship between mouth-fixation and language development. Spearman's rho was used to quantify the relationship between mouth-fixation and measures of communicative development before and after mouth-fixation phase-shift, for each sex and for ASD-males (Table 1).

Conclusions: Measures of communicative development were correlated with age and not with mouth-fixation *prior* to mouth-fixation phase-shift. *After* the phase-shift, vocabulary measures and mouth-fixation were negatively correlated in females, during their period of decline in mouth-fixation. As such, vocabulary growth was greatest just *after* the peak in mouth-fixation. Similar relationships existed for TD-males and ASD-males. Results suggest that sex-dimorphic chronologies of developmental events in typical-development are present in both language and in an apparent behavioral correlate, and can inform our understanding of developmental trajectories that deviate from those of TD-infants in ASD, as TD-females appear chronologically advanced.

159   **124.159**   Sex and ASD Risk Status Predict Both 3-Year Expressive Language and Expressive Language Growth from 1 to 3 Years in Children at High and Low Risk for ASD

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Background: Sex differences have been found in both language development and ASD severity; relative to males, typically developing females show slightly better expressive language from 12-24 months (Eriksson et al., 2012), and females with ASD may show more severe ASD symptoms (Frazier et al., 2014). The purpose of this study was to examine early expressive language development in males and females at high and low risk for an ASD diagnosis. The potential importance of this question is twofold: (1) to characterize the developmental trajectories of expressive language of toddlers who have an older sibling with ASD (high-risk, HR-sibs) and toddlers without a sibling with

ASD (low-risk, LR-sibs); and (2) to understand the extent to which a child's sex, in addition to risk status, contributes to language development. Results may have implications for developmental monitoring as well as understanding genetic underpinnings of ASD.

Objectives: To examine the effect of sex and risk status for ASD on children's expressive language (EL) development from 12-36 months and EL outcome at 36 months.

Methods: Expressive language was measured for HR-sibs (n=69; male=36) and LR-sibs (n=42; male=23) at 12, 24, and 36 months as age equivalency scores (in months) using the expressive language (EL) subscale from the Mullen Scales of Early Learning (MSEL; Mullen, 1995). Hierarchical linear modeling was used to examine both growth from 12 to 36 months in EL and 36-month level of EL

Results: The overall trajectory of EL from 12 to 36 months was best characterized by significant positive, linear growth, $p<.01$. EL at 12 months showed little variability across individuals; therefore, the intercept was set at 36 months. EL growth and 36-month EL level were both modeled as random effects. Sex significantly predicted EL growth and 36-month EL, with males showing decreased growth and lower EL compared to females at 36 months. Males gained 0.85 years of EL growth for every year that females gained, $b=-.15$, $p=.01$, and at 36 months, their EL was almost 4 months lower, $b=-3.61$, $p<.01$. Risk status also significantly predicted EL growth and 36-month EL level, with HR-sibs showing decreased growth and lower EL compared to LR-sibs at 36 months. HR-sibs gained 0.85 years of EL growth for every year that LR-sibs gained, $b=.15$, $p=.02$, and at 36 months had an age equivalent EL almost 5 months lower than that of LR children, ($b=4.75$, $p<.01$). Sex and risk status did not interact to predict growth in language between 12 and 36 months or level of EL at 36 months.

Conclusions: Although sex and risk status independently affect children's expressive language, no interaction was found. Males and HR-sibs each showed slower EL growth and lower EL at 36 months relative to their counterparts. The lack of an interaction suggests that HR-sibs males are not at multiplicative risk for slower language growth and deficits by 3 years.

160 **124.160** Stability of Temperament in Toddlers with Autism Spectrum Disorders

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Background: Temperament has been defined as individual differences in behavioral styles relating to emotional reactivity, attention, and self-regulation (Rothbart and Bates, 1998). Previous studies have shown that three major domains of temperament, surgency/extraversion, negative affectivity, and attentional control, are stable in typically-developing children from toddlerhood to preschool age (Putnam et al., 2006). However, little is known about the stability of temperament over time in toddlers with ASD. Given the complex and variable patterns of development in ASD, particularly in the toddler and preschool years, understanding whether temperament is a stable construct may provide support for the use of temperament as an additional tool for exploring the heterogeneity of ASD and for understanding variation in individual children.

Objectives: To examine the stability of toddlers' temperamental traits from age 2 to age 3.

Methods: Participants included 64 toddlers with ASD who were derived from a clinic- referred sample and assessed by a multidisciplinary team. Measures includes the Toddler Behavior Assessment Questionnaire-Supplemental (TBAQ-S; Goldsmith, 1996). Parents completed the temperament scale prior to their child's first visit at the mean age of 23 months (range 16.4- 30.8 months) and before their child's second visit at the mean age of 37 months (range 31.0-48.0 months). The TBAQ consists of 3 composite scales: Surgency, Negative Affectivity, and Attention. Surgency is demonstrated through approach behaviors such as smiling, laughter, and body movements. Negative Affectivity behaviors relate to anger, fear and frustration. Attention is defined by the ability to regulate attention and exercise inhibitory control over behaviors.

Results: Pearson's r correlations were computed to assess the association between each composite scale across the first and second visits. All composite scales demonstrated strong associations over time: Surgency ($r=.481$, $p<.001$), Negative Affectivity ($r=.559$, $p<.001$), and Attention ($r=.561$, $p<.001$). In addition, paired-samples t-tests were conducted to compare changes over time. Results showed a significant positive increase in the Attention composite scale across the two time points ($p<.001$, $d=0.583$) with a moderately large effect size ($d=0.583$). This improvement in attention regulation appears to be driven by the subscale Inhibitory Control ($p<.001$, $d=0.78$).

Conclusions: These findings indicate that, similar to typically developing children, the three major domains of temperament are stable from age 2 to age 3 in toddlers with ASD. Furthermore, like very young children developing typically, their peers with ASD demonstrate significant improvements in attention over this period of time. These results suggest that temperamental factors in young children with ASD behave in a similar manner to those in TD children over the early preschool years, and can be viewed as separate axes for understanding intrinsic characteristics of individual children with ASD.

161 **124.161** Temperamental Features in Toddlers with ASD Are Independent of Symptom Severity

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Background: Temperament is defined as constitutionally-based aspects of behavior in the domains of reactivity and regulation (Rothbart and Bates, 1998). Temperament in toddlers with Autism Spectrum Disorder (ASD) remains largely unexplored, and information on the temperamental profiles of this cohort may shed light on their developmental patterns, heterogeneity of presentation, and treatment options. While research in this area has begun, it mainly focuses on the affective and attentional differences between toddlers with ASD and their typically developing and developmentally delayed peers (Garon, 2009; Koller, 2014). To complement previous work, this study examined the associations between temperament and autism symptom severity in a large sample of toddlers with ASD.

Objectives: The main goal was to examine the relationship between temperamental domains of the Toddler Behavior Assessment Questionnaire-Supplemental (TBAQ-S) and the severity of autism symptoms (ADOS-G) in toddlers with ASD, thereby determining whether the TBAQ-S captures a construct independent of social features in toddlers with ASD.

Methods: 182 toddlers with ASD (149 males) between 16 and 48 months of age (mean age = 28 months) were derived from a clinic-referred sample and received a comprehensive developmental and diagnostic assessment of cognitive, language, and social-communication skills. Prior to the testing, parents completed the TBAQ-S, which includes three composite scales: Attention— Attentional Focusing, Attentional Shifting, Inhibitory Control, Low Pleasure, Perceptual Sensitivity; Negative Emotion—Discomfort, Sadness, Soothability/Falling Reactivity, Anger, and Social Fear; and Surgency— Positive Anticipation, High-Intensity Pleasure, Activity Level, and Social Fear (Goldsmith, 1996; Jones, 1999). Associations between the TBAQ-S and ADOS-G severity were determined.

Results: Partial Pearson's r correlations, accounting for chronological age, were performed between the ADOS calibrated severity scores (CSS) and the thirteen TBAQ-S subscale scores as well as the three TBAQ-S composite scale scores. No significant correlations were found between any subscale or composite scale and ADOS severity. The three composite scales were modestly negatively correlated with CSS (Attention: r = -.12; Negative Emotion: r = -.16; Surgency: r= -.18).

Conclusions: The findings indicate that temperamental dimensions of behavior are largely independent of autism symptomatology, indicating the unique contribution of temperament to an individual's behavioral profile and strengthening the independent value of both the ADOS and the TBAQ-S. These results are perhaps not surprising, given that temperament captures vastly different aspects of behavior than that measured by the ADOS. Dimensions of temperament may further expand our understanding of the heterogeneity in functioning and development within the autism spectrum.

162 **124.162** The Role of Audiovisual Synchrony in Modulating Attention to Biological Motion in Infancy

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Background: Preferential attention to biological motion is present in human infants from the first days of life and plays a critical role in facilitating filial attachment and in guiding social interaction (Simion et al., 2007). In humans, biological motion includes gesture, gait, and facial expressions, actions that contain both rich social information and non-social audio-visual synchronies (AVS). By 24-months, these two features hold different significance for TD and ASD toddlers: while TD toddlers show a preference for biological motion regardless of underlying AVS, ASD toddlers preferentially attend to AVS, suggesting a disruption to normative processes of social development (Klin et al., 2009). Mapping the trajectory of how AVS influences preferential attention in typical development will establish a much needed framework for examining *when* deviations from this normative trajectory are first observed in ASD and *how* such deviations may impact developmental outcomes.
Objectives: The goal of this study is to measure longitudinal change in the association between AVS and preferential attention to biological motion in children at low-risk (LR) and high-risk (HR) for ASD.
Methods: 88 LR (49 male) and 95 HR (67 male, 50%>12 months) were shown point-light biological motion animations as in Klin et al. (2009). An upright point-light animation was presented on one half of the screen, with the inverted version playing on the opposite side in reverse order. Presentation was counterbalanced to control for side bias. Eye-tracking data, collected at months 2, 3, 4, 5, 9, 15, and 24, were used to calculate percentage of fixation time during each trial. Levels of AVS were quantified in all animations by measuring synchronous change in motion and sound.
Results: Spearman correlations revealed that preferential attention to audiovisual synchrony was developmentally modulated in LR infants: no association between preferential attention and AVS was seen at months 2, 3, 4, or 24, with the latter time point replicating the cross-sectional results of Klin et al (2009). Significant associations were observed at months 5 (r=.26, p<.001), 9 (r=.23, p<.05), and 15 (r=.36, p<.001). Data from HR infants showed increased variability at all time points.
Conclusions: The present findings reveal a period in typical development when preferential attention is associated with AVS. Previous studies have identified strong effects of AVS on selective attention to inanimate objects during early infancy (Bahrick, Lickliter & Flom, 2004), but in the context of socially-rich biological motion, the present study shows a peak in preferential attention to AVS at 15 months.

Intriguingly, this time point coincides in typical development with a period of increased visual attention to the mouth (Jones & Klin, 2013), an area of high AVS, and also to the onset of the oft-cited "vocabulary spurt" (Benedict, 1979), consistent with accounts of how language learning affects attention to faces (Lewkowicz & Hansen-Tift, 2012). Future analyses will examine associations between attention to AVS and to the mouth in the current cohort, and will focus on parsing the heterogeneity of HR infants to better understand the increased variability in their looking patterns.

163 **124.163** The Role of Early Gesture on Expressive and Receptive Vocabulary in Infants at High and Low Risk for Autism Spectrum Disorder

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Background: Gesture use has been found to predict infant's later language abilities (Iverson & Goldin-Meadow, 2005). Infants who have an older sibling with ASD (HR-sibs) have been found to produce fewer gestures (Stone, McMahon, Yoder, & Walden, 2007), understand fewer words (Mitchell et al., 2006) and produce fewer words (Zwaigenbaum et al., 2005) in their second year of life than low-risk controls (LR-sibs). However, less is known about the developmental trajectories of expressive and receptive vocabulary and the extent to which gesture use and language interact during this pivotal period for communication development.
Objectives: To assess the extent to which early gesture use and ASD risk status predict: (1) growth in expressive (EV) and receptive vocabulary (RV) from 12 to 18 months and (2) the level of EV and RV at 18 months.
Methods: Gesture use, EV, and RV were examined in HR-sibs (n=69; male=36) and LR-sibs (n=42; male=23) at 12, 15, and 18 months using the MacArthur-Bates Communicative Development Inventory (MCDI; Fenson et al., 2007). Gesture use was measured via the Total Gestures summary score. EV and RV were measured using the "Words Produced" and "Words Understood" total scores, respectively. Hierarchical linear modeling was employed to examine the contributions of infants' 12-month gesture use and ASD risk on receptive and expressive growth and levels.
Results: The overall trajectory of EV and RV from 12 to 18 months was best characterized by significant positive, linear growth, $ps<.01$. EV and RV showed little variability across individuals at 12 months; therefore, the intercept was set at 18 months. Gesture use at 12 months did not predict growth in EV or RV from 12 to 18 months,,$ps > .05$, but significantly predicted 18-month levels of EV and RV. For every additional type of gesture infants produced at 12 months, they produced 1 more word at 18 months, $b=1.25$, $p=.002$, and understood 4 more words at 18 months, $b=4.15$, $p<.001$. Risk status significantly predicted growth in EV from 12 to 18 months, $b = 5.31$, $p = .003$, and levels of EV at 18 months, such that HR-sibs demonstrated slower growth and lower levels of EV at 18 months than LR-sibs. HR-sibs produced on average 5 fewer words per month between 12 and 18 months and 28 fewer words at 18 months than LR-sibs, $b=28.37$, $p<.01$. In contrast, risk status did not predict growth in RV, $p>.05$, but did significantly predict RV at 18 months. HR-sibs understood 40 fewer vocabulary words at 18 months than LR-sibs, $b=40.12$, $p<.001$. Infants' use of gestures did not interact with their risk group status to predict either growth of EV or RV or 18-month levels, $ps>.05$.
Conclusions: Although gesture use and risk status independently predicted 18-month levels of expressive and receptive vocabulary, no interactions were found. Implications of these findings will be discussed.

164 **124.164** Visual Attention Patterns of Toddlers with ASD: Comparison of Performance on the Visual Exploration Task (VET) and the VET-Toddler

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Background: The presence of restricted interests is one of the core characteristics in individuals with Autism Spectrum Disorders (ASD). Eye-tracking is an effective tool to capture visual patterns of individuals when presented certain visual stimuli. Previous eye-tracking studies found that children with ASD showed unique patterns of exploration, detail orientation, and perseveration in the Visual Exploration Task (VET). The VET was mainly used with school-age children or older individuals with ASD previously. However, as the VET was designed with images appealing to an older population, it may not be as reliable and valid a task for toddlers. We developed a toddler adaption of the VET (VET_T) using developmentally appropriate images and arrays, with fewer and bigger stimuli per slide and compared the visual attention patterns of toddlers using the VET and VET_T.
Objectives: This study compared the visual attention patterns of toddlers with ASD on the VET and VET_T in an effort to determine the utility of each eye tracking measure with. The goal was to compare visual exploration patterns across the VET and VET_T.
Methods: 40 toddlers with a diagnosis of ASD (17-35 months of age) participated in this study. Each participant completed the VET and VET_T, which includes a total of 19 visual arrays (12 VET and 7 VET_T). Randomized Arrays were organized to include high autism interest (HAI) items, low autism interest (LAI) items and social items. Four major outcome variables representing visual exploration

patterns were calculated: 1) Percentage of time onscreen, 2) Exploration: Number of images viewed per second onscreen, 3) Perseveration: Duration of fixation per image explored, and 4) Detail Orientation (DO): Number of discrete fixations per image explored. A series of repeated measures ANOVA were conducted to test the differences in visual patterns of toddlers on the VET and VET_T.
Results: No significant difference was found in percentage of time onscreen between the two tasks. However, toddlers with ASD showed different visual exploration patterns in the two tasks: 1) Toddlers with ASD were significantly more detail oriented in the VET_T ($p<.05$). Toddlers with ASD also showed significantly higher DO towards HAI items ($p<.05$), especially in the VET_T (significant interaction effect, $p=.001$);
2) No significant differences in exploration were found between tasks. However, in LAI and social arrays, the significant interaction effect indicated that toddlers with ASD showed more exploration for social items than LAI items in the VET_T
3) Toddlers with ASD showed significantly higher perseveration in VET_T ($p<.05$). No significant difference was found in stimulus types.
Conclusions: The use of the VET_T task did not increase the percentage of time on screen for toddlers with ASD when compared to the VET. However, toddlers with ASD did have higher exploration, detail orientation and perseveration when using the VET_T in comparison to the VET. With more developmentally appropriate stimulus, visual exploration patterns of toddlers with ASD are more manifested in the VET_T. Therefore, the VET_T might be a better tool in examining visual patterns of younger children with ASD.

165   **124.165** Visual-Motor Integration Associated with Familial Liability for Autism

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Background: School-age children with Autism Spectrum Disorder (ASD) exhibit particular difficulty with tasks that rely heavily on hand-eye coordination. In addition, these children show what appears to be an ASD-specific bias against using visual feedback during motor learning that is a robust predictor of their motor and social impairments (Haswell et al., 2009). Compelling evidence also suggests motor deficits are observable as early as 6 months of age in children who later develop ASD (Flanagan, Landa, Bhat, & Bauman, 2012). However, the interplay of early motor, visual and social skill development in ASD is not well understood. Because integration of visual input with motor output is vital for the formation of internal models of action necessary not only to develop a wide range of motor skills, but also to imitate and interpret the actions of others, closer examination of motor, and specifically visual-motor, deficits is of critical importance in understanding the pathophysiology of ASD.
Objectives: The goal of this study was to examine for behavioral markers of motor development, with a focus on visual-motor integration, in infants identified as at high risk for ASD (e.g., infants who have at least one sibling with an ASD diagnosis) using the ball-catching component of the Autism Observation Scale for Infants (AOSI; Bryson, Zwaigenbaum, McDermott, Rombough, & Brian, 2007). We hypothesized that infants at high risk for ASD would be delayed in developing a visually guided, open-handed reach strategy of catching.
Methods: Thirty-six 6-month-olds were tested (18 high-risk for ASD because they had an older sibling with ASD; 18 low risk, having no family history of ASD). The AOSI was video-recorded and the ball-catching component was scored offline by two trained raters, blind to risk group. The coding schema characterized the maturity of five behaviors during ball-catching: 1) anticipation of the examiner's action of rolling the ball toward the child; 2) visual tracking of the ball during the roll; 3) anticipatory grasping behavior during the roll; 4) maturity of lifting the ball after contact; and 5) visual-motor integration during object exploration. The first three rolls of the ball-catching task for each child were scored, and scores were averaged across trials.
Results: An independent samples Mann-Whitney U test indicated that the distributions of anticipation scores were different across groups, with high-risk infants showing less anticipatory grasping compared to low-risk infants (p = .022). High-risk infants also displayed less mature lifting (p = .024). No other significant group differences were observed, with the majority of children in both groups immediately looking at the ball or the examiner prior to the roll, tracking the ball for most of its trajectory, and simultaneously exploring the ball with their eyes and hands.
Conclusions: Results suggest that early motor delays are more common in high-risk infants compared to low-risk infants and that high-risk infants less rapidly interpret the action intentions of others. Findings preliminarily support our hypothesis that high-risk infants do not use visual information to guide their movements as effectively as their low-risk age peers.

166   **124.166** When an Early Diagnosis of ASD Resolves, What Remains?

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Background: It has been documented that some children with an early diagnosis of Autism Spectrum

Disorder (ASD) do not meet criteria for the diagnosis at a later age. It is unclear, however, if deficits remain overtime when ASD symptomatology resolves.

Objectives: To characterize the residual learning, cognitive, and emotional/behavioral diagnoses and educational needs of a group of school-age children with a history of an early diagnosis of ASD that resolved.

Methods: A chart review of 38 children diagnosed with ASD at a University-affiliated inner-city diagnostic early intervention program between 2003 and 2013 who had follow up evaluations indicating resolution of the original ASD diagnosis. This group represents 7% of the 569 children diagnosed with ASD by the program during this period. Original and follow up diagnoses were made by an experienced multidisciplinary team (consisting of developmental pediatrician, psychologist, and speech and language pathologist) based on the DSM-IV criteria, Childhood Autism Rating Scale (CARS) and/or the Autism Diagnostic Observation Schedule (ADOS). All children had follow up visits and repeat evaluations for diagnostic clarification and/or educational planning an average of 4 years after the original diagnosis. The initial cognitive assessment was based on the Bayley Scales, and at follow up on the WPPSI, WISC, or Stanford Binet. Data collected included: demographics, age, cognitive level, CARS, developmental diagnoses and services at original and follow up evaluations.

Results: The mean age at initial diagnosis was 2.6y± 0.9y and at follow up 6.4y± 2.8y. The sample was 80% male; 44% Hispanic, 36% Caucasian, 10% African American; 46% had Medicaid; and 42% were bilingual. The mean initial CARS was 32±3 and at follow up 25±4. The initial ADOS (21/38) categorized 29% as having autism and 67% as ASD and it was negative at follow up when available (23/38). Initial cognitive testing (29/38) found 33% with intellectual disability, 23% in the borderline range and 44% in the average range and at follow up (33/38) revealed 6% in the borderline range and the rest in the average range. At follow up, 68% had language or learning disability, 49% were diagnosed with externalizing behavior problems (Attention Deficit Hyperactivity Disorder, Oppositional Defiant Disorder, Disruptive Behavior Disorder), 24% with internalizing problems (mood disorder, anxiety, OCD, selective mutism), 5% with a significant mental health diagnosis (psychosis.nos), and 8% warranted no diagnoses. Twenty six % of the group was in a mainstream academic setting without support, 13% in a mainstream class with paraprofessional support, 29% in an integrated setting/resource room, and 21% in a self-contained class.

Conclusions: When an early ASD diagnosis resolves, at least in the early elementary years, there are often other learning and emotional/behavioral diagnoses that remain. Understanding the full range of possible positive outcomes in this scenario is important information for parents, clinicians, and the educational system.

Poster Session
125 - Genetics
5:30 PM - 7:00 PM - Imperial Ballroom

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167   **125.167** A Comparison of Gene Expression in Inflamed Ileocolonic Tissue and Peripheral Blood from GI Symptomatic ASD Children

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Background: Gastrointestinal symptoms are common in children with autism spectrum disorder (ASD) and are often associated with mucosal inflammatory infiltrates of the small and large intestine. Whole transcriptome analysis of biopsy tissue from ASD[IC] (ASD with ileocolitis) and non-ASD IBD (Crohn's disease and ulcerative colitis) patients has provided molecular evidence for an overlapping, yet unique, IBD-like condition in ASD children. In this analysis we examined data from two separate cohorts: one from an earlier study that measured gene expression in GI tissue only and the other from the current study where we evaluated gene expression in GI tissue and peripheral blood from the same ASD[IC] individuals.

Objectives: The purpose of these analyses was: (1) to evaluate the reproducibility of transcriptome results derived from an earlier analysis of gastrointestinal tissue from ASD[IC] samples in a second cohort and, (2) to compare gene expression in inflamed tissue to gene expression in peripheral blood from the same patients to identify a peripheral biomarker for GI inflammation.

Methods: Study tissue, collected under appropriate IRB approval, consisted of ileocolonic biopsies (Study 1 and 2) and whole blood (Study 2 only) from two groups of children undergoing ileocolonoscopy for active gastrointestinal symptoms: (1) those with an ASD diagnosis and, (2) typically developing children.

In the initial study ("Study 1"), for each ASD individual a biopsy from either the terminal ileum (N=21) or colon (N=21) that demonstrated the histologic presence of either ileal infiltrates (ileitis), colonic infiltrates (colitis) were used. Histopathologically normal tissues from the identical locations were obtained from 14 control individuals for comparison.

The second study consisted of inflamed ileum or colon biopsy tissue and whole blood from ASD[IC] children (12 in each group) and the same number of (histopathologically normal) tissues and blood samples from a total of 24 typically developing children.

Total RNA was isolated from the tissue biopsy specimens and whole blood and used to query whole

genome DNA microarrays. Pair-wise comparisons of gene expression were made between ASD[IC] and control groups for each of the two tissues. Next, the list of genes that were uniquely expressed in inflamed GI tissues from ASD[IC] was compared to the list of genes differentially expressed in the peripheral blood from those same individuals.

Results: In Study 1, pair-wise analyses between inflamed ileal mucosa from ASD[IC] and non-inflamed control samples resulted in 3497 differentially-expressed genes (DEGs), versus 2949 DEGs in the comparison of colonic tissue gene expression. In Study 2, the numbers were comparable: 2451 DEGs in the TI comparison and 2821 DEGs between inflamed and non-inflamed colonic tissues. A comparison of the whole blood samples from ASD (with GI inflammation) versus TD samples (without GI inflammation) yielded 3183 DETs. The overlap between all genes that were differentially expressed both in ASD ileocoloinc tissue *and* blood revealed a biomarker consisting of 9 candidate genes.

Conclusions: We have shown overlapping gene expression uniquely found in inflamed gastrointestinal tissue (in two distinct locations) and blood from two separate cohorts of ASD[IC] children that my represent a diagnostic biomarker.

168   **125.168** A Comprehensive Meta-Analysis of Common Genetic Variants in Autism Spectrum Conditions

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Background: Autism Spectrum Conditions (ASC) are a group of neurodevelopmental conditions characterized by difficulties in social interaction and communication alongside repetitive and stereotyped behaviours. ASC is heritable, and common genetic variants contribute to substantial phenotypic variability. More than 600 genes have been implicated in ASC to date. Nevertheless, a comprehensive investigation of candidate gene association studies in ASC is lacking.

Objectives: To systematically review candidate gene association studies in ASC, and perform a meta-analyses of common genetic variants investigated in three or more independent cohorts.

Methods: We systematically reviewed the literature for association studies for 553 genes associated with ASC. We identified 58 common genetic variants in 27 genes that have been investigated in three or more independent cohorts and conducted a meta-analysis for 55 of these variants. Additionally, we investigated publication bias and sensitivity, and performed stratified analyses based on ethnicity or study methodology for a subset of these variants.

Results: We identified 16 variants nominally significant for the mean effect size, nine of which had P-values < 0.01. The top nine variants were located in seven genes: *DRD3*, CNTNAP2, *EN2, RELN*, *OXTR*, *SLC25A12,* and *MTHFR*. The most significant SNP was rs167771 in *DRD3* (OR = 1.822, P-value = 9.08×10^{-6}). The mean effect sizes for the variants investigated were modest and lay between 0.781 (0.446 - 1.368) for *MAOA* uVNTR and 1.822 (1.398-2.375) for *DRD3* rs167771. In the stratified analyses, seven variants had P-values below 0.05. These seven variants were in five genes (*EN2, OXTR, RELN, SLC6A4*, and *SLC25A12*). Publication bias was significant for two variants in *OXTR*. Sensitivity was an issue for five of the variants investigated. Finally, heterogeneity in effect sizes was significant for a large fraction of the variants tested and was positively correlated with a number of independent datasets investigated per common variant. We were able to remove some of the heterogeneity after stratifying for ethnicity and study methodology.

Conclusions: This is the first study to comprehensively examine common variants in candidate genes for ASC through meta-analysis. It supports the role of common genetic variation in the aetiology of ASC and prioritizes specific variants for further investigation.

169   **125.169** A Genetic Multi-Mutation Model of Autism Spectrum Disorder

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Background: The degree of genetic vs environmental determination as it relates to the cause(s) of autism is paramount to our understanding of the disorder. Until now, concordance of twin pairs has varied significantly in published literature. In this analysis we use a novel mathematical model for evaluating the genetic component for twins that takes into account the varied ages of twin sets in autism research. We present a method novel to autism research for evaluating autism concordance. Objectives: To evaluate how well ASD concordance data fits a multi-mutation model. Methods: The design of this study is cross-sectional. Data for this study was provided by parents of child with autism spectrum disorder through their online participation in the Interactive Autism Network (IAN) based in the United States. The IAN project is an online, voluntary research registry

that collects data from families using a set of standardized psychometric instruments and questionnaires. To be included in this analysis, participants must be from twin sets in IAN with at least one twin affected by ASD and for all affected twins must have provided their zygosity and date of diagnosis. A total of 320 twin sets were included (60 identical and 260 fraternal).

Results: The multi-mutation genetic model fits ASD age-of-onset data from IAN very closely (R>0.99). For an ASD susceptible cohort of twins with the same age of 120 months (10.3 years), for example, the modeling predicts that the monozygote concordance will reach 94% and the dizygotic concordance will reach 19%.

Conclusions: The multi-mutation model for autism fits the monozygotic twin data in the IAN data set very well suggesting that the vast majority of autism cases have a genetic susceptibility to acquire autism. Additional research should be performed on cohorts of twins that can be followed over time to see if the model concordance pattern over time is consistent with the actual experience of the discordant twins.

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170   **125.170** A Peripheral Blood-Based Biomarker for Gastrointestinal Inflammation in ASD GI-Symptomatic Children

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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 may 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 blood based biomarker for ASD-associated enterocolitis could potentially allow for earlier identification of co-morbid GI disease, earlier GI intervention for affected patients, GI prognostic biologic markers, methods of non-invasive monitoring of response to GI treatment, and correlations between GI disease activity and ASD core symptomatology.

Objectives: The goal of these studies is to develop a non-invasive (blood-based) biomarker for GI inflammation in ASD children. In this talk I will outline our strategy and early results towards this objective.

Methods: The initial study cohort was comprised of tissue (GI biopsy and whole blood) from 24 ASD children undergoing clinically-indicated ileocolonoscopy for chronic GI symptoms, and 24 non-ASD (typically developing, TD) children also undergoing ileocolonoscopy. Differential gene expression between inflamed GI tissue from ASD children and non-inflamed tissue from TD children was examined and compared to differential gene expression in peripheral blood from the same individuals to identify co-differentially expressed transcripts that can serve as a biomarker 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 (i.e. Crohn's disease and ulcerative colitis) yet has distinctive features that may suggest a novel IBD variant in this population. These earlier findings were apparent in this second cohort as well. In addition, we found that there is significant differential gene expression in peripheral blood derived from children with ASD and ileocolonic inflammation compared to TD children without evidence of GI inflammation. Some of the key biological pathways that are coordinately down-regulated in the blood of the ASD (with inflammation) group are oxidative phosphorylation glutathione metabolism, and NOD-like receptor signaling. The overlap between co-differential gene expression in GI tissue and peripheral blood consisted of 40 potential candidate biomarkers.

Conclusions: The search for biomarkers of disease 'pre-disposition' and disease 'in-progress' through the molecular analysis of peripheral blood is gaining favor due to several obvious advantages: (1) tissue accessibility, (2) the ability to sample longitudinally, over time, and (3) the ability to sample pre- and post-treatment. We have identified a number of potential biomarkers that may be diagnostic for ileocolonic inflammation in ASD children. If these biomarkers can be validated and shown to be both specific and sensitive, they would have immediate and significant clinical utility.

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171   **125.171** Advances in the Genetics of Dup15q Syndrome: Insights Gained from Induced Pluripotent Stem Cells

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Background: Duplications of maternal chromosome 15q11.2-q13 are one of the most common cytogenetic anomalies associated with autism spectrum disorders (ASD). There are two major structural versions of this copy number variant: isodicentric chromosome 15 [idic(15)] and interstitial duplication of chromosome 15 [int.dup(15)]. Both structural versions of 15q11.2-q13 duplication syndrome result in a disorder characterized by hypotonia, developmental delay, epilepsy, and ASD.

Objectives: To develop human induced pluripotent stem cell (iPSC) models of 15q11.2-q13

duplication syndrome in order to 1) understand the local gene dysregulation underlying the disorder, 2) understand the impact of 15q11.2-q13 duplications on global gene expression in human iPSC-derived neurons, 3) to identify cellular phenotypes associated with the disorder, and 4) to test potential therapeutic approaches to restore normal 15q gene expression.

Methods: iPSCs with idic (15), maternal and paternal int.dup(15), and maternal interstitial triplication of chromosome 15 were generated from patient fibroblast or cord blood samples using either retrovirus, lentivirus, episomal, or sendai virus reprogramming methods. 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 five different patients with duplications of chromosome 15q11.2-q13, and have differentiated them into forebrain cortical neurons. 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. We identified global transcriptional changes between idic(15) and neurotypical iPSC-derived neurons that suggest defects in neuronal development pathways and upregulation of genes involved in protein degradation. Early electrophysiology experiments and examination of dendritic spine morphology corroborate a defect in neuronal development.

Conclusions: Human iPSCs derived from chromosome 15q11.2-q13 individuals 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 neuronal development.

172 **125.172** Analysis of Genomic Copy Number Variations and Exome Sequencing in Japanese Autism Spectrum Disorder Subjects

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Background: Copy number variation(CNV) studies have revealed the importance of rare *de novo* and inherited CNVs in autism spectrum disorder (ASD). Family-based studies have reported a high rate of *de novo* CNVs in idiopathic ASD cases from simplex families compared to that of multiple families. Recently, exome sequencing studies have revealed the importance of rare single nucleotide variations in ASD risk.

Objectives: To date, almost of the CNV and exome sequencing studies in ASD have focused predominantly on the Caucasian populations, with little reprensentation of the Asians and Africans. In this study, we have examined the global CNV in Japanese sampled and also sequenced the exomes of ASD and their parents samples.

Methods: ASD family samples were recruited in collaboration with the Asperger Society Japan. All the subjects were Japanese; diagnosis was made according to DSM-IV criteria and supported by Autism Diagnostic Interview-Revised scores. Among the 203 familes, 191 were simplex, while the remaining 12 were multiple. The samples were analyzed using Affymetrix Genome-Wide Human SNP Nsp/Sty 6.0 microarray. Three different calling algorithms, PennCNV, Birdseye and Canary, were used to identify the autosomal CNVs.Twenty families which met the highest quality control parameters in array studies, and with at least one rare/interestiog CNV were selected for exome sequencing. Genomic DNA was captured using SureSelect Human All Exon v5 kit, and sequenced on HiSeq2000.

Results: CNV analysis:above 90% of the CNVs in children are found to be inherited; almost equally from both the parents. Among the CNVs which are spanning genes, 71% are deletions in the case of *de novo* events; it's only 53% in inherited cases. 281 highly confident *de novo* CNVs were identified; and hence supposed to have some functional significance. Among these 281 CNVs, 23 are found be rare *de novo* events. These 23 rare *de novo* CNVc were validated with qPCR using SyBr Green. A few potential candidate genes like ABR, PITPNA, YWHAE, TRAPPC9, CSMD3, BRD1, MAPK8IP2, PANX2 etc with a possible role in neurodevelopment were identified.Exome Sequencing: Based on GERP and Grantham scores, 15 *de novo* events that resulted in missense, nonsense, frameshift or splice site mutations were considered to be of major impact. These *de novo* events occurred in the following genes: DPP6, MATN2, AVPRIA, C6orf32, PELI3, ATAD3B, CNKSR3, ARHGAP8, PRPF8, SF3B2, TRIP12, ADAMTS18, DLX1, NEK8, NALCN. Majority of these mutations were predicted to have a damaging effect on the respective protein structure/function. Several of these genes have been implicated in neural functions, while a few of them have been previously reported to be associated with ASD.

Conclusions: We found several novel/ultra-rare *de novo* and inherited CNVs and SNVs, many of them are potentially deleterious, in Japanese ASD subjects.

173 **125.173** Autism Traits in Extended Family Members

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Background: The broad autism phenotype (BAP) is a well-established construct that reflects the presence of sub-threshold ASD traits in non-affected relatives of individuals with ASD. BAP traits are (a) increased in parents of individuals with ASD compared to parents of individuals from non-ASD and (b) more frequent in parents of individuals from multiplex families vs. simplex families. The BAP has been assessed using the Broad Autism Phenotype Questionnaire (BAP-Q; Hurley et al 2007; Sasson et al 2013) and the Social Responsiveness Scale-Adult Research Version (SRS:ARV, Constantino 2005). For this study, we investigated the presence of BAP traits among parents from extended ASD families (i.e., ASD occurs in multiple generations and cousin pairs).

Objectives: This study evaluated BAP traits in parents of individuals with ASD in extended ASD pedigrees. Our hypothesis is that parents (connecting relatives of cousin pairs) from extended ASD families would demonstrate increased scores on measures of ASD traits compared to parents from simplex families.

Methods: 43 parents of individuals with ASD (25 mothers/18 fathers) from extended pedigrees (EXT) were evaluated as part of a larger study of ASD genetics. All parents were from single branches within larger pedigrees and completed the BAP-Q and SRS:ARV as part of a multi-trait evaluation protocol. Parental scores on these measures were compared to those from the Simons Simplex Collection (SSC; N=2616 mothers and fathers) using either a t-test for independent samples or the Wilcoxon signed rank sum test.

Results: Mean [sd] BAP-Q Total scores for the two groups (BAP-Q Total EXT=4.42 [2.13], SSC 1.75 [.43]) differed significantly (unpooled variances t-test p<0.0001). BAP-Q subscores (Aloof p<0.0002, Pragmatic p<0.0001, Rigid p<0.0001) also were significantly higher in the EXT parents. Comparison of maternal and paternal EXT and SSC mean BAP-Q showed a similar pattern of results as EXT maternal and paternal BAP-Q means were significantly higher than SSC means with the exception of the maternal Aloof subscore (p=0.17). Mean SRS Total scores and subscores for the EXT and SSC groups did not differ significantly; this same pattern was observed when comparing maternal SRS scores for the EXT and SSC groups. However, paternal Total SRS scores were higher among EXT fathers (p=.019). In addition, paternal means for the Motivation (p=.014), Communication (.036), and Cognition subscales were significantly higher in the EXT fathers.

Conclusions: Sub-threshold autism traits as measured by the BAP-Q are significantly greater in parents of individuals with ASD from extended pedigrees. However there is limited evidence that these same parents are more impaired on the SRS:ARV. This may reflect different degrees of "sensitivity" to ASD impairments and is in line with findings showing that the BAP-Q detected greater numbers of parents with sub-threshold impairments vs. the SRS:ARV (Davidson et al 2014). The presence of elevated BAP-Q scores in parents from extended ASD adds to the evidence that such families are enriched for ASD and related traits and should continue to be a focus of genetic studies.

174 **125.174** Autism-Risk, Schizophrenia-Risk, and Central Nervous System-Related Genes Display Genomic Features Common to Genes of Developmental Regulation

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Background: A large subset of genes in the human genome are involved in regulation of developmental processes. These include functional subsets like chromatin remodelers, transcription factors, translational regulators, and intracellular signaling transducers. They typically contain large introns, produce longer more complex proteins, and preference retention of transposable element (TE) insertion into intronic sequences over time for reasons not entirely understood. Each of these features is related to general functions of these developmental genes. A previous study of ours reported higher absolute TE content in autism-risk genes (Williams et al., 2013). In addition, King et al. (2013) reported preliminary findings of longer gene size in risk genes. Therefore, in this study we investigate whether autism (ASD)-risk, schizophrenia (SZ)-risk, and central nervous system (CNS)-related genes share features with genes of developmental regulation, so that we may better understand the functions and mutational trends of our genes of interest.

Objectives: Using whole genome control (WGC) for comparison, we determine whether ASD-risk, SZ-risk, and CNS-related genes are enriched in TEs, are longer, and code for larger proteins. Housekeeping (HK) genes are used as a comparison group due to their compactness.

Methods: All known protein-coding genes were acquired from *RefSeq* to compile the WGC. Autism genes with 10+ rating were downloaded from *AutismKB* database (N = 451). Core SZ-risk genes were acquired from *SzGene* database (N = 38). CNS genes were taken from the human *Neurogenesis and Neural Stem Cell (PAMM-404)* PCR array from *Qiagen* to be used as a representative sample (N = 85). Human HK genes were taken from Eisenberg and Levanon (2003) (N = 565). TE content was acquired on human genome 18 from the *TranspoGene* database and data on gene and protein lengths from *NCBI RefSeq*. TE analysis was performed using a negative binomial regression, meanwhile a gamma regression was used for assessing gene and protein lengths.

Results: All groups significantly varied from WGC in terms of intronic TE content; meanwhile, there were no significant differences in non-intronic (promoter, exonic, exonized) content in experimental groups versus control, with the exception of the HK genes, which displayed significantly greater numbers of exonized TEs and fewer exonic elements (p-values < 0.001). Gene length varied significantly across all groups: ASD, SZ, and CNS gene groups were significantly longer in length than WGC, while HK genes exhibited the opposite trend (p-values < 0.001). Protein lengths followed similar

trends as gene length across groups, with the exception of the SZ gene group, whose protein lengths did not vary compared to WGC in spite of having the largest gene length average.
Conclusions:
ASD-risk, SZ-risk, and CNS-related genes house considerable TE content, are larger, and produce larger protein products as compared to WGC. Meanwhile, HK genes, known for their overall compactness and small intronic sizes, exhibit opposite trends as seen in the other experimental gene groups. These results suggest that ASD-risk, SZ-risk, and CNS-related genes may be classed with developmental regulatory genes and, as such, likely follow functional and mutational trends in this large subset of mammalian genes.

175 **125.175** Characterization of Gene Variants Involved in Synaptic Pathways in Extended Utah ASD Pedigrees

ABSTRACT WITHDRAWN

Background: Genes in synaptic pathways have been identified as risk factors for ASD in several large recent studies of Autism Spectrum Disorders (ASD) using exome sequencing in parent-child trios and/or cases and controls. Study of these gene variants and phenotypic characterization of carriers will be critical to inform future in vitro analyses of synaptic structure and function resulting from specific mutations.
Objectives: We have focused on variants in synaptic genes with significant evidence in previous studies where potentially functional variants also occur in ASD families ascertained in Utah. We describe occurrence in cases and unaffected relatives and give detail on phenotypic characteristics of Utah variant carriers including ASD severity (or evidence of any clinical symptoms if the individual is unaffected), IQ, and reported presence/absence of seizures and other health conditions.
Methods: Our data resource includes 518 individuals from Utah families. The Illumina HumanExome chip was genotyped on 186 with ASD and 332 unaffected relatives, and whole exome sequencing (Agilent SureSelect and Illumina GAIIx) was done on 61 relatives with ASD and 27 unaffected relatives in eight extended high-risk pedigrees. The genes studied in these families include *CACNA2D3, SCN2A, TRIO. SHANK3, NRXN1, NRXN2, NRXN3. NLGN1, NLGN2, NLGN3,* and *NLGN4.* Each gene is involved in synaptic transmission, formation, or function, and each has been implicated in ASD and other psychiatric conditions. For each gene, we describe the occurrence of variants that are likely functional in at least one Utah ASD case. We give further variant information using available sequence annotation tools (e.g., PolyPhen, Annovar). We then describe occurrence of the variant in other affected and unaffected family members, and associated phenotypic characteristics.
Results: Multiple variants in synaptic genes were found. We focus particularly on those where functional variants occurred in both affected and unaffected relatives. For example, a rare variant in *SCN2A* (rs2228980) occurred in three families, including three affected cases, three unaffected parents, an unaffected grandparent, and two unaffected siblings. However, in these families, 8 additional siblings (4 affected and 4 unaffected) did not carry the variant. Another example is a rare variant in *CACNA2D3* (rs142687394), which occurred in three different families, including three cases, three unaffected parents, and two unaffected siblings. The variant was not found in five other unaffected siblings.
Conclusions: Variants in genes in this important gene pathway occur in both affected and unaffected relatives in Utah families, suggesting reduced penetrance, even when variants appear to be likely damaging. We note associations with possible seizures, clinical severity, and lower IQ, but these associations are not universal, suggesting pleiotropy. Characterization of particular variants in synaptic genes will inspire additional *in vitro* studies of synaptic structure and function resulting from these gene variants. In addition, our sample includes viably frozen peripheral blood mononuclear cells from many subjects, allowing the potential for the creation of derived neuronal cells for further studies of synaptic function specific to both affected and unaffected individuals.

176 **125.176** Characterization of Neuronal Development in Autism Using iPSCs Reveals Disease-Specific Changes in Axon Formation and Expression of Synaptic Function Genes

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Background: Autism spectrum disorders (ASD) comprise a genetically and phenotypically heterogeneous group of complex neurodevelopmental conditions. Although tremendous progress had been made in identifying ASD risk loci, the impact that these genetic variants have on ASD pathophysiology remains largely unknown. This is largely a result of the lack of genetically-relevant human disease models. The advent of human induced pluripotent stem cell (iPSC) technology and advances in neural differentiation methodologies, have made it possible to study the cellular and molecular mechanisms that underlie ASD. It is now possible to functionally analyze specific populations of developing neurons derived from ASD-affected individuals. These stem cell-based differentiation approaches mimic in vivo neurogenesis and, as such, provide valuable information about activity-dependent maturation of synapses during neural network formation.
Objectives: The objective of the current study is to functionally characterized ASD-specific

phenotypes in iPSC-derived neuronal cultures.

Methods: We have generated a collection of iPSC lines from peripheral blood mononuclear cells attained from clinically and genetically well-characterized patients affected with idiopathic ASD. These iPSC lines have been differentiated into forebrain neurons by mimicking the steps in neurodevelopment from stem cells through to embryoid bodies, neural progenitor cells, immature neurons, and onto differentiated neuronal cultures. Given the developmental nature of ASD, we focused on analyzing ASD-associated cellular phenotypes by employing microscopy based analysis of neurite outgrowth coupled to transcriptome analysis.

Results: Comparative analysis of ASD-specific and control iPSC-derived forebrain neurons has revealed disease-specific alterations in neurite outgrowth. In addition, high content transcriptome analyses has revealed abnormalities in the expression of key genes involved in neuronal development and axonal growth, including pathways associated with the extracellular matrix and the development of supporting cells such as oligodendrocytes.

Conclusions: ASD-specific iPSC-derived neurons have altered phenotypes compared to those from control individuals. Consistent with its developmental nature, these alterations are observable even at early time points during neural development.

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177   **125.177** Chromosomal Microarray Results and Medical Management for Children with Autism Spectrum Disorder and Other Developmental Conditions

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Background: As part of first-tier clinical testing for patients with autism spectrum disorder (ASD) and/or developmental delay (DD), we have performed whole genome, high density chromosomal microarray analysis (CMA) on 2200 individuals with either or both of these diagnoses over the last four years. A significant number of individuals with an ASD diagnosis (21.7%) or other developmental delays (30%) were shown to have clinically reportable genomic copy number variants (CNVs).

Objectives:

1. To determine the magnitude of the impact of genetic testing results on diagnoses and medical management strategies. This was measured by the frequency at which a general diagnosis of ASD and/or DD could be further refined to a known syndrome or rare disease with genetic testing. Another metric we present is the frequency at which the known syndrome or rare disease has associated medical guidelines for more specific care.

2. To analyze the functional roles of the genes involved in our clinically reported CNVs and determine the specific molecular pathways most commonly represented by genes in these CNVs.

Methods: **We performed a retrospective analysis of de-identified data collected by Lineagen on 2200 individuals. We used physician-provided diagnoses and ICD-9 codes to determine clinical diagnoses of ASD and/or DD. Clinically reported CNVs were analyzed using public databases (OMIM, DECIPHER, PUBMED) for association with known syndromes, rare diseases, and accompanying medical management guidelines. DAVID software was used to perform bioinformatics analyses on genes within CNVs.**

Results: **A significant number of the CNVs were associated with known microdeletion/microduplication syndromes or other genetic disorders, with some of these having distinct medical guidelines for treatment and care. We occasionally found and reported incidental findings that would also affect medical management. Furthermore, bioinformatic analysis indicates that many of the genes contained in the CNVs are thought to be involved in the etiology of ASD, have known neural functions, and/or have functions in energy-related pathways. We summarize and present all these findings from our patient cohort.**

Conclusions: **Our study indicates that CMA testing has significant benefit to physicians managing patients with these conditions. Large scale, clinical CMA testing results can also give insight into potential pharmaceutical targets and the molecular pathways involved, in order that effective and targeted treatments for these conditions may be developed.**

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178   **125.178** Circadian Network and Autism: Unusual Alternative Splicing Pattern of the JARID1 Genes

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Background: The circadian clock coordinates diverse cellular processes and functional outcomes, including behavior and cognition. Abnormalities in the clock genes may have a role in autism, but the underlying mechanism remains unknown. Members of the JARID1 gene family (JARID1a-d), histone demethylases, have been shown to be involved in the circadian molecular machinery in a recent work of our collaborator. JARID1a activates CLOCK-BMAL1, whereas JARID1b and JARID1c act as repressors. These opposing roles suggest that the optimal ratio among JARID1 isoforms is vital in maintaining the proper function of the circadian system. Imbalance in these isoform ratios may contribute to the etiology of diseases. Furthermore, miR132 orchestrates translational control of the circadian clock by targeting chromatin remodeling genes, including MECP2 and JARID1a. The splicing profiles of JARID1, and factors that regulate the expression of such isoforms, are not fully known. Our hypothesis is that

JARID1 mis-splicing may present in at least a subset of subjects with autism. Recent findings have shown cross links between DNA methylation and gene regulatory processes, including alternative splicing and miRNA. Therefore, we used data from a DNA methylation marker for subject stratifications.

Objectives: To investigate the role of circadian genes and their potential mis-splicing in autism.

Methods: We evaluated the expression level of multiple JARID1 alternative splicing transcripts in autistic subjects stratified based on the absence or presence of a given DNA methylation-related marker (DM) in lymphoblastoid cell line-derived RNAs, using Exon array profiling, TaqMan assays, followed by DNA sequencing. Expression levels of the identified isoforms were also investigated in the brain samples from control and a Jarid1 mice model at different circadian timing.

Results: A distinct pattern was detected in the expression level of alternatively spliced JARID1 isoforms for autistic subjects with DM compared to those without DM and controls. Additional experiments, including miRNA mimics, are underway to further characterize the role of miR132 in regulating JARID1a by finding which isoforms(s) show miR132-dependent expression.

Conclusions: This is the first study to evaluate a clock gene in autism, at the alternative splicing level in conjunction with DM markers. Our data indicates an unusual splicing process for the X-linked member of this circadian gene family (JARID1c), resulting in unusually high level of intron retained isoforms, as well as the potential role of the long noncoding RNAs and circular RNAs in the regulation of this circadian gene expression.

179 **125.179** Common Autism Genetic Polymorphisms Hidden in HLA and KIR Genes

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Background: Although there has been extensive research into the genetics of autism, only a small percentage of the genetic risk has been identified after studying thousands of subjects. Genome wide association studies (GWAS) examining up to a million SNPs have detected rare variants in a small number of autism spectrum disorder (ASD) cases (under 10%). It has been suggested that rare variants are major contributor to genetic diseases and that autism involves the interaction of many rare variants. The extreme genetic heterogeneity of genes involved in both innate and adaptive immunity indicates that GWAS technology inadequately interrogates these complex gene families (Gourraud & et al., 2014, PLOS One, 9(7):e97282). We have, therefore, taken a more targeted approach to ASD genetic risk by examining human leukocyte antigens (HLA) and killer immunoglobulin-like receptor (KIR) genes (chromosomes 6 and 19 respectively), and have found several genetic associations that appear to fulfill the criteria of "common variants" for ASD.

Objectives: To demonstrate unequivocally that specific HLA alleles and KIR gene content/haplotypes constitute important "common ASD variants" (greater than 5% differences between ASD and control populations).

Methods: PCR-site specific primers (SSP) methodology is used to type HLA alleles and KIR genes from subjects and parents to determine inheritance and haplotypes. Standard statistical procedures are used for determining chi square, odds ratios, and meta-analysis.

Results: We, and others have documented that genes in the HLA and KIR gene complexes are strongly associated with ASD. The data, summarized in Table 1, documents that specific HLA alleles/haplotypes and KIR genes/haplotypes fulfill the "common variant criteria". For example, in three different population studies (P1-P3), the HLA-A2 allele is increased in the ASD subjects between 10.8 and 15.8% with odds ratios between 1.74 and 3.02. Furthermore, the killer-cell activating gene alleles, KIR3DS1 and KIR2DS1, also are found in ASD subjects 15-22% more frequently than in normal controls. Other HLA class I alleles (B7 and B15) and Class II alleles (DR15 and DR1104) are significantly more frequently found in ASD subjects, as are HLA extended haplotypes and KIR gene-content haplotypes (unpublished). Several alleles (A11 and DR7) and KIR haplotype CA01 are found less frequently in ASD subjects, suggesting that they may have a protective effect against ASD.

Conclusions: Our results suggest that HLA and KIR gene variants fulfill the criteria as common variant associations in ASD. These two immune gene complexes work together to modulate NK-cell killing with HLA as ligands for KIR receptors. The role that genes in the immune system play in the etiology of ASD is presently unclear but warrants further investigation.

180 **125.180** Contribution of Small Copy Number Variations (CNVs) to Autism Spectrum Disorder (ASD)

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Background: Autism Spectrum Disorder (ASD) is characterized by significant and persistent deficits in communication/social interaction and by restricted and repetitive patterns of behavior, interests or activities. ASD has a complex genetic architecture, with involvement of rare, relatively large Copy Number Variations (CNVs) in nearly 10% of the cases. Despite the advancement of high-throughput genomic approaches, the detection of small CNVs (1 to 100 Kb) and large indels is still challenging and therefore little is known about their contribution to ASD. We used a customized Comparative Genomic Hybridization array (aCGH) in order to screen small potentially pathogenic CNVs in a sample of Brazilian subjects with idiopathic ASD.
Objectives: To assess the importance of small CNVs in the etiology of ASD.
Methods: All patients were diagnosed by psychiatrists using DSM-IV, ICD-10 and ASQ. Children's behavior was characterized by score questions of CARS. Patients with known autism-related syndromes, or exposed to teratogenic drugs /infectious agents during pregnancy were excluded from the study. All patients were negative for *FMR1* expansion and for CNVs at 15q11.13, 16p11.2 (proximal region) and 22q13 through multiplex ligation probe amplification (MLPA) analysis (SALSA KIT P343-B1 AUTISM-1; MRC-Holland, Amsterdam). The customized aCGH included 269 ASD candidate genes, with a high density of probes targeting exons and exon-intron junctions. CNVs ($\geq$ 1 kb) were only considered potentially pathogenic if they were located at coding regions and had a frequency $\leq$ 1% in our sample of 200 non-affected Brazilian subjects and in the Database of Genomic Variants (DGV). All CNVs were validated through Affymetrix 500K SNP-array, MLPA, and/or qPCR.
Results: The customized aCGH was validated by analyzing 15 patients with CNVs from around 60 to 375 Kb at 3p26.3, 15q11-13, 16p11.2, and 22q13 previously detected by the Affymetrix 500K SNP array or by the commercial P343-B1 MLPA kit. All these CNVs were detected by the customized aCGH. Eighty patients with non-syndromic ASD and 20 with syndromic ASD were included in the study. We identified nine CNVs that fulfilled our abovementioned criteria of potential pathogenicity, ranging from 9.5 Kb to 25 Mb, in nine patients with idiopathic ASD. Four CNVs were considered small (< 100 kb). Two of them, detected in non-syndromic patients, affected single genes, namely a duplication at *SLC17A6* and a deletion at *GRM5*. Other two distal 16p11.2 deletions, detected in one syndromic and in one non-syndromic patient, have between 38.9 and 61.8 kb, and involved three genes.
Conclusions: The use of an array designed to detect small CNVs, along with large ones, is a good strategy to improve the elucidation of ASD etiology, as we found a prevalence of 9% of CNVs in our cohort of idiopathic ASD patients, 44% of them smaller than 100 kb. To our knowledge, the two CNVs detected at 16p11.2 are the smallest distal 16p11.2 deletions described so far, and these findings may help to identify the causative ASD gene(s) in this region.

181   **125.181** Differences in Small Non-Coding RNA Expression in Primary Auditory and Temporal Lobe Association Cortex May Have Effects on Cell Cycle, Immune and Other Pathways in Autism Spectrum Disorders

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Background: Dysregulation of multiple expressed genes related to brain function and development is a key component of autism spectrum disorders (ASD). Atypical expression of individual regulatory small non-coding RNA (sncRNA), including microRNA (miRNA), could have profound effects upon many important functional pathways. The superior temporal sulcus (STS) is a brain region with a critical role in social perception and associated with core social impairments of ASD. In contrast, the adjacent primary auditory cortex (PAC) has function less central to the core features of ASD. We set to examine expression differences of sncRNA in these two regions of the brain.
Objectives: The goal of this study is to identify sncRNA that are differentially expressed in ASD in the STS, where we expect to see differences compared to typically developing subjects, and PAC where we do not. Furthermore, we investigate the functional implications of these expression differences through evaluating the biological and cellular pathways represented by the gene transcripts targeted by the altered miRNA.
Methods: We measured sncRNA expression levels in total RNA extracted from STS and PAC dissected from fresh-frozen brain of ASD and typically developing individuals. Affymetrix miRNA 3.0 microarrays were used to screen a total of 36 samples for 5,607 sncRNA including 1,733 mature human miRNA, 1,658 human pre-miRNA, and 2,216 human snoRNA, CDBox RNA, H/ACA Box RNA and scaRNA. Predicted mRNA targets of significantly altered miRNA were found using DIANA microT-CDS and their biological function was assessed by overrepresentation analysis against the KEGG database. As a validation study of these results, brain regions were pooled and reanalyzed to determine changes in ASD brain and these functional results were compared to studies publishing mRNA expression data.
Results: Among miRNA, miR-4753-5p and miR-1 were dysregulated in the superior temporal sulcus (STS) of ASD compared to typically developing brain. miR-664-3p, miR-4709-3p, miR-4742-3p and miR-297 were dysregulated in primary auditory cortex (PAC) of ASD compared to controls. Four small nucleolar RNA (snoRNA) and 8 pre-miRNA were dysregulated in STS and 5 snoRNA and 7 pre-miRNA were dysregulated in PAC of ASD. In both regions, miRNA were functionally related to various nervous system, cell cycle and canonical signaling pathways including PI3K-Akt signaling which has been implicated in previous ASD studies. Disruption of immune related pathways was unique to STS. Our

predicted functional pathways had significant overlap with studies looking at genes associated with ASD and others looking at expression in other regions of brain.

Conclusions: Altered sncRNA expression appears not only in STS, but also in primary auditory cortex, suggesting that transcriptional abnormalities in ASD may also impact brain regions not directly associated with core behavioral impairments. Disruption of immune related pathways, commonly implicated in genetic analyses of ASD, was unique to STS. Alterations in sncRNA may underlie dysregulation of molecular pathways implicated in autism.

182   **125.182** Distribution and Mutational Specificity of Autistic Trait Severity in Neurofibromatosis Type 1 (NF1)

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Background: Very recent studies of quantitative autistic trait (QAT) burden in individuals with Neurofibromatosis Type 1 (NF1) have estimated the prevalence of the broader autism phenotype (BAP) to be on the order of 40-60%. NF1 presents a unique opportunity for the examination of genotype-phenotype correlation because it is: a) caused by a highly penetrant mutation of a single gene; b) reasonably prevalent (1 in 2500); c) exhibits autosomal dominant transmission in families; and d) every family's mutation is unique.

Objectives: In this study, we examined the distribution of quantitative autistic traits in NF1, their relationships with sex and ADHD symptomatology, and explored evidence for mutational specificity by examining within-family trait correlations for QAT.

Methods: 160 of 320 invited individuals from 253 families (50.0%) agreed to participate. Participants completed and mailed in age-appropriate versions of the Social Responsiveness Scale-2 (SRS-2) and a Conners ADHD Rating Scale. Of the enrolled individuals, the SRS-2 was completed for 103 individuals with a range of age from 30 months to 74 years from 78 families. ADHD rating scales were completed on 97 subjects. A within-family intra class correlation coefficient for SRS-2 scores was computed for pairings of co-affected first degree relatives in 18 families.

Results: These data replicated a pronounced pathological shift in the distribution of SRS2 scores (see Figure 1 below) in comparison to the general population distribution. In contrast to what is observed in familial autistic syndromes, no statistically-significant sex effects on scores were observed, and SRS2 scores for male and female NF1 subjects appeared continuously distributed. An SRS2 intra class correlation of 0.767 was observed for pairings of first degree relatives with NF1, substantially higher than correlations on the order of 0.30 typically observed for first degree relatives in clinical samples (Lyall et al., 2014; Constantino et al., 2006) and in the general population (Constantino and Todd, 2003)--a scatter plot is provided in Figure 2. The correlation between SRS2 and ADHD index scores was moderate, as previously reported in population-based samples.

Conclusions: Exploration of the relationship between specific NF1 genotypes and autistic social impairment appears strongly warranted and may offer insights into mechanisms by which mutational variation in this unique autism candidate gene influences autistic trait severity. The magnitude of the within-family correlation strongly suggests that it is specific to NF1 genotype and not attributable to family genetic background, since the latter typically manifests in substantially lower trait correlations between first degree relatives.

183   **125.183** Do Parental Medical and Psychiatric Conditions Have Sex-Differential Risk Effects for Autism?

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Background: The male predominance in autism suggests that generally, the liability to developing autism may be sex/gender-differential. However, exact mechanisms contributing to this sex/gender-differential liability remain unclear. When investigating etiological-developmental mechanisms and risk/protective factors for autism, it is important to consider sex/gender-differential effects, rather than simply "controlling for" sex/gender. Both sex/gender-independent and -dependent effects should be tested in epidemiological and causal investigations.

Objectives: To test whether parental medical and psychiatric conditions contribute to any sex-dependent and/or -independent risks for autism in offspring.

Methods: Parent-report data from studies utilizing the medical history questionnaire of the Childhood Autism Risk from Genetics and Environment (CHARGE) study, publicly available on the National Database for Autism Research (NDAR) were analyzed, with a specific focus on testing for sex-differential risk effects. Parental conditions were grouped into 8 composite predictors: (1) maternal lifetime immune-dysregulation, (2) maternal immune-dysregulation during pregnancy, (3) maternal lifetime neuro/developmental conditions, (4) maternal lifetime psychiatric conditions, (5) maternal

lifetime obesity, (6) paternal lifetime immune-dysregulation, (7) paternal lifetime neuro/developmental conditions, and (8) paternal lifetime psychiatric conditions. We used loglinear analysis to test for sex-differential risks of parental conditions to child ASD diagnosis, followed by logistic regression to evaluate odds ratio (OR). Finally, we calculated a fully adjusted logistic regression model, including all risk conditions and their interaction with child sex.

Results: An initial 1,511 reports were collected. Only participants without missing data on the variables of interest were entered into the analysis, resulting in 867 reports (children with autism: 203 males, 41 females; control children: 468 males, 155 females). Loglinear analysis showed trends towards significant 3-way interactions among child ASD diagnosis, child sex, and (i) paternal lifetime immune-dysregulation (p=0.067), (ii) maternal lifetime obesity (p=0.066). Follow-up logistic regressions showed trends towards a significant "sex-paternal immune-dysregulation" multiplicative effect (p=0.070, male child plus the condition increased risk, OR=2.064), and a "sex-maternal obesity" multiplicative effect (p=0.074, female child plus the condition increased risk, OR=2.988). In the final model, maternal immune-dysregulation during pregnancy (p=0.013, OR=1.544, 95% CI=1.097-2.171) and paternal lifetime psychiatric condition (p=0.015, OR=1.639, 95% CI=1.099-2.445) increased autism risk independent of sex, while maternal lifetime obesity increased autism risk in a marginally sex-dependent manner, that female child plus the condition increased risk (p=0.052, OR=3.495, 95% CI=0.990-12.346).

Conclusions: Maternal immune-dysregulation during pregnancy and paternal lifetime psychiatric conditions may increase risk for child ASD diagnosis independent of sex/gender, while maternal lifetime obesity confers a possible heightened risk for ASD in females. Sex/gender-differential effects should be regularly investigated in understanding the risk/protective factors and etiological-developmental mechanisms of autism.

184 **125.184** Documentation of HLA-DRB1*1302 As a Maternal Prenatal Risk Factor for Autism Using Imputation in a Maternal-Fetal Incompatibility Model

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Background: The Major Histocompatibility Class (MHC) *HLA-DR*, and in particular its highly polymorphic beta chain gene, *HLA-DRB1,* have been studied in autism. The association of autism with HLA genes and haplotypes suggests that an underlying dysregulation of the immune system in autism may be mediated at least in part by HLA genes (Torres AR et al, 2012). Early studies by Reed Warren and others raised the question of whether an *HLA-DRB1* gene acting in the mother during pregnancy might contribute to autism in her fetus. Later, Lee et al, 2006, analyzed two datasets and reported that in one of them, individuals with autism and their mothers but not their fathers had a significantly higher frequency of *HLA-DR4* alleles compared with controls. We followed up these studies using TDT in maternal trios (maternal grandparents & mothers) as well as TDT in case trios, and found an odds ratio of 4.7 (95% CI: 1.3 to 16.2) for transmissions of *HLA-DR4* to mothers of individuals with autism from maternal grandparents, but we did not see increased transmission to the individuals with autism. In the present study, we used the very large Simons Simplex dataset to extend these findings *in silico* by HLA imputation of GWAS data.

Objectives: To attempt a more in-depth study of the HLA region in autism by a newer method.

Methods: We used HLA*IMP2, Dilthey et al. 2013, and HIBAG, Zheng et al. 2013, to impute *HLA* alleles for *HLA-A, -B, -C, -DPB1, -DQA1, -DQB1, -DRB1, -DRB3, -DRB4,* and *-DRB5* in individuals with autism and their parents from GWAS data available in the Simons Simplex Collection Version 14 on the Illumina Human 1M Duo dataset. Families were limited to those of European descent. All individuals' data were imputed without familial information. We tested for association with autism by the Maternal-Fetal Genotype Incompatibility Test as implemented in the Mendel software. We received IRB permission for this study.

Results: *HLA-DRB1*1302* showed a significant effect (p<3.6 x 10-4) under the non-inherited maternal antigens model, in which offspring without the allele whose mothers who were heterozygous for the allele had increased risk. No alleles showed significant RHD-type incompatibility effects (i.e., heightened risk for heterozygous offspring of mother without the allele). This result remained significant after correction for multiple comparisons.

Conclusions: The present study supported action of an *HLA-DRB1* allele in autism as a maternally acting gene allele in a very large dataset. Maternally acting gene alleles are key determinants of the intrauterine environment during pregnancy. They may be of particular importance very early during pregnancy when the ratio of maternal to fetal mass is largest. This is important for the pathogenesis of autism as well as for potential treatment, since the prenatal period is the earliest opportunity for treatment of autism.

185 **125.185** Dysregulation of Regulatory Small Non-Coding RNAs in the Superior Temporal Gyrus Brain Region of Autism Spectrum Disorders

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Background:
mRNA transcriptomes vary enormously between brain regions. Neocortex transcriptomes are relatively homogeneous with physical proximity correlating with transcriptome similarity. However, transcriptomes of primary sensorimotor cortices are quite distinct from adjacent cortex. Molecular mechanisms responsible for normal regional patterning could involve regulatory RNA, such as small non-coding RNAs (sncRNA) (miRNA, snoRNA), which play fundamental roles in brain development throughout lifespan. Superior temporal gyrus (STG) is a region with importance to neuropsychiatric disorders, including ASD. It consists of two regions, superior temporal sulcus (STS) and primary auditory cortex (PAC), which although adjacent, have different functions. STS is association cortex, involved in social perception, joint attention, interpreting facial gaze and speech inputs, and implicated in ASD. PAC is a primary sensory cortex modulating auditory processing, not associated with ASD.
Objectives:
1) To assess differential regional and age-related expression in STS and PAC in postmortem human brains of TD and ASD. 2) To compare to previous miRNA ASD studies.
Methods:
Affymetrix miRNA 3.0 arrays were run on 28 samples (8 ASD / 6 TD subjects; 2 brain regions; ages 4-50 years of age). Mixed Regression Models were used to identify regionally differentially expressed genes (p<0.005, |fold-change|>1.2). Spearman Rank correlation was used for age-related expression and co-expression relationships (p<0.005).
Results:
We found distinct regional and age-related changes of differentially expressed sncRNAs in TD in STS and PAC, which were significantly attenuated in ASD. This is in line with observations of regional attenuated mRNA expression in ASD brain (Voineagu et al, 2012, Ziats and Rennert, 2012). In addition, because genes function in coordinated networks, to characterize network alterations in ASD, we investigated the co-expression relationships of the age-related miRNAs in TD brains, based on similarity of expression profiles, and compared them to the ones in ASD. In TD, defined positive and negative co-expression clusters were identified, suggesting coordinate expression and/or regulation (Fig. 1). In contrast, ASD brains displayed significant deviations from this coordinated expression, thus potentially dysregulating a large number of downstream mRNA targets (Fig. 1). We then compared our findings to other miRNA studies in ASD to find gene families with broad dysregulation in ASD (Table 1). Seven miRNA gene families were dysregulated in subsets of ASD cerebellar cortex samples versus non-ASD controls (P of overlap=0.0002) (Table 1, (Abu-Elneel et al., 2008)). Five miRNAs were differentially expressed in lymphoblastoid cell clines (LCL) of affected versus unaffected monozygotic twins discordant for ASD diagnosis/severity (P=0.046) (Table 1, (Sarachana et al., 2010)). Two miRNAs were differentially expressed in LCL between ASD and controls (P=0.047) (Table 1, (Talebizadeh et al., 2008)). One miRNA was differentially expressed in LCL between ASD affected sibs vs unaffected sibs (P=0.413, n.s.) (Table 1, (Ghahramani Seno et al., 2011)). Several of these overlapping miRNAs have fundamental roles in brain development and function.
Conclusions: The combined effects of the differentially expressed sncRNA in ASD brains, likely contribute to aberrant development and function of STS and PAC and may contribute to core ASD symptoms including social dysfunction and communication.

186   **125.186** Exploring Non-Coding Regulatory SNPs As Genetic Markers for Autism Spectrum Disorders

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder of high prevalence that clearly involves genetic risk factors. However, the connection between ASD genetic risk factors and the development of ASD is poorly understood. Most current approaches to understand genetic risk factors in ASD focus on genes, although most human disease-associated single-nucleotide polymorphisms (SNPs) are located in regulatory regions which control gene expression. It remains challenging to pinpoint regulatory regions that are likely to be important for a specific disease. It is known, however, that functionally relevant regulatory regions are determined through epigenetic modifications which define where chromatin is accessible in the genome.
Objectives: The goal of this study was to evaluate whether regulatory regions obtained from epigenetic studies of mouse behavior could highlight non-coding regions with genetic links to ASD in human populations.
Methods: We used high-throughput sequencing (HTS) to uncover regulatory regions that show an increase in chromatin accessibility following contextual conditioning in the mouse hippocampus, which were disproportionally enriched around genes known to be linked to ASD according to the SFARI gene database (https://gene.sfari.org/autdb/Welcome.do). We then used genotyping to investigate whether SNPs in one of the candidate regions, located within and intron of Shank3, were significantly associated with ASD in in a cohort of 472 ASD (diagnosed by research reliable clinicians using the ADOS and ADI) and 209 typically developing children.
Results: Using HTS we show that learning produces increases in chromatin accessibility at 3064 regulatory regions in the mouse hippocampus. 59 of the 420 autosomal ASD associated genes

according to SFARI show an increase in chromatin accessibility following conditioning within their regulatory regions (promoters or introns), including an internal promoter within the Shank3 gene. Genotyping of common SNPs within this region reveals that there is a significant increase in frequency (Fisher exact test p=0.03) of the heterozygous allele in ASD cases versus controls for SNP rs6010065.

Conclusions: Overall our results demonstrate that using epigenetic data obtained from mouse is a viable strategy to highlight functionally relevant regulatory regions for genetic association studies of ASD. Future work will include genotyping of the remaining 58 candidate regions as well as further investigation of the mechanism underlying the effect of mutations within the Shank3 internal promoter.

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187   **125.187** Genetic Variation in Melatonin Pathway Enzymes in Children with Autism Spectrum Disorder and Comorbid Sleep Onset Delay

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Background:
A large proportion of individuals with autism spectrum disorder (ASD) present with comorbid sleep disorders. Disrupted sleep not only affects cognitive functioning, but exacerbates ASD-related behavioral impairments. Previous studies established a strong influence of common genetic variation in the etiology of ASD. Genetic factors likely contribute also to comorbid expression of sleep disorders in ASD. Variations in genes whose products regulate endogenous melatonin modify sleep patterns in humans, and have also been implicated in ASD. However, there are major challenges identifying even modest, replicable effects related to this variation. It is possible that variable phenotypic expressivity in ASD, specifically expression of comorbidities, can be explained by underlying genetic differences. Stratifying ASD cases based on presentation of sleep disruption may help address issues related to phenotypic heterogeneity in genetic analyses and help reveal underlying relationships between genotype and phenotype.

Objectives:
Our hypothesis was that individuals with ASD and comorbid insomnia would harbor a greater load of variation in genes related to maintenance

Methods:
We studied a clinically unique ASD subgroup, consisting solely of children with comorbid expression of sleep onset delay. We evaluated variation in two melatonin pathway genes, a*cetylserotonin O-methyltransferase* (*ASMT*) and *cytochrome P450 1A2* (*CYP1A2*). We sequenced the protein coding region of *ASMT*, and genotyped seven predicted 'dysfunctional' single nucleotide polymorphisms (SNPs) in *CYP1A2*.

Results:
All patients were either homozygous, or heterozygous, for variants evidenced to alter *ASMT* transcript production. Compared to current estimates in ASD without reported evidence of sleep disturbances we observed higher frequencies (p≤0.04) for variants evidenced to decrease *ASMT* expression. We also observed substantially higher frequencies than currently reported in populations of European ancestry (p≤0.0007) for variant alleles in three SNPs that have been associated with decreased CYP1A2 enzymatic activity. Finally, we detected a relationship between genotypes in *ASMT* that are associated with lower gene expression, and genotypes in *CYP1A2* that are associated with decreased enzymatic activity (r^2=0.63).

Conclusions:
Our results indicate that expression of sleep onset delay in individuals with ASD relates to melatonin pathway genes. Our findings suggest a mechanism connecting lower levels of *ASMT* transcript production with reduced CYP1A2 metabolic activity in children with ASD and comorbid sleep onset delay. We are currently in the process of attempting to replicate these genetic findings in a larger, clinically similar dataset.

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188   **125.188** Homozygous Deletions of Non-Coding Transcriptional Control Sites Leads to Autism Spectrum Disorder

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Background: Noncoding DNA comprises 99% of the genome but methods for understanding its normal function have greatly lagged our understanding of the protein coding sequence. Autism Spectrum Disorder (ASD), associated with defects in social and/or cognitive function, has previously been linked to disruptions of gene coding regions by *de novo* Copy Number Variants (CNVs), Single Nucleotide Variants (SNVs), or inherited recessive biallelic SNVs, but most cases remain unexplained

Objectives: Identify and understand new mechanism in Autism.

Methods: Here we present CNV and homozygosity analyses in 183 families ascertained through the Homozygosity Mapping Collaborative for Autism (HMCA). This is a specialized ASD cohort highly enriched for families that are consanguineous and/or have multiple affected children. For this study we genotyped parents, children, and additional family members where available, for a total of 747

individuals (255 affected children) from 183 families. To compare findings in our cohort to other autism data sets with distinct ascertainment practices, we also analyzed 706 families from the Autism Genetic Resource Exchange (AGRE) cohort (3013 individuals, 1591 affected) and 1024 families from the Simons Simplex Collection (SSC) (3875 individuals, 1027 affected). The AGRE cohort is enriched for multiplex families, but is largely non-consanguineous, while the SSC is a non-consanguineous cohort enriched for simplex families.

Results: In the entire HMCA about ~25% of affected individuals (39/237) carry a rare homozygous deletion versus ~15% of unaffected. Thus approximately 10% of affected children may be explained by double deletions. We sought to enrich for causative variants through (a) experimental validation with an independent technology (b) strict segregation within the family (c) rejection of double deletions present among unaffected individuals, children or parents, in all three data sets. Overall we identified 16 events that satisfy all three-selection criteria. Most of the selected events (12/16) disrupt regions identified as transcriptional control sites by the ENCODE project (H3K4Me1, H3K4Me3, and H3K27Ac marks). MonteCarlo simulation confirmed the statistical significance of the finding. In addition, derived from multiple pure cell culture experiments, the importance of control regions is supported by methylation marks defined in primary neuron cultures.

Conclusions: CNV analysis of 183 ASD families enriched for consanguinity demonstrates that children affected with ASD in these families are significantly enriched for autosomal homozygous deletions compared to unaffected siblings, especially in highly consanguineous families (25% versus 15%), suggesting that homozygous deletions account for up to 10% of affected children in consanguineous families. Most homozygous deletions are small (<100 kb) and few interrupt coding regions, presumably inactivating genes, but most do not. Instead we find that affected children are significantly enriched for deletions of DNA regulatory regions, with 12/16 regions disrupting ENCODE regulatory elements, a rate much higher than expected by chance (p<0.05). Our data suggest an important new mechanism of ASD, define a powerful approach to identify essential noncoding DNA regions, and highlight the importance of patterned gene activation in cognitive and social function.

189 **125.189** Identification of Gene-Environment Interactions Associated with Autism Spectrum Disorders

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Background: There is increasing interest in understanding genetic and environmental risk factors and their interplay in autism spectrum disorders. However genome-wide gene-environment interaction studies have been hindered mainly due to the lack of specific exposure and genome-wide genotyping data from the same individuals. We have previously presented preliminary gene-environment results from The Study to Explore Early Development (SEED), a multi-site case-control study of ASD with comprehensive phenotyping and genome-wide genetic and prenatal environmental exposure data. Since that presentation, we have genotyped additional cases and controls and examined additional exposures.

Objectives: The main purpose of this study is to identify genetic and environmental factors that influence risk for ASD. Specifically, we sought to identify single nucleotide polymorphisms (SNPs) whose effects on ASD risk vary across levels of selected prenatal environmental exposures including SSRI use, B2AR use, smoking, alcohol use, and infection.

Methods: For our GxE analysis, we examined prenatal exposures across four domains including maternal use of tobacco, alcohol, and medication (B2ARs and SSRIs) as well as maternal infection. Prenatal environmental exposure information was obtained from maternal self-reported data using a structured interview. Genotypes for 1,321 SEED children (590 cases and 731 controls) were measured using Illumina Omni1 and Affymetrix Axiom arrays. After applying data quality control measures, and performing imputation to obtain about 4 million genotypes per person, initial analysis was performed using a new joint likelihood ratio test for marginal genetic main effects and gene-environment interaction. To maximize our power and appropriately account for gene and environment independence assumptions we also plan to implement a case-only GxE likelihood ratio test of association that uses an Empirical Bayes-type shrinkage estimator to address gene-environment independence.

Results: Our GxE analysis using data from 873 SEED children revealed a genome-wide significant ($P < 5 \times 10^{-7}$) interaction between genotype and smoking for several neighboring SNPs on chromosome 2. We are in the process of completing final GxE analyses for the complete set of 1,321 SEED samples and will present our latest findings, in the largest set of samples, at the conference.

Conclusions: We have identified interactions between genomic regions and specific *in utero* environmental exposures that are associated with ASD. Our results suggest that coupling genetic

and environmental exposure information to determine ASD risk may be more fruitful than looking for genetic marginal effects alone. SEED has proven to be a particularly useful resource for these types of integrative of studies.

190 **125.190** Imaging Autism in Mouse and Man

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Background: Autism Spectrum Disorders (ASDs) are complex and still poorly understood. They are highly heritable, yet no single gene discovered to date accounts for more than 1-2% of known cases. Currently 250+ genes have been associated with Autism in the human population, and while ASD is associated with communication and social deficits, as well as repetitive behaviours, individual clinical presentations are highly heterogeneous.
Objectives: To identify clusters within the autistic spectrum using brain imaging as a shared endophenotype in both clinical studies and mouse models of the disease.
Methods: A cohort of over 100 children and adolescents diagnosed with autism were imaged on a 3T MRI. A separate control cohort of over 300 was also acquired on the same scanner using the same imaging protocols. Information about neuroanatomy and brain connectivity was extracted using state of the art image processing algorithms.
At the same time, over 30 mouse lines carrying mutations linked to autism were imaged on a 7T MRI, totaling over 500 scans. Data were assessed for alterations in anatomy and then further clustered into distinct groupings of mouse models sharing common anatomical phenotypes. We additionally investigated which areas of the brain were most consistently affected across all mouse models. Lastly, the mouse imaging data was integrated with the gene expression maps from the Allen Brain Institute to explore potential processes driving the imaging findings.
Results: Human imaging results comparing children and adolescents with autism to typically developing controls showed patterns that were diffuse throughout the brain and furthermore significantly more variable in the autistic cohort. The mouse data revealed that the brain areas affected were specific to each individual mouse model studied, resulting in a similarly diffuse and heterogeneous pattern of brain alterations once all the models were taken in aggregate. The most consistently affected brain regions were the corpus callosum, cortex, and cerebellum. The mouse models further clustered into three sets with shared imaging phenotypes.
Conclusions: Autism presents with marked hetereogeneity in phenotype. Using imaging of neuroanatomy and brain connectivity we identified the same variability in these endophenotypes. Combining mouse and human imaging data suggests potential stratifications of autism into clusters sharing similar phenotypes.

191 **125.191** Integrating Analytical Methods to Identify Rare Variants Associated with ASD in High-Risk Utah Pedigrees

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Background: Despite recent advances in research on autism spectrum disorder (ASD), most genetic risk factors remain elusive. Previous large-scale genetic studies estimate >1000 genes are involved in ASD; however, this heterogeneity may be reduced when looking within individual pedigrees.
Objectives: Integrate genome-wide Shared Genomic Segments (SGS) analysis with the pedigree extension of the Variant Annotation, Analysis, and Search Tool (pVAAST) to increase power to detect rare genetic variation contributing to ASD risk in high-risk ASD pedigrees.
Methods: High-risk pedigrees were identified through the Utah Population Database. The Familial Standardized Incidence Ratio (FSIR) was used to find pedigrees with significantly more cases than expected compared to similar background pedigrees matched for age, sex, and size. DNA was collected through blood draws on affected and unaffected family members. A total of 196 samples were genotyped (Illumina OmniExpress12v1.1) on four of the largest high-risk pedigrees, including 44 affected relatives, 4 relatives with broad autism phenotype, and 146 unaffected relatives (siblings, parents, grandparents). Genotyping data was used to identify genomic sharing using SGS analysis. A subset of 88 samples from these pedigrees underwent exome sequencing (Agilent SureSelect and Illumina GAIIx). Variants in significant SGS regions were functionally annotated and analyzed with pVAAST to identify the likelihood of the variants contributing to disease risk. Pedigree variants were compared to background exomes sequenced through the 1000 genomes project, and were selected to match ethnicities with the pedigrees.
Results: In pedigree 25002 (ASD FSIR=5.56, p<0.0001), we identified a 12Mb region on chromosome 15 that was significantly shared between family members diagnosed with autistic disorder, compared to unaffected family members (wpSGS p<0.001). Subsequent pVAAST analysis of exomic variants in this region identified 4 genes most likely to contribute to risk for autistic disorder. The variants in these genes were shared between multiple affected family members, and include rs35697691 in mitogen-activated protein kinase 6 (*MAPK6*, p=0.048), two variants, rs1867380 and rs142159680 in aquaporin 9 (*AQP9*, p=0.0087), rs55686434 in myosin 5C (*MYO5C*, p=0.037), and rs16976466 in protogenin (*PRTG*, p=0.041).

Conclusions: The complexity and heterogeneity of autism spectrum disorder require innovative strategies for identifying genetic risk factors. Here, we combined two pedigree based analyses, SGS and pVAAST. First, SGS identified a significantly shared region of interest at 15q21-15q22. Then, pVAAST interrogated rare variants from sequenced exomes to identify 4 genes with evidence for ASD risk. The 4 genes, *MAPK6*, *AQP9*, *MYO5C*, and *PRTG* are expressed in brain. Of particular interest are *PRTG* and *MAPK6*. *PRTG* has been previously linked to attention-deficit hyperactivity disorder and reading disabilities. Variants in *MAPK6* has been previously associated with autism, as well as other neurological disorders like bipolar disorder and epilepsy. This analysis strategy has been effective at identifying regions and genes involved in genetic risk for ASD, and increase understanding of the genetic etiology of ASD.

192 **125.192** Intergenerational Patterns of Quantitative Autistic Traits in Hispanic Families

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Background: Previous research in predominantly Caucasian samples has revealed distinct patterns of aggregation of quantitative autistic traits (QAT) in close family members of individuals affected by Autism Spectrum Disorders (ASD), including siblings (Virkud et. al., 2009) and parents (Lyall et al., 2014).
Objectives: To characterize quantitative autistic trait patterns in Hispanic families affected by ASD using English and Spanish versions of the Social Responsiveness Scale-2 (SRS-2).
Methods: The sample was comprised of 168 families of self-reported Hispanic ethnicity recruited from the University of Miami, who fell into one of three groups: i) families with a child affected by ASD, ii) families in whom a child had a non-ASD psychiatric diagnosis, psychiatric controls (PC), or iii) families of typical controls (TC). Each family included one index child that defined family category and at least one sibling. All index children and siblings had at least one biological parent of self-report Hispanic ethnicity (s-rHE): for each group a minimum of 75% of fathers and 75% of mothers were of s-rHE. Quantitative autistic trait scores of index children (n=164) and siblings (n=153), were assessed by parent-reports using the Social Responsiveness Scale-2 (SRS-2, Constantino & Gruber, 2012). Fifty-nine index children and 53 siblings were additionally rated by teacher-reports, and 142 mothers and 157 fathers (138 pairs) were rated by spousal-report using the SRS-2. In this study, we implemented either *English* or *Spanish versions* of the SRS-2, depending on the primary language spoken by the rater. Index cases of ASD were confirmed using the Autism Diagnostic Observation Schedule and either the Autism Diagnostic Interview – Revised (ADI-R) or the Social Communication Questionnaire (to ascertain developmental history).
Results: In keeping with prior studies in non-Hispanic samples, QAT scores of children with ASD diagnosis were three standard deviations higher than those of typical controls; unaffected sibs and children in families affected by other psychiatric conditions exhibited intermediate levels of QAT (Table 1). SRS-2 intra class correlation coefficients between biological mothers and fathers by spousal-reports were uniformly elevated: ASD group ICC=.52, df=61, p<.0001; PC group ICC=.66, df=15, p<.002; TC group ICC=.59, df=59, p<.0001. A significantly higher proportion of concordantly elevated SRS scores for spousal pairs (i.e. *both* parents in *upper* quartile of the distribution, defined in Table 2) were observed in the ASD group than in the typical control group (16.1% vs. 3.3%, Fisher's exact, p=.03).
Conclusions: This study provides cross-cultural confirmation of the aggregation of QAT in the family members (parents and siblings) of Hispanic children affected by ASD. There was evidence of pronounced preferential mating for QAT, and spousal concordance for sub clinical elevation in QAT was significantly associated with clinical affectation in offspring. Findings support the role of additive genetic influences in the intergenerational transmission of ASD susceptibility in Hispanic families, suggest the possible role of mate selection in offspring ASD risk, and support the ability of the SRS-2 to trace sub clinical affectation as a proxy for transmission of inherited liability in this population.

193 **125.193** Investigation of Parent-of-Origin Effects in Autism Spectrum Disorders

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Background:
The detection of Parent-of-Origin (PofO) effects aims to identify whether or not the functionality of alleles, and in turn associated phenotypic traits, depends on the parental origin of the alleles. Autism Spectrum Disorders (ASD) are considered to be heritable neurodevelopmental disorders but in the majority of ASD cases, the genetic cause cannot be identified. Exploring and identifying possible PofO effects is an important step in trying to understand the genetic mechanisms underlying ASDs.
Objectives:
To investigate parent-of-origin effects, such as imprinting and maternal genetic effects, in ASD using Genome Wide Association Study (GWAS) datasets.
Methods:
We use a multinomial model run in the software EMIM to investigate parent-of-origin effects in the

Autism Genomic Project (AGP) dataset. Since this model is complex, it has less power than a typical GWAS analysis, and given that the GWA threshold of 5×10^{-8} has been considered strict, we employ a Bayesian adapted threshold that takes into account the power at each SNP.
Results:
Based on the use of the Bayesian threshold approach, we found 103 different regions that were found to have an imprinting and/or maternal genetic effect(s). We found two results $< 5 \times10^{-7}$, one for paternal imprinting on chromosome 7 and the other for a maternal genetic effect on chromosome 15 in the MGA gene. We found 4 regions that have been previously identified as showing evidence of PofO effects in ASD. These include a maternal genetic effect in a region that was also identified as having a maternal genetic effect by Tsang et al. 2013 on chromosome 11 in the MAML2 gene and a maternal imprinting effect on chromosome 18 where Yuan and Dougherty 2014 found a maternal genetic effect (it is worth noting that maternal imprinting and maternal genetic effects have been known to mimic each other).
Conclusions:
To our knowledge, this is the first genome-wide study to test for both imprinting and maternal genetic effects simultaneously in ASD and the first to implement the Bayesian adapted thresholds that take into consideration the power of the test. We found some promising results that we are currently hoping to replicate in the Simons Simplex Collection autism data set.

194   **125.194** Linkage Analysis of Whole Exome Sequence Data in Multiplex Autism Families Including Cholesterol Covariates

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Background:
The analysis of multiplex autism families may provide valuable insights into the risk of developing autism spectrum disorder (ASD). It is not known whether "sporadic" ASD is truly sporadic or a consequence of reduced penetrance, but our previous analyses of *de novo* variation suggest that multiplex families have a different underlying etiology. Linkage analysis is a method that is once again increasing in popularity for analyzing next-generation sequence data as it can leverage family structure to increase power compared to population-based methods and multiplex families may be enriched for high-penetrance, functional rare variants. It has also been observed that individuals with Smith-Lemli-Opitz syndrome show many autistic features and abnormal cholesterol measures have been demonstrated in individuals with ASD who do not have SLOS.
Objectives:
We aimed to analyze whole exome sequence (WES) data in multiplex ASD families from the Autism Genetic Resource Exchange collection using linkage analysis methods designed to incorporate covariate measures to see if some families show stronger evidence of linkage to particular loci in the presence of these covariate measures.
Methods:
WES was performed in 69 families with 2-3 affected children from the AGRE collection. Quality filtering was performed in GoldenHelix SVS and Mendelian inconsistencies removed using Sibpair. Seven covariate measures were tested; total cholesterol, HDL cholesterol, ApoA1, ApoB, triglycerides and two categorical variables, hypercholesterolaemia and hypocholesterolaemia. Incorporating covariates into categorical trait linkage analysis is more challenging than quantitative traits, however some nonparametric methods exist. Here we use IBDReg, an approach that uses quasi-likelihood measures to test for which covariates might be influencing evidence for linkage at particular loci.
Results:
Significant evidence of linkage to ASD when including covariates was found on chromosome 1 (p=2.2×10^{-7}), chromosome 2 (p=7.2×10^{-6}) and chromosome 21 (p=6.1×10^{-6}) for hypercholesterolaemia as the covariate and chromosomes 1 (p=1.1×10^{-7}), 2 (p=1.6×10^{-6}), and 21 (p=5.1×10^{-6}) when hypocholesterolaemia were used as covariates. Several other regions with suggestive evidence of linkage of ASD were also observed for all covariates except ApoB, which had no signals even in the suggestive range.
Conclusions:
Including covariates which may be relevant to ASD may help with interpretating WES results, particularly in families with multiple affected children. Different covariates produced different evidence of linkage to ASD, depending on which covariate was included, which may assist in classifying families with different underlying ASD etiologies. Interpreting the results of these kinds of linkage analyses is challenging and simulations are currently underway to calculate empirical p values. However, all of our signals have previously been reported in AGRE families or other ASD cohorts. The signals on chromosome 1 and 2 are close to reported linkage peaks in the literature, in particular the signal on chromosome 2 is in the 2q21.2 region which is part of the 2q21-q33 region which has been repeatedly reported in linkage analyses of ASD families. The locus on chromosome 21 is close to a region previously reported in a subset of ASD families with language regression. These regions are

being examined in detail to attempt to identify the linked causal variants.

195 **125.195** Modulating RBFOX1 Expression in Human Stem Cell-Derived Glutamatergic Neurons

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Background:
Autism spectrum disorders (ASDs) are a group of neurodevelopmental conditions that currently afflict about 1 in every 68 children. The hunt is ongoing for the highly heterogeneous genetic causes of ASD. Both our group and others have identified potentially pathogenic copy number variants (CNVs) and point mutations in ASD individuals in the *RNA binding protein, fox-1 homolog 1* (*RBFOX1*) gene (Griswold, et al, 2012). *RBFOX1* is a neural splicing cofactor that regulates alternative splicing. Due to the high level of ASD genetic heterogeneity, investigations of ASD loci using genome wide association studies (GWAS) have identified relatively few consistent signals of interest. However, when we conducted a combined analysis of over 20,000 individuals from four independent family-based GWAS datasets, one of our strongest signals was in *RBFOX1* (top SNP, rs74733079, discovery p=1.558 x 10^{-6}, meta p=2.635 x 10^{-5}). In addition to ASD, *RBFOX1*has been connected to bipolar disorder, epilepsy, and schizophrenia.
Objectives:
To better understand the impact of *RBFOX1* on ASD, we are evaluating how *RBFOX1* expression modulates neuronal function in iPSC-derived glutamatergic neuronal cells.
Methods:
Given the neurodevelopmental nature of ASD, iPSC provide a unique opportunity to understand potential pathogenic mechanisms that may be at work during early phases of development. To that end, we have examined the impact that changes in RBFOX1 expression have on neuronal functionality in the developing neuronal cultures. The viability and functionality of the glutamatergic neurons in which *RBFOX1* has either been overexpressed or silenced by RNA interference are assessed at multiple time points during *in vitro* neurogenesis. Overexpression experiments are performed with lentiviral transduction and genomic integration the wild type form of *RBFOX1* variant 4 driven under a CMV promoter, as well as an ASD-specific nonsense mutation at R173X that we identified in a sporadic ASD family. Each condition is compared at a gross morphological level to determine if modulating *RBFOX1* produces recognizable qualitative or quantitative phenotypes. Since *RBFOX1* plays a key role in splicing and transcription, RNA-seq analysis of the iPSC-derived neurons under three conditions (*RBFOX1* knockdown, overexpression and no treatment) will be used to complement the functional analysis to identify key networks regulated by *RBFOX1*.
Results:
Neuronal precursors cells (NPCs) from the control stem cell line were transduced with lentivirus on day 27 of the glutamatergic differentiation scheme. Cells overexpressing a RBFOX1-eGFP construct successfully glowed. RNA was extracted from all cells, purified, and reverse transcribed for quantification by qPCR. Following measurement of both *RBFOX1* and the internal control *GAPDH*, the shRNA was determined to be successful at ~40-45% knockdown of endogenous *RBFOX1* expression and the RBFOX1-eGFP vector was strongly (~35x) overexpressing the gene. The alteration of *RBFOX1* levels through the RNAi-mediated silencing of *RBFOX1* or the transgene overexpression showed alterations in transcriptional profiles, including differences in splice variant composition of the transcriptome. These changes are consistent with the known function of *RBFOX1*as a regulator of splicing.
Conclusions:
Initial results suggest that *RBFOX1* plays a central role in establishing key transcriptional networks in neural development.

196 **125.196** Mutation Characteristics in Families with Two or More Siblings with Autism Spectrum Disorder

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Background:
Autism spectrum disorder (ASD) is genetically heterogeneous, with >100 susceptibility genes known.
Objectives:
To examine the characteristics of all classes of genetic mutation (small sequence-level changes, structural variation, and copy number variation) in well-characterized ASD-multiplex families by analyzing both de novo and rare inherited mutations.
Methods:
We used whole-genome sequencing (WGS) of 85 quartet families (two parents and two ASD-affected siblings) to comprehensively examine the roles of all classes of mutation in familial ASD.
Results:
In 36/85 (42%) of families, at least one child with ASD had DNA alterations potentially relevant to the disorder. We detected de novo damaging missense and loss-of-function (LoF) single nucleotide and

structural mutations in ASD-risk genes in 13/85 (15%) of families. Fifteen additional families carried rare inherited LoF mutations in known ASD-susceptibility genes, and eight more families had de novo or inherited LoF variants in genes associated with autosomal dominant neurodevelopmental disorders. In only one of these families was the same damaging de novo mutation (1.8kb deletion in SCN2A) found in both ASD siblings, but in another 10 families, affected siblings shared inherited ASD-risk variants.

Conclusions:
Taken together, in 11/36 (31%) of families a de novo or rare inherited and presumed penetrant ASD-risk variant(s), identified in the index case, was also found in the sibling with ASD. These siblings tended to be more alike in their phenotypic features than those who did not share a risk variant. In the remaining   families with familial ASD, the siblings carried different mutations, emphasizing the need for WGS in confirmatory and predictive diagnosis.

197   **125.197** PTEN Mutation in Children with Autism and Macrocephaly: A Case Report of Two Previously Unrecognized Promoter Region Mutations

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Background:
Autism is characterized by impairment in communication, social interaction, insistence on sameness and restricted repetitive actions & stereotyped movements. 20% of children with Autism Spectrum Disorders (ASD) have macrocephaly and 10% are associated with known genetic syndromes. Phosphatase and tensin analogue on chromosome 10q23.3 gene (PTEN), is a tumor suppressor gene which encodes a dual specificity Phosphatase ,that negatively regulates the PI3K/AKT pathway. PTEN germline mutations have been associated with macrocephaly, seizures, tumors and mental retardation with four hamartomous syndromes Recent work by Butler et al (2005) and Goffin et al (2001) have shown the association of PTEN germline mutation in patients with macrocephaly and ASD.
Objectives: Prevalence of PTEN mutation in a clinical population of ADOS proven cases of autism spectrum disorder (ASD) and relative and absolute macrocephaly (>2SD above mean HC for age and sex).
Mutation identification for these patients by DNA sequencing of the promoter and coding regions of the PTEN gene.
Phenotype-genotype correlation of subjects with ASD and PTEN mutation
Methods:
Study eligible participants in the Autism Clinic and the JHH Genetics clinics were enrolled after obtaining signed informed . Parents of eligible subjects completed intake questionnaires (SRS) ,the children were administered the Mullen Scales of Early Learning or the subtests of the Stanford Binet . Children over age 12 months of age were administered the Autism Diagnostic Observation Schedule (ADOS) .6 ml-10 ml of blood was drawn for this assessment in children with ASD who are above the age of 18 months and were sent to the DNA Diagnostic Center at JHH. Genomic DNA (gDNA) was isolated from the blood sample within 24 hours of. A portion of the gDNA was diluted and used for PCR amplification of the promoter region and coding exons of the PTEN gene and were then sequenced bi-directionally and compared to normal control reference sequence *in silico* to identify mutations
Medical records for subjects with positive PTEN mutation were reviewed for an initial correlation of potentially pathological mutations, and cognitive and behavioral phenotype that may be associated with the underlying mutation.
Results:
Five out of 25 subjects were found to have mutations in the promoter region of the PTEN gene , of which three were previously reported rare PTEN variants, and 2 had not been previously reported in the scientific literature.
Conclusions:
This is a case report of two new variants in the PTEN mutations in a subset of children with ASD and macrocephaly and indicates that PTEN mutation screening should be done in the initial diagnostic workup of children with macrocephaly and autism.

198   **125.198** Penetrance and Specificity of Significant Chromatin Pathway Sequence Risk Variants in Utah Extended ASD Pedigrees

ABSTRACT WITHDRAWN

Background: Progress has been made in identifying rare genetic risk variants for autism spectrum disorders (ASD) in collaborative case-control and/or parent-child trio studies. A recent Autism Sequence Consortium (ASC) study identified chromatin remodeling as one significant gene pathway for ASD risk. Functional variants in chromatin remodeling-related genes may lead to changes in brain cell development or migration.
Objectives: We studied Utah high-risk ASD families where specific variants reported by the ASC in chromatin remodeling genes occurred. We are characterizing additional likely damaging variants in this pathway not reported by the ASC but occurring in our family sample. Because our families have large sibships with multiple affected and unaffected individuals, we have the opportunity to observe

penetrance, specific associations with clinical phenotypes, and differences in environmental exposures.

Methods: Our analysis used 518 individuals from Utah families distinct from the ASC sample. These included 186 with ASD and 332 unaffected relatives genotyped with Illumina HumanExome chip, and 61 with ASD and 27 unaffected relatives with whole exome sequence data (Agilent SureSelect and Illumina GAIIx). We first searched for occurrence of specific likely-damaging chromatin pathway gene variants reported in the ASC study in our existing molecular data. We characterized additional variants in our families in all genes in this pathway implicated by the ASC using available sequence annotation (e.g., PolyPhen, Annovar), and validated variants found in exome sequencing using Sanger sequencing. For each variant, we report demographics and phenotype data (ASD severity, IQ, behavioral questionnaires, evidence of medical and/or psychiatric co-morbidities). Finally, we report differences in the occurrence of previously validated environmental risks (pregnancy risk factors) in affected individuals with variants vs. unaffected individuals with variants.

Results: Eight Utah families were found to segregate six rare, non-synonymous, likely damaging variants appearing in the ASC in five chromatin pathway genes. Twelve other chromatin pathway genes were not found to harbor variants seen in the ASC study; however, we are determining the presence of other novel, potentially damaging variants in these genes. Table 1 shows gene variants studied to date which include only those that appeared in the recent ASC study. Each of these variants occurs in unaffected relatives, indicating reduced penetrance. The variant in *ASH1L* only occurred in unaffected relatives, suggesting that it may have been a false positive in the ASC study. Across all variants studied to date, the ADI (affected relatives) and Social Responsiveness Scale (unaffected relatives) scores with and without each variant do not demonstrate a clear pattern of elevation in any subgroup.

Conclusions: Variants in highly significant risk genes from the ASC study studied to date show reduced penetrance in our family data through occurrence in unaffected relatives. Associations with clinical and subclinical variables are complex and differ by gene and gene variant. We are in the process of studying additional available environmental .exposure data (additional birth risk factors, infections in early life, air quality data) to determine if exposure differences could partially account for presence/absence of ASD in siblings with the same variant.

199 **125.199** Province of Ontario Neurodevelopmental Disorders Network: Integrated Discovery from Genes to Treatment

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Background:
Emerging data from human and animal studies have been producing several potential molecular targets, yet there still exists a large gap between the time at which a potential target is identified and the first phase III trial, due to either (1) a target that is not relevant to the disease or not amenable to pharmacological intervention or (2) difficulty in stratifying patients into those most likely to respond to the intervention and/or identifying appropriate clinical end-points or biomarkers. While autism is highly heritable, over 450 genes have been implicated, and no single gene accounts for more than 1% of cases. In areas of other biomarkers, such as imaging, there is also great variability in findings. The observed heterogeneity in ASD suggests that a single treatment is unlikely be effective for most individuals and that in addition to novel targets, we need biologically informed ways of predicting treatment response.

Objectives: To develop an integrated discovery system that will facilitate the translation of genomic and epigenomic findings into treatments by accelerating the discovery of new molecular targets and stratification strategies.

Methods:
With funding from the Ontario Brain Institute and several industry partners, we developed an ICH—GCP compliant clinical trials network dedicated to neurodevelopmental disorders, which we embedded in a multiplatform , multisite biomarker core. Children recruited contribute a genomic sample, extensive phenotypic behavioral and cognitive data, some specific to their diagnosis and some quantifying cognition and behavioral deficits irrespectively of diagnosis (e.g. empathic accuracy, inhibition, attention, social function) as well structural and functional imaging and electrophysiological data. Classification algorithms are used within heterogeneous data to allow for new clustering techniques, in an effort to identify biologically homogeneous subgroups. Children recruited in the clinical trials already have contributed all of the above to allow for prediction of treatment response. In addition, we develop biological models of neurodevelopmental disorders, including mouse models as well as induced pluripotent stem cell (iPS) lines derived from skin or blood of research participants, based on knowledge of mutations in patients. We use cutting-edge technologies, including induced pluripotent stem-cells, and high-throughput imaging and behavioural phenotyping in genetically altered mice to identify mechanisms of disease and the effectiveness of therapeutics.

Results:
At the time of submission, more than 1000 children ages 18 months to 18 years have been recruited and characterized across four sites. More than 45 mouse models of ASD related mutations have been characterized and imaged. This presentation will use empathic accuracy to demonstrate the translational paradigm from genomics and epigenomics to imaging and ultimately to treatment. The rest of the pNEL will highlight novel findings in genomics, epigenomics and imaging in children across the platforms, as well as, cross species data within the POND platforms.
Conclusions:
We present the rational, methods and feasibility of an integrated discovery system aimed at exploring the biological heterogeneity of ASD and related disorders, using cross species genomic, phenotypic and imaging data, with the ultimate goal of predicting treatment response. Early data demonstrates the effectiveness of this approach

200 **125.200** Quantification of FMRP in Human and Mouse Tissues By Capture Immunoassays

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Background: The Fragile X syndrome is due to mutations of the FMR1 gene that result in the absence of fragile X mental retardation protein (FMRP). About half of males with the fragile X syndrome have ASD. Fragile X is recognized as being one of the most common syndromic causes of ASD. Fragile X screening is recommended for autism evaluations.
Objectives: Current methods for quantitating the levels of FMRP are not very sensitive. Our objective was to improve the methods.
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. 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. Using mAb 5C2 (BioLegend) and R477 (an inhouse rabbit polyclonal to FMRP), we have also developed a similar immunoassay for the quantification of Fmrp in mouse tissues.
Results: We have employed the assay to screen 2000 newborn dried blood spots (DBS) and present their distribution. We found a high variable expression of FMRP that had an average level 7 folder higher than that of normal adults. 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 4 known male fragile X positive cases among samples stored up to 47 months. We have used the mouse tissue assay to quantify Fmrp in brainstem, cerebellum, hippocampus, and cortex strains of mouse (C57 BL and FVB) in seven weeks-old animals. The latter assay will allow studying the developmental variation of Fmrp expression in different organs.
Conclusions: Our new assay allows for sensitive and accurate quantitation of FMRP, in human and mouse blood and tissues. It is particularly sensitive for detecting and quantitating newborn blood spots on filter paper, as the drying of blood appears to inactivate proteases that reduce FMRP in stored whole blood samples.

201 **125.201** Recurrence Rates for Autism in Multiplex Families and Twins Demonstrate Sex Differences in Familial Genetic Liability

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Background: Autism spectrum disorders (ASDs) are more prevalent in males, suggesting a multiple threshold model for ASD liability. This model states that females in the population are protected by sex-differential mechanisms, and that a greater genetic burden is required for females to manifest an ASD phenotype than for males. Under this model, autistic females' siblings are also predicted to share this greater genetic liability, whereas the siblings of autistic males are predicted to share comparatively lesser genetic liability. However, ASD recurrence rates reported in the literature have not demonstrated a significantly increased risk to siblings of affected girls as compared with siblings of boys.
Objectives: Previous studies of recurrence risk utilized population cohorts or infant siblings of children with ASD, samples that include a combination of families with simplex and multiplex genetic architecture. Since sporadic cases from simplex families are enriched for *de novo* risk variants that are unlikely to be shared with siblings, including these families is likely to obscure recurrence patterns. The purpose of this study is therefore to utilize a strictly multiplex family sample from the Autism Genetic Resource Exchange (AGRE) to determine if recurrence risk in these families follows predictions from a female protective model.
Methods: We assess recurrence rates and associated quantitative traits in full siblings from 1,120 multiplex nuclear families and concordance rates in 305 twin pairs from AGRE. We compare recurrence rates and phenotypes between males and females overall, and between twin pairs or

families with at least one affected female (female-containing, FC), versus those with only affected males (male-only, MO).

Results: We observe a significantly higher recurrence rate in males than females, siblings of female than male probands, and higher concordance in FC than MO twin pairs. Recurrence rates approach 50%, consistent with a dominant inheritance pattern in high-risk families as has been proposed. We also find a significant negative relationship between interbirth interval and ASD recurrence that is driven by male children in MO families.

Conclusions: By classifying families as MO or FC *post hoc*, using full pedigree information, we observe significant recurrence rate differences between families harboring sex-differential familial liability. However, recurrence rates near 50% for females from FC families and for males overall suggest that simply conceptualizing females' genetic risk as quantitatively greater than males' may be insufficient. Consideration of the robustness of female protective factors and/or the sex-differential penetrance of specific risk variants is necessary. Furthermore, the male-specific relationship between shorter interbirth intervals and increased ASD risk speaks to the higher genetic risk load in females and potentially more frequent contributions from environmental, including maternal, risk factors in males. Understanding the mechanisms driving these sex-differential risk profiles will be useful for treatment development and prevention.

202   **125.202** Scalable Sequencing Pipeline on Cloud

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Background: While sequencing methods have been approved as clinical diagonosis tools, computation time and cost are still substantial barriers preventing the use of next generation sequencing (NGS) in a clinical setting. For this technology to be adopted by clinicians, the turnaround time of genomic data analysis must be within hours and the cost of rendering to clinically actionable information should be reduced to the level of typical lab test costs.

Objectives: Here we introduce our cloud-based NGS analysis pipeline and benchmark results of all public whole exome and genome data from autism studies.

Methods: We built a generic workflow management system running on clouds, then implemented Genome analysis toolkit (GATK) workflow as our NGS pipeline. We tested this system on Amazon Web Service (AWS) platform with all autism whole exome and whole genome data sets available to us, in order to examine scalaiblity and cost-effectiveness of our pipeline.

Results: Test results showed that the pipeline works in a scalable manner up to hundred exomes or genomes which is a typical batch size in sequencing. We will also discuss our findings on autism specific data in joint variant calling and characteristics of rare / de novo / knockout variants.

Conclusions: N/A

203   **125.203** Sleep Problem Profiles of Individuals with ASD-Associated Mutations

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Background:

Classifying ASD phenotypes by recurrent gene disrupting mutations has promise as an effective means of identifying potential subtypes of the disorder (Bernier et al, 2014). Sleep difficulties, such as difficulty falling asleep, frequent waking, and restless sleep, are frequently reported comorbidities in ASD (Liu et al, 2006; Matsuoka et al, 2014; Williams, Sears, & Allard, 2004). Recent studies report profound sleep problems in children with ASD-associated gene disruptions, *CHD8* and *ADNP* (Bernier et al, 2014; Helsmoortel et al, 2014; Vandeweyer et al, 2014). Further exploration of sleep problems in individuals with disruptive, ASD-associated gene mutations can inform common etiological contributions to ASD and sleep by expanding symptom profiles associated with gene disruptions. Clarifying specific kinds of sleep issues accompanying ASD can better inform support of daytime behavior and functioning for children and their families.

Objectives:

To provide an assay of sleep problems in individuals with *ADNP*, *CHD8*, *DYRK1A*, and *TBR1* loss-of-function mutations.

Methods:

Participants were 14 children from the Simons Simplex Collection (SSC) sample who met strict criteria for ASD and had an ASD-associated loss-of-function gene event. Due to recurrence in the literature, the following gene events were chosen for analysis out of a larger sample of 265 children (54 female) with identified loss-of-function mutations in the SSC: *CHD8* (n=8 (2 female)), *ADNP* (n=2 (1 female)), *DYRK1A* (n=2 (1 female)), and *TBR1* (n=2 (1 female)). Incidences of various sleep problems were measured by parent report on a clinician-administered medical history questionnaire. Sleep-specific items were clustered into summary variables: bedtime problems, daytime sleepiness, night-time awakenings, and sleep-disordered breathing (see Table 1 for category items). For preliminary analysis, sleep summary variables were analyzed with a multivariate general linear model in relation to gene disruption type, controlling for IQ and comorbid behavior problems.

Results:

See Table 1 for incidence of sleep problems for each gene mutation group in the present sample. Preliminary analysis indicated that *ADNP*, *CHD8*, *DYRK1A*, and *TBR1* groups differ significantly from each other in parent-reported night-time awakenings ($F_{(1,2)} = 21.05$, $p = 0.046$). Half of each gene group endorsed frequent or prolonged awakenings at night, while the *CHD8* group shows additional awakening problems in the form of sleepwalking and frequent nightmares (See Table 1, Figure 1). The incidence of night-time awakenings appears to be a significant sleep issue for individuals with one of these selected mutations (>50% endorsed) compared to the whole loss-of-function sample (<40% endorsed, see Figure 1). As additional subjects are being evaluated, continued analyses will tease apart group differences.
Conclusions:
Deeper inspection of sleep problems in individuals with noted ASD-associated mutations to *ADNP*, *CHD8*, *DYRK1A*, and *TBR1*, while preliminary, suggests that endorsement of night-time awakenings is exacerbated in individuals with particular ASD-associated mutations. This suggests a potentially disruptive impact of these loss-of-function mutations on biological mechanisms responsible for sleep maintenance. Findings highlight night-time awakenings in this population as an area needing further study.

204 **125.204** Social Communication Skills and Impairments in Children with Dup15q Syndrome: Is There a Distinctive Phenotype That May Inform Intervention Targets?

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Background: Duplications on chromosome 15q11.2-13 are highly associated with autism spectrum disorder (ASD), intellectual disability (ID), and epilepsy. Most studies to date have focused on diagnostic categorization of this cohort rather than performing a deeper characterization of the social communication, cognitive, and language profiles of this high-risk cohort.
Objectives: To determine whether there are distinctive features of the social- communication deficits found in children with Dup15q mutations and, if so, whether these characteristics could guide more targeted interventions for this genetically-based subgroup within the autism spectrum. Our study is driven by the hypothesis that there will be a distinctive developmental phenotype in children with Dup15q syndrome that will vary in severity across mutation size and location, and that this phenotype will be defined by expressive language and motor impairment with relatively preserved non-verbal social abilities. Interventions that capitalize on these strengths may ultimately facilitate gains in social communication function in these children.
Methods: In this ongoing study, children ages 18 months to 10 years with Dup15q syndrome are recruited from the Dup15q Alliance registry as well as the national Dup15q clinics, and they undergo a comprehensive, developmentally informed clinical phenotyping battery. We compare cognition, expressive and receptive language, social communication, play, and motor ability in this cohort (both intersitial and isodicentric cases) to that of an age matched cohort of children with non-syndromic ASD drawn from several existing studies in our UCLA Center for Autism Research and Treatment (CART). Measures include: Autism Diagnostic Observation Schedule (ADOS), Mullen Scales of Early Learning and/or Stanford- Binet Intelligence Scales, Early Social Communication Scale (ESCS), the Vineland Adaptive Behavior Scales, and the Structured Play Assessment (SPA).
Results: 14 children with Dup15q syndrome have been recruited for the study. Age range is 22 to 94 months, 6 males . All have isodicentric 15q [idic(15)], all have global developmental delay and/or intellectual disability. 8 children had developmental levels appropriate for ADOS testing and all of these children (8/8) met criteria for ASD on the ADOS, 1/8 with mild-moderate severity and 7/8 with moderate-high severity. Common, consistent characteristics that distinguished this group from those with non-syndrome ASD included: Expressive language delays greater than receptive language delays, verbal IQ lower than nonverbal IQ, significant gross motor delays (>2 standard deviations from normal), consistent lack of eye contact and *inability to initiate* joint attention on the ADOS and ESCS, and consistent *evidence of response* to joint attention on the ADOS and ESCS.
Conclusions: A distinctive social communication profile is emerging in children with Dup15q syndrome, with impairments in motor function, visual attention, and initiation of engagement that may prevent the development of appropriate language and social communication behaviors. Targets for intervention include expressive language, initiation of joint attention, and overall attention to social cues in the environment.

205 **125.205** Social-Communication and Restricted and Repetitive Behavior (RRB) Profiles in Children with Phelan-Mcdermid Syndrome Compared to Non-Syndromic Autism Spectrum Disorder (ASD)

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Background: Phelan-McDermid syndrome (PMS) is a genetic syndrome caused by mostly de novo chromosomal abnormalities in the terminal end of 22q that includes the *SHANK3* gene. Loss of *SHANK3*, either through deletion or mutation, results in a phenotype characterized by significant

intellectual disability, severe speech delay, hypotonia, minor dysmorphic features, and autistic-like behaviors. PMS is described as a common genetic form of ASD, accounting for up to 1% of ASD cases, with features including poor eye contact, self-stimulation, and repetitive mannerisms. However, the specificity, type, and degree of ASD symptoms in PMS remain unclear.

Objectives: The purpose of this investigation is to examine overlap and differences in ASD phenotype between PMS and non-syndromic ASD and to inform measurement targets for intervention research in PMS and ASD.

Methods: We analyzed ASD symptom profiles in a prospectively recruited sample of (n=24) of children with PMS (age 1.7 to 8.4 years) and a convenience sample of non-syndromic children with ASD, intellectual disability (ID), and language delay (n=38, age 2.1-8.2 years). The comparison group was a subsample of a larger community-based study of autism, selected on chronological age and developmental quotient scores <45. Measures included the ADOSG/ADOS2, ADI-R, and developmental/behavioral assessments. Non-parametric tests (Mann-Whitney U) were conducted on demographic and domain scores on the ADOS and ADI-R.

Results: Mean ADOS2 and ADI-R domain scores were in the ASD range for the PMS sample. Children with PMS did not differ on mean social-communication (or social affect) domain scores on the ADOS2 or ADI-R. However, subdomain analyses showed more severe communication impairments in PMS relative to non-syndromic ASD (ADOSG, communication domain). Peer relationships were less impaired in PMS relative to non-syndromic ASD (ADI-R, A2). The RRB domain also differed significantly between groups with lower scores in PMS relative to non-syndromic ASD on the ADOS2. Domain analysis of ADI-R scores indicate the PMS group had significantly fewer lower-order repetitive behaviors (ADI-R, C3 & C4) and higher scores on encompassing preoccupations/circumscribed interests (ADI-R, C1).

Conclusions: Results from our study are the first to characterize ASD features in PMS relative to non-syndromic ASD. Findings are consistent with a growing body of literature indicating the overlap between ASD and the clinical features of PMS. Our findings suggest potential for a distinct RRB profile in PMS relative to non-syndromic ASD with ID. Investigations of neurobehavioral profiles in PMS are needed to understand the unique behavioral phenotype associated with *SHANK3* deficiency.

206   **125.206** Strategies for Detecting Increased ASD Risk in Male and Female Probands

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Background: An excess of male cases has consistently been observed in autism spectrum disorder (ASD), however no clear mechanism for this sex bias has been demonstrated. The possibility of a female protective effect (FPE) has received considerable attention, especially given the excess of *de novo* CNVs in females with ASD in several cohorts. Under this FPE model we would expect an excess of ASD risk in females (as is observed for *de novo* mutations) and an increased ASD recurrence rate in the siblings of females with ASD, compared to the siblings of males with ASD (often called the Carter Effect). However, despite several studies with large sample sizes the Carter Effect has not been observed for ASD diagnosis. The evidence for the FPE mediating ASD sex bias is therefore contradictory.

Objectives: To assess the likelihood of observing increased ASD risk in females under an FPE model directly (*de novo* mutation) and indirectly (Carter Effect).

Methods: A family-based simulation was used to estimate the power to detect the FPE directly (proband *de novo* mutation rate) and indirectly (sibling ASD recurrence rate). To perform this calculation estimates of the ASD risk architecture were required. Two models were used: 1) ASD is caused entirely by inherited genetic risk (the ideal scenario for observing the Carter Effect); and 2) 50% of ASD risk is from common variation, 3% from de novo and 47% from unique environmental effects (estimates based on Gaugler et al, *Nature Genetics*, 2014).

Results: Under the first model (100% inherited risk), approximately 3,000 probands were required to detect the Carter Effect with 80% power. To date, only one analysis of ASD recurrence rate has exceeded this threshold (Grønberg, JAMA Pediatrics, 2013). However, under the second model (50% inherited risk, 3% de novo) this power was reduced considerably. Even with a samples size of 10,000 the probability of detecting the Carter Effect was less than 20%. Under this second model the probability of detecting a significant difference in the burden of *de novo* mutation between affected females and males was 80% with only 500 probands.

Conclusions: The sample size required to reliably detect the Carter Effect is at least an order of magnitude greater than the largest study of ASD recurrence rate performed to date. In contrast, the direct observation of a higher burden of known ASD risk factors (such as *de novo* mutation) can be observed with the sample sizes currently available for analysis. Therefore, a model of ASD sex bias being predominantly a consequence of a female protective effect fits the available data well.

207   **125.207** Systems Biology Approaches to Determine Genetic Risk Factors for Autism Spectrum Disorders

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Background: Autism spectrum disorder (ASD), a complex neurodevelopmental syndrome, presents with an extreme degree of clinical and genetic heterogeneity. Common variants have been shown to explain up to 50% of ASD liability whereas rare genetic causes can be identified in 10% of ASD cases. The analysis of the genetic architecture of the variable ASD phenotype is mandatory in understanding the complex basis of this disease. Several single gene studies have been reported shaping the ASD phenotype. However, no study so far has considered the network context of underlying genes to understand phenotypic variability.

Objectives: Using systems biology approaches, we aimed at identifying genetic patterns and networks that shape the autism phenotype as defined through the Autism Diagnostic Instrument Revised (ADI-R). Our approach includes identification of underlying genes influenced by associated common and rare variants integrating available knowledge on eQTL, gene-expression during brain development, regulatory sequence patterns as well as protein-protein network information. Finally, we model the phenotypic presentation using the network state of an individual patient.

Methods: Regression modeling predicting ADI-R derived factors was performed using the Autism Genome Project (AGP) data set with whole genome single nucleotide polymorphism (SNP) data. Modeling was further supported by machine learning approaches. Underlying network model construction was based on brain expression data (Kang et al 2011), eQTL and mQTL data (GeneVar, Gibbs et al 2010) and protein-protein interaction database (STRING, GeneMania). Models were validated and further refined by integrating information on functional rare variants in an independent German ASD data set with whole genome SNP data, CNV and exome sequencing data (Autism Sequencing Consortium). Both dataset are matched for gender and ethnicity, and all models were controlled for ethnicity.

Results: Here we show preliminary results: We reproduced previously published ADI-R factor analysis (Liu et al 2011) in both the AGP and the German dataset supporting a six factor (Eigenphenotypes) solution corresponding to Joint attention, Social interaction and communication, Non-verbal communication, Repetitive sensory-motor behavior, Peer interaction as well as Compulsion/Restricted interests. A total of 730525 SNPs were included in regression modeling predicting the extracted six factors. In addition, 6 components controlling for ethnicity based on the genetic background were included. Results of Eigenphenotype modeling and subsequent network analysis are presented.

Conclusions: As ASD is a complex neuropsychiatric disorder with a varying genetic heterogeneity, our research will aid in discovering the association of SNPs with disease phenotype. This project will contribute to a deeper insight into ASD pathomechanisms and potentially provide predictive models for clinical setups.

208 **125.208** Systems Biology of Late-Onset Severe Regressive Autism
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Background: Regression is commonly described in ASD. However, the causes of regressive ASD in the vast majority of cases are unclear. Furthermore, there is debate regarding the precise definition of regression and whether it is a distinct phenomenon within ASD.

Objectives: To pursue an intense, multimodal investigation of a rare, severe example of this phenomenon, ASD with late-onset severe Regression (ASDR). Examining an extreme cohort will maximize our ability to identify neurobiological features relevant to regression.

Methods: In addition to meeting criteria for ASD, ASDR subjects met the following criteria: (1) loss of language skills, (2) loss in at least one other domain: social skills or adaptive behavior, bowel or bladder control, play, and motor skills, (3) loss must have occurred after 24 months of age, (4) must not have regained level of skill prior to loss, and (5) full-scale IQ<70. To investigate the genetic contribution to regression, we performed whole-exome sequencing and CNV analyses on 15 ASDR probands and their unaffected siblings and parents to search for novel or rare *de novo*, recessive, and hemizygous mutations. To study neural systems, we performed fMRI analyses involving a block design of alternating fearful face versus house images in 4 cohorts: 7 ASDR, 7 low-functioning ASD (LFASD), 14 high-functioning ASD (HFASD), and 19 typically-developing (TD) subjects. To quantify the social phenotype, we collected eye-tracking data as our 4 cohorts viewed emotional faces: 5 ASDR, 7 LFASD, 40 HFASD, and 11 TD.

Results: Genetic analysis identified one or more novel or rare mutations in almost all of the probands and a diverse list of candidate genes. Coexpression network analysis showed that a significant number of these genes converge in the cerebellum and thalamus during mid-late fetal development (P=0.009, permutation testing). fMRI revealed abnormal hyperactivity in these brain regions compared to LFASD, HFASD, and TD subjects. Eye-tracking results replicated prior findings of decreased fixation on the eyes and increased fixation on the mouth in HFASD relative to TD. However, the amount of time subjects with LFASD and ASDR spend looking at the eyes is not significantly different from TD. Among individuals on the autism spectrum, those with ASDR fixated on eyes the most.

Conclusions: The combination of genetic findings and coexpression network analysis predicted a

distinct neuroimaging signature in ASDR subjects: enhanced, face-evoked activity in the cerebellum and thalamus. The cerebellum is involved in the use of visual social cues for making mental inferences. Given the role of the thalamus in modulating cortical neural rhythms, abnormal hyperactivity may explain why individuals with ASDR generally have high levels of encephalographic abnormalities, anxiety, and stereotyped patterns of behavior. The initial normal development of children with ASDR suggests that the early development of the social brain may follow a typical trajectory, raising the possibility that some aspects of social function will be preserved, as reflected by our eye-tracking results. Although ASDR and other forms of ASD are, eventually, clinically similar, the natural history of ASDR marks a unique set of genetic, neural, and behavioral mechanisms.

209 **125.209** Targeted Behavioral Intervention for Children with Dup15q Syndrome Focuses on Language and Joint Attention

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Background: Duplication of 15q11.2-q13.1, or Dup15q Syndrome, is one of the most common copy number variations (CNV's) associated with autism spectrum disorders (ASD). The Dup15q phenotype is characterized by social communication deficits, intellectual disability, impaired speech, hypotonia, motor delays, and epilepsy (Battaglia, Parrini & Tancredi, 2010). Many children with Dup15q syndrome are minimally verbal. To date, there has been no research on targeted behavioral interventions for this population. An ideal intervention for the specific deficits found in Dup15q syndrome is JASPER (Joint Attention, Symbolic Play, Engagement and Regulation). JASPER is a play-based intervention focused on joint engagement in play routines with the therapists as a platform for developing play and communication skills (Kasari et al., 2006). JASPER has been used successfully to increase communication in minimally verbal children with ASD (Kasari et al., 2008; 2014).
Objectives: To evaluate the feasibility and effectiveness of JASPER in a pilot sample of children with Dup15q syndrome.
Methods: Three children participated in this pilot study (2 female). Two participants were non-verbal (ages 3:2 and 5) and the third used phrases (age 7:11 years). Assessments included the Autism Diagnostic Observation Schedule 2 (ADOS-2), the Early Social Communication Scales (ESCS) to measure joint attention and requesting, the Mullen Scales of Early Learning/Stanford-Binet Intelligence Scales, and the Vineland Adaptive Behavior Scales. Participants received between 10 and 16 JASPER intervention sessions. Sessions were 30 minutes in length and occurred twice per week. The first and last sessions were coded for the time the child spent engaged in joint activities.
Results: All three participants met diagnostic criteria for ASD, based on ADOS-2 scores, and all scored in the very impaired range on cognitive assessments. The ESCS was administered to the two non-verbal participants. Both participants demonstrated low rates of joint attention skills. Notably, both participants showed more responses to joint attention during the book task, compared to pictures on the wall, likely secondary to the fact that shifting gaze to the book required less motor control and visual attention. All participants showed large increases in the amount of time spent engaged from first to last session (Participant 1: 22% engagement in reciprocal activities to 45% engagement in reciprocal activities; Participant 2: 21% to 50%; Participant 3: 33% to 100%).
Conclusions: This is the first intervention study in Dup15q syndrome. JASPER is not only feasible but beneficial for children with 15q11.2-13.1 duplications, as it targets the core deficits that characterize the syndrome. Specifically, children demonstrated inflated ADOS scores, indicative of autism characteristics, intellectual disability, low rates of joint attention skills and impaired language. Given these characteristics, an intervention that focuses on supporting joint attention and language through an engaging, developmentally appropriate play interaction is warranted. Initial results indicate that the JASPER sessions were successful in terms of increasing the amount of time that participants were able to engage in reciprocal activities. These data support the need for larger scale research to evaluate the effects of a targeted behavioral intervention in children with Dup15q syndrome.

210 **125.210** The Language Phenotype of the 16p11.2 Deletion and Duplication in Children with and without Autism Spectrum Disorders (ASD): The Svip Study

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Background: Studies have shown that a significant number of individuals with the BP4-BP5 16p11.2 copy number variant (CNV), deletion or duplication, are more likely to show cognitive and language impairments (e.g., Hanson et al., 2014) and higher prevalence of Autism Spectrum Disorders (ASD). However, our understanding on the language phenotype of 16p11.2 CNV in children with/without ASD is still limited.
Objectives: To examine the patterns of language phenotype of 16p11.2 CNV with and without ASD based on clinician observations of spontaneous expressive language (Observation of Spontaneous

Expressive Language [OSEL]; Kim, Junker, & Lord, 2014) and parent reports (Children's Communication Checklist-2 [CCC-2], Bishop, 2003).

Methods: General Linear Model (GLM) was performed to examine the effects of 16p11.2 CNV and diagnosis (ASD/non-ASD) while controlling for gender, verbal IQ (VIQ), and chronological age in predicting OSEL syntax and OSEL pragmatic-semantic-profile (PSP) totals as well as CCC-2 scaled scores. The OSEL syntax totals are computed by combining grammatical usages of 24 items including different types of *pronouns* [e.g., *subjective/objective/possessive*], *verb tenses* [e.g., *regular/irregular past, progressive*], *sentence forms* [e.g., *coordination/subordination*]. The OSEL PSP totals include three domains. The first domain represents skills associated with *Initiation of Reciprocal Communication*, which includes items such as *Verbal request* and *Asks for information about others' experiences.* The second domain, *Narrative Skills*, includes items such as *Reporting main ideas* and *Reporting sequence of events*. The third domain, *Unusual Features*, includes items such as *Dominates conversations* and *Stereotyped/idiosyncratic language*. The CCC-2 results in scaled scores for 10 domains targeting grammar (*Syntax*), phonology (*Speech*), and semantic (*Semantics*) and pragmatic skills (*Initiation, Nonverbal Communication*) as well as a *Social interaction Difference Index* (SIDI) created to measure communication impairments in ASD.

Results: The GLM revealed a significant effect of 16p11.2 CNV for OSEL syntax totals and several domains on the CCC-2. Children with 16p11.2 deletion demonstrated significantly lower OSEL syntax and CCC-2 *Syntax* scale scores compared to children with 16p11.2 duplication (p's<0.05). Children with the deletion also scored significantly lower on CCC-2 *Speech* (phonology) scale. On the contrary, children with the duplication showed more impairments on CCC-2 *Semantics* and *Initiation* scales (p's<0.05) and on the SIDI. Similar trends emerged for the OSEL PSP totals with children with the duplication scoring lower, but the effect did not reach statistical significance. A significant effect of ASD diagnosis emerged for the OSEL syntax and PSP domain totals as well as CCC-2 SIDI while controlling for the CNV. Children with ASD showed significantly lower OSEL syntax totals and higher scores (meaning more impairments) on the PSP *Narrative Skills* as well as more impairments in SIDI compared to the non-ASD group (p's<0.05).

Conclusions: Both clinician observations and parent reports show children with 16p11.2 deletion demonstrate more limited syntactic and phonological skills compared to those with the duplication even while controlling for the presence of ASD; whereas children with the duplication show more impairments in pragmatic-semantic skills compared to the deletion group. Not surprisingly, children with ASD showed more impairments in syntactic and narrative skills while controlling for the CNV.

211   **125.211** Tissue-Specific Expression Quantitative Trait Loci (eQTL) in GI Symptomatic ASD Children

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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 a second dataset derived from SNP analysis of DNA from the same individuals, we are exploring expression quantitative trait loci (eQTL).

Objectives: The immediate goal of this study is to search for statistical associations between gene expression data and genetic polymorphisms in a population (ASD) and tissues (colon and terminal ileum) previously uncharacterized by eQTL studies. The longer-term goal is to determine if there are specific eQTLs that track with individual IBD subtypes.

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 the magnitude of the p-value conditional on an expression fold change of at least 1.5.

Results: The number of children analyzed varies by tissue. There were 18 ASD[IC] with colon samples and 22 ASD[IC] terminal ileum samples. Within the colon, 27 SNP-transcript combinations met the p<1x10E-6 and fold change >1.5. These 27 SNP-transcript combinations reside in 13 regions. Within the terminal ileum, 24 SNP-transcript combinations, residing in 13 regions, met the same threshold criteria. At this level of significance, one gene was observed in both tissues: Williams Beuren syndrome chromosome region 27 on chr 7q11.23. Deletion of genes in this region is known to cause the neurodevelopmental disorder Williams Beuren Syndrome and was recently implicated with ASD in a linkage study (Nijmeijer 2014). Additional genes at the given eQTL significance threshold, such as RYR2 (colon: rs10802598 $p=2.25 \times 10^{-8}$) and EPHB1 (colon: rs10512944 $p=1.88 \times 10^{-12}$) have been previously related to ASD and/or ASD-phenotypes through other studies and approaches.

Conclusions: This is the first eQTL analysis of colonic and terminal ileum tissues within an ASD population, providing a novel dataset. The benefits of such an eQTL analysis are two-fold: 1) potential elucidation of ASD SNP associations, by relating SNPs to gene expression and, 2) identification of polymorphisms that tag colonic and/or terminal ileum gene expression. Additional analyses are underway to identify eQTLs in IBD (non-ASD) samples. A subsequent comparison across all groups will potentially identify eQTLs associated with specific tissue and that may have contrasting expression levels between disease and non-disease groups.

212　**125.212** Use of Blood Transcriptomes to Characterize ASD Phenotypes

B. Stamova[1], Y. Tian[1], C. W. Nordahl[2], M. D. Shen[2], S. J. Rogers[2], D. G. Amaral[2] and F. R. Sharp[1], (1)MIND Institute and Department of Neurology, University of California Davis Medical Center, Sacramento, CA, (2)MIND Institute and Department of Psychiatry and Behavioral Sciences, University of California Davis Medical Center, Sacramento, CA

Background: RNA expression differences have been reported in autism spectrum disorders (ASD) for blood and brain. Significantly for the present study, a recent investigation of ASD brain found that some genes displayed differential alternative splicing (DAS) of targets of the splicing factor A2BP1. This data and the fact that DAS is implicated in a number of neuropsychiatric disorders led us to consider to following aims.
Objectives:

- To determine if there is DAS in blood mRNA in: a) ASD subjects compared to typically developing (TD) controls; and b) ASD subgroups related to total cerebral volume (TCV), since abnormal brain enlargement is one of the most consistent findings in the neuropathology of a subset of ASD.
- To develop a method, which addresses ASD heterogeneity at transcriptome level and can identify subgroups of ASD with common affected pathways. This can be instrumental in identifying candidates for specific pharmacological treatments, and in associating these pathways with specific clinical or molecular phenotypes.

Methods: RNA from blood was processed on whole genome exon arrays for 2-4 year old ASD and TD boys. Mixed Effects Regression Models were used to predict DAS for all ASD (n=30), ASD with normal TCV, and ASD with large TCV compared to TD controls (n=20) (FDR p<0.05).
Results: A specific DAS signature was observed for All ASD, and distinct DAS was observed for the TCV-based ASD subgroups. A number of genes predicted to have DAS in ASD are known to regulate DAS (SFPQ, SRPK1, SRSF11, SRSF2IP, FUS, LSM14A). In addition, a number of genes with predicted DAS were involved in pathways implicated in previous ASD studies, such as Natural Killer Cell, mTOR, and NGF signaling. However, this was the first study to suggest DAS occurred in these pathways. To address ASD heterogeneity and identify convergent pathways in ASD subgroups, we performed sub-analysis at the level of each individual ASD subject. A variety of different combinations of pathways appeared to be associated with idiopathic ASD. This would be consistent with many genetic and/or environmental causes of ASD which are also associated with many different pathways. However, it also showed convergence on similar biological processes at least for subgroups of ASD subjects. Notably, 60% of ASD subjects in this study had DAS abnormalities of mTOR signaling, of significance since single-gene disorders often associated with ASD clinical features also had aberrant mTOR signaling including Fragile X, tuberous sclerosis, PTEN, and neurofibromatosis. Thus these data point to possible abnormalities of mTOR pathways in a subgroup of 'idiopathic' ASD which may have clinical relevance since mTOR inhibitors, like rapamycin can modulate these pathways.
Conclusions: This study suggests DAS occurs in blood of 2-4-year old boys with ASD compared to TD controls. ASD subgroups based on TCV exhibited distinct DAS, suggesting they may have different biological underpinnings. It is likely that many of these changes reflect differences in the ASD peripheral immune system and may be associated with the immune and autoimmune dysregulation observed in some ASD subjects.

213　**125.213** Use of a Quantitative Autism Score (QAS) Reveals Genetic Associations

E. R. Martin[1,2], N. D. Dueker[1], A. J. Griswold[1], H. N. Cukier[1], D. Van Booven[1], J. M. Lee[1], P. L. Whitehead[1], J. R. Gilbert[1,2], J. L. Haines[3], J. P. Hussman[4], M. L. Cuccaro[1,2] and M. A. Pericak-Vance[1,2], (1)John P. Hussman Institute for Human Genomics, University of Miami Miller School of Medicine, Miami, FL, (2)Dr. John T. Macdonald Foundation Department of Human Genetics, University of Miami Miller School of Medicine, Miami, FL, (3)Case Western, Cleveland, OH, (4)Hussman Institute for Autism, Baltimore, 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 variants within 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 15 QAS items are scored as present/absent and summed to yield a total score (0-15). Individuals with higher scores are those with more core features of ASD. The score was then calculated in 1051 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 1051 subjects ranged from 2 to 15 with a mean value of 9.44 (sd=2.49). We found significant association for the gene *CDH4* (p= 1.0×10^{-5}) 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. Including only synonymous variants increased significance for *CDH4* (p=1.6×10^{-6}) and also resulted in significant association at *AP4M1* (p=8.1×10^{-5}). *AP4M1* was identified in our extended ASD family study (Cukier et al 2014), plays a role in intracellular trafficking of glutamate receptors, and has been implicated in intellectual development. Single-variant tests within these two genes identified seven variants (5 rare, 1 low frequency, 1 common) in *CDH4* and two variants (1 low frequency and 1 common) in *AP4M1* associated (p<0.05) with QAS.

Conclusions:

Our study identified two genes, *CDH4* and *AP4M1*, associated with the number of core ASD features. These ASD genes add support to the importance of genes involved in neuronal cell adhesion and excitatory/inhibitory balance in ASD etiology.

Poster Session
126 - Other
5:30 PM - 7:00 PM - Imperial Ballroom

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214   **126.214**   Locomotor, Anxiety, and Risk Assessment Related Phenotyping and Striatal Transcriptome Analysis in Four Autism Mouse Models

E. Elliott and O. Oron, *Faculty of Medicine, Bar Ilan University, Safed, 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 will help to identify behaviors and molecular mechanisms that are in common in multiple models, 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 autism mouse models. In order to discover common molecular pathways that are dysregulated in all mouse models, we did whole transcriptome sequencing in 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), Dark Light (DL), and Elevated Plus Maze (EPM) on all mouse models at basal conditions, and also at one hour, and 24 hours, after restraint stress. Rotorod test was also performed on all animals to test motor function. We extracted RNA from the striatum of all four mouse models, and their controls, and performed whole throughput RNA sequencing (RNA-seq) on all samples. This has produced data about the whole genome transcriptome in the striatum of all four mouse models.

Results: In the OF test, the CNTNAP2 and BTBR mice displayed hyperactivity at all conditions, the Chr16p11.2del displayed hyperactivity after stress, and Shank3 KO displayed hypoactivity. However, Shank3 KO also displayed motor deficits in the rotorod test. In DL, both the Shank3 KO and CNTNAP2 KO mice spent more time in the light area, suggesting less anxiety-like behavior, as well as less risk-assessment. In addition, in the EPM test, the Shank3KO, CNTNAPKO, and Chr16p11.2del models all spent significantly more time in the open arms, suggesting less anxiety-like behavior as well. Close

analysis of the behavior of the CNTNAP2KO model in both the EPM and DL tests shows that their behavior can be explained by less time doing risk assessment. RNA-seq data collection has already been performed and the data is currently being analyzed to be presented in the conference. Conclusions: All four mouse models displayed a dysregulation in locomotor activity, highlighting the importance of locomotion and motor function in autistic behavior. In addition, all genetic mouse models displayed a similar behavioral profile in the EPM and DL mazes, demonstrating that there is a shared behavioral outcome to several genetic mutations involved in autism. The profile suggests less anxiety-like behavior, which may be explained by less assessment of potential risks. By comparing these behaviors to whole transcriptome analysis in the striatum, we will be able to identify shared molecular dysregulation that is directly involved in these behavioral phenotypes.

215   **126.215** Extracellular Signal Related Kinase Activation in Autistic Disorder

C. Erickson[1], *L. K. Wink*[1], *E. V. Pedapati*[1], *T. L. Schaefer*[1], *R. Shaffer*[1], *B. Bayon*[2], *B. Ray*[2] and *D. K. Lahiri*[3], *(1)Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (2)Indiana University School of Medicine, Indianapolis, IN, (3)Psychiatry and Molecular Genetics, Indiana University School of Medicine, Indianapolis, IN*

Background: Limited pathophysiological understanding of autistic disorder has plagued treatment development efforts in the field. Extracellular signal related kinase (ERK1/2) is a subfamily of mitogen-activated protein (MAP) kinases that mediate transmission of signals from cell surface receptors to cytoplasmic and nuclear effectors. Direct and indirect evidence from mouse and human models points to potential ERK1/2 dysregulation as a potential molecular marker of autistic disorder pathophysiology. ERK1/2 activation (phosphorylation) is an index of overall cellular activity.
 Lymphocytic ERK1/2 activation has been shown to be dysregulated and correlate with brain ERK1/2 dysregulation in humans with and animal models of fragile X syndrome (FXS), a common single gene cause of autism. Taking steps to assess ERK1/2 activation in the pathophysiology of idiopathic autistic disorder will open up new targeted treatment opportunities focused on this potential marker of molecular dysregulation.
Objectives: We sought to evaluate peripheral lymphocytic ERK1/2 activation in an initial group of youth with idiopathic autistic disorder compared to age- and gender-matched neurotypical peers. We hypothesize that lymphocytic ERK1/2 activation will be increased in youth with ASD compared to control subjects consistent with preclinical findings of enhanced ERK1/2 activation in murine models of ASD.
Methods: We enrolled as many subjects as possible into this study (enrollment period January-June 2012) of lymphocytic ERK1/2 activation in youth with autistic disorder compared to matched neurotypical peers. Diagnostic criteria from the Diagnostic and Statistical Manual for Mental Disorders, 4[th]Edition, Text Revision (DSM-IV-TR) were utilized. All subjects with autistic disorder met strict criteria for autistic disorder based on a score of greater than 13 on the Social Communication Questionnaire (SCQ) combined with a clinical interview using DSM-IV-TR autistic disorder criteria conducted by a physician with extensive experience in ASD diagnostics and research. All subjects, those with autistic disorder and controls, completed the SCQ and full medical and developmental histories. Additionally, subjects with autistic disorder completed the Aberrant Behavior Checklist (ABC), cognitive testing, and the Social Responsiveness Scale (SRS). To study peripheral lymphocytic ERK1/2 activation, lymphocytes from patients' blood were collected, washed, counted, fixed in formaldehyde, and stained with phospho-ERK1/2 anti-body. ERK1/2 activation was reported as the percentage of ERK1/2 positive staining cells, minimum of 200 cells counted.
Results: 36 youth with autistic disorder and 19 youth with neurotypical development were enrolled (see Table 1; Subject Characteristics). Mean ERK1/2 activation was significantly increased in the samples from the youth with autistic disorder compared to controls (6.2 ± 4.0% versus 2.8 ± 2.1%; p=0.001). A receiver operating curve (ROC) analysis looking at ERK1/2 activation and diagnosis had an area under the curve of 0.792 (p<0.0001) showing a significant association between ERK1/2 activation and diagnosis of autistic disorder in our sample. Future analysis will include correlation assessments of ERK1/2 activation and results from the ABC, SRS, and cognitive testing.
Conclusions: Peripheral ERK1/2 holds promise as a potential marker of molecular dysregulation in youth with autistic disorder. Future larger-scale study is warranted to study ERK1/2 activation in autism.

Keynote Address
131 - Reflections on 50 years of ASD Early Intervention Science
9:00 AM - 10:00 AM - Grand Ballroom

Speaker: S. J. Rogers, University of California at Davis, Sacramento, CA

In May of 1965, Life Magazine published a cover story on Ivar Lovaas's UCLA autism intervention study, bringing autism and the challenges it creates for children and families into the public eye for the first time. Fifty years later, early autism intervention is the topic of lawsuits, protests, and hope. The powerful effects of high quality intensive early intervention delivered in the first few years of life provide new insights into the multiple mechanisms underlying developmental and behavioral impairments associated with early ASD. This

keynote will (1) describe and illustrate the kinds of gains that high quality intervention can facilitate, (2) identify treatment elements common to the most successful approaches, highlighting research from the Early Start Denver Model (Dawson and Rogers 2010), and (3) consider varying ways of conceptualizing treatment response.

9:00 **128.001** Reflections on 50 years of ASD Early Intervention Science
S. J. Rogers, *University of California at Davis, Sacramento, CA*

In May of 1965, Life Magazine published a cover story on Ivar Lovaas's UCLA autism intervention study, bringing autism and the challenges it creates for children and families into the public eye for the first time. Fifty years later, early autism intervention is the topic of lawsuits, protests, and hope. The powerful effects of high quality intensive early intervention delivered in the first few years of life provide new insights into the multiple mechanisms underlying developmental and behavioral impairments associated with early ASD. This keynote will (1) describe and illustrate the kinds of gains that high quality intervention can facilitate, (2) identify treatment elements common to the most successful approaches, highlighting research from the Early Start Denver Model (Dawson and Rogers 2010), and (3) consider varying ways of conceptualizing treatment response.

Panel Session
132 - Responses to Early Intervention and Mechanisms of Change
10:30 AM - 12:30 PM - Grand Ballroom B

Panel Chair: Sally Rogers, *MIND Institute and Department of Psychiatry and Behavioral Sciences, University of California Davis Medical Center, Sacramento, CA*

Discussant: Charles Nelson, *Harvard University Boston Children's Hospital, Boston, MA*

New studies of early intervention effects in ASD are being published monthly, with varying designs, methods, measures, and outcomes. There is growing acceptance of the ideas that (1) individual outcomes in autism reflect transactional processes among environmental and biological variables throughout life and (2) that developmental processes and rates may be particularly malleable in early childhood. There is increasing impetus among families and care professionals for early intervention research findings to be incorporated into an increased range, sophistication, and availability of services to young children and their families. However, this impetus is tempered by concerns about overemphasis on early childhood services, unreliability of early symptoms, difficulties with assessment processes, and lack of community services for early identification, diagnosis, and treatment. In order to guide public services and clinical practice, early intervention science must move more deeply into two areas (among many): (1) mechanisms by which specific intervention practices may be changing children's developmental trajectories or rates, (2) individual or subgroup patterns of response to specific interventions, and (3) variables that mediate and moderate intervention response. This international panel brings together a distinguished group of scientists involved in studying the processes and mechanisms involved in response to early interventions.

10:30 **132.001** The Social Brain and Language Learning
P. K. Kuhl, *University of Washington, Seattle, WA*

Background: Research on typically developing infants during the initial stages of language learning suggest that social interaction is a necessary component for learning. Work has shown, for example, that infants exposed to a new language during an early sensitive period for phonetic learning, can learn phonemes from the new language if exposed socially during interaction with a live human being. Infants exposed to the same language material, in the identical setting and on the same schedule but via television, learned nothing. This stark contrast between learning under social and nonsocial conditions led to the "social gating hypothesis (SGH)," the notion that infants require social interaction to enact other computational processes ("statistical learning") when exposed to natural language.
Objectives: I will describe the research stemming from the SGH, which includes research on children with autism spectrum disorder (ASD) using phonemes, words, and the motherese style of speaking to infants to probe possible early markers of risk in children with autism.
Methods: The studies described utilize both behavioral measures on typically developing infants and children with ASD as well as brain measures (EEG and MEG).
Results: The results suggest, in typically developing children, that early language learning depend on a social context and social interaction. In children with ASD, our results hold promise that our brain measures of language processing may some day contribute to the development of reliable "biomarkers" for children at risk for ASD.
Conclusions: I discuss the meaning and implications of the claim that language learning is "gated" by the social brain.

10:55 **132.002** Studying Why and for Whom Intervention Works
P. J. Yoder, *Special Education, Vanderbilt University, Nashville, TN*

Background: This presentation will provide a methodological overview of how research methods and statistical procedures can be used to identify (a) the defining characteristic of a subgroup for whom treatment works best (i.e., moderators) and (b) a mechanism by which treatment works (i.e., a mediator).

Objectives: Audience members will be able to identify the common misconceptions about how to identify mechanisms and characteristics of treatment responders. Audience members will be able to say why using the experimental design element in mediational and moderation analysis provides a better way to identify mechanisms and characteristics of treatment responders. Audience members will be able identify the key statistical test required to identify a treatment mechanism. Audience members will be able to identify the two key findings required to identify the characteristic of children who benefited most from a treatment.

Methods: Lecture format will be used to talk about the general issues. Two studies, each using a randomized between-group experimental design and samples of children with Down syndrome (N > 50), will be used to illustrate the issues.

Results: The first study confirmed the hypothesis that daily therapy sessions was more facilitative of spoken vocabulary than weekly therapy sessions because the former affect speech-like nonverbal vocal communication early in the treatment phase. The second study confirmed the hypothesis that initial verbal imitation ability defined the subgroup of children in which speech recasts worked better than a common therapy method. The region of significance for "high verbal imitators" was .5 SD above the sample mean and included 26% of the sample.

Conclusions: Identifying correlates of change within a treated group is insufficient to identify characteristics of treatment responders. Fortunately, we have the methods to identify for whom treatment works and why: mediational and moderation analyses in the context of randomized between-group experiments.

11:20 **132.003** Social Learning Processes Underlying Treatment-Related Changes in Children with ASD Receiving the Early Start Denver Model

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

Background: Social learning, i.e. the transmission of behavior from one person to another, requires the successful deployment of multiple attentional, cognitive and motivational processes. Understanding the specific components and mechanisms of social learning that are involved in response to early intervention in children with ASD is critical to select, refine and individualize educational procedures in this population.

Objectives: To identify the specific social learning processes that moderate and mediate response to the Early Start Denver Model in preschoolers with ASD.

Methods: A number of novel experimental eye-tracking and behavioural tasks aimed at 'dissecting' the different attentional, cognitive and motivational processes underlying social learning were administered to a group of preschoolers with ASD receiving the Early Start Denver Model (ESDM) program (anticipated final sample size = 50). Participants were tested at baseline and after one year of treatment. The link between performance in the tasks and 1-year treatment outcomes will be analyzed to determine the specific social learning processes that underlie response to the ESDM.

Results: Data collection and analysis is still ongoing. Preliminary findings based on a subset of participants suggest that social motivational processes underlying social learning, including spontaneous propensity to imitate others, spontaneous purposeful (versus purposeless) use of play materials, and social response to a playful- versus an emotionally-neutral partner, are more relevant in predicting ESDM treatment outcomes than attentional and cognitive learning mechanisms, initial IQ and language.

Conclusions: This is the first research program to examine the link between social learning profiles in children with ASD and treatment outcomes in response to the Early Start Denver Model through a fine-grained, theory-driven analysis of the multiple components underlying social learning. Preliminary results of this ongoing study suggest that spontaneous propensity to engage with and imitate others might be a critical active ingredient in the response of children with ASD to the ESDM.

11:45 **132.004** Early Interventions for Autism: Mechanism and Developmental Science

J. Green[1], A. Pickles[2], H. McConachie[3], E. Jones[4], T. Gliga[5], T. Charman[6] and M. H. Johnson[5], (1)Institute of Brain, Behaviour and Mental Health, University of Manchester, Manchester, United Kingdom, (2)Department of Biostatistics, King's College London, London, United Kingdom, (3)Institute of Health and Society, Newcastle University, Newcastle upon Tyne, United Kingdom, (4)Birkbeck College, University of London, London, United Kingdom, (5)Centre for Brain and Cognitive Development, Birkbeck College, University of London, London, United Kingdom, (6)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom

Background: Suitably designed trials of early interventions for autism, combining the benefits of randomisation with repeated measures follow-up in a developmental context, can illuminate both the processes behind treatment effectiveness, and causal mechanisms within developmental science (Green and Dunn 2008).

Objectives: To identify the active ingredients of autism intervention and to use intervention trials to illuminate developmental science.

Methods: The presentation will draw from findings within two randomised controlled trials of parent-mediated, video-aided and developmentally-focused social communication intervention for autism. 1) The Preschool Autism Communication trial (PACT; Green et al 2010), a three site RCT (N=152) of the PACT social communication intervention against usual care in 2-5 year old children diagnosed with core autism; pre-designed to enable the study of treatment mechanism. The PACT mediation analysis (Pickles et al 2014) extended traditional techniques by including exploration of instrumental variables to address post-randomisation confounding, and exploited repeated measures to address measurement error in the mediator.
2) Intervention within the British Autism Study of Infant Siblings (iBASIS), a two site RCT (N=54), testing parent mediated intervention for infants at familial risk for autism, not selected for atypicality. Baseline at 9 months, treatment endpoint 14 months, follow up 24 months. The design tested intervention impact on pre-specified infancy risk markers for later autism using intention to treat analysis.
Results: PACT mediation analysis showed that a treatment effect on parental communicative synchrony with the child (effect size (ES) 1.22 (0.85,1.59) at 13 month endpoint, 1.44 at 6 months), strongly mediated (70%) an improvement in child communication initiation with parent (ES 0.41 (0.08, 0.74) at 13 months, 0.5 at 6 months). Other parental interactive behaviours did not significantly contribute to this mediation. In turn, the improvement in the child's communication initiation strongly mediated (73%) a more modest treatment effect on autism symptoms (ADOS; ES -0.24 (-0.59, 0.11) at endpoint).
New complimentary data will be presented from iBASIS on the intervention effect on parent-infant interaction (parent nondirectiveness, child attention), atypical infant behavior (AOSI), infant cognition (GAP attention disengagement) and brain function (ERP to speech sounds).
Conclusions: PACT mediation suggests a causal chain of effect from parent behavior with child to child behaviour with parent, to child behavior with researcher; identifying the active process of intervention and supporting the intervention theory. It also suggests the ADOS symptom change may be meaningful in direction and amenable to further improvement if the causal chain of effect can be enhanced; thus implying logical ways of strengthening treatment effectiveness. For developmental science, the causal direction of effect from parent behaviour to improved child social communication amplifies previous findings on the assocation between early parental synchrony and later child functioning (eg Siller et al 2008).
The comparative data from iBASIS will show how intervention can similarly effect parental communication behaviour in infancy; along with impact on infant's attention to caregiver, atypical behaviour, ERP response, attention disengagement, language and adaptive outcomes. Implication of these findings for the developmental science of the autism prodrome will be presented.

Panel Session
133 - EU-AIMS: Translating Cellular and Animal Models of Synaptic Gene Deficits to Large-Scale Clinical Studies
10:30 AM - 12:30 PM - Grand Ballroom A

Panel Chair: Eva Loth, *Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom*

Discussant: Jan Buitelaar, *Department of General Psychiatry and Child and Adolescent Psychiatry, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands*

Autism spectrum disorders are one of the most common and severe neurodevelopmental disorders yet effective treatments for the core symptoms are still lacking. This is mainly due to a) the high clinical, etiological and genetic heterogeneity between affected individuals, b) restricted knowledge of the underpinning pathophysiological mechanism(s), and c) the absence of reliable biomarkers to identify more biologically homogeneous subgroups. This panel will present examples of the integrated translational approach adopted in EU-AIMS, a large-scale public-private partnership, to identify biomarkers and new treatment targets for ASD. First, we combine patient-derived pluripotent stem cells (Price) and animal models (Steckler) of monogenic forms of ASD to understand pathophysiological mechanisms. Here, we focus on genes affecting synapse development and function (SHANKs, neurexins, neuroligins) and their downstream effects on excitatory-inhibitory balance and brain connectivity. Next, we translate this to patients using methods such as MRS. Preliminary findings from a pharmacological study validate the Glutamate/ GABA system as a tractable treatment target. Finally, we carry out linked large-scale clinical studies spanning children and adults with ASD and patients with specific synaptic gene deficits to identify biomarkers (including markers of E/I imbalances) for patient stratification that can be used in future clinical trials.

10:30 **133.001** Utility of Rodent Mutants with Altered Synaptic Signaling Pathways to Test Possible Pharmacological Interventions for ASD

*T. Steckler[1], S. Baudouin[2], T. M. Boeckers[3], F. Esclassan[4], G. Gilmour[5], G. Kumar[6], **M. E. Modi**[7], M. M. Petrinovic[8], J. Talpos[9] and P. Scheiffele[10], (1)Neuroscience Therapeutic Area, Janssen Research and Development, Johnson & Johnson, Beerse, Belgium, (2)Cardiff School of Biosciences, Cardiff, United Kingdom, (3)Institute for Anatomy and Cell Biology, Ulm University, Ulm, Germany, (4)Eli Lilly,*

Sunningdale, United Kingdom, (5)In Vivo Pharmacology, Eli Lilly, Sunningdale, United Kingdom, (6)Neurosciences, Janssen Pharmaceuticals, Beerse, Belgium, (7)Neuroscience, Pfizer, Cambridge, MA, (8)F. Hoffmann-La Roche, Basel, Switzerland, (9)Janssen Pharmaceuticals, Beerse, Belgium, (10)Biozentrum University of Basel, Basel, BS, Switzerland

Background: The lack of robust and replicable animal models of ASD has hindered progress in the development of effective therapeutic interventions for ASD. Recent advances in understanding the neurobiology underlying ASD led to the generation of novel animal models with high construct validity, based on gene mutations and altered CNVs reported in patients suffering from ASD, including those with mutations of genes involved in the formation of neuronal networks and synaptic plasticity. Common to these genetic models are abnormalities in glutamatergic and/or GABAergic systems.
Objectives: One goal of EU-AIMS (European Autism Interventions - A Multicentre Study for Developing New Medications), a public-private partnership within the context of the EU's Innovative Medicines Initiative, is to develop and validate novel mouse and rat models to facilitate the advancement of novel therapies to treat ASD. We hypothesized that compounds acting at glutamatergic or GABAergic mechanisms might be efficacious to (partially) reverse abnormalities seen in these rodent models.
Methods: A strong focus within the EU-AIMS consortium has been the phenotypic characterization of behavioral, electrophysiological and morphological alterations in KO mice and rats lacking functional cell adhesion molecules (neurexin/neuroligins) and rodents lacking functional shank proteins. Behavioral testing focused on both key ASD-related symptoms and cognitive function, including novel, touch-screen-based tests of cognitive flexibility. Because glutamatergic abnormalities have been described in some of these models, we have started to evaluate the effects of compounds acting at glutamatergic mechanisms in those models, including compounds acting at group I mGluRs.
Results: The talk will cover the characterization of the rodent models. We will discuss behavioral data from these animals, with special emphasis on cognitive deficits and their potential translational value for the clinic. We will further show EEG and fMRI data and relate them to clinical observations. For example, structural and functional MRI revealed altered brain volume and neural activity in NLGN3 KO rats, and an altered E/I balance was seen in MRS in these animals. In NLGN3 KO mice, an up-regulation of mGluR1 was observed and we will present first data from pharmacological intervention studies, leading to partial rescue of phenotypical abnormalities in these mice.
Conclusions: Behavioral abnormalities, as well as electrophysiological and morphological alterations (e.g., increased repetitive behavior, impaired social interaction, cognitive deficits, changes in neural activity and biochemistry) observed in at least some models are in line with alterations reported in ASD patients, suggesting good face validity on top of high construct validity. These phenotypes are accompanied by altered glutamatergic function. The preliminary pharmacological intervention studies suggest that these models are of utility for drug development. Whether there is also good predictive validity will only be addressed conclusively once efficacy readouts from the animal models have been successfully shown to translate to the clinic. Importantly, this translational aspect is currently addressed in the clinical work-packages of EU-AIMS, making this a powerful consortium to address the unmet medical needs of ASD patients.

10:55 **133.002** Cellular Phenotypes in Induced Pluripotent Stem Cells from Autistic Individuals

J. Price[1], G. Cocks[1], A. Kathuria[2], K. Warre-Cornish[1], R. Taylor[3] and L. Andreae[4], (1)Cells and Behaviour Unit, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (2)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (3)MRC Centre for Developmental Neurobiology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (4)MRC Centre for Developmental Neurobiology, King's College London, London, United Kingdom

Background: The etiology of autism is poorly understood. Genetic and environmental factors somehow converge during perinatal development to produce the combination of symptoms and co-morbidities that characterize this condition. Induced pluripotent stem cells (iPSCs) permit not only the study of cellular phenotypes associated with autism, but also their developmental trajectory. Thus this cellular system might offer a means to observe aspects of the etiology of autism in a simple in vitro model.
Objectives: To discover cellular phenotypes in iPSC-derived neurons associated with autism, and to observe their ontology
Methods: We generated iPSC lines from hair root biopsies from three categories of individuals: autistic patients carrying deletions in synaptic genes (SHANK3 and NRXN1); non-syndromic patients; and neurotypical control individuals. We differentiated these iPSCs into parvocellular hypothalamic neurons, and devised cellular and molecular analyses to follow their differentiation.
Results: We discovered that cells from all three categories of individuals differentiate into parvocellular neuronal types as identified by RNASeq expression, electrophysiological recordings, and histochemical analyses, with GNrH$^+$cells being the most numerous. In neurons derived from the SHANK3 individuals, we see morphogenetic phenotypes: the cells develop a different size and shape from controls.   We also see differences in responsivity to cytokines that imply that the cells from autistic individuals carry epigenetic differences from controls.
Conclusions: There are detectable cellular phenotypes observable in neurons derived from iPSCs that appear to be associated with autism. This suggests that at least some of the pathophysiology

associated with this condition can be captured in this cellular system. What remains to be determined is how generalizable these phenotypes are across a range of autistic individuals, and the extent to which they correspond with clinical phenotypes, and with clinical heterogeneity.

11:20 **133.003** EU-AIMS Clinical Research Platform to Identify Biomarkers for Patient-Stratification

E. Loth[1], D. G. Murphy[2], T. Banaschewski[3], S. Baron-Cohen[4], S. Bolte[5], T. Bourgeron[6], T. Charman[7], S. Durston[8], J. Horder[9], M. H. Johnson[10], E. Jones[11], L. Mason[11], L. O'Dwyer[12], A. M. M. Persico[13] and J. Buitelaar[12], (1)Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (2)Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (3)University of Heidelberg, Heidelberg, Germany, (4)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (5)Division of Child and Adolescent Psychiatry, Stockholm County Council, Stockholm, Sweden, (6)Pasteur Institute, Paris Cedex 15, France, (7)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (8)Psychiatry, Brain Centre Rudolf Magnus, University Medical Center Utrecht, Utrecht, Netherlands, (9)De Crespigny Park, Institute of Psychiatry, King's College London, London, England, United Kingdom, (10)Centre for Brain and Cognitive Development, Birkbeck College, University of London, London, United Kingdom, (11)Birkbeck College, University of London, London, United Kingdom, (12)Department of General Psychiatry and Child and Adolescent Psychiatry, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands, (13)Child and Adolescent Neuropsychiatry Unit & Lab of Molecular Psychiatry and Neurogenics, Rome, Italy

Background: There are no effective treatments for the core symptoms of ASD because the underlying pathophysiology(ies) remain(s) poorly understood. Clinical trials are further hampered by the profound clinical and etiological heterogeneity among individuals with ASD, as any treatment is likely only effective in some biological sub-groups. Hence, large-scale multi-disciplinary studies and new biomarker stratification approaches are needed to identify more biologically homogeneous ASD subgroups. EU-AIMS capitalizes on rare monogenic forms of ASD affecting synaptic plasticity to identify new tractable treatment targets. This approach generates predictions for potential biomarkers linked to downstream effects on the excitatory-inhibitory balance and cortical-network function underpinning cognitive development. Acceptance of these biomarker approaches by regulatory authorities is crucial to maximize their usefulness for future clinical trials.
Objectives: (1) to develop new approaches and methodologies to identify biomarkers for patient stratification; (2) to obtain qualification advice on these approaches from the European Medicines Agency (EMA); (3) to test candidate biomarkers tapping E/I imbalance in patients who harbor specific synaptic gene deficits (Phelan McDermid Syndrome) and a large cohort of children and adults with ASD.
Methods: (1) The EU-AIMS Longitudinal European Autism Project (LEAP) is carried out in 7 European centres and will include approximately 400 individuals with ASD from 6-30 years and 250 controls with typical development or diverse intellectual disabilities. All participants are comprehensively characterized in terms of clinical symptom profile, comorbidities, quality of life, neurocognitive profile, brain structure and function, biochemical biomarkers, and genomics. We use an accelerated longitudinal design so that predicted biological differences can be compared across developmental stages. This will allow us to assess, e.g., whether differences in E/I imbalance vary according to developmental stages, sex, and/ or between genetically-driven molecular subgroups. (2) The LEAP protocol was submitted to the EMA to obtain qualification advice on the biomarker approaches and methodologies used. (3) The cohort is compared to approximately 50 children and adults with PMS to establish whether biomarkers linked to specific synaptic deficits are shared by other ASD-subgroups.
Results: (1) We developed measures suitable for a broad age and ability range, including direct and indirect proxies of E-I imbalance. For example, a pilot study demonstrates a link between glutamate concentration in the basal ganglia, functional connectivity and severity of ASD symptoms. (2) The EMA endorsed the overall design and methodologies of EU-AIMS LEAP for the identification of biomarkers. We will present a summary of key recommendations. (3) We will report preliminary results comparing children and adults with ASD and those with PMS on candidate biomarkers affecting E-I imbalance and their dimensional relationship with symptom profile.
Conclusions: The design of LEAP provides new approaches to identify biomarkers for patient stratification and to map them both to genetic-molecular and symptom profiles. Obtaining QA from the EMA represents an important first step to inform regulatory guidelines for medication trials in ASD in Europe. The comparison of biomarkers between patients with ASD and PMS will help to ascertain how far treatment targets identified using synaptic gene models may be applicable to broader ASD sub-groups.

11:45 **133.004** Glutamate and GABA in Autism Spectrum: A Clinical in-Vivo Magnetic Resonance Spectroscopy Assay

L. A. Ajram[1], J. Horder[2], M. A. Mendez[3], A. Galanopoulos[4], L. Brennan[5], R. Wichers[6], D. J. Lythgoe[7], S. C. Williams[8], D. G. Murphy[9] and G. M. McAlonan[9], (1)Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Kings College London, London, United Kingdom, (2)De Crespigny Park, Institute of Psychiatry, King's College London, London, England, United Kingdom, (3)Forensic and

Neurodevelopmental Sciences, Institute of Psychiatry, King's College London, London, United Kingdom, (4)Behavioural and Developmental Clinical Academic Group, King's Health Partners, London, United Kingdom, (5)Institute of Psychiatry, Kings College London, London, United Kingdom, (6)Institute of Psychiatry, King's College London, London, United Kingdom, (7)King's College London, London, United Kingdom, (8)Neuroimaging, Centre for Neuroimaging Sciences, Institute of Psychiatry, King's College London, London, United Kingdom, (9)Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom

Background: There are currently no pharmacological treatments for the core symptoms of Autism Spectrum Disorder (ASD). However, accumulating evidence indicates an imbalance between excitatory (E) glutamate and inhibitory (I) GABA in ASD. Therefore modulating E/I balance may constitute a tractable treatment approach for this condition and this may explain the early promise of proGABA and anti-glutamate drugs such as riluzole.

Objectives: To investigate the hypothesis that, compared to unaffected controls, individuals with ASD have differences in the E/I response to a riluzole drug challenge.

Methods: We used MEGAPRESS proton magnetic resonance spectroscopy ($[^1H]$-MRS) to measure concentrations of Glx (glutamate + glutamine) and GABA in unmedicated adult men with and without ASD diagnosis. Individuals were scanned twice, one week apart. Fifty mg of riluzole or matched placebo was administered in a randomised, double blind, crossover design, 1 hour before spectra were acquired from the left basal ganglia and bilateral prefrontal cortex. An inhibitory index was calculated as GABA/(GABA+Glx) for both treatment conditions.

Results: Preliminary results show that, in the basal ganglia, riluzole increased the inhibitory index in both groups (drug effect p=0.015). However, in the prefrontal cortex, riluzole increased the inhibitory index in the ASD group only, although the result did not reach statistical significance (ASD prefrontal Inhibitory Index: placebo = 0.69; riluzole = 0.74; drug*group effect p=0.1). Post-hoc testing suggested that increases in inhibitory indices in both groups were mainly driven by an increase in GABA, (and not a reduction in Glx).

Conclusions: Data acquisition is ongoing. If confirmed, these preliminary findings bring us closer to Proof of Concept that individuals with ASD have differences in E/I responsivity. By validating the glutamate-GABA system as a tractable treatment target in ASD, we hope this work will both support trials of existing drugs (such as riluzole), and facilitate the development of new drugs that act on this system. Our MRS approach may also provide a safe, non-invasive tool to help fractionate the sample and predict who will be responsive to glutamate-GABA treatments in a 'personalized' medicine approach to ASD.

Panel Session
134 - Factors Associated with Adult Outcomes for Individuals with ASD
10:30 AM - 12:30 PM - Grand Ballroom C

Panel Chair: Laura Klinger, *TEACCH Autism Program; Department of Psychiatry, University of North Carolina, Chapel Hill, NC*

Discussant: Peter Bell, *Eden Autism Services, Princeton, NJ*

There is a growing literature documenting the social, employment, and mental health difficulties faced by adults with ASD. With the increasing rates of ASD diagnoses, the number of individuals with ASD entering adulthood each year will double over the next 6 years. While we know that employment rates are extremely low, little research has examined what factors are related to positive adult outcome. The talks in this panel describe the results of four separate large-scale studies focused on identifying factors that affect adult outcome. The presentations incorporate a range of methodologies including a long term follow up study from childhood, two prospective studies from adolescence into adulthood, and a high school employment intervention program. Further, the presentations incorporate a variety of adult outcome measures including employment, adaptive behavior, social connectedness, mental health, motor skills, and quality of life. Across these studies, the importance of several childhood and adolescent factors emerges and potential intervention targets are identified. Each presentation will address implications for promoting positive adult outcomes.

10:30 **134.001** Correlates of Middle Adult Outcome: A Follow-up Study of Children Diagnosed with ASD from 1970-1999

L. G. Klinger[1], M. R. Klinger[2], J. L. Mussey[1], S. P. Thomas[2] and P. S. Powell[3], (1)TEACCH Autism Program; Department of Psychiatry, University of North Carolina, Chapel Hill, NC, (2)Allied Health Sciences, University of North Carolina, Chapel Hill, NC, (3)Psychology, University of North Carolina, Chapel Hill, NC

Background: While there is a developing literature on Autism Spectrum Disorder (ASD) in adulthood, few longitudinal studies from childhood to adulthood have been conducted. The majority of these studies have focused on the transition years from adolescence to young adulthood or focused on

describing adult outcomes. Thus, there is little research on autism in middle adulthood or predictors of positive outcome in this age group.

Objectives: This research capitalizes on a unique dataset of individuals diagnosed with ASD as children by the TEACCH Autism Program from 1970-1999. A caregiver survey was conducted to: (1) Document outcomes (employment, social connectedness, mental health, quality of life) in middle adulthood; (2) Examine current predictors of adult outcome; (3) Examine childhood predictors of adult outcome.

Methods: Thus far, surveys have been completed for 81 adults with ASD in middle adulthood (21-64 years of age, Mean = 34 years) diagnosed during childhood (initial diagnoses from 21 months to 17 years, Mean = 6.5 years). Adult outcome was measured by employment status (Taylor & Seltzer Vocational Index), quality of life (Schalock & Keith Quality of Life Questionnaire), social isolation (NLTS-2 items), and mental health (Anxiety Depression and Mood Scale). Current predictors included autism symptom severity (Social Responsiveness Scale, SRS-2), adaptive behavior (Waisman Activities of Daily Living), and language ability (NLTS-2 items). Childhood predictors included symptom severity (Childhood Autism Rating Scale), adaptive behavior (Vineland), and IQ.

Results: Seventy-eight percent of adults with ASD had moderate to severe autism on the SRS-2. Despite significant ASD symptoms, a range of developmental level is represented (e.g., little to no difficulty with conversations were reported for 42% of adults). With regards to adult outcome, caregivers reported that only 43% of adults with ASD were employed and 36% were described as being social isolated (no contact with peers in the past 12 months). Regression analyses were conducted to examine predictors of adult outcome. Current adaptive behavior was the single best correlate of adult outcome. Controlling for both current symptom severity and language skills, adaptive behavior was significantly related to employment (*partial r*=+.55), social isolation (*pr*=-.30), depression (*pr*=-.26), and quality of life (*pr*=+.36). When controlling for adaptive behavior, symptom severity and language ability had little to no impact on adult outcome. Similar analyses were conducted for childhood predictors. Adaptive behavior in childhood controlling for childhood IQ and symptom severity was an equally strong predictor of employment (*pr*=+.38), social isolation (*pr*=-.29), depression (*pr*=-.28), and quality of life (*pr*=+.38). The contributions of current and childhood adaptive behavior were largely independent; each significantly predicted outcome when the other was used as a covariate.

Conclusions: Both childhood and adult adaptive behavior were strong, independent predictors of a wide variety of adult outcomes. The contribution of adaptive behavior went beyond that of either symptom severity or intellectual/language functioning. Interventions targeting adaptive behavior skills are often overlooked; however, these findings emphasize the importance of improving adaptive behavior across the lifespan regardless of symptom severity and communication skills.

10:55 **134.002** Longitudinal Development of Manual Motor Performance in Autism Spectrum Disorder from Childhood to Mid-Adulthood and Predictions of Adaptive Daily Living Skills

B. G. Travers[1], E. D. Bigler[2], M. D. Prigge[3], A. Froehlich[4], N. Lange[5], A. Alexander[6] and J. E. Lainhart[7], (1)Kinesiology, Program of Occupational Therapy, Waisman Center, University of Wisconsin-Madison, Madison, WI, (2)Psychiatry, University of Utah, Salt Lake City, UT, (3)Pediatrics, University of Utah, Salt Lake City, UT, (4)University of Utah, Salt Lake City, UT, (5)McLean Hospital, Belmont, MA, (6)Waisman Center, University of Wisconsin-Madison, Madison, WI, (7)Psychiatry, Waisman Center, University of Wisconsin-Madison, Madison, WI

Background: Cross-sectional studies suggest that individuals with Autism Spectrum Disorder (ASD) exhibit difficulties with motor skills (for a meta-analysis see Fournier et al., 2010). However, the longitudinal development of motor skills in ASD, especially from childhood into adulthood, is unclear. A key question is whether motor skills improve, plateau, or decline in ASD from childhood into adulthood. Because many activities of daily living require manual motor skills (i.e., dressing, preparing food, etc.), another key question is whether difficulty with motor skills is predictive of both current and future adaptive daily living skills.

Objectives: 1) To examine age-related changes in repeated measures of grip strength and finger tapping in ASD compared to typical development from early childhood into mid-adulthood, and 2) to examine manual motor performance as a predictor of current and later (adulthood) daily living skills.

Methods: Ninety males with ASD and 56 age-matched males with typical development between the ages of 5 and 39 years (M = 18.0 years) were included in these analyses. Participants completed bimanual measures of grip strength and finger tapping speed and the Vineland Adaptive Behavior Scales up to three times over the course of 10 years as part of a broader longitudinal study. Mixed-effects penalized regression spline models examined manual motor performance as a function of diagnostic group and age. Partial correlations (controlling for age and IQ) examined whether Time 1 manual motor performance could significantly predict Vineland daily living standard scores concurrently and ten years later.

Results: The ASD and typically developing groups demonstrated significantly different developmental trajectories for grip strength ($p < .001$) and finger tapping speed ($p < .001$). Follow-up analyses demonstrated that in participants younger than 15 years of age, there were trends but no significant group differences in grip strength, $t(88) = 1.76$, $p = .09$, $d = 0.388$, or finger tapping, $t(88) = 0.87$, $p = .39$, $d = 0.191$. However, in individuals 15 years and older, group differences were sizable and significant in both grip strength, $t(139) = 6.56$, $p < .001$, $d = 1.136$, and finger tapping, $t(139) = 5.38$, $p < .001$, $d = 0.933$. Across both groups, grip strength and finger tapping speed significantly

predicted both concurrent daily living skills and daily livings skills 10 years into the future (all p's < .04, controlling for age and IQ). This finding remained even when only including adults in the analyses. **Conclusions**: The group with ASD demonstrated atypical manual motor development, characterized by similar performance on grip strength and finger tapping from 5 to 14 years of age but increasingly poorer performance in grip strength and finger tapping from 15 to 39 years of age. These results suggest that individuals with ASD may experience increasingly more pronounced manual motor performance difficulties as they transition from adolescence into adulthood. Moreover, motor skills were found to relate to both current and future daily living skills (both across our entire sample and only in the adults), which suggests that manual motor performance may predict independent living skills in adulthood.

11:20 **134.003** Disconnection from Postsecondary Education and Employment Among Young Adults on the Autism Spectrum

P. T. Shattuck, A. M. Roux, J. Rast and J. Rava, AJ Drexel Autism Institute, Drexel University, Philadelphia, PA

Background: Young adults who are not employed and not enrolled in school or vocational training after high school are defined as disconnected from pathways that lead to independence. Prior research found that slightly more than half of youth on the autism spectrum do not transition into paid employment, vocational education, or college of any kind in the first two years after high school -- despite the variety of services aimed at preventing disconnection.
Objectives: We aim to answer several questions about this disconnected group. What are the differences in characteristics and experiences between those who had no services after high school and those who had any services? What services have these disconnected young adults used since high school and what unmet services needs do they and their parents report? What are the correlates of not getting any services, ever getting vocational services, and ever having unmet service needs since high school? What experiences during high school reduce the risk of postsecondary disconnection?
Methods: We used secondary data from the National Longitudinal Transition Study 2 (NLTS2) -- a 9-year prospective study of youth who were enrolled in special education and ages 13-17 at the study's outset in 2001. Outcome variables about disconnection came from Wave 5 conducted in 2009 when participants were ages 21-25. Measures of seven types of service use and four types of secondary extracurricular activities come from Waves 1-5. Estimates were weighted to population levels. We used logistic regression to examine correlates of disconnection and service use; propensity score modeling to test the effect of extracurricular participation during high school on the likelihood of postsecondary disconnection. We used multiple imputation to handle missing data.
Results: At Wave 5, 38.8% of youth had never had postsecondary education nor a paid job. Among disconnected youth, 31.3% did not receive any postsecondary services that might help achieve job or postsecondary education attainment. Coming from a household where parents were more educated was associated with lower odds of being completely without services and higher odds of ever getting vocational services. Youth living in a suburban community (versus urban) were significantly more likely to have no services since high school. Participation in extracurricular activities during high school was associated with a reduced risk for poor postsecondary work and school outcomes even after adjusting for the propensity of high school-era participation. About two-thirds of high school students had participated in at least one of the four types of extracurricular activities.
Conclusions: The high rate of total disconnection from postsecondary education, training, and job opportunities is a serious problem. Our work suggests exposure to certain types of experiences during high school, like extracurricular activity participation, can reduce the risk of disconnection. Efforts to promote access to helpful services after high school should be targeted at those with highest risk of not getting any services.

11:45 **134.004** Evaluating the Effectiveness of Project Search to Support Employment for Young Adults with Autism Spectrum Disorder

M. R. Klinger[1], A. W. Duncan[2], L. G. Klinger[3], M. M. Daston[4] and E. Riehle[5], (1)Allied Health Sciences, University of North Carolina, Chapel Hill, NC, (2)Div of Developmental and Behavioral Pediatrics, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (3)TEACCH Autism Program; Department of Psychiatry, University of North Carolina, Chapel Hill, NC, (4)Project SEARCH, Cincinnati Children's Hospital, Cincinnati, OH, (5)Cincinnati Children's Hospital, Cincinnati, OH

Background: Young adults with Autism Spectrum Disorder (ASD) experience chronically low rates of post-school employment significantly below those for youth with other developmental disabilities. Roux et al. (2013) reported that 46% of youth with ASD between 21-25 years of age had never been employed and only one-third were currently employed. Thus, it is imperative to identify programs that support transition-aged youth with ASD to obtain competitive employment.
Project SEARCH is a widely used model of high school transition designed to improve employment outcomes for youth with developmental disabilities (DDs) in their last year of school (Rutkowski et al. 2006). Over the course of the year, youth rotate through three internships that allow them to experience workplace immersion and learn marketable job skills. In an onsite classroom, they learn employability skills such as appropriate workplace conduct. The goal is competitive employment with

high rates of success reported. Little research has examined Project SEARCH's effectiveness for individuals with ASD.

Objectives: The purpose of this study was to compare employment outcomes of young adults with ASD to young adults with other DDs who completed Project SEARCH. This study represented a large, community-based intervention across multiple intervention teams and sites.

Methods: Data were collected across 175 school system intervention sites located across the US and the UK during 2009-2013. All sites received training and support delivering the intervention from Project SEARCH. A database was created to measure Project SEARCH effectiveness including whether each student was employed, where they were employed, hourly wage, and hours/week worked. Data were collected from 4275 individuals (3467 did not have ASD but had other DDs; 808 had ASD).

Results: Gender and presence of multiple disabilities were included as covariates in logistic regression analyses of diagnosis (ASD vs. Non-ASD) because the diagnostic groups significantly differed from one another on these factors and these factors were related to employment outcomes. The effect of ASD on whether individuals were employed at the end of Project SEARCH was examined. ASD diagnosis significantly affected employment (p=.001) with those with ASD being less likely to be employed than those without ASD (53% versus 61%). Additionally, hours worked per week and hourly wages were examined for those employed using ANOVA. ASD diagnosis significantly affected hours worked [p=.02; marginal means: ASD=22.6 hours/week, non-ASD=24.5 hours/week]. However, ASD diagnosis did not affect hourly wages [ASD=$9.20/hour, non-ASD=$9.15].

Conclusions: Roux et al. (2013) reported that 33% of individuals with ASD 1-4 years post high school were currently employed and those employed earned an average $8.10/hour. The rates observed here were considerably higher (53% individuals with ASD currently employed at an average of $9.20/hour). However, those with ASD were less successful at obtaining employment and worked fewer hours than individuals with other DDs. This study represents one of the largest examinations of adult ASD employment interventions and shows that while Project SEARCH is effective for individuals with ASD, it is less successful than for other DD populations. Possible ASD specific modifications to Project SEARCH to increase its efficacy will be discussed.

Panel Session
135 - From Genomic Discovery to Genetically Defined Autism Subtypes
10:30 AM - 12:30 PM - Grand Ballroom D

Panel Chair: Brian O'Roak, *Molecular and Medical Genetics, Oregon Health & Science University, Portland, OR*

Discovering the genetic basis of idiopathic autism spectrum disorder has been challenging. Recently, new genomic approaches leveraging exome sequencing have identified large numbers of new candidate genes based on new or "de novo" mutations in families with a single affected child, so called simplex families. Even with the likelihood of hundreds of genes involved, many genes are now moving beyond candidates to bona fide risk factors for autism. Detailed analysis of genetically defined autism subtypes may revolutionize our understanding of the disorder and provide significant targets for interventions. In this session, the results of the complete sequencing of the Simons Simplex Collection, ~2,500 families will be presented. The roles of different mutation types and classes of genes will be addressed, as well as how roles may differ in boys and girls with autism. We will also explore how novel biomolecular modules relevant to autism are being discovered using emerging data from the developing brain and new computational approaches. These potentially link many risk genes together into common pathways. Finally, the session will end with detailed discussions of two new genetically defined autism subtypes, unexpected clinical associations, and rationale for moving forward with this genotype first approach.

10:30 **135.001** Defining the Contribution of Different Classes of De Novo Mutation to Autism

I. Iossifov[1], B. J. O'Roak[2], S. J. Sanders[3], M. Ronemus[4], N. Krumm[5], D. Levy[4], J. Shendure[6], E. E. Eichler[7], M. W. State[3] and M. Wigler[4], (1)Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, (2)Oregon Health & Science University, Portland, OR, (3)Psychiatry, UCSF, San Francisco, CA, (4)CSHL, Cold Spring Harbor, NY, (5)University of Washington, Seattle, WA, (6)Department of Genome Sciences, University of Washington, Seattle, WA, (7)Howard Hughes Medical Institute, Seattle, WA

Background: Genetics is a major contributor to autism spectrum disorders (ASD) and the role for de novo (DN) mutations in these disorders has been established

Objectives: We sought to make precise estimates of the contributions of different types of de novo mutations in different classes of idiopathic autism.

Methods: We used comparative genomic hybridization (CGH) over ~1,000 families, whole exome sequencing (WES) over ~2,500 families and whole genome sequencing (WGS) over 40 families from the Simons Simplex Collection (SSC), each with a single affected child.

Results: We found that children with ASD have an increased incidence of DN missense, 'likely gene-disrupting' (LGD), and copy number variant (CNV) mutations compared to unaffected siblings. We estimated that 70% of DN CNV, 42% of DN LGD and 13% of DN missense mutations contributed to 6%, 9% and 12% of diagnoses in simplex families, respectively. DN mutation in coding sequence contributes to nearly 30% of all simplex and 45% of female diagnoses. We found a list of ~40 genes

with DN LGD mutations in more than one affected child. Males with DN LGDs or DN CNVs have lower IQ. The gene targets of DN LGDs in ASD males with lower IQ overlap with targets in ASD females and with individuals having intellectual disability or schizophrenia, but not significantly with targets in ASD males having higher IQ. We estimate the number of vulnerable genes in which LGD mutation can cause ASD in females or lower IQ ASD in males to be ~400, with a similar number of genes vulnerable to missense mutation. LGD targets are enriched for chromatin modifiers and FMRP-associated genes in both affected males of lower IQ and females. Embryonically expressed genes are significantly enriched in DN targets, LGD and missense, only in affected females.

Conclusions: WES and CGH have proven to be powerful tools for understanding the genetic architecture of ASD and for identifying ASD genes. But larger family collections will be necessary to identify the majority of the ASD genes and to characterize DN mutation in non-coding regions through WGS.

11:00 **135.002** The Discovery of Gene Modules for Autism Utilizing Co-Expression and PPI Networks

F. Hormozdiari[1], O. Penn[1], E. Borenstein[1] and E. E. Eichler[2], (1)University of Washington, Seattle, WA, (2)Howard Hughes Medical Institute, Seattle, WA

Background:
Despite extensive genetic heterogeneity underlying disorders such as autism spectrum disorders (ASD) and intellectual disability (ID), there is compelling evidence that risk genes will map to a much smaller number of biologically functional modules. However, discovering and distinguishing between these modules is still a major challenge.
Objectives:
We introduce a novel computational method (MAGI) for the discovery of disease modules enriched for mutations in probands and apply it to the recently published *de novo* mutations from ASD/ID samples to discover ASD biomolecular modules with specific phenotypic properties.
Methods:
MAGI simultaneously considers protein-protein interaction and RNAseq expression profiles during brain development. It is based on a combinatorial optimization algorithm that aims to find modules of genes that maximize the number of mutations seen in cases and limit the number of mutations observed in controls, while ensuring a high number of protein interactions and high coexpression among these genes. The method first finds a set of small seed pathways, enriched in *de novo* mutations, and then merge them into larger modules using a local search approach.
Results:
Applying the method to published exome sequencing data from 1,116 ASD and ID patients, we discovered two distinct modules ($p < 0.005$) that differ in their properties and associated phenotypes. The first module consists of 80 genes associated with the Wnt and Notch signaling pathways. In addition the module is significantly enriched in genes associated with chromatin remodeling and transcription regulations. Probands with truncating mutations in this module are enriched for micro and macrocephaly (KS test $p = 0.013$). The second module associated with synaptic function, including long-term potentiation and shows higher levels of postnatal expression. Probands with *de novo* mutations in these modules are found to have lower IQ. In addition, missense mutations in both modules are predicted to be more deleterious. Applying the method independently to epilepsy and schizophrenia exome sequencing cohorts, we found marked overlap among modules suggesting shared common neurodevelopmental pathways. Furthermore, analyzing the full Simon Simplex Collection (SSC) and Autism Sequencing Consortium (ASC) studies revealed an 8.1-fold enrichment of newly discovered *de novo* mutations in these two predicted modules ($p < 10^{-8}$). Preliminary results of adding mutations found in the full Simons Simplex Collection (SSC) to the analysis (2,661 probands in total) identification more refined and biologically coherent modules (e.g. SWI/SNF complex, Wnt signaling, long-term potentiation, proteasome, and ubiquitin-mediated proteolysis pathways).
Conclusions:
Our approach provides a molecular framework for reducing the genetic heterogeneity of these diseases and a method for identifying *de novo* missense mutations important in ASD etiology. We believe that using MAGI to find more refined gene modules for ASD will not only improve our understanding of relevant biological pathways important for neuronal development in general and autism specifically, but also has the potential to further refine distinguished subtypes of ASD that may lead to the development of future specific disease therapy.

11:30 **135.003** Disruptive CHD8 Mutations Define a Subtype of Autism Early in Development

R. Bernier[1], H. A. Stessman[2], B. Coe[1], J. Gerdts[1], B. J. O'Roak[3] and E. E. Eichler[4], (1)University of Washington, Seattle, WA, (2)Genome Sciences, University of Washington, Seattle, WA, (3)Oregon Health & Science University, Portland, OR, (4)Howard Hughes Medical Institute, Seattle, WA

Background: Autism spectrum disorder (ASD) is a heterogeneous disorder with significant genotypic and phenotypic complexity (Geschwind, 2009). While various behaviorally defined subtypes have been proposed, these have not been tied to genetic etiology, linked to treatment indicators, nor been diagnosed consistently by expert clinicians (King et al, 2014). Indeed, with the transition to the DSM-5, all behaviorally defined subtypes have been subsumed by the umbrella term Autism Spectrum

Disorder, allowing for identification of subtypes more closely aligned to biological mechanisms (APA, 2013). The genetic etiology of ASD is no less varied. Over 100 genes and genomic regions have been suggested as candidates or associated with ASD (Betancur, 2011), and over 800 genes have been predicted to play a role in ASD (Iossifov et al, 2012; Neale et al, 2012; O'Roak et al, 2012a; Sanders et al, 2012). Given that parsing the behavioral heterogeneity has yielded limited utility, genetically defined subtypes may prove more beneficial in illuminating molecular mechanisms underlying ASD, the course and prognosis of a subgroup of individuals with ASD, and individualized treatment targets. Severe disruptive mutations in chromodomain helicase DNA binding protein 8 (*CHD8*) have been strongly associated with ASD and provide a likely candidate for a specific subtype of ASD (O'Roak et al, 2012b; Talkowski et al, 2012; Neale et al, 2012).

Objectives: To determine if *CHD8* mutations define a specific subtype of ASD through the identification of patients, comprehensive follow up evaluation, and extensive phenotype-genotype correlations.

Methods: Expanding upon our description of individuals with truncating mutations to CHD8 reported in Bernier et al, 2014, we identified a total of 25 independent mutations through targeted sequencing (N=22) of 7,097 individuals with autism or developmental delay from multiple research cohorts as well as through clinical referral (N=3); no truncating events were identified in 8,916 controls, including 2,413 unaffected siblings. We re-contacted all patients and their families who were willing to participate in follow up assessment (N=18) and collected medical records for those unavailable for assessment (N=7). In-depth, structured clinical assessment, review of medical records, and medical/dysmorphological evaluation was conducted. Clinical assessment included diagnostic assessment and evaluation of cognitive, adaptive, language, motor, and executive functioning abilities.

Results: ASD was the most common diagnosis observed in our cohort. Of the 25 identified individuals evaluated, 23 meet strict diagnostic criteria for ASD. Although patients varied in age from 4-41 years of age, we observed striking similarities in their facial characteristics. Predominant features included increased occipitofrontal circumference (OFC), pronounced supraorbital brow ridges, hypertelorism with down-slanted palpebral fissures, broad nose with full nasal tip, and pointed chin. Other recurrent physical features included slender, tall build and large, flat feet, which were reported in several individuals. 80% of individuals reported significant GI problems, characterized as recurrent and consistent problems with constipation. Cognitive ability ranged from intellectual disability to average functioning. Sleep problems were common as was precocious puberty in the female patients.

Conclusions: Our findings indicate that *CHD8* disruptions define a distinct ASD subtype and reveal comorbidities between brain development and enteric innervation.

12:00 **135.004** The Transcriptional Regulator Adnp Links the Nbaf(mSWI/SNF) Complexes with Autism

***F. Kooy**[1], G. Vandeweyer[1], C. Helsmoortel[1], A. Van Dijck[1], C. Romano[2], B. de Vries[3], E. E. Eichler[4] and N. Van der Aa[1], (1)University of Antwerp, Antwerp, Belgium, (2)Oasi Institute, Troina, Italy, (3)Radboud Universtiy Medical Center, Nijmegen, Netherlands, (4)Howard Hughes Medical Institute, Seattle, WA*

Background:
Mutations in ADNP were recently identified as a frequent cause of syndromic autism, characterized by deficits in social communication and interaction and restricted, repetitive behavioral patterns. remodeling complex. Compared to controls, the frequency of truncating mutations in ADNP is significantly higher in patients (p:0.001852, odds ratio 13.24668, one-sided Fisher's exact test). We estimated this gene to be mutated in approximately 0.2% of ASD cases, making it one of the most frequent ASD genes known to date. Based on its functional domains, ADNP is a presumed transcription factor.

Objectives:
To understand more of the functional and clinical consequences of mutations in ADNP.

Methods:
A detailed and systematic clinical assessment of the symptoms observed in our patients allows a detailed comparison with the symptoms observed in other SWI/SNF disorders. Functional studies include the expression profiling of the mutated cell lines.

Results:
The gene interacts closely with the SWI/SNF complex by direct and experimentally verified binding of its C- terminus to three of its core components. While the mutational mechanism of the first 10 patients identified suggested a gain of function mechanism, an additional patient reported here is predicted haploinsufficient. The latter observation may raise hope for therapy, as addition of NAP, a neuroprotective octapeptide named after the first three amino acids of the sequence NAPVSPIQ, has been reported by others to ameliorate some of the cognitive abnormalities observed in a knockout mouse model.

Conclusions:
While we are beginning to understand the genotype-phenotype correlation, it is concluded that detailed clinical and molecular studies on larger cohorts of patients are necessary to establish a better insight in the genotype phenotype correlation and in the mutational mechanism.

**Panel Session
136 - Co-Occurring Psychiatric Disorders and the Lifecourse in ASD: Clinical**

and Epidemiological Perspectives
10:30 AM - 12:30 PM - Grand Salon

Panel Chair: Connor Kerns, *AJ Drexel Autism Institute, Drexel University, Philadelphia, PA*

Discussant: Brian Lee, *Drexel University School of Public Health, Philadelphia, PA*

There is a growing body of evidence that individuals with autism spectrum disorder (ASD) frequently experience co-occurring psychiatric symptoms. This scientific panel integrates clinical and epidemiological perspectives to examine the conceptualization, measurement, and negative outcomes of this co-occurrence. Our first talk highlights key insights regarding the conceptualization of psychiatric syndromes in ASD derived from clinical evaluations of several thousand children and adolescents with ASD, other psychiatric syndromes and typical development. Talk 2 synthesizes the literature on comorbid psychopathology in ASD, examining how different measurement approaches may influence prevalence estimates. Using national data, talks 2 and 3 then examine the relationship of co-occurring psychiatric symptoms in ASD to life course outcomes, in particular adverse childhood experiences and criminality. The overarching goal of this panel will be to consider the implications of co-occurring psychiatric syndromes in ASD to epidemiologic research, clinical practice and public health – that is, to consider how our conceptualization of psychiatric co-occurrence may inform etiological models, measurement and treatment development as well as our ability to address the real-word service needs of individuals with ASD.

10:30 **136.001** Programmatic Research into Co-Occurring Psychiatric Syndromes in Autism Spectrum Disorder

K. D. Gadow, *Psychiatry, Stony Brook University, Stony Brook, NY*

Background: People with autism spectrum disorder (ASD) commonly experience the symptoms of a wide range of non-ASD psychiatric syndromes, which raises a number of questions about diagnosis and treatment and has important implications for models of pathogenesis. Do seeming psychiatric syndromes meet conventional criteria for diagnostic validity? To what extent are psychiatric syndromes in ASD similar to or different from disorders diagnosed in typically developing (TD) individuals? Do the core deficits associated with ASD alter the clinical presentation of traditionally-defined syndromes? Are psychiatric syndromes in ASD associated with the same clinical correlates (risk factors) as similar syndromes in TD populations. Is the assessment of co-occurring symptoms clinically informative?
Objectives: For the past 20 years our research team has addressed these and related questions in children and adolescents referred for clinical evaluation of ASD and non-ASD psychiatric syndromes as well as community-based TD samples. This presentation summarizes the results of these studies and suggests directions for future research.
Methods: Parents and teachers completed a DSM-IV-referenced rating scale with established psychometric properties in several thousand children and adolescents (ages 3-18 years) with ASD, psychiatric referrals, and public school children. The parents of the referred children also completed an extensive background questionnaire that included a range of psychosocial variables commonly used in epidemiologic and case-control studies, and subsamples of these youth are currently participating in genetic and imaging studies
Results: Co-occurring psychiatric symptoms in ASD appear to meet conventional criteria for diagnostic validity, share many similarities with conventional DSM-defined syndromes, result in relatively high levels of symptom-induced impairment, are associated the important real-world outcomes, and evidence similar biopsychosocial clinical features (risk factors) as comparable syndromes in TD populations. Nevertheless, findings from studies comparing ASD and TD samples also evidence group differences therefore challenging conventional ideas about nosology
Conclusions:
Evidence for the existence of behavioral syndromes within the ASD clinical phenotype is compelling. Moving forward, future studies will need to address not only diagnostic heterogeneity within ASD (e.g., HFA, males) and heterogeneity in co-morbidities (e.g., anxiety) but also heterogeneity within co-morbid symptoms (e.g., social anxiety) and heterogeneity in etiological pathways (e.g., stress, cytokines). The incorporation of neuroscience into traditional, behaviorally-oriented research strategies for addressing the real-world service needs of people with ASD holds considerable promise for answering some of the more vexing questions about diagnosis and nosology and is essential in examining pathogenic processes, developmental trajectory, and response to intervention.

10:55 **136.002** Modifying Symptom and Diagnostic Criteria for Additional Psychiatric Disorders in ASD: What Is the Evidence?

E. Simonoff, *Department of Child and Adolescent Psychiatry, King's College London, London, United Kingdom*

Background: Research has consistently demonstrated that a high proportion of people with ASD experience additional mental health problems and fulfil the diagnostic criteria for other psychiatric disorders, such as ADHD, oppositional defiant disorder, anxiety disorders and depression. The reported rates are extremely high, with more than 70% of individuals fulfilling criteria for at least one psychiatric disorder, and this has raised questions about the conceptual diagnostic framework, the

breadth of autism spectrum and the appropriate methods to evaluate symptomatology amongst people with ASD. Psychopathology studies have used two assessment methods: (1) standardized instruments, including questionnaires and interviews, applied in the usual way and (2) modified measures, in which the questions and/or symptom criteria have been modified. At present there is a lack of systematic comparison of the two methods and hence no consensus regarding the best strategy for evaluation psychiatric symptoms and disorders in people with ASD.

Objectives: To improve understanding of the different methods of psychopathology assessment in ASD and their implications for the prevalence, comorbidity and risk factors.

Methods: A systematic review of articles reporting on the prevalence and co-occurrence of psychopathology amongst people with ASD is undertaken. Databases used to ascertain articles were Medline, PsycInfo and PubMed, which were searched for the last 20 years. This includes both clinical and population-based samples but is limited to main areas of psychopathology, including behavioural (oppositional defiant and conduct) disorder, affective (anxiety and mood) disorder and ADHD. As well as classifying studies according to the use of standardized vs ASD-modified assessment criteria, articles are also stratified according to participant age, level of intellectual functioning, and informant used to assess psychopathology.

Results: Data review and analysis is underway. The focus will be on whether there are systematic differences in the prevalence and patterns of co-occurrence of psychiatric symptoms and disorders according to the method of assessment and accounting for other factors.

Conclusions: The implications of standardized vs ASD-specific assessment methods will be discussed in light of the findings. Comparison will be made with other instances in which this issue has been explored, e.g., affective disorders in children, psychiatric diagnosis in significant intellectual impairment.

11:20 **136.003** Adverse Childhood Experiences and ASD: The Role of Co-Occurring Psychiatric Symptoms

C. M. Kerns[1] and B. Lee[2], (1)Drexel University, Philadelphia, PA, (2)Drexel University School of Public Health, Philadelphia, PA

Background: Children with autism spectrum disorders (ASD) are at risk for adverse childhood experiences (ACEs) such as domestic violence or family socioeconomic hardship, which predict numerous negative outcomes later in life. However, the extent to which children with ASD experiences ACEs, relative to children without ASD, is not known.

Objectives: We describe differences in the prevalence of ACEs for children with and without ASD in a nationally representative sample of children in the U.S. Furthermore, we investigate whether such differences may be attributable to co-occurring psychiatric symptoms.

Methods: We examined data on 84,352 children (ages 2-17 years; 1,608 with ASD) from the 2011-2012 National Survey of Children's Health conducted by the CDC. Cross-sectional data were obtained from parental self-report. Specific ACEs of interest included socioeconomic hardship, parental separation, household substance abuse, neighborhood violence, household mental illness, domestic violence, parental incarceration, and parental death. The presence of parent-reported co-occurring psychiatric symptoms (anxiety problems, depression, behavioral or conduct problems, and AttentionDeficit-Hyperactivity Disorder (ADHD)) was also assessed. All analyses accounted for the complex survey sampling design using sample weights.

Results: While 24.4% of children without ASD were reported as having multiple (2+) ACEs, 34.4% of children with ASD had multiple ACEs. Similarly, 42.4% of children with ASD were reported as having at least one co-occurring psychiatric symptom, as compared with only 6.0% of children without ASD. For many of the specific ACEs examined, children with ASD experienced more ACEs than children without ASD. For example, children with ASD were twice as likely to have lived with someone who was mentally ill or suicidal, compared to children without ASD (18.1% vs. 9.1%). In survey-weighted logistic regression models adjusting for age, sex, race, family structure, and poverty level, children with ASD were more likely to have multiple ACEs than children without ASD (OR: 1.66, 95% CI: 1.18-2.34). However, after further adjustment for the presence of a co-occurring psychiatric symptom, children with ASD were no more likely to have multiple ACEs than children without ASD (OR: 0.92, 95% CI: 0.66, 1.30).

Conclusions: Children with ASD experience ACEs at a higher rate than children without ASD. However, this appears to be largely explained by the co-occurrence of psychiatric symptoms, such as anxiety, depression, behavioral or conduct problems, and ADHD.

11:45 **136.004** Autism Spectrum Disorders and Criminal Convictions: The Role of Psychiatric Comorbidity

*R. Heeramun[1], C. Magnusson[2], C. H. Gumpert[3], S. Granath[4], C. Dalman[5], M. Lundberg[5] and **D. Rai**[6,7], (1)Avon and Wiltshire Mental Health Trust, Bristol, England, United Kingdom, (2)Karolinska Institutet, Stockholm, Sweden, (3)Centre for Psychiatry Research & Education, Karolinska Institutet, Stockholm, Sweden, (4)Research and Development Unit, The Swedish National Council for Crime Prevention, Stockholm, Sweden, (5)Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden, (6)Avon and Wiltshire Partnership NHS Mental Health Trust, Bristol, United Kingdom, (7)Centre for Academic Mental Health, University of Bristol, Bristol, United Kingdom*

Background: The literature related to criminal offending in individuals with autism spectrum disorders (autism) is inconsistent. It is still unclear whether individuals diagnosed with autism are more likely to

engage in, or be convicted for criminal activity. Importantly, there is little information on potentially modifiable factors, such as psychiatric co-morbidity, that may help identify individuals at high risk of criminal activity and inform preventative strategies.

Objectives: To test the following hypotheses: 1) that individuals with autism are more likely to receive a criminal conviction than the general population in Sweden, and 2) that potentially treatable psychiatric co-morbidities may be important factors that modify this risk.

Methods: Longitudinal population-based study based on a record-linkage cohort of all non-adopted singletons in Sweden born between 1984 and 1995 with data on both biological parents and at least 15 years (the age of criminal responsibility in Sweden) follow up until 31 December 2011 (n=1,339,255 including n=15,368 with autism). Unique personal identification numbers were used to link data with the National Crime Register and other Swedish health and administrative registers leading to an information rich cohort with extensive data. After testing the proportional hazards assumption, the risks of criminal convictions in individuals with autism compared with those without were estimated using Cox proportional hazards regression models. The models were adjusted for various individual and family level socioeconomic and demographic characteristics.

Results: Individuals with autism appeared to be at a higher risk of having criminal convictions than those without [Hazard Ratio (HR) 1.31, 95% Confidence Interval (CI) 1.26-1.37]. However, stratifying the risk estimates by a recorded history of co-morbid psychiatric diagnosis revealed that: as compared to individuals without a diagnosis of autism or psychiatric conditions, individuals with autism with a psychiatric co-morbidity were more likely [adjusted HR 1.45 95% CI (1.39-1.52)], but those with autism without a co-morbid psychiatric diagnosis were less likely [adjusted HR 0.59 95% CI (0.51-0.67)] to be convicted for a criminal offence in Sweden. Further analyses on the types of criminal activity (e.g. convictions for violent vs. non violent crimes) and the role of individual co-morbidities (e.g. ADHD, conduct disorder, psychotic disorders) is underway and will be presented at the meeting.

Conclusions: These preliminary results suggest that co-morbid psychiatric conditions may be a major factor in relation to the risk of criminal offending in individuals with autism.

Poster Session
137 - Innovative Technology Demonstrations
10:00 AM - 1:30 PM - Imperial Ballroom

1   **137.001** Shared Genomic Segments (SGS) Analysis Method: Application to Extended Utah Pedigrees at High Risk for ASD

V. Rajamanickam[1], T. M. Darlington[2], R. Sargent[1], N. J. Camp[1] and H. Coon[2], (1)Genetic Epidemiology, University of Utah, Salt Lake City, UT, (2)Psychiatry, University of Utah, Salt Lake City, UT

Background: Shared Genome Segments (SGS) analysis is a method used to identify shared regions of DNA among cases using high-density SNP genotypes. These regions can then be used to prioritize subsequent experiments to search for causal sequence variants. This approach will be particularly advantageous when functionally relevant variants are regulatory, allowing an investigator to focus on full targeted sequencing with an SGS region, a compliment to the whole exome approach.

Objectives: The method will be described in detail, including a flow chart of the steps required to apply the method successfully, input file formats, examples of run commands, example output, and a visualization tool for output. We have analyzed extended pedigrees at high risk for Autism Spectrum Disorder (ASD). Different options to apply the method using this data resource will be demonstrated.

Methods: The SGS test identifies if the length of consecutively shared SNPs, identified as identical-by-state, or IBS, is longer than expected by chance. IBS is established by determining if allelic types at sequential SNPs are consistent across cases. IBS does not infer identity-by-descent (IBD; the same inherited segment from a common ancestor) which is our true interest. However, if the length of SGS shared IBS is significantly longer than by chance, given the known relationships, then IBD is implied. Theoretically, chance IBD sharing in distant relatives is extremely improbable. Genomewide statistical significance can be found for pedigrees with at least 15 meioses. SGS is efficient, and can have more power than traditional association tests.

Results: Pedigree members were genotyped using the Illumina HumanOmniExpress12v1.1 array. While SGS can be used to test for sharing across all pedigree cases, due to heterogeneity we did not expect all affected cases to share the same segments in these large pedigrees. We therefore started with a program option, weighted pairwise SGS (wpSGS), which combines sharing across all possible pairs, weighted by number of meioses between the pairs. We show results of wpSGS; with the increased length illustrated by the ratio against both internal pedigree controls, and also to unrelated controls (pairs selected from 168 North-West European individuals—CEU/GBR—from the 1000 Genome Project). Statistical significance for observed SGS regions (p-values) are estimated by generating null genome simulations (a user-specified number), based on a genetic model estimated from the 1000 Genome Project controls.

Conclusions: We present a flow chart and example commands to use the software with different analysis options and control sets. We show input file structures and format of the output. We show how the null genomes are simulated; including incorporation of linkage disequilibrium (LD) and a

recombination model. We show how SGS can also be set up for validation testing of sharing across subsets of pedigree cases identified by wpSGS. We demonstrate additional software to visualize and prioritize results. Through this demonstration, we show that SGS is an easily applied, efficient, useful pedigree analysis tool in the search for susceptibility variants for complex diseases, such as ASD.

2   **137.002**   Creating a Spatial Data Architecture for the National Database for Autism Research

M. L. Miranda[1,2], P. Maxson[1], N. Sandberg[1] and D. Hall[3], (1)National Center for Geospatial Medicine, University of Michigan, Ann Arbor, MI, (2)School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI, (3)Omnitec Solutions Inc., Bethesda, MD

Background: The etiology of autism spectrum disorder (ASD) remains largely unknown. While genetic vulnerabilities have been linked to development of ASD, much remains unexplained. Researchers have begun to identify social and environmental stressors that might influence early brain development which may manifest as changes commonly associated with ASD. Linking social and environmental data to the clinical, genomic, and imaging data in the National Database for Autism Research (NDAR) holds great potential for building a more robust research platform for basic science and clinical research on ASD.
Objectives: The National Institute for Mental Health, Omnitec, and the National Center for Geospatial Medicine (NCGM) at the University of Michigan are partnering to capture geospatial information on families affected by ASD. The collaborative team is especially interested in residential information on parents and children over both space and time. The resulting spatially-enabled data architecture will link environmental and social data to existing NDAR data. By combining clinical, social, and environmental data on a national scale, scientists can investigate the relationships among chemical and non-chemical stressors and ASD.
Methods: NCGM will employ strategies to consent families living with ASD, many of whom may already be enrolled in the NDAR. NCGM will launch a website through which affected families can enter self-reported information. Families will complete a short, secure, online questionnaire designed to gather geographic data to facilitate linkage of NDAR clinical, genomic, and imaging data with social and environmental exposure data.
Results: The resulting website and subsequent datasets will facilitate collaboration across families, clinicians, and researchers to better understand autism spectrum disorder. This national effort will grow as families become more aware of the resource. Once clinical information is linked with social and environmental data, the research community will be able to look at spatial relationships. Spatial patterns in the data can inform new research questions as well as identify areas for targeted recruitment and intervention strategies.
Conclusions: This ground-breaking effort will be the first of its kind to generate self-reported patient information that is geographically linked to relevant social and environmental stressors and to further connect those datasets with research-grade data captured by NIH-funded laboratories. Long-term benefits of this effort include the building of collaborative relationships among affected families, clinicians, and scientists; the creation of nationally-based samples for future research; and increased awareness and understanding of autism spectrum disorders.

3   **137.003**   Delsia: An Innovative Funding Vehicle That Is Turning Science and Technology into Reality for the Autism Community

D. G. Smith[1], E. Clayton[2] and R. H. Ring[3], (1)Autism Speaks, Boston, MA, (2)Autism Speaks, New York, NY, (3)Autism Speaks, Princeton, NJ

Background:
The autism community is faced with a staggering array of unmet medical and behavioral healthcare needs. Research alone will not answer the urgent call for improved healthcare and quality of life coming from individuals, parents and family members living with autism. It is essential that scientific and technological research advances are translated into innovative and accessible products that can transform lives.
A translational "valley of death" is readily apparent along the continuum from autism research to product commercialization. The system for capitalizing new product development, where risk and need are the greatest, is broken. Government funding agencies and academia are not in the business of bridging this gap, and financial return may be too small or speculative for traditional venture investors. Innovative funding models that involve mission-driven nonprofit partners are necessary to expand the impact of basic research.
Objectives:
Our objective is to bridge the "valley of death" with a new, innovative funding mechanism, Delivering Scientific Innovation for Autism LLC (DELSIA). The mission for DELSIA is to transform lives by accelerating the development and commercialization of innovative products that promise to improve healthcare and quality of life for people with autism.
Methods:
DELSIA partners with entrepreneurs, start-ups and small and large companies in biomedical, life sciences, software and electronic technology and services sectors. We aim to efficiently apply our capital and to engage our community and unparalleled network of autism advocacy, research and services experts to deliver the most impactful results.

Results:
DELSIA has given financial awards to businesses and entrepreneurs in biomedical and software technology sectors, and is actively seeking new investment opportunities that span our scope of interest.
Conclusions:
Novel funding models involving nonprofit venture philanthropic enterprises are necessary to repair the broken links between early research and late-stage product development. DELSIA was created to meet this need through partnering with entrepreneurs and companies that are developing products and services for the improvement of healthcare and quality of life for the autism community.

4 **137.004** A Novel Approach for Efficient Submission of Research Data to the National Database for Autism Research (NDAR)

P. Langthorne, *F. Farach, D. Voccola, C. Tirrell and L. Rozenblit, Prometheus Research, LLC, New Haven, CT*

Background: Researchers seeking to share their data with coordinating centers such as NDAR, face numerous barriers to establishing new connections and maintaining existing ones, including the high cost of restructuring or recoding datasets and disconnects between dataset attributes.
Objectives: We sought to dramatically reduce the time and money required to establish and maintain the interoperability of data between research centers, with particular attention to interfacing with NDAR. The ideal solution would maintain high data quality on both sides of the interaction, so that all beneficiaries of the data sharing agreement would have high confidence in the accuracy of the data. The solution needed to scale to large volumes of research data collected without a substantial increase in the effort required to establish or maintain the sharing connection.
Methods: We created a process where manual recoding of data is replaced by data sharing instructions in the form of extraction and transformation scripts. These scripts are stored in revision-controlled file repositories accessible to all members of the data sharing team. The source data from transmitting researchers are stored in relational databases built on the RexDB® platform, while the data sharing team works exclusively on the data extraction and transformation scripts. This division ensures that the researchers' data are not impacted or altered in any way. NDAR receives flat data files that conform fully to the organization's published expectations for data structure and assessment values, while researchers continue to enter and analyze data in structures with which they are familiar.
Results: Over the course of seven typical (20-60 subjects, 400-1000 fields each) data submissions to NDAR, the need for duplication, retranscription, or restructuring of the source data is fully eliminated. Separating the extraction and transformation scripts from data files has also eradicated the impact of additional data collection on the time required to repeat successful transmissions. Revision controlled management of these scripts provides a new benefit: traceability of the transformation process itself. Now, point-in-time retrieval of extraction scripts and explanations for modifications to the data sharing interface are possible. None of the datasets provided to NDAR within this framework drew any audits or revision requests following any of the submissions, an indication of the high data quality levels achieved.
Conclusions: This method has proven to be successful and efficient for interfacing research data with NDAR. It presents little-to-no impact to transmitting investigators' data, ensures high data integrity, trivializes the complexities of repeatedly modifying a growing dataset over time, and introduces traceability to the collaborative process of integrating two collections of data with one another. Anecdotal evidence indicates that NDAR submissions have transformed from a time consuming process into an opportunity to improve the quality of research data for future analyses. As this framework becomes more widely utilized, we expect even broader adoption of ad-hoc data sharing agreements within the research community, permitting researchers to investigate questions of increasing complexity.

5 **137.005** Olfactory Detection Thresholds in Children with Autism Spectrum Disorders Using Pulse Ejection Systems

H. Kumazaki[1,2], A. Tomoda[1], K. Okada[3], T. Muramatsu[2] and M. Mimura[2], (1)Research Center for Child Mental Development, University of Fukui, Yoshida-gun, Fukui Prefecture, Japan, (2)Department of Neuropsychiatry, School of Medicine, Keio University, Tokyo, Japan, (3)Department of Information & Computer Science , Graduate School of Science and Technology, Keio University, Yokohama, Japan

Background: Sensory abnormalities occur in patients with autism spectrum disorder (ASD) worldwide. Unusual reactions to odor stimuli are well known sensory symptoms in ASD. However, olfactory laboratory tests have provided limited information about such abnormalities in ASD. Conventional techniques for measurement of olfactory function have problems of dispersion of scents in the air, and tedious examination.
Objectives: In this study, we used an olfactory measurement that uses pulse ejection. Pulse ejection systems are capable of presenting scents for a short duration even at the picoliter level. Unlike existing techniques for measurement of olfactory function, our olfactory display employs pulse ejection and measures olfaction by varying the quantity of ejected odorant. The odor detection

threshold can be quantified by the ejection quantity. This allows the pulse ejection system to quantify the human ability to smell with great precision. This study examined odor detection thresholds with this new system for measurement of olfactory function in a sample of adolescents with ASD.
Methods: Of the 30 participants, 15 were patients with ASD (3 women, 12 men) and 15, controls (3 females, 12 males). They were referred to our laboratory in August 2014 for examination of sensory symptoms. All the patients 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. To obtain data from normal age-matched healthy controls (HC), healthy schoolchildren and adolescents aged 8–18 years were recruited from the community. None had a below-average IQ, physical problems, or psychiatric psychopathology. Odor detection thresholds were assessed using the olfactory measurement system with olfactory display by pulse ejection. The equipment comprised an ejection head that could hold three small and one large tank, for a maximum of four scents. We used isoamyl acetate and ethyl butyrate flavor for the odorants. The subjects' scores ranged between 10 and 160. Statistical analysis was performed with the Statistical Package for the Social Sciences, version 15.0. Descriptive statistics were used for the samples. Age differences between the groups were analyzed using the independent samples t-test. Differences in odor detection thresholds were analyzed using the Mann–Whitney U-Test.
Results: There were no significant differences between groups with regard to mean age and gender proportion. The odor detection threshold for both flavors was significantly impaired in the ASD group compared to the HCs (for the isoamyl acetate flavor; ASD, 75.6 ± 57.3 vs. HC, 17.8 ± 13.6; $p < 0.01$ and for the ethyl butyrate flavor; ASD, 78.9 ± 52.1 vs. HC, 12.2 ± 4.6; $p < 0.01$).
Conclusions: Odor detection for the isoamyl acetate and ethyl butyrate flavors was impaired in adolescents with ASD. Implications for further research are discussed.

6   **137.006** Feasibility of Ecological Momentary Assessment of Emotion in Adolescents with Autism Spectrum Disorders

M. L. Kovac[1], E. Hanna[2], S. Miller[3] and G. S. Dichter[4], (1)University of North Carolina at Chapel Hill, Chapel Hill, NC, (2)Duke University, Durham, NC, (3)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Carrboro, NC, (4)University of North Carolina, Chapel Hill, NC

Background: Ecological Momentary Assessment (EMA) is a method of obtaining subjective information from respondents in a natural setting (Shiffman & Stone, 1998). EMA has been implemented successfully with different populations, including adolescents and severely mentally ill individuals (aan, Hogenelst, & Schoevers, 2012; Forbes et al., 2012); however, the feasibility of using EMA with adolescents who have Autism Spectrum Disorders (ASD) has only recently been investigated (Khor et al., 2014).
Objectives: EMA was used in the present study to gather subjective reports of affect and behavior in order to: (1) determine the feasibility of using a low-cost EMA protocol with this population (2) examine the frequency of social and nonsocial behavior and (3) examine positive affect (PA) among adolescents with and without ASD in real-world contexts.
Methods: Thirty-nine adolescents participated in the present study. Sample characteristics are displayed in Table 1.

Table 1: Sample Characteristics for Participants with EMA Data

	N	Mean Age	%Male	Mean IQ
ASD	19	14.11 (SD=3.33)	74%	102.2 (SD=16.9)
TD	20	14.5 (SD=1.96)	80%	113.1 (SD=10.6)

Participants with autism met criteria for ASD on the ADOS. Technology used in the EMA protocol was free to researchers in order to optimize accessibility and minimize cost. Prompts were delivered using automated Outlook messaging and surveys were accessed on Qualtrics by participants' home computers or smartphones. Six EMA prompts were delivered over the course of four days. Each prompt contained a link to an online survey which asked participants where they were when they were contacted, whom they were with, and what they were doing. Participants then completed the Positive and Negative Affect Scale for Children (PANAS-C) (Laurent et al., 1999) online.
Results: Participants completed 210 (out of 234) surveys, yielding a 90% response rate (94% among typically developing participants, 85% among participants with ASD). There was no correlation between age and the number of surveys completed (r=-.23, p>.16) or IQ and the number of surveys completed (r=.27, p>.05). With regard to behavior, there were no group differences in frequency of social or nonsocial behavior. However, when the nonsocial category was further divided into circumscribed interests for the ASD group and "Primary Interests" for the TD group, a group difference emerged, such that the ASD group participated in more circumscribed interests (relative to time spent engaging in primary interests in the control group), t=2.59, p=.01 (see Figure 1). There were no group differences in self-reported positive affect (*p*>.05).
Conclusions: The results of the present study confirm that EMA is a promising tool for research with individuals with ASD. Participants were highly adherent with the protocol, and there were no correlations between age and survey completion rates or IQ and survey completion rates. Notably, the EMA protocol was low-cost and accessible and thus has great potential for use in under-

resourced settings. Participants with ASD did not engage in nonsocial behaviors significantly more than their typically developing peers; however, they did engage in activities related to their circumscribed interests more than their peers engaged in hobbies or interests they identified as "primary."

7   **137.007** Can Virtual Reality be Used for Behavioral Analysis in Autism Spectrum Disorder? a Simulation for Interpersonal Distance Preference Assessment

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Background: Virtual reality technology (VRT) is frequently addressed as a possible approach for rehabilitation in individuals with autism spectrum disorder (ASD) by promoting improvement in social interaction abilities and executive function. However, few studies use fully immersive virtual reality setups and evidence on the ability of ASD subjects to interact in such environments in the same manner as they do in the real world is scarce.
Objectives: In this study we aim to evaluate the potential of VRT to assess behavioral measures in the study of interpersonal distance preference in ASD, interacting with an adult for conversation.
Methods: Five male teenagers with high-functioning ASD (9-12years, 10.8±1.64) and four neurotypical male teenagers (8-15years, 11.25±2.99) performed a stop-distance paradigm in two environmental settings: a real environment (open room) and its virtual replication. Participants were instructed to stop (or request it from the other person or avatar) when the interpersonal distance was comfortable for having a conversation. Two experimenters conducted the study: one male and one female of ages 25 and 30, respectively, without any previous contact with the participants. Once the participant established the distance, a waist-to-waist measure was taken with a digital laser measure. In the virtual replication, two virtual humans (VH) with the experimenters' apparent age were used. The experiment varied randomly in walking mode (approaching: starting away and walking towards; receding: starting close and walking away), the walking person (experimenter or participant), experimenter's gaze orientation (direct or averted) and gender of the experimenter. The same conditions were imposed in the virtual setup, where the user wore a head-mounted stereoscopic display (Oculus® Rift) and its position in the room was tracked via an infrared emitter (WorldViz® PPT), placing the participant in the virtual room matching his real position. When the participant established the distance to the VH, it was registered based on the virtual positions of him and the VH. Values were transformed into the eye contact distance. Statistical analysis were conducted with $\alpha=0.05$.
Results: Distances in the control group, for both real and virtual setups, matched a normal distribution ($p=0.2$ for real and $p=0.10$ for virtual setups), whereas ASD group did not ($p<0.01$ for both settings). Positive significant *Spearman's* correlations were found between real and virtual measured distances, for both ASD ($\rho(79) = 0.58$, $p<0.01$) and controls ($\rho(63) = 0.39$, $p<0.01$). In the ASD group, the real and virtual setups resulted in statistically equal distance evaluations (Wilcoxon signed ranks test: ṡ+=38.58; ṡ-=43.38; Z=-1.113; $p=0.27$; N=80). When comparing with the control group (Wilcoxon-Mann-Whitney test), the mean interpersonal distance of ASD group differed statistically in both real (U=2007; W=5247; $p=0.026$) and virtual setups (U=1812; W=5052; $p<0.01$).
Conclusions: Results indicate that the virtual setup achieved comparable results with the real setup. Moreover, differences from the control group found in both setups show that the computerized simulation was able to identify the deficits observed in the real environment. Such results enforce the idea that fully immersive technology might aid in the study and intervention in ASD, expanding the possibilities of rehabilitation techniques when incorporating this type of systems.

8   **137.008** Eye Tracking Analysis of Attention to Text for Children with Autism Spectrum Disorders

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Background: Despite the pivotal nature of learning to read, a sub-group of individuals diagnosed with autism spectrum disorder (ASD), typically those with co-occurring intellectual disabilities or speech and language impairments, lack the reading skills needed to achieve independence (Howlin, Goode, Hutton, & Rutter, 2004). Reading instruction for these children should therefore begin at an early age, with procedures known to enhance early literacy outcomes. However, it is currently unknown whether strategies that promote early literacy for typical children, such as print-salient, repetitive books coupled with simple words and print referencing, have the same impact on children with ASD.
Objectives: The primary objective of this study was to use eye tracking technology to examine how children with moderate to severe ASD differentially attended to pictures and text when presented with each on a computer screen. A second objective was to evaluate whether print referencing tactics (i.e., text highlighting) could increase the extent to which children attended to relevant textual and

pictorial cues.

Methods: Eleven children with moderate to severe ASD viewed two brief video displays, each lasting approximately 100 seconds, of textual and pictorial stimuli presented on a laptop computer. One display consisted of 14 unrelated slides of textual and pictorial stimuli and a second display consisted of a 13-page electronic book with related text and pictures across all pages. Presentation order was counterbalanced across participants. Eye gaze was assessed using the Tobii X2-60 portable eye tracking unit and Tobii Studio Professional Software. Using a within subject design, we compared total fixation duration (total seconds each child looks at the presented stimuli), total gaze directed toward text vs. picture, mean latency to fixation, and stimulus of initial fixation (text or picture) for each child during each video display.

Results: Some participants demonstrated higher levels of attention to stimuli in the unrelated slides and others to stimuli in the electronic book. Almost all participants demonstrated greater attention to pictures than to text, though print referencing tactics (highlighting) led to an increase in attending to text for some participants. In addition to statistical and visual analyses, we will demonstrate videos that depict the temporal path including fixations and saccades, as well as a video and audio recording of the child during the eye tracking session.

Conclusions: Overall, the participants in the present investigation were more likely to attend to pictorial and textual stimuli that was unrelated from one page to the next than to a repetitive electronic book. This is somewhat surprising given the consistent finding that children with ASD often perform better under predictable routines. The outcomes suggest print referencing, in the form of text highlighting, may be an effective early literacy intervention to increase attention to text among individuals with ASD. Eye tracking analyses of children with moderate to severe ASD when presented with pictures and text might provide important information that can be used to hypothesize potential early reading interventions for this group.

9   **137.009** The Effect of Gaze-Contingent Feedback on the Performance of Adolescents with ASD in a Virtual Reality Driving Environment

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Background: Increasingly researchers are attempting to utilize virtual reality (VR) environments as paradigms for potential intervention with individuals with ASD. Recent studies examining VR driving environments have suggested that individuals with ASD may demonstrate atypical gaze patterns during driving tasks (Reimer et al., 2013; Wade et al., 2014). Given potential differences of gaze pattern and information processing during driving tasks (Sheppard et al., 2009), VR platforms that integrate feedback regarding gaze patterns may represent powerful tools for teaching driving skills.

Objectives: With this work, we introduce the design of, and preliminary experimental results from, a gaze-contingent VR driving environment. This system extends our previous work by (1) generating targeted feedback aimed at correcting inappropriate gaze patterns, (2) integrating electroencephalography (EEG) data acquisition as an additional metric of driver state and (3) investigating the effectiveness of such a system on a sample population.

Methods: A novel VR driving module was linked to various data acquisition modules in a local area network in order to measure a range of signals from participants. Eye gaze information was collected using a remote eye tracking device from Tobii at a sampling rate of 120 Hz. This information included gaze position as well as fixation duration times for key regions of the virtual environment. Eight channels of physiological signals were wirelessly logged at 1000 Hz and included ECG, PPG and GSR. In addition, EEG data were recorded wirelessly at 128 Hz. Two groups of adolescents with ASD aged 13 to 18 years were recruited for this study. One group received targeted feedback based on both driving performance and gaze pattern while the other group received feedback related only to performance. Participants in both groups participated in 6 lab visits, each lasting approximately one hour. Seven individuals in the gaze-contingent group and 9 in the strictly performance-based group completed the protocol.

Results: Analysis of the data indicates that there are significant differences between the two groups with respect to gaze pattern. Interestingly, the group receiving gaze-related feedback seems to show a shift in gaze pattern towards a pattern more characteristic of TD individuals. The gaze position of this group was on average 1.13 cm lower and 1.11 cm further to the left than the gaze position of the group receiving only performance-related feedback. Further analysis remains for other measures of performance and gaze as well as for EEG and physiology.

Conclusions: Individuals with ASD demonstrate gaze patterns while driving that may not be safe for optimal driving. Dynamic feedback related to gaze pattern during driving may shift gaze patterns of individuals with ASD towards a more appropriate pattern.

10   **137.010** Littlehelper: Using Google Glass to Assist Individuals with Autism in Job Interviews

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Background: With the rapid increase in the prevalence of autism spectrum disorders (ASD) in 1990s (Gurney et al. 2003), there are approximately 50,000 individuals with ASD turning 18 years old every year (Shattuck et al. 2012). The community-based employment rate is quite low, ranging from 25% to 50% (Shattuck et al. 2012). The hallmark social impairments of ASD, most notably poor eye-contact and inappropriately modulated speech, may provide an inaccurate impression of one's ability. There has been little work in developing assistive technology to help individuals with ASD to overcome these social obstacles.

Objectives: To develop an application called LittleHelper on the Google Glass platform to assist individuals with ASD in maintaining appropriate eye contact and speech volume in an environment simulating a job interview with a single interviewer.

Methods: We rely on a face detector to detect the location of the interviewer's face. When the face is off-center, a red square will appear at the center of the display, and a flashing semi-transparent arrow will guide the user to turn so as to align the interviewer's face within the square. With the cooperation from a local server, LittleHelper progressively builds an image mosaic of the entire environment so as to locate the face if it falls out of the visual field. For the sound level detection, we use a temporally-smoothed root mean square (RMS) in measuring the sound level from the audio signal. We first train a noise floor level to adapt to the ambient sound level. This noise floor allows us to determine when the user speaks and the corresponding sound level. In an offline process, we determine the socially-acceptable voice volume as a function of the ambient noise level and the distance with the interviewer. The latter is estimated based on the size of the face as detected by the face detector. At real-time, we measure the voice level of the user and use a graphical slider to visually indicate if the level is within the acceptable range.

Results: We have measured the socially-accepted volume range based on the opinion of five subjects, in response to the same speaker speaking at different volume levels and at different distance from the subjects. The distance ranges from 0.5m to 3m at an interval of 0.5m. The voice detection and visual feedback are all computed in real-time locally at the Google Glass. To build the image mosaic, LittleHelper sends an image and the face location to a local server through Wi-Fi every one second to create the image mosaic (Brown and Lowe 2007). Figure 1 shows the two screen shots captured from the display when the Google Glass user followed the arrow towards the face and started speaking loudly.

Conclusions: We have designed a Google Glass app, LittleHelper, to help individuals with ASD to maintain proper eye contact and voice level during a job-interview-like setting. The current limitations include the requirement of a server to offload complex computation and the inability to handle multiple persons in a social setting.

11   **137.011**   Using Wearables to Augment Social Interactions for Adults with ASD

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Background: Leveraging the success of our android-based assistive application to support social skills (MOSOCO), we are building a tool on a Glass platform to further cut down on on the stigma associated with bulky assistive technologies by making a seamless tool that can be accessed without having to interrupt the social interaction it is supporting.

Objectives: The overarching goal of this work is to establish the effectiveness of using the Glass platform to support social skills for adults with ASD in real-time and identify the underlying mechanisms that support improvements in social interactions. To prepare our tool for a deployment study, we aim to ensure our users find the tool helpful and easy to use in social interactions.

Methods: We conducted design sessions with adults with ASD to advance of initial prototype supported by the Glass Accessibility Program.

Results: Using the Technology Acceptance Model, feedback from adults with ASD yielded user's values related to assistive technology that impacted our design.

Conclusions: Acceptability of a tool by the user is a critical component to ensure technologies are truly useful and support the values of the user.

12   **137.012**   Teaching Executive Function and Social Cognition Using a Kinect-Based Intervention Tool

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Background: Although many studies have demonstrated success in teaching social skills through various behavioral, developmental, and psychological approaches, these interventions are typically costly and/or are not available in many communities. In addition, social skills groups or teaching social skills in busy, social settings such as school may be overwhelming to some children and may impact the child's ability to learn the skills being taught. The majority of the social skills interventions that have shown success do not necessarily include access to neuro-typical peers or even measure the generalizability to their peers. To successfully learn social skills, certain cognitive skills such as planning, memory, and flexible thinking (i.e. executive function skills) may be necessary. Few social skills interventions consider this prerequisite and this may affect outcomes for some students.

Objectives: While decreasing cost and increasing accessibility, the objectives of this project are to: 1) develop a KINECT-based game that effectively teaches executive function and social skills while

keeping motivation for learning high and sustainable; 2) measure the effectiveness of the game in teaching the target skills with school-age ASD children who do not have intellectual impairment; 3) assess the usability of the system in the home environment with parent implementation; and 3) measure the generalization of the skills being taught in typical peer interactions.

Methods: A single subject, multiple baseline design was implemented with 8 children in 1-4 week baselines. Each child received the intervention in the home via the KINECT system for 20 minutes/session for 5 sessions each week for 6 weeks for a total of 10 hours of intervention. During baseline and following the intervention, participants were observed in a naturalistic gaming sessions with neurotypical peers, with parents, and alone to test the generalization of the skills learned through the gaming system.

Results: Data are being analyzed to assess the effectiveness of the intervention including standardized measures of executive function and social skills, and behavioral observations coded by blind raters. Data will also look for strong indicators of characteristics of children and parents who may be best suited for this type of intervention.

Conclusions: If executive function and social understanding can be taught in an efficient, effective, motivating, generalizable and feasible way using technology, this could have huge implications for how treatment is delivered. This kind of technology could allow individuals with ASDs, and potentially other populations, to practice and learn social rules in a safe and predictable environment, and then practice the skills with peers in the natural environment. Results from our research, video clips of children using the game, and an interactive display of the KINECT game will be demonstrated.

13 **137.013** Socially Animated Machine (SAM): A Novel Design for Robotic Research in Children with Autism Spectrum Disorders

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Background:
Children with Autism Spectrum Disorder (ASD) display significant impairments in social communication that can have serious implications for long-term social and emotional functioning. Recent research suggests the value of using robots to improve social communication. Researchers investigating robots as tools for therapy in ASD have reported increased engagement and novel social behaviors (i.e., turn-taking, imitation, joint attention) when robots are part of the social interaction. Although a wide variety of robotic designs have been employed in previous studies, research shows that children with ASD respond more positively to robots that are cartoonish than robots that take on a humanoid form. However, as these animal-like robots typically offer only a limited range of facial expressions, they may not translate well to the human face and therefore skills learned within the session may fail to generalize to real-world social situations.

Objectives:
The overall objective of this study is to design a novel social robot, or Socially Animated Machine (SAM), with a unique mix of anthropomorphic and non-humanoid features. The aims of this study are to 1) conduct a pilot study to explore whether SAM is capable of forming complex facial expressions similar to those observed in the human face, and 2) conduct a usability study to examine the acceptability of SAM.

Methods:
Approximately 100 typically developing children ranging from 7-12 years will participate in the pilot study. These children will be asked to label and match photos of SAM expressing various emotions to schematic drawings and photos of human faces displaying these emotions. Approximately 20 children with ASD ranging from 7-12 years will participate in the usability study. These children will participate in a fifteen-minute social interaction with SAM. During the interaction, level of engagement will be measured based on eye-gaze patterns using faceLAB[TM] eye-tracking technology. Self-reported levels of enjoyment will also be measured using ten-point Likert-type scale items.

Results:
Preliminary results of the pilot study (N=9) suggest that typically developing children are able to label SAM's emotions with 67% accuracy and match SAM's emotions to schematic drawings and human expressions with 69% and 54% accuracy, respectively. Preliminary results of the usability study (N=8) suggest that children with ASD are able to maintain gaze on SAM's face during the social interaction. Children who completed the robot-based interaction reported feeling very happy (M=9.57, SD=1.13) and comfortable (M=10, SD=0) while talking with SAM. They were also very eager to have an additional interaction with SAM (M=9.86, SD=.38).

Conclusions:
Preliminary findings suggest that SAM is capable of forming facial expressions that can be labeled and matched with adequate accuracy. The degree of accuracy is expected to increase with a larger sample size. Additionally, results indicate that children with ASD are engaged and enjoy interacting with SAM. Overall, these findings suggest that SAM's robotic design helps to fill the void in current research by offering an animal-like, approachable appearance while still maintaining some subtle details of the human face. Additional data collection is expected to clarify and strengthen results.

14 **137.014** Social Personalized Human-Machine Interaction for People with Autism: A Close Look at

Proprioceptive and Visual Orientation Integration

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Background: Research in socially assistive robotics (SAR) is in expansion, and enable to propose more personalized social learning environments for individuals with Autistic Spectrum Disorder (ASD)(Feil-Seifer2005;Tapus2012), to cope with their impaired skills in communication and social interaction while using their affinity towards robots(Hart2005). Individuals with ASD also suffer from visual and sensorimotor impairments (Haswell2009;Greffou et al.2012).
Objectives: We work in collaboration with 2 care facilities (MAIA Autisme;FAM-La Lendemaine) with the final objective to propose a personalized human-robot environment for social learning. We hypothesize that the individual's reliance to proprioceptive and kinematic visual cues will affect the way s/he interacts with a robot. Hyporeactivity to visual motion of the scene and overreliance on proprioceptive information is linked in ASD subjects to difficulties to integrate social cues and to engage in successful interactions. Our present research defines each participants' perceptivo-cognitive and sensorimotor profile with respect to the integration of visual inputs.
Methods: Our subject pool is composed of 7 autistic adults (26.1±7.9years), 6 autistic children (10.9±1.8), and 7 typically developed adults (21.8±10.3). We evaluated the participants' profiles with two methodologies. First, the Sensory Profile and the Adolescents/Adults Sensory Profiles (AASP) developed by Dunn (1999,2002) were filled in accordance with participants' age. In addition, in order to have homogeneous scores between age groups to assess Movement, Visual, Touch, and Auditory processing, we matched and adapted the items with a special care on their belonging of neurological threshold and behavior response/self-regulation. Second, we designed an experimental setup to assess the effect of a moving virtual visual scene (VVS) on postural control, and the individual's capability to use proprioceptive inputs provided in dynamics of balance to reduce visual dependency(Isableu et al.2011). Participants were asked to stand quietly in postural conditions of increasing balance difficulty (normal vs tandem Romberg) in front of a virtual scene rolling at 0.25Hz with an inclination of ±10°.
Results: We observed a correspondence between AASP patterns and postural behaviors. A higher movement sensitivity in AASP leads to greater postural stability, and postural sway is less driven by VVS. A visual sensation seeking behavior also leads to smaller postural responses to VVS and a higher visual sensitivity leads to a greater postural coupling response with VVS. A relation between age and postural instability has been found, but not between age and postural response to VVS. Clustering analyses allowed us to identify 3 groups with significant different behavioral responses: (G1)strong visual independence to VVS suggesting an overreliance on proprioceptive input, (G2)moderate reactivity to VVS suggesting a reliance on both visual and proprioceptive input, and (G3)hyperreactivity to VVS suggesting a weak proprioceptive integration and strong visual dependency.
Conclusions: Our work permits us to characterize 3 groups within our participants. These results will help us to model customized Human-Robot Interaction sessions and adapt the robot's behaviors as a function of the participants profile (dependence on visual and proprioceptive input).

15   **137.015**   Using Robots As Therapeutic Agents to Teach Children with Autism Recognize Facial Expression

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Background: Recognizing and mimicking facial expressions are important cues for building great rapport and relationship in human-human communication. Individuals with Autism Spectrum Disorder (ASD) have often difficulties in recognizing and mimicking social cues, such as facial expressions. In the last decade several studies have shown the individuals with ASD have superior engagement toward objects and particularly robots. However, majority of the studies have focused on investigating robot's appearances and the engineering design concepts and very few research have investigated the effectiveness of robots in therapeutic and treatment applications. In fact, the critical question that "*how robots can help individuals with autism to practice and learn some social communicational skills and applied them in their daily interactions*" have not been addressed yet.
Objectives: In a multidisciplinary research study we have explored how robot-based therapeutic sessions can be effective and to what extent they can improve the social-experiences of children with ASD. We developed and executed a robot-based multi-session therapeutic protocol which consists of three phases (i.e. baseline, Intervention and human-validation sessions) that can serve as a treatment mechanism for individuals with ASD.
Methods: We recruited seven (2F/5M) children 6-13 years old (Mean=10.14 years), diagnosed with High Functioning Autism. We employed NAO, a programmable humanoid robot, to interact with children in a series of social games for several sessions. We captured all the visual and audio communications between NAO and the child using multiple cameras. All the capturing devices were connected to a monitoring system outside of the study room, where a coder observed and annotated

the responses of the child online. In every session, NAO asked the child to recognize the type of prototypic facial expression (i.e. happy, sad, angry, and neutral) shown on five different photos. In the 'baseline' sessions we calculated the prior knowledge of every child about the emotion and facial expression concepts. In the 'intervention' sessions, NAO provides some verbal feedback (if needed), to help the child recognizing the facial expression. After finishing the intervention sessions, we included two 'human-validation' sessions (with no feedback) to evaluate how well the child can apply the learned concepts when a human is replaced with NAO.

Results: The following Table demonstrates the Mean and Standard Deviation (STD) of face recognition rates for all subjects in three phases of our study.

Facial Expression Recognition Rate(%)	Baseline	Intervention	Human-Validation
Mean(STD)	**69.52(**36.28)	**85.83(**20.54)	**94.28(**15.11)

Conclusions: The results demonstrate the effectiveness of NAO for teaching and improving facial expression recognition (FER) skills by children with ASD. More specifically, in the baseline, the low FER rate (69.52%) with high variability (STD=36.28) demonstrate that overall, participants had difficulty recognizing expressions. The intervention results, confirms that NAO can teach children recognizing facial expressions reliably (higher accuracy with lower STD). Interestingly, in the human-validation phase children could even recognize the basic facial expressions with a higher accuracy (94%) and very limited variability (STD = 15.11). These results conclude that robot-based feedback and intervention with a customized protocol can improve the learning capabilities and social skills of children with ASD.

16 **137.016** Affect and Social Behaviors of School-Aged, High Functioning Children with ASD during Robot Interaction

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Background: Recent group studies confirm earlier case study observations that social robots both elicit and mediate adaptive social behaviors in children with autism spectrum disorders (ASD). Robots have the potential to serve as powerful reinforcers in communication and social skills interventions. Previously, we found that a social robot mediates greater speech production than an adult in a cross-sectional group of school-aged children with high-functioning autism spectrum disorders (HFA) (Kim et al., 2013).

Objectives: To explore and enrich our understanding of increased speech production mediated by interaction with the social robot, in terms of participants' affect and engagement behaviors.

Methods: Participants were school-aged children with high-functioning autism (N = 26; ages: M = 9.4 SD = 2.4; FSIQ: M = 94.2 SD = 11.7; diagnoses confirmed by clinical best estimate using ADOS). Each completed brief, semi-structured, triadic interactions with a confederate and either a social robot or another adult, in randomized crossover. Using qualitative, Likert-scale measures, two independent raters judged video recordings of these interactions on the adaptive quality of social, regulatory, and affective behaviors. Measured behaviors included 1) affective valence; 2) quality of eye contact; 3) willingness to engage in social physical contact (e.g., shaking hands with the adult or petting the robot); 4) acknowledgement of confederate's or interaction partner's spoken or nonverbal bids; and 5) number of increasingly restrictive cues required to elicit response to a question or an instruction to act. Interactions with the confederate and interaction partner were judged for each behavior. Where ratings disagreed by differences greater than one, raters discussed their ratings and achieved consensus.

Results: Children with HFA exhibited more positive affect during interaction with the robot than during interaction with the adult (p < .001; d = 0.97). When interacting with the robot, children also exhibited better eye contact (p < .001, d = 0.97), greater willingness to engage in physical touch aspects of the structured interaction (p < .001, d = 0.71), and better acknowledgment of the interaction partner's social overtures (p < .001, d = 0.98), than when interacting with a human adult. Previous findings of increased utterance production during robot interaction, as opposed to interaction with the adult partner, were positively correlated with eye contact ratings (r = .467, p < .05) and positivity of affect (r = .402, p = .052) during interaction with the robot, but not during interaction with an adult (r = -.02, r = .08, respectively).

Conclusions: Our explorations suggest that children with HFA who enjoyed interacting with the robot, or who demonstrated better eye contact, showed greater robot-mediated behavioral improvement (as measured by speech production). We also found that children with HFA enjoyed interacting with the robot more than with the adult interaction partner. These results shed light on the mechanisms by which robots may facilitate communication in children with ASD. Further work will need to examine the sustainability of these increases over extended usage, en route towards the development of more automated tools to provide additional learning opportunities to individuals affected with ASD.

17 **137.017** Understanding Interaction Dynamics in Socially Assistive Robotics with Children with ASD

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We present a novel analysis of an existing dataset examining one-on-one interactions between children with an ASD diagnosis and a robot. We conclude that children's reaction to the robot can vary on a continuum of object-to-agent, at least partially independent of the designers' intent. We also find that some behaviors meant to promote social responses may inadvertently inhibit them by promoting other, conflicting behaviors.

Background:
An increasing body of work in human-robot interaction for socially assistive robotics (SAR) for children with ASDs points towards the value of SAR as an intervention tool (Scassellati, Admoni, and Matarić, 2012). Our work contributes to this area by extending our understanding of children's behavior using dynamics of the interaction to understand children's perceptions of robot agency.

Objectives:
Based on a qualitative evaluation of the video data from the study, we defined the following broad hypotheses:

1. For the children who spoke most, the robot's bubble-blowing distracted from the interaction;
2. For the children who spoke least, the robot's bubble-blowing engaged them in the interaction;
3. Differences in behavior were more a function of individual reactions than the implemented differences between the robots and can be classified into agent-like vs. object-like treatment of the robot.

Methods:
The data discussed in this abstract come from a prior experiment described in Feil-Seifer and Matarić (2012); the analysis and results described are new. The data were hand-coded for 20 robot, child, and parent behaviors. In order to model the dynamics of behavior, we examine ordered pairs of events (first A happened, then B). In addition, we use a clustering algorithm to group sessions based on participants' behavior.

Results:
We find limited differences in the behavior of children across the original experimental conditions. However, we find correlations between their overall speech and their reactions to the robot's bubble-blowing behavior, suggesting that the behavior is not beneficial with more verbal children, while it can be a way to engage less verbal children. Our clustering uncovers a more meaningful classification based on the child-robot interaction pattern: while some children are highly engaged with the robot verbally (as if with an agent), other children are more engaged with the button pushing or movement behaviors (as if with an object).

Conclusions: One of the most exciting aspects of SAR for children with ASDs is the potential for robots that can support therapeutic goals. We suggest the division of robot behaviors into agent-like and object-like, and the customization of the robot's role to an individual child's needs.

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18 **137.018** A 3-D Learning Environment for Infants and Toddlers at-Risk for ASD: Can Technology Improve Early Social Communication Vulnerabilities

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Background: Early detection and intervention is critical to optimal treatment for children with ASD. [1, 2]. Technology-assisted intervention approaches are being considered due to their potential flexibility, controllability, duplicability, and overall lower costs when compared to traditional human dominant intervention [3-5]. However, very few systems have been designed for infants and toddlers. In the current work we present a proof-of-concept system designed to enhance early social orienting, specifically enhancing early response to name within a three dimensional technological learning environment.

Objectives: We designed a closed-loop, computer-assisted intervention system for potential future use with infants and toddlers at risk for ASD. The system incorporated a series of target monitors, a non-contact eye-tracking system, and a series of audio and visual cues within a reinforcement hierarchy designed to improve children's social orienting within this technological environment. The system was designed to operate in closed-loop fashion (i.e., automatically responded to estimated child gaze to activate components of the hierarchy) in real time. The ultimate goal of the current system was to create a technological learning environment that systematically enhances a child's ability to respond to caregiver's attempts to garner attention by calling his/her name from a variety of

locations.

Methods: The name prompting system encompassed a series of coordinated target monitors within a room. These monitors would initially display a name press (i.e., recording of individual calling child's name) and activate an internal prompt hierarchy based on estimated child gaze in real time. If the child did not look at the target monitor when name was called, then coordinated visual/audio attention attractors appeared based estimated gaze in order to cue for orientation to correct target. When the participant looked at the target monitor, then social and non-social reward videos and animations were displayed to reinforce this orientation. The attention tracking system computed orientation in real-time via vision driven head pose estimation algorithms. This data was fed back into system to further advance the experimental protocol. In order to test system feasibility 7 typically developing infants and toddlers (all under 2) participated in a coordinated series of 10 trials within the system. Trials were interspersed with introductory, transition, and conclusion activities to familiarize children with the system.

Results: All the participants tolerated the system well with all infants and toddlers completing the entire experiment. The participants' performance was well distributed across the prompting levels with in excess of 98.57% of all trials ultimately resulting in correct orientation. Preliminary data also suggest that the attention attractor was capable of shaping participants' attention to the target position.

Conclusions: This work provides preliminary support for the feasibility for employing technologies with very young children potentially at risk for ASD. The development of robust technological systems capable of addressing meaningful core early social communication vulnerabilities prior to the full manifestation of ASD impairments may represent new paradigms for intervention science.

19 **137.019** The Benefits of Online Play: An Investigation of Virtual Worlds for Children with Autism Spectrum Disorder

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Background: Children with autism and their families participate in virtual worlds, a persistent digital environment which participants can access via the internet and interact with one another. Previous work has shown how parents create safe online environments within virtual worlds for their children with autism to play and socialize without fear (Ringland et al., 2015). Play is an important part of childhood development and these virtual worlds provide a space to play that is free from bullying and harassment, dangers often encountered in other environments children with autism play in. Minecraft is an open-ended, free-play type of game, where players can interact in a virtual world with no particular goals or play requirements. The open-endedness of Minecraft allows for an expression of individuality and creativity during play, which may make the game particularly compelling for players. Minecraft allows players to interact with others and be as socially engaged as the individual player desires in a procedurally generated virtual world. This allows for a freedom of expression and open play for children participating in a Minecraft virtual world. Parents have created and maintain a Minecraft virtual world specifically for their children with autism.

Objectives: To explore the role that virtual worlds play in the daily lives of children with autism, including potential therapeutic benefits.

Methods: This work reports on results from an ongoing digital ethnography. The digital ethnography includes immersive participant observations in the virtual world, analysis of digital artifacts associated with the virtual world's community, and in-depth, semi-structured interviews with players of the virtual world. This study is structurally similar to others conducted with disability communities in virtual worlds, such as Irani et al.'s work in Second Life (2008). In-world observations include participating in activities on the server, recording dialogue as it appears in the chat, and writing extensive field notes on everyday practices and events as they occur in the virtual world. Researcher participation in the world also included building an in-world home office that acts as a home-base for in-world activities and enabled other players to visit and ask the researcher questions, as the researcher's presence and purpose were made clear to the community through announcements on Autcraft web forums and through in-world chat. We used an inductive approach to derive the emergent themes from our data, following techniques similar to those employed in grounded theory.

Results: We will present the results of our observations and interviews to illustrate how families of children with autism integrate technology such as virtual worlds into their daily living and how these types of play may be beneficial.

Conclusions: Virtual worlds have the potential to be an important part of a child with autism's daily living experience. Members of the Minecraft virtual world form relationships with each other and participate in group-play, which is an important part of development for children with autism.

20 **137.020** ASC-Inclusion – a Virtual World Teaching Children with ASC about Emotions

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Background: Children with Autism Spectrum Conditions (ASC) experience difficulties communicating their own emotions and recognizing the emotions of others. These difficulties appear in different modalities, including facial expressions, vocal intonation, and body language. Such deficits may hamper the social functioning of children with ASC and increase their exclusion. Alongside these difficulties, individuals with ASC tend to have intact and sometimes superior abilities to comprehend and manipulate closed, rule-based, predictable systems, such as computerized environments, and may better learn from them than from non-structured settings. 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. Harnessing these qualities for the sake of emotion recognition and expression training, children with ASC may be more motivated to learn about the emotion world through virtual computerized environments.

Objectives: To demonstrate the up to date status of the ASC-Inclusion project, as well as a summary of open trials of the system, conducted so far.

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. Two additional features were added this year, addressing parent-child collaborative use of the system, and computer's formative assessment of feedback to users. When complete, the system is planned to be available for home or school use, and as an aid to therapists. An iterative process of testing, feedback and evaluation supports the system's development. So far, the system has versions in four different languages: English, Hebrew, Swedish, and Polish.

Results: The current presentation will demonstrate:
1. The system at its open trial evaluation status: its virtual world and emotion recognition training in the different modalities, as well as the expression training components, using the above technologies for analysis and feedback on the children's' performance. The environment, tutorials and games presented have been evaluated and approved by our panels of families and professionals.
2. Preliminary results of the open trials conducted with 30 children per site in the UK, Israel, Sweden, and Poland.

Conclusions: The ASC-Inclusion project offers children with ASC and their families the benefit of state of the art educational technology for enhancement of their socio-emotional communication repertoire. A multi-site evaluation of the project is in process and preliminary results will be presented.

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21   **137.021** Design of a Collaborative Virtual Environment to Foster Collaborative Skills for Children with ASD

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Background:
Researchers are increasingly exploring virtual reality environments as potential intervention platforms for children with autism spectrum disorder (ASD). To date much of this work has focused on interaction with preprogrammed and/or confederate avatars in hopes that such interactions may foster higher level social communication skills. Such systems are often limited by the programming burden of realizing fluid social communication paradigms and/or restraints in the flexibility of employing confederate partners. Another paradigm with potential use in ASD intervention may be distributed Collaborative Virtual Environments (CVEs). CVEs may represent safe, flexible environments for children with autism to communicate and interact with one another and/or peers. Further, controlled tasks may be designed within the environments that may ultimately enhance interaction skills, with potential for generalization, without relying on preprogrammed or facilitated interaction.

Objectives:
In the current work we present a novel CVE environment with the potential capability of promoting communication between children with autism and their peers. This CVE utilizes a flexible conversation environment, instead of a limited and predefined conversation environment, across a series of collaborative task where the interaction is governed by contingent cooperative behavior of the participants.

Methods:
Our CVE was developed with Unity3D game engine (http://unity3d.com/). A series of seven block pattern games were designed in a shared virtual environment, which can be accessed by two users from different locations through internet. The connection between two agents was realized using network socket. The distributed users communicate by voice in real time in the CVE. The interaction was governed by implicit rules that required cooperation and communication in order to achieve

success (e.g., turn taking of varied intervals, tasks where participant had to simultaneously move the mouse to achieve success, and tasks where participants required their partners to identify colors of blocks not visible to them to achieve success). Quite simply tasks were designed such that participants would have to communicate with their partners in order to achieve success.
Results:
The Unity-based CVE system has been developed with seven different collaborative tasks. We were able to achieve real-time voice interaction and registration of cooperative movement within task. We conducted initial pilot and interview/feedback sessions with 3 adult participants. All participants indicated that the contingent activities both (1) required them to think about collaborative strategies for communicating with their partner and (2) that they enjoyed completing the puzzles. Participants also indicated a degree of frustration with the system noting that the tasks seemed to require very precise coordination of activities that was hard to achieve.
Conclusions:
Initial pilot feasibility results supported the potential value of CVE in fostering collaboration and communication skills for participants. Our CVE may offer a way to explore and train the collaboration skills of children with autism beyond the limits of traditional VR paradigms. Opportunity of feedback from verbal and nonverbal (eye gaze) information may represent a future enhancement of this paradigm.

22   **137.022**   Generative Language Learning in Severe Autism: Experimental Evaluation of a Mobile Application

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Background: Severe autism includes a "delay in, or total lack of, the development of spoken language". Many learn to communicate through alternative means such as tablets and mobile technology. However, utterances on these devices are often very limited; minimally-verbal individuals with autism do not surpass single-word responses limited to requesting and labeling purposes, and vocabulary repertoires are small. Matrix training is a language intervention to systematically build up vocabulary and teach longer word combinations to produce more complex utterances. In this generative approach to instruction, words are arranged in a matrix format so that some multiword phrases are taught and others develop without direct instruction. Specifically, linguistic elements (e.g., nouns, verbs, etc.) are presented in systematic combination matrices, which are arranged to induce generalized rule-like behavior, a particular difficulty in autism.
Objectives: A mobile application, SPEAKmore!, was developed to carry out matrix training on a tablet device (see Figure 1). This study aimed to answer

1. Does language training with SPEAKmore! facilitate production of action-object combinations on a tablet device? This was accomplished by measuring the percentage of correct target forms in intervention probes.
2. Do newly learned skills generalize to untrained action-object combinations. This was achieved by taking generalization probes during the intervention phase assessing performance on combinations that were never taught before.

Methods: An experimental single subject design, that is a multiple probe design (Horner & Baer, 1978), was used across sets of action-object combinations with generalization probes of untrained combinations. This design is currently implemented with five participants, who are between 8-12 years old, have an official diagnosis of severe autism according to CARS-2 and ADOS-2 scores, qualify as minimally verbal by having no more than 10 spoken words, and communicate primarily on a tablet. These students were taught action-object combinations on a 6x6 matrix with SPEAKmore!. From the total pool of 36 possible symbol combinations, the researcher created four different sets of three symbol combinations each that were actively taught. The remaining 24 combinations were tested for generalization effects.
Results: Preliminary results are available for two of the five participants. Figure 2 shows participants' performance measured as the percentage of correct symbol combinations. Both participants demonstrate a similar pattern of successful acquisition of word combinations during the intervention condition and subsequent generalization to untrained stimuli. Within three intervention sessions, both participants reached over 80% correct and their performance remained at this level. Performance on generalization increased steadily for both over the course of intervention. Effect sizes as measured by the Non-overlap of all Pairs Index indicate a medium-strong effect for participant 1 and a strong effect for participant 2.
Conclusions: Results suggest that matrix training through a mobile application may be a promising approach to teach new vocabulary and enhance the complexity of utterances for tablet communicators with severe autism. To further investigate the robustness of this technology intervention, findings need to be replicated using (a) different language targets (e.g., agent-action, adjective-object combinations), and (b) expansions from two-term to three-term semantic relations (e.g., agent-action-object).

23   **137.023**   Creating Exploratory Touch-Screen Games That Include Novel and Surprising Aspects As

Motivators of Communication for Children with Autism

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Background: Unpredictability and "lack of sameness" are frequently stressful for children with ASC. However, work with the ECHOES virtual environment suggests that novel and surprising aspects (i.e. *discrepancies*) can be experienced as interesting, positive motivators of communication when present in a technology alongside substantial sameness. ECHOES deliberately included novelty (e.g. new digital objects), however, intermittent software errors also caused *unintentional* surprises, such as the character making "mistakes" in an activity he had previously demonstrated correctly. Children were observed to frequently and spontaneously initiate to social partners about these discrepancies (Alcorn, Pain, & Good, 2013). Subsequent qualitative and quantitative analyses of child-ECHOES interactions, combined with "lessons learned" from school studies, have identified characteristics that may have allowed discrepancies to be perceived as motivating but still emotionally manageable. These have been formulated as six high-level principles intended to support transfer of "motivating but manageable" discrepancies to new designs: establishing and maintaining *integrity* of the environment and activities, ensuring *flexibility* and *resolvability* of child-system interactions, and offering wide *variety* of discrepancies at an appropriate *frequency*. These should pose *ambiguous* opportunities for communication, rather than demanding specific behaviours or communicative forms.
Objectives: To reproduce the phenomenon of discrepancies as positive communicative motivators for young children with ASC, in a new interactive technology.
Methods: Transfer lessons learned from ECHOES to the design of three new touch-screen games, guided by the high-level principles for incorporating discrepancies.
Results: Games draw upon the original ECHOES "Magic Garden" setting, cause-and-effect play, and exploratory, non-competitive format (originally developed with extensive stakeholder input). One involves sorting apples by colour; two centre on growing flowers or vegetables by shaking a magic cloud. Each has a "baseline" and a "discrepant" version. The main source of novelty is the child initially encountering digital objects and forming expectations about their behaviours. After baseline versions are familiar, additional objects and properties are introduced in discrepant versions. Surprises include altered object appearances, sound effects, and timings between events. The character also makes occasional "mistakes" with his actions and utterances. These things are expected to interest children and pose opportunities for them to spontaneously initiate communication for a range of goals (e.g. share information or affect, ask question, request), and using any behaviours (e.g. speech, gestures, gaze).
Conclusions: Three games were successfully developed, embodying principles thought to effectively motivate spontaneous communication using discrepant aspects. This process has highlighted that designing "motivating but manageable" games requires concurrently designing how they will be used. For example, the *integrity* principle determined the need for baseline versions which children should play multiple times in order to develop clear expectations—a pre-requisite for violating expectations later (i.e. surprises). Establishing sufficient "sameness" to counterbalance discrepancies will always partly rely on variables *outside* the game itself, including the physical environment, social partner actions, and the frequency and duration of game play. The principles must be realised collectively in the technology *and* its context.
Preliminary results will soon be available from games testing with children, as the first step in gauging their success at motivating communications.

24 **137.024** Design and Assessment of a Web-Based Training Tutorial Developed to Empower Parents with the Knowledge and Skills Necessary to Effectively Improve Their Child's Communication and Behavior during Daily Activities

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Background: There is a growing consensus that early intervention strategies can significantly improve long-term outcomes for children with autism and their families. Due to a critical shortage of trained professionals in this area many children who are eligible for early intervention services do not receive them. One way to bridge the gap between the need for services and their availability is to provide access to the information parents need to foster their child's development within daily interactions at home. More effective interactions would improve long-term outcomes by helping to remediate the core deficits associated with the disorder and reduce caregiver stress. While successful parent training programs have been developed, access to such programs is limited due to the lack of trained clinicians providing such services. One powerful way to increase the accessibility of this program is through web-based technologies.
Objectives: To develop and evaluate the feasibility and efficacy of technology-based, multi-media, interactive tutorial ("Enhancing Interactions"), which utilizes the principles of instructional design to help caregivers identify individual steps in everyday routines that can help to move a child from intolerance of an activity towards independent participation and engagement.

Methods: 96 parents with a child between 18 months to 6 years of age with autism enrolled in the study. Mean age of parents was 34 (range 21-52).   The sample was 4% African American, 88% Caucasian, 2% Asian, and 6% other. 30 percent received their child's diagnosis within the past 6 months. Participating parents were randomly assigned to either "immediate" participation or "delayed" participation (i.e., completing the program after an eight week waiting period, following post-test measures). Pre- and post-test scores of parents' knowledge of the concepts presented in the tutorial were used to evaluate teaching effectiveness. For parents assigned to the immediate participation group, user satisfaction was gauged with The System Usability Scale (SUS) (for technical aspects) and the User Satisfaction Questionnaire (for tutorial content). Group comparisons in behavioral change in parenting skills and child behavior over the 8 week period was assessed with the Parent Interview of Autism-Clinical Version (PIA-CV), Parent Efficacy Scale (PES), and parent questionnaires. Changes in parenting stress were assessed by the Parenting Stress Index/Short Form (PSI/SF).

Results: Previous analyses of the Enhancing Interactions content show an increase in the number of correct items on a test of concepts, from 12.6 to 20.4 (t=10.72, p<.001.) and an increase percentage of participants receive passing scores from pre- to post-test (8% compared to 80%). Survey data collection is ongoing and scheduled to be complete in 8 weeks. Full analysis of changes in parental stress levels and in child and parenting behaviors will be presented.

Conclusions: We have developed a customize approach to teaching parents how to use daily activities as a context for enhancing their child's interactions and communication skills. By targeting a child's daily routines and interactions, the tutorial shows potential to provide a means for caregivers to feel empowered with the knowledge and skills necessary to effectively help soothe the pressures created by autism.

25   **137.025** Investigating the Usability of a Tablet-Based Interface for Management of Anxiety-Related Arousal in Children with Autism Spectrum Disorder

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Background: Comorbid anxiety is a significant concern in autism spectrum disorder (ASD) due to its high prevalence, negative impact on physical and psychological well-being, and interaction with the core deficits of ASD. Current methods for assessment and treatment of anxiety rely on the observation of behaviour or self-reports, which are often ineffective in children with ASD due to known deficits in communication and diminished introspective ability. To reduce these barriers, we have developed a device, called the Anxiety Meter, that translates a user's heart rate into a visual display of arousal level. The Anxiety Meter interface consists of a tri-colour gradient (red, yellow, and green) with a moving bar to mark the user's level of arousal in real time.

Objectives: Evaluate the usability of the Anxiety Meter interface in a sample of children with ASD.

Methods: A sample of children with ASD (n=9; age: 10.7 +/- 1.8 years; full-scale IQ: 101.4 +/- 11.2; 6 male) completed device training and one anxiety-inducing task (public speaking), preceded and followed by a baseline task (movie-watching). For the anxiety-inducing task, participants were given 2 minutes to prepare for a 3-minute speech on a topic of their choice. Participants sat in front of a tablet computer with the Anxiety Meter placed at eye level and were asked to indicate when they recognized they were anxious through pressing a button. Usability was evaluated according the to the ISO 9241 Standard using measures of interface effectiveness, efficiency, and user satisfaction. Interface effectiveness was defined as the user's ability to recognize arousal states. Efficiency was measured as the time between indication of arousal on the device and the user's recognition of the arousal level. Satisfaction was evaluated based on a user-rated likeability score from 1 to 5.

Results: Users were detected anxiety states indicated by the device with sensitivity and specificity of 0.7±0.3 and 0.9±0.2, respectively (effectiveness). Average time needed for recognition of anxiety states across participant was 70.6±48.5 seconds (efficiency). The likeability of the application was rated as 4.1±0.9 (satisfaction). Based on these results, the main usability issue identified was the need for an auditory or tactile indicator to user attention during arousal states. Participants also suggested personalization of gradient colors.

Conclusions: Our results suggest that the Anxiety Meter interface is usable for children with ASD, though there is a need for an auditory or tactile signal to gain user's attention during arousal states. Future studies should investigate the clinical effectiveness of the device in improving awareness of arousal signs in this population.

26   **137.026** Seeing the Doctor without Fear: Systematic Desensitization for Medical Visits in ASD

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Background: People with asd not only have greater medical needs than the rest of the population (Gurney, McPheethers and Davis, 2006), but they also have particular characteristics that make it very difficult for them to get the medical services (need for anticipation, lack of flexibility, problems identifying and describing symptoms, hypersensitivity to certain stimuli, stress over waiting times, etc.). Going to a medical visit can be a traumatic experience for people with ASD and their families.

Objectives: To respond to this difficulty an important Spanish Hospital together with a private foundation are developing a free software and a Web called "Doctor TEA" for desensitization before medical visits. The project explain with cartoons, pictograms and movies several medical services so people with ASD can anticipate the event and feel less stress.
Methods:
The project will focused on the following:
-To design, implement, and evaluate a program based on
new technologies that make the medical environment more
familiar and less stressful to patients with ASD before, during,
and after a hospital visit.
- To evaluate the effectiveness of this program for reducing
patient stress and anxiety, improving the family's quality care
perception, and reducing medical visit time.
Results: The project design software is built on a Web platform with a set of structured contents (in film format of a real hospital, in 2D and 3D) showing the physical spaces, medical professionals, techniques, and instruments used during a medical examination, including many interactive games. The project is freely available at www.doctortea.org
Conclusions: Daily clinical practice demonstrates that with preparation and specific training in reducing sensitivity to medical procedures, patient anxiety is considerably reduced. The reasoning behind this program, which will be freely available to the public in the future, is to try to demonstrate that information, communications and technologies (ICTs) can help people with autism to anticipate and understand medical visits and tests that any hospital or health centre may perform.

27   **137.027** A Smartphone Application Designed for Teaching Emergency Safety Skills to Children with Autism Spectrum Disorders

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Background: Safety in emergency situations is a major concern for parents of children with Autism Spectrum Disorders (ASD). Many children with ASD demonstrate a lack of safety awareness and may be more at risk of injury than typically developing children. Training children to recognize emergencies, dial 911 and communicate to a dispatcher can save lives.
Personal mobile smartphones are rapidly replacing landline phone use and children are reported to be the largest new user group of mobile technology. However, due to the complexity of mobile smartphone devices, compared to landline phones, children may not know how to access the emergency call function, bypass a passcode, access the phone keypad, and/or dial 911 on a mobile device. Further, 911 dispatchers are often unable to verify a location from a mobile phone call and therefore require a caller's report of their address and/or location, name, and emergency.
Applied Behavior Analysis (ABA) has been shown to be an effective way to teach children with ASD new target skills. The Behavior Skills Training (BST) model (i.e., instruction, modeling, rehearsal and feedback) is an effective way to teach emergency skills. Given the unique needs of children with ASD, and the progression toward widespread use of mobile technology, an emergency skills training program for mobile phones using ABA principles would be a novel and effective way to prepare children with ASD for emergencies. Traditional emergency education programs do not incorporate ABA techniques or address the specific needs of children with ASD.
Objectives: The objective of this study was to design a smartphone mobile training application (app) using ABA principles and simulated practice to teach children with ASD to recognize an emergency and to respond to the emergency by calling 911 on a mobile phone to seek help.
Methods: Using a sociotechnical approach an inter-disciplinary team of experts from developmental pediatric medicine, behaviour therapy, simulation, biomedical engineering, and mobile app design developed a smartphone app that utilizes the principles of ABA and simulation training techniques, including video modelling, simulated practice (rehearsal), prompting strategies and fading of promtps (for errorless learning opportunities) and feedback (via positive reinforcement).
Results: The app includes a video model, simulated training to recognize emergency situations, and teaching how to dial 911. The app includes both verbal and visual prompts which gradually fade when mastery is achieved. Feedback is given through gamification, with points for success. The advanced levels also provide practice responding to a simulated 911 dispatcher with voice recognition capabilities, including identifying type of emergency, name, location and description of emeregency event. Accuracy (percentage of steps correct) , frequency of use and level of achievement are collected.
Conclusions: Using ABA principles, we developed a fully operational prototype of a smartphone app designed to teach children with ASD to recognize emergencies, to respond to the emergency by

dialing 911 and to communicate with a 911 dispatcher on a mobile phone. Studies are planned to evaluate effectiveness and utility of the app for emergency skills training in children with ASD.

28   **137.028** An Interactive App for Social Skills Training in Autism Spectrum Disorder

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Background: Deficits in social communication are defining features of autism spectrum disorder (ASD). These deficits negatively affect long-term outcomes for those with ASD and have been associated with 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 clinical 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 their shortcomings in teaching skills that can be generalized to new contexts.
Objectives: The objective of this study is to build and evaluate a novel technology for supporting social skills training in children with ASD in order to facilitate skill generalization.
Methods: An interactive "app" was developed on the Android platform to allow rehearsal of skills in social situations. Building on key strategies for teaching generalizable skills in ASD, the app features rehearsal with variation (repetition of skills across different situations), systematic fading of prompts (decreasing user supports with progress), reinforcement (rewards for positive behaviours), and feedback (reports of user performance). Each social scenario is designed as a multi-level game that personalizes training based on each child's needs and strengths. At each level, the scenario details (e.g., background, interaction partner) are varied. With increasing difficulty level, the amount of visual and auditory noise increases and user prompts decrease. To allow seamless user interactions, the app employs speech recognition and generation. An eye-tracking algorithm is used to ensure appropriate eye contact throughout the interaction. Various features for personalization of scenarios and rewards are provided for both the child and the caregiver.
Results: A fully functional prototype has been implemented (Figure 1). A usability study with 10 children with ASD is in progress.
Conclusions: To the best of our knowledge, Holli is the first interactive technology-supported prompting system for social skills training in ASD. This app can ultimately improve outcomes for individuals with ASD by providing a portable, accessible, and cost-effective system for social skills intervention.

29   **137.029** Mebook – a First-Person Social Narrative Game

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Background: The gateway to social interaction is greeting. It is the first and last thing in many social situations. Unfortunately, individuals diagnosed with Autism Spectrum Disorder (ASD) face significant challenges when engaging in social interactions (APA, 2000). Social narrative intervention has proved useful in helping children with ASD learn social skills (Collett-Klingenberg and Franzone, 2008). However, social narratives are delivered in text and still images, often based on scenarios and characters that are foreign to the reader. As young ASD readers often have short attention span, such a presentation may be enhanced by taking advantage of modern gaming platforms. Digital learning games have been shown to stimulate the learners' interest in the material, even engaging students with low self-efficacy (Amon and Campbell, 2008, Saridaki and Mourlass, 2011). Many platforms also include cameras that allow customization of games through the use of self-images. Self-images, as a tool for interventions, have been shown to be effective for establishing desirable responses in young children with ASD (Ihrig and Wolchik, 1988). The combination of games and self-images may improve the efficacy of social narratives by engaging and holding the attention of the reader, allowing the child to connect with the characters in a story, and subsequently, learning the material faster.
Objectives: This technical demonstration showcases **MEBook** , effective social narrative intervention for increasing social greeting behavior with peers and adults.
Methods: **MEBook** is an animated social narrative game consisting of: 1) an animated social narrative story with the self-image of the child as the main character (Figure 1 left) and 2) a gaming session to practice the target behavior with other characters (Figure 1 right). **MEBook** shows the child, with adults and peers, in various greeting scenarios with animations of the child and/or other characters waving, speaking or engaging in appropriate greeting behavior. The story is read by, or narrated to,

the child. Gaming sessions follow a story. These sessions use a Microsoft Kinect™camera to detect when the desired greeting gesture (a wave) is performed either in response to an animated character's greeting wave or in initiation when an animated character appears on the screen. Visual, sound, and verbal feedback are given continuously. A child can have as many chances as desired.
Results: A multiple baseline single subject study, with three boys with ASD (7-12 years), was conducted**.** Details of the study are described in a separate IMFAR submission. Participants showed significant increase in their total responses rates. This occurred as the participants began **MEBook** intervention. In addition, after the introduction of the **MEBook** intervention, and all through their intervention phase, two participants showed much eagerness to play **MEBook** even before their therapy session.
Conclusions: **MEBook**, a software system that creates individualized social greeting stories using games and self-images of the participants, was designed. The application, via the Microsoft Kinect™ camera, provides participants with practice chances to rehearse different greeting scenarios. A multiple baseline single-subject study saw showed promising results.

30   **137.030** Using Mobile Phones Screen Mirroring to Improve Social Skills for Children with Autism
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Background: The Android OS for mobile devices has the build-in capability of allowing a user to mirror his or her screen into another person's Android device. This simple but great feature may be used to communicate own thoughts or reflect on others' thoughts or behaviors. A simple mobile application called "Mirror-T" was designed to enable the use of the mirroring feature to improve social skills through engagement and enjoyment in children with autism
Objectives: to assess benefits of the Mirror-T program as an intervention in improving social skills in highly functional children with autism
Methods: Eight high-functioning children with autism and 10 typically developing children who were matched on chronological age are being tested using the Mirror-T application and screen mirroring feature to determine the engagement and enjoyment factors during the use of the program.
Results: Results will be available upon completion of the testing in Feb 2015
Conclusions: No conclusions available yet.

31   **137.031** Technology-Based Framework to Improve Quality of Life of Parents of Children with Autism in Gaza Strip
M. Habash, *Leeds Becket University, Ottawa, ON, Canada*

Background: Gaza Strip suffers from severe political and socio-economic challenges. The region lacks any institutional or governmental facilities to offer help to people with autism and their families. The lack of abilities to screen, assess, or provide intervention to children with autism increases families stress and leads to further suffering for the children. A technology-based framework was designed and reviewed, and currently under implementation with four families of children with autism to offer them world-class services for their children with autism using computers and mobile technology.
Objectives: To evaluate the effectiveness of a culturally-appropriate technology based framework for families of children with autism in the Gaza Strip and assess the possible areas of improvements to the lives of the families and their children using technology.
Methods: A 2-way computer application and a video channel were developed to enable the delivery of information and facilitate the communication with the participating families. Currently at the first phase, families were given the opportunity to share and request information from volunteer expert facilitators regarding their children's cases. Families participated in the implementation of different interventions and received feedback on regular basis based on data they collected and submitted on regular basis. Quantitative and qualitative data is being collected during the first phase of the study and will be reported on for the meeting
Results: Results will be available for the meeting
Conclusions: Conclusions will be published upon completion of the phase

32   **137.032** Enhancing the Perceptive and Cognitive Visual Processes in Low-Functioning Autism: Sigueme (FOLLOW-ME)
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Background:

 Individuals with low-functioning autism often are not prepared to manage the abstraction level that the language requires cannot use programs oriented to it. Besides, in the most severe cases they cannot manage graphical representations and do not understand that what is represented in image corresponds to a specific meaning.

Objectives:

Sigueme´s goal is to design and develop an educative software tool to allow the teaching and learning of skills to enhance the development of two processes in people with low-functioning autism:
the visual-perception and the cognitive-visual processes. The software developed is made up of six incremental phases, which range from basal stimulation to the classification of pictograms,
photographs and text, making use also of videos, gestures and words.

Methods:

The phases are:

Attention. This phase presents a series of animation sequences divided in four groups. Its objective is to improve the user's attention to various visual and auditory stimuli.
Video. To train visual attention through moving images in realistic 3D video sequences. This phase is divided into scenes, environments and areas containing different everyday concepts.
Image. To increase the abstraction of the previous phase presenting the same concepts using animated 2D photographs with simple movements.
Drawing. To work an equivalence between concepts presented as a photo, as a picture and as a grey scale silhouette.
Pictograms. To help in the recognition of pictograms and the generalization of concepts from previous phases. Its goal is to enhance mental and linguistic representation.
Games. Different exercises are suggested to classify simple objects taking into account colour, functionality, similarity, etc.

Depending on the skills of the user, some phases can be performed in three interactive modes: just see, touch or hit. The second one requires that the user touches the screen to continue the

exercise, and the third that the user touches the correct image that they are asked to.
Results:
Daily observation SIGUEME tool use and PECS system implementation show that:
a)   Thirteen students have used "Image Phase" of SIGUEME to train the "cause-effect" relationships. They have achieved visual attention to basal stimuli and videos, increasing visual and auditory attention and facilitating access to levels 1 and 2 of PECS.
b)   Ten students who have done activities of "Image, drawing, pictograms Phases" of SIGUEME with the objective to train equivalence between a concept shown as a photograph, picture or grey-scale silhouette have achieved level 3 of PECS.
c)   "Games Phase" of SIGUEME focuses on the recognition of concepts and training of cognitive processes by categorizing and sorting. Nineteen students who have worked this phase have accessed to levels 4 and 5 of PECS.
d)   All students have shown great motivation because content personalization of SIGUEME tool.
Conclusions:
SIGUEME is a useful tool as reinforcement in the implementation of communication systems such as PECS. In addition, the personalization obtained with the editor tool allows creating a version of SIGUEME per user, with adapted content to his/her interests and immediately environment. There are so many versions of SIGUEME as customization made of the same.

33   **137.033** AMP: An Autism Management Platform
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Background:
To ease the burden of collecting and managing data in support of the treatment and education of those diagnosed with autism spectrum disorder, we have built AMP (Autism Management Platform), a health care and educational information system consisting of a mobile application, web client, secure data repository, and analytics engine. Together these components simplify the means by which multimedia data can be captured, disseminated, navigated, and analyzed by caregivers, educators, and clinicians. The result is a fully-integrated, intuitive system that aims to improve data sharing and facilitate data mining, with the ultimate goal of streamlining the treatment process for families and

professionals alike. Because AMP has been designed as a modular platform, features can be easily augmented in response to new users, or new perspectives on treatment plans.

Objectives:

In designing AMP priority was given to producing a cohesive and integrated suite of tools capable of supporting multiple users with multiple roles within ASD treatment. In particular, a multi-modal interface that can easily deployed on tablets, smart phones, and desktop computers was a driving requirement in order to easily support in-the-field usage. This includes tracking IEP goals, collecting clinical data during therapy sessions, and analyzing data in real-time to identify pertinent trends. While several commercial solutions exist that provide some of these functions individually, AMP is notable in the level of integration provided, as well as the fact that the system is based completely on free and open source software. The result is an affordable, evolvable system.

Methods:

The AMP system can be decomposed into several major subcomponents. A mobile app allows users involved in the day-to-day care of an individual, such as a parent or teacher, to capture data ``in the moment'' using a smart phone or tablet. A healthcare professional, such as a neurologist, can use the web client to monitor their patients' data using a dashboard view, drilling down into items of interest, responding to feed items, or making private notes as they see fit. Finally, an analytics engine works in conjunction with a database to aggregate and mine patient data for patterns, the results of which can be visualized in the web client.

Results:

The subcomponents of AMP are fully implemented and capable of scaling to real-world clinical and educational environments. The mobile application has been tested for compatibility with a wide variety of Android tablets and smart phones. The system is currently in the user-testing phase, and recently completed a one-month pilot study in a high-school special day class supporting 10 students and 23 staff members. Initial feedback is positive with 80% of staff reporting an increase in the ease with which data is collected and tracked. We are currently transitioning to testing in a clinical setting.

Conclusions:

Though still in its infancy, AMP fills a gap in existing autism technologies, and shows promise for improving the ease with which data can be collected, shared, and analyzed to improve the treatment and education of those living with an ASD diagnosis.

34   **137.034** Use of Behavior Imaging to Assess Inter-Rater Reliability in a Multi-Site Pharmaceutical Trial

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Background: Multi-site pharmacological trials offer numerous methodological advantages over single-site trials. Multi-site trials can enhance external validity, provide greater statistical power, are often more representative of the patient population [5,7,8]. However, multi-site trials are sometimes associated with disadvantages such as reduced data quality, greater heterogeneity of results, and poorer interview quality [3,4]. While some of these issues may be controlled statistically, the systematic error due to interviewer errors across multiple sites cannot be addressed statistically [3]. The need to reduce such errors has been highlighted in a number of studies [1,3,5,8]. Approaches used to enhance inter-rater reliability include such measures as rater training and co-rating of video recorded interviews [1]. A behavior imaging (BI) technology was used for such a purpose in a multi-site pharmaceutical trial. This technology facilitated the training of raters and provided automated assessment of inter-rater reliability measures. The system was based on a store-and-forward telehealth method.

Objectives: The objective of the study was to document rater reliability outcomes for two interview protocols that included the Autism Diagnostic Observation Schedule (ADOS) and the Social Communication Interaction Test (SCIT). Both were administered and scored in the multi-site pharmaceutical trial. Attention was placed on identifying items in both of the diagnostic tests that contributed to inconsistencies in ratings between raters and the "Gold Standard" (GS). The feedback allowed targeted training of the raters to improve the inter-rater reliability.

Methods: This experimental study was conducted in collaboration with four national medical research institutions. Reliability checks were done at the beginning of the study. Raters at four sites viewed pre-recorded interviews and scored their observations through the BI on-line platform. After each rater completed the scoring, the results were compared to the GS through an automatically generated report. The report identified discrepancies in the scoring and recommendations for improving the rater's accuracy. Raters were required to repeat their assessments until their scores matched the GS.

Results: All raters completed reliability checks for ADOS and SCIT. Table 1 depicts training examples of rater assessments using SCIT protocol. A rater is considered not reliable if there is a difference of more than 1 for each of the domains and more than 10% for the total score. The summaries show that Rater #1 matched the Gold Standard in the domains A, B, E, and F, while domains C and D were different by one point in relationship to the GS. However, none of the differences were greater than "1" and the total score was the same as that for the GS. Therefore, Rater #1 was considered "Reliable". Rater #4 met the Gold Standard for domains A and F. Domain D was off by 2 points and domain E was off by 1 point. The difference between the GS and Rater #4 was off by 25% and was,

therefore, not considered "Reliable".
Conclusions: The study demonstrated the practicality of using the BI technology to document inter-rater reliability throughout the duration of a pharmacological study, conducting effective interviewer-observer training, and performing ongoing maintenance of assessment reliability.

35 **137.035** Analysis of Parent Responses to Using a Remote Autism Diagnostic Assessment System

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Background: A remote autism diagnostic assessment system was designed through a series of research studies conducted with clinicians and parents of children with autism. This system includes a smartphone video capture application for parents to follow clinician instructions to record and share video evidence of their child's behaviors; and a HIPAA-conforming web-based platform for clinicians to complete a diagnostic assessment for autism based on parent-collected naturalistic evidence.
Objectives: A field study was conducted to analyze parents' reaction to using the video capture application in their home.
Methods: Participant families had children between the ages of 21-86 months; 29 were referred for an ASD evaluation, 8 were typically developing, and the remaining 6 had other diagnoses. Using the video capture application parents recorded four 10 minute scenarios that included the child playing alone, the child playing with a sibling or parent, family mealtime, and parent concern(s). These scenarios were chosen because they are likely to encourage social communication and play behavior. A follow up survey was conducted to solicit parents' responses with regards to ease-of-use of the application, validity of the approach, adoption challenges, and their recommendations.
Results: Data shows that 95% (41/43) of parents found the video capture application easy to use. Parents found two aspects of design directly contributing towards the simplified capture experience. First, the design is simple, has clear iconic visuals, and needs "few clicks" to capture and upload. Second, the capture application has embedded clinician's prescription to guide parents in staging the environment (e.g. instructions about probes like books, toys and maintaining appropriate field of view) and use of social presses to engage the child (e.g. name call, pointing, eliciting child request) during the recording. Parents anticipated that the capture application would facilitate effective communication with caregivers about the child's naturalistic behaviors and would enable timely assessment. Although 58% (25/43) of parents reported that their child noticed the recording device, 91% (39/43) indicated that they captured either all (reported by 31 parents) or three (reported by 8 parents) scenarios representing naturalistic behaviors. Furthermore, when asked about privacy, 8 out of 43 parents mentioned some concerns about video sharing but all parents were willing to record and share if it was beneficial to their child. Parents recommended that having control over data capture and deletion, as well explicit data sharing policies could boost their trust and ease their privacy concerns. Parents suggested adding out-of-home recording scenarios since some behaviors of concern are more likely to trigger at school or other out-of-home environments. Majority of the parents (84% = 36/43) considered this method a valid approach for sharing clinical information. Among 7 parents who had some concerns, 5 recommended that this method should compliment in-person diagnosis instead of replacing it and 2 questioned its effectiveness for children with mild conditions.
Conclusions: Through in-home evaluation, parents confirmed that the video capture application facilitated a simplified and effective capture experience. Next, through a systematic study with clinicians the validity of the resulting diagnostic assessments will be analyzed.

36 **137.036** Web-Based Toolkit for Multimodal Data Analysis in ASD Research

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Background: Understanding human behavior and development through analysis of internal psychophysiological signals can provide objective insights into subtle behavioral, social, cognitive, and affective characteristics of individuals. Internal measures can afford caregivers, clinicians, and researchers with information that can both enhance and complement their own observations. For example, physiological signals, like electrodermal Activity (EDA), heart rate (HR), and heart rate variability (HRV), provide a window into an individual's internal affective and regulatory state, which may be otherwise unavailable or unobservable through audio-visual cues, especially in individuals with limited communication abilities and/or who have impoverished non-verbal displays (e.g., reduced facial expressivity). Recent advances in wearable sensing technology have made it possible to record ambulatory psychophysiological data from children with Autism Spectrum Disorder (ASD) together with time-synchronized video data in a variety of naturalistic settings. However, qualitative analysis and review of multimodal physiological data synchronized with video remains a cumbersome process, typically requiring multiple specialized software packages and complex configurations of data.
Objectives: To provide a suite of free, open, and easy-to-use tools to support qualitative analysis of physiological and behavioral data together with time-synchronized video to support ASD research.

Methods: We have developed the Computational Behavioral Science Toolkit (CBST), a free, web-based application for viewing and annotation of multimodal psychophysiological and behavioral data together with time-synchronized video. CBST runs in any modern web browser without the need for installing specialized software, and data loading and interaction is accomplished via a simple drag and drop interface.

Results: Members of our lab and collaborators from both technical and non-technical fields have used CBST to review, present, and perform qualitative analyses on data collected in several on-going multi-site studies. Our demonstration will include opportunities for interacting with the application, present examples of physiology and video data from both assessment (ADOS-2) and intervention studies we are engaged in, and provide information on how other researchers can access and use the toolkit in their own research.

Conclusions: CBST provides a simple, free, web-based platform for viewing, analyzing, and presenting multimodal psychophysiological and behavioral data.

37 **137.037** Tablet-Based Method for Handwriting Assessment

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Background: Handwriting is crucial for success in school, daily living, and communication with others. Difficulties with handwriting can interfere with a child's ability to dedicate cognitive resources necessary to learn a wide range of subject matter and consequently mask a child's capabilities in other areas. As high as 37% of children are estimated to have handwriting difficulties; it is one of the most common reasons children are referred for occupational therapy and is associated with a number of developmental diagnoses –including children with autism spectrum disorder (ASD) who struggle to develop a wide range of skilled motor behaviors and are therefore particularly vulnerable to handwriting impairments. Existing handwriting assessments are limited to labor-intensive manual measures of letter formation that produce qualitative, categorical (correct vs. incorrect) ratings and computerized kinematic analyses that lack any measures of letter-form.

Objectives: To developed a fully automated cloud-based handwriting analysis program for Android and Apple tablets that seamlessly enables evaluators and interventionists across a range of disciplines to quantify handwriting performance across multiple dimensions.

Methods: Our approach incorporates both real-time kinematic feedback as well as a detailed, quantitative measure of letter formation. This novel and unique letter-form analysis employs a computational morphometric algorithm that maps the template letter to the subject's letter, and in so doing, generates a continuous measure of letter formation that is highly reliable. To date, a research-suitable version of this program has been developed and piloted in children using two tasks: English characters (42 Typically Developing [TD], 6F; 28 ASD, 2F; 23 Attention-Deficit Hyperactivity Disorder [ADHD], 4F) and Non-English characters (45 TD, 7F; 25 ASD, 3F; 25 ADHD, 5F). For each task, children completed three conditions: copy, trace, and fast trace. All groups were balanced for age, sex, PRI (WISC-IV), Socio-economic status, and handedness. Motor abilities were assessed using the Physical and Neurological Examination for Subtle Signs (PANESS).

Results: Consistent with previous research, our novel computerized assessment of letter-form revealed impairments in children with ASD compared with TD children across all tasks and conditions (English copy p =.031, trace p<.001, fast trace p<.001; Non-English copy p =.062, trace p=.014, fast trace p=.021; figure 1), as well as significant differences between ASD and ADHD in the English fast trace condition (p=.036; figure 1). No group differences (TD, ASD, and ADHD) were observed in terms of handwriting kinematics.

Letter form, in both tasks, was correlated with the WISC-IV's working memory index across all conditions in the ASD group (p<.008) and with PANESS total score for the trace condition (p<.05). These results may suggest decreased automaticity and greater recruitment of higher order cognitive systems (e.g. mPFC and DLPFC) in the ASD group.

Conclusions: Our novel method is sensitive to diagnostic differences, particularly in ASD and can be used for both English and Non-English characters which allows for inclusion of an international community. The tablet based handwriting assessment will empower both professionals and interventionists to readily implement and evaluate the efficacy of targeted interventions for handwriting, serving a large public health need.

38 **137.038** Placeholder TD

39 **137.039** Placeholder TD2

40 **137.040** Placeholder TD3

Poster Session
138 - Diagnostic, Behavioral and Intellectual Assessment

41   **138.041** A Comparison of Clinical Versus Self-Report Measures: An Evaluation of the Broad Autism Phenotype in Parents of Individuals with Autism

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Background: The Broad Autism Phenotype (BAP) refers to a constellation of subclinical behavioral features related to the core symptoms of autism, expressed among unaffected relatives and indexing genetic liability. Studying the BAP is critical for understanding the complex etiology of autism. While in-person objective assessments of the BAP have been well validated (e.g., Piven et al. 1997), they are often labor- and time-intensive. Questionnaires offer a time-efficient alternative, but may be subject to reporting bias. It is therefore important to identify valid yet efficient assessments that reliably capture the BAP. Recent work (Sasson et al., 2014) reported significant discrepancies on questionnaires of self- and informant-reports of the BAP in fathers of children with autism when they were positive for particular BAP features, suggesting that clinical judgment is required for a deeper characterization of the BAP, particularly in fathers. This study investigates agreement between objective clinical ratings of BAP features using gold standard objective, relative to questionnaire measures.
Objectives: To compare agreement between questionnaire and direct assessment measures of the BAP in a large sample of parents of children with autism.
Methods: Participants included 171 parents of children with autism (107 mothers; 64 fathers). All participants completed a self- and informant-report version of the Broad Autism Phenotype Questionnaire (BAPQ; Hurley et al., 2007), a well-validated questionnaire that quantifies BAP characteristics. Personality features of the BAP were assessed using the Modified Personality Assessment Scale (MPAS; Tyrer, 1988), in which subjects and informants are interviewed separately about personality styles, and ratings are conducted by blind, independent coders relying on concrete behavioral examples. Pragmatic language was assessed using the Pragmatic Rating Scale (PRS, Landa et al., 1992), in which a semi-structured conversational interview is conducted and objective coders rate the presence of clinically significant pragmatic language violations. BAP (+) status was defined by the presence of at least two of the directly assessed BAP characteristics (*Aloof*, *Rigid*, or *Pragmatic Language deficit*). On the BAPQ, parents were classified as BAP (+) based on published criteria.
Results: A series of 2x2 chi-squared analyses were conducted to assess differences between questionnaire (BAPQ) and direct assessment (MPAS/PRS) scores. Overall, the BAPQ was less accurate in classifying fathers as BAP (+) ($p < .05$). This relationship was driven by discrepancies in *Aloof* ratings ($p < .01$). *Rigid* traits and *Pragmatic language* ratings were consistent across questionnaire and direct assessment in both groups.
Conclusions: Results mirror those of Sasson et al. 2014, suggesting that fathers may be less likely to endorse *Aloof* traits and overall BAP features in themselves. Alternatively, clinical evaluation (i.e., MPAS) may be more sensitive in capturing such traits in fathers. Data will be further explored to examine specific agreement between self- and informant-report measures on both the MPAS and BAPQ, assessing whether variables such as social cognition and gender may predict consistency (or lack thereof) between each measure. This study has implications for future phenotyping efforts relevant to molecular genetic, neurobiological studies of autism incorporating data from both affected individuals and unaffected family members.

42   **138.042** A Comparison of Diagnostically Relevant Item Response Characteristics Between Females and Males with Autism

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Background: Males are 4-5 times more likely to be diagnosed with Autism Spectrum Disorder (ASD) than females. This powerful observation implies, not only that males are at greater risk, but that there may be real differences in the expression of ASD between males and females. Previous work from our group and others has primarily focused on broad indicators (IQ, social and repetitive behavior composite scores, etc.). No prior studies have evaluated measurement factors that may lead to sex differences in specific item characteristics relevant to diagnosis.
Objectives: To compare diagnostically-relevant item characteristics (discrimination and thresholds) between females and males with ASD.
Methods: We analyzed data from 2,418 probands with ASD (304 females and 2114 males) included in the Simons Simplex Collection. A series of multi-group confirmatory factor analyses (MG-CFA) were conducted using items measuring four constructs hypothesized to show sex differences in item endorsement - interpersonal relationships, social avoidance, need for sameness, and restriction of interests. Items measuring each of these constructs were selected from the Autism Diagnostic Interview-Revised (ADI-R), Social Responsiveness Scale (SRS), and Repetitive Behavior Scale-Revised (RBS-R). Chi-square difference tests compared item discrimination and threshold differences between males and females with ASD.
Results: Restricted interests items showed highly significant differences in item thresholds between

males and females; item discrimination was consistent across sexes. Restricted interests items were less likely to be endorsed (higher thresholds) for females relative to males across all three instruments. There were also two interpersonal relationships items that showed nominally significant sex differences, reflecting that females with ASD are teased less frequently than males and that females with ASD are more likely to share enjoyment. However, these differences did not meet false discovery rate correction.

Conclusions: No sex differences in the measurement characteristics of social avoidance and need for sameness items were observed. Less frequent teasing and increased endorsement of shared enjoyment, while not meeting false discovery rate correction, may suggest a small influence of early socialization experiences and greater peer support in providing some protection for females with ASD from interpersonal relationship difficulties. Additional research is needed to directly evaluate early learning or peer relationship protective factors as modifiers of the expression of ASD in females. Most striking was the observation that restricted interest items from three separate instruments showed higher thresholds in females but equal discrimination. Equal discrimination implies that restricted interests items are an important and relevant aspect of restricted/repetitive behavior in females and males. Sex differences in item thresholds could be interpreted as implying measurement artifact resulting from the use of male-centric items within existing instruments. However, the present analyses suggest this explanation is unlikely because the restricted interests item from the SRS (#39) had no obvious sex bias in wording/exemplars. Instead, fewer restricted interests in females with ASD appears to be a real phenomenon. Additional research is needed to completely rule out the possibility of measurement or rater bias. If lack of bias is confirmed, future investigations should evaluate biological and environmental protective factors that lead females to express fewer restricted interests.

43   **138.043**   A Longitudinal Evaluation of Restricted Behaviors and Sensory Interests in Angelman's Syndrome Using the Behavior and Sensory Interests Questionnaire

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Background: Angelmans Syndrome (AS) is a neuro-genetic disorder characterized by severe intellectual and developmental disability. Clinical reports have described a high level of sensory interests and repetitive behaviors (RRB) in AS, though there has been a paucity of research in this area. Currently only a single study (Walz, 2007) using the Gilliam Autism Rating Scale, has looked at RRBs in this population. However, Richler et. al (2010) examined how restricted and repetitive behaviors and interests (RRBs) developed over time in a sample of children with ASD. For children with ASD, RSM scores remained relatively high over time whereas IS scores started low and increased over time. In addition, having a higher nonverbal intelligence (NVIQ) at age 2 was associated with improvement in RSM behaviors over time. There was no relationship between NVIQ at age 2 and IS behaviors.

Objectives: The current study describes the type, number and intensity of RRB's in large AS population over a four year time period, using a newly standardized scale, the Behavior and Sensory Interest Questionnaire (BSIQ) to describe these behaviors.

Methods: A sample of 152 (50.7% female) children ranging from age 36-209 months (mean 84, SD 42). Participants were drawn from an eight year longitudinal study. Subjects were followed from 1 to 4 years. The BSIQ, a newly standardized interview based measure designed to evaluate the number, type, and intensity of a comprehensive array of RRBs was administered to all parents (Hanson et al, submitted). Children also received additional cognitive and behavioral testing.

Results: This is the first study to take a comprehensive look at RRB behaviors in an AS population. Of the behaviors exhibited, 85% were RSM behaviors and 15% were IS behaviors. Analysis showed that the majority of children (94%) with AS exhibited at least 1 RRB. High percentage of flapping behavior exhibited; heterogeneous among all IQ groups (range of 53-88%). This is consistent with Walz 2007 which also found a commonality between flapping behaviors (56%) in individuals with AS. Analysis is ongoing for the longitudinal trajectory of these behaviors as well as the impact of cognitive ability.

Conclusions: Implications suggest that providers should be aware of the high prevalence of behaviors in individuals with AS and the possibility that these behaviors can impact current and future functioning of children with AS as well as have a negative impact on family members. Future research is needed to explore and confirm these findings. In addition, these behaviors should also be compared to those children with other developmental issues, such as ASD.

44   **138.044**   A Method for Universal Screening of Social Challenges in Elementary School Students

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Background: The current prevalence of ASD is 1 in 68, which is based on eight year old children (CDC,

2014). Yet, the National Children's Health Survey, which included 17,000 households with children between 6 and 16 years, indicated rates of 1 in 50 (Blumberg et al., 2013). Thus, many individuals are diagnosed with ASD after early childhood. Further, a substantial literature indicates that social challenges in elementary school students are associated with limited academic performance (DiPerna & Elliott, 1999; Wentzel, 1991, 1993). However, schools do not perform systematic, general screening for social challenges. Universal screening of elementary school children may help to detect children with milder forms of ASD and lead to improved functioning. This report describes the empirical development of the Social Challenges Screening Questionnaire (SCSQ), a brief questionnaire to identify elementary school students at risk for ASD or other social disorders.

Objectives: To empirically develop and test the SCSQ, which is appropriate for universal screening in elementary schools.

Methods: The development phase included 30 participants (28 males) diagnosed with ASD after age 6 years (ages 6 to 54 years; $M = 19.55$, $SD = 10.93$) and one parent informant.. Diagnosis of ASD was confirmed with ADI-R, ADOS, Vineland 2, and Stanford-Binet 5. Participants for the validation phase were 35 teachers from eight charter schools who completed the SCSQ on 549 general education students (ages 8 to 11 years, $M = 9.51$, $SD = 0.65$). Students with scores in the upper 2.5% of the distribution ($n = 15$) and a comparison sample of students ($n = 35$) from the lower end of the distribution, were selected for follow-up assessment with the Social Responsiveness Scale 2. The subsample ($n = 50$) consisted of 33 males and 17 females (ages 8 to 11 years of age; $M = 9.42$, $SD = 0.67$).

Results: Scores on the SCSQ ranged from 0 to 14 ($M = 1.38$, $SD = 2.42$) and every item was endorsed by this sample. Cronbach's alpha was .85. Inter-item correlations ranged from .008 to .638 and the deletion of any one item did not change reliability substantively in either direction (range =.82 to .85). In the subsample of 50 students, total scores on the SRS-2 ranged from 2 to 167 ($M = 60.22$, $SD = 41.13$) and were significantly correlated ($r = .87$, $p < .01$) with the SCSQ. An ROC curve was applied to compare the SCSQ to an SRS-2 dichotomy (0 = unaffected, 1 = affected) which indicated an optimal threshold score of 6 to yield a sensitivity of .94 and a specificity of .88.

Conclusions: Just as screening for vision and hearing impairments can lead to a referral to a specialist, the SCSQ should lead to a referral for formal evaluation for ASD. Then, students with mild impairments can be identified early within schools and enrolled in appropriate evidence-based intervention programs. The combined effect of universal screening, skilled evaluation, and early intervention may help to improve academic and long term functioning for students with social challenges.

45 **138.045** Ability and Disability in Autism Spectrum Disorder: A Systematic Literature Review Employing the International Classification of Functioning, Disability and Health-Children and Youth Version (ICF-CY)

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Background: The International Classification of Functioning, Disability and Health (ICF) was initiated by the World Health Organization (WHO) in 2001 to provide a comprehensive and an universally accepted framework for the description of health-related functioning. The ICF is based on an integrative biopsychosocial model of functioning and comprises over 1,400 categories related to various components of health, specifically; *body functions* (physiological functions of body systems), *body structures* (anatomical parts of the body), *activities* (execution of tasks), *participation* (involvement in a life situation) and *environmental factors* (physical, social and attitudinal environment of people). To facilitate the practical use of this comprehensive framework, so called ICF Core Sets have been developed for several health conditions. These are shortlists of generally-agreed-upon ICF categories that capture the aspects of functioning that are pertinent to individuals with a certain health condition. In order to facilitate the use of the ICF in ASD, the Karolinska Institutet Center of Neurodevelopmental Disorders (KIND) has initiated the process of developing ICF Core Sets for ASD, which are lists of generally-agreed-upon ICF categories that are pertinent to individuals with a certain health condition.

Objectives: The objective was to use a systematic review approach to identify, number, and link functional ability and disability concepts used in the scientific ASD literature to the nomenclature of the ICF-CY (Children and Youth version of the ICF, covering the life span).

Methods: Systematic searches on outcome studies of ASD were carried out in Medline/PubMed, PsycINFO, ERIC and Cinahl, and relevant functional ability and disability concepts extracted from the included studies. These concepts were then linked to the ICF-CY by two independent researchers using a standardized linking procedure. Since the search yielded large number of studies, samples were analyzed until no more new ICF-CY categories were identified.

Results: Seventy-one studies were included in the final analysis and 2475 meaningful concepts contained in these studies were linked to 146 ICF-CY categories. To restrict the results to those categories that are most relevant to ASD, only those that were identified in at least 5 % of the studies were reported. This left 99 categories for the final results, of which 63 were related to *Activities and Participation*, 28 were related to *Body functions*, and 8 were related to *Environmental factors*. The five most frequently identified categories were *basic interpersonal interactions* (51%), *emotional functions* (49%), *complex interpersonal interactions* (48%), *attention functions* (44%), and *mental functions of language* (44%).

Conclusions: The broad variety of ICF-CY categories identified in this study reflects the heterogeneity

of functional alterations found in ASD – both with respect to disability and exceptionality – and underlines the potential value of the ICF-CY as a framework to capture an individual's functioning in all dimensions of life. The current results in combination with three additional preparatory studies (expert survey, focus groups, clinical study) will 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.

46 **138.046** Accuracy of ASD Diagnoses in a Sample of Black and Hispanic School-Aged Children

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Background: Recent prevalence estimates from the Center for Disease Control (CDC) indicate that the rate of autism spectrum disorder (ASD) has risen disproportionately in Black and Hispanic populations, with 110% and 91% increases respectively. While better diagnostic practices and increased awareness may account for part of this increase, it remains unclear whether there is truly an epidemic in these populations or whether misdiagnosis or over-diagnosis may contribute to current prevalence estimates. Results from recent studies are mixed, with some indicating minorities are less likely to be diagnosed with ASD, and others considering minority status an additional risk factor. Further research is needed to better understand the presentation of ASD in minority populations.

Objectives: (1) To establish the diagnosis of ASD using gold-standard practices in an ethnically and racially diverse population of children who were previously diagnosed with ASD through community or educational resources. (2) To determine whether specific risk factors, either alone or in combination, can predict ASD diagnosis in this population.

Methods: Sixty children between the ages of 5 and 12 presented to the Seaver Autism Center at Mount Sinai for autism-focused diagnostic evaluations as part of ongoing studies examining evidence-based practices to improve the health and well-being of Black and Hispanic children with ASD. Sixty percent of the sample (n=36) presented with a previous diagnosis or IEP classification of ASD. All participants received comprehensive gold-standard evaluations, including a psychiatric evaluation, the Autism Diagnostic Observation Schedule (ADOS-2) and the Autism Diagnostic Interview-Revised (ADI-R). ASD diagnoses were based on consensus diagnosis and DSM-5 criteria.

Results: Twenty-eight percent of the sample identified their child as Black, 47% as Hispanic, and 25% as both Black and Hispanic. Of the 36 children presenting with a past diagnosis of ASD, approximately 70% (n=25) of diagnoses were confirmed and 30% (n=11) did not meet criteria for an ASD diagnosis. Of the 25 cases with confirmed ASD, 16% (n=4) also received a diagnosis of Attention Deficit/Hyperactivity Disorder (ADHD). Among the 11 cases previously diagnosed with ASD who did not meet criteria according to our consensus diagnosis, 82% (n=9) received a diagnosis of ADHD. Both groups endorsed multiple risk factors for ASD, including perinatal complications, admission to the neonatal intensive care unit (NICU), and delays in motor and language development. There were no significant differences between groups in the number or type of risk factors reported.

Conclusions: Our results suggest that there is a proportion of Black and Hispanic children who carry a diagnosis or classification of ASD whose symptoms may be better explained by other diagnoses. Within our sample, clinically significant ADHD symptoms were present in all but two participants whose ASD diagnoses were not confirmed through gold-standard evaluation. Future studies must explore ways to enhance diagnostic practices in community-based and educational settings to improve accuracy of diagnoses and to ensure optimal treatment. Given the high prevalence of risk factors found across groups in this study, it is important to continue examining risk factors in larger samples of ethnically and racially diverse children.

47 **138.047** Additional Testing Shows High Performance of Machine Learning Classifiers and Supports Potential for Rapid, Mobile Autism Risk Detection

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Background:
In 2012, we published two pilot studies that used machine learning methods to construct and test the performance a small number of behaviors for autism risk detection. The outcome showed promise, however the studies were limited to archival data, relatively small numbers, an imbalance in the number of cases versus controls, and insufficient testing in less severe forms of autism. We have recently completed two studies aimed at addressing these limitations.
Objectives:
The objective was to test the accuracy of our original machine learning classifiers for detection of autism risk in a larger collection of archived samples and in prospectively generated clinical data.

Methods:
Archival data were gathered from the Simons Simplex Collection, Simons VIP, AGRE, and NDAR. Prospective clinical data were gathered at Boston Children's Hospital during a clinician run IRB-approved study. We ran the "observation" based classifier (OBC), constructed from our original analysis of ADOS, on the archival samples and compared the output to clinical outcome. The caregiver-directed classifier (CDC), constructed from our original analysis of ADI-R data, was mobilized for use on iPads and made available to families in advance of the clinical team evaluation. The outcome from this mobile CDC was later compared to the best estimate clinical diagnosis.
Results: We assembled an independent collection of ADOS data from 2333 spectrum and 283 nonspectrum individuals. We tested OBC outcomes against the outcomes provided by the original and current ADOS algorithms, the best estimate clinical diagnosis, and the Comparison Score severity metric associated with ADOS-2. The OBC was highly statistically correlated with the ADOS ($r = -0.8143$) and ADOS-2 ($r = -0.7793$) and exhibited >97% sensitivity and >77% specificity in comparison to both ADOS algorithm scores. The correspondence to the best estimate clinical diagnosis was also high (accuracy = 97%), with sensitivity of 97% and specificity of 83%. Concomitantly, we recruited 222 participants from Boston Children's Hospital; 69 (31%) were given a clinical diagnosis of ASD. The sensitivity of the MCDC in detecting ASD was 90% and the specificity was 80%.
Conclusions: Using a larger sample size, more controls and higher numbers of lower severity cases of autism, the performance of our classifiers drop expectedly below the initial levels seen in the pilot studies. However, the performance against best estimate clinical outcomes remains high and support the potential for use of machine-learning tools to streamline the process of initial detection and triage of autism risk, opening the bottleneck for more children to receive critical care earlier in development.

48   **138.048** An Item Response Theory Analysis of the Childhood Autism Rating Scale, Second Edition (CARS-2)

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Background: Evidence-based autism-specific rating scales yielding valid and reliable scores are often desired in combination with gold standard measures to render the diagnosis of ASD. The Childhood Autism Rating Scale, Second Edition (CARS-2) is an autism-specific rating scale that developers propose is effective in discriminating between children who have autism and those who have severe cognitive deficits. Previous studies examining the CARS have used Rasch scaling; however, there are no studies of CARS-2 psychometric properties and validity using similar techniques.
Objectives: Using a clinic-based secondary dataset, investigators used IRT techniques to examine the distribution of items across the ASD continuum as well as to determine the level of measurement precision across the construct continuum in a sample of participants with ASD, intellectual disability (ID), or ASD with comorbid ID.
Methods: A total of 173 participants (81.5% male; M_{age} = 44.19 months; SD = 12.9 months; 50.9% African-American) with a diagnosis of ASD-only (35.8%; n = 62), ID-only (13.3%; n = 23), or ASD and ID (50.9%; n= 88) were administered the CARS-2, Standard Version (CARS-2-ST).
Results: All 15 items on the CARS-2-ST fit to a Generalized Partial Credit Model (GPC) indicated that items were locally independent based on the standardized LD-χ^2(i.e., |LD| < 2 for all items). Inspection of step parameters and option response functions (ORFs) for each items shows that only item 15 has a unique curve for each response category, while most items show fewer than the suggested number of categories are used as expected. 6 items (4, 6, 9, 10, 13, and 14) had poor discrimination (i.e., a < .5), indicating little contribution to the differentiation between children with varying degrees of ASD. Item 10 (i.e., Fear or Nervousness) performed particularly poorly (see Figure 1). The S-χ2 item-fit statistic for polytomous data was used to determine absolute fit of the model to each item indicating that 4 items (1, 2, 8, and 14) had poor fit. Global fit was deemed acceptable, M_2 = 27.12, p= 0.08 , RMSEA = 0.05 . Marginal reliability for response item scores was deemed acceptable at .93, however, this estimate over and underestimates the level of precision depending on the location along the continuum. Consequently, a revised 15 item scale collapsing items down to 4 response categories reduced the number of unclear ORF's (see Figure 2), improved item discrimination, good fit across items, and acceptable marginal reliability at .90. Additional IRT analyses as well as nominal logistic regression analyses will be conducted to further examine the psychometric properties and validity of the CARS-2.
Conclusions: Preliminary analyses indicate that mid-point ratings (e.g., 3.5) may not be as helpful as expected at discriminating among children on the ASD continuum. In addition, based on content reasons removing item 10 from the sample studied could be considered due to poor differentiation of individuals across the ASD continuum.

49   **138.049** An Online Verbal IQ Test: Development, Validity, and Standardization of an Adaptive Vocabulary Test for Remote Phenotyping of Parents

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Background: Autism Spectrum Disorders (ASD) are defined by a dyad of behaviors, but comorbid intellectual disability (ID, which affects 30-70% of individuals with ASD) can present equal or even greater challenges to achieving successful adaptation and long term outcomes. In behavioral and neuropsychological studies of autism, researchers use IQ as a matching or co-varying variable. Unfortunately, this practice limits a) statistical power to find case-control group differences on measures that correlate with IQ, and b) our ability to understand the impact of autism on cognitive ability. Because IQ is ~ 50% heritable, offspring typically do not deviate much from average parent IQ. Thus, matching case and control on parent IQ would allow us to assess the impact of autism on IQ and all measures that correlate with it. However, collecting parent IQ can be impractical with standardized clinician administered tests, since both parents often cannot come to the lab. Requiring IQ assessment of both parents would likely bias the sample and prove expensive and time-intensive for both researchers and participants.
Objectives: To develop an online test of verbal IQ (the Verbal Adaptive Test, VAT) that can be administered remotely or on a lab computer in a fraction of the usual time.
Methods: We developed a multiple-choice vocabulary task and piloted 209 items to 1,599 adult participants recruited online. An Item Response Theory (IRT) model was fit to the data, and individual item performance was assessed across several parameters including difficulty, guessing, loadings on the primary factor, and discrimination, which measures how well an item discriminates between two individuals of similar abilities.
Results: A three-parameter model demonstrated the best fit to the item response data. Several indices of performance suggested overall desirable item performance. Briefly, 75.1% of items had discrimination >1 (which is considered 'good'; $M = 1.37$, SD = 0.62), and 90.3% of items loaded saliently on the primary factor. In addition, the VAT Standard Error of Measurement (SEM) is less than or equal to the average SEM of the WAIS VCI (Wechsler Adult Intelligence Scales Verbal Comprehension Index) across a broad range of abilities (see figure). Initial items targeted IQ scores less than 100, and additional items targeting IQ scores greater than 100 and at both ability extremes are being added. Preliminary simulated data results suggest that the VAT will decrease test administration by more than 40%.
Conclusions: The VAT is an efficient and accurate online verbal IQ test that performs above desired metrics at both the individual item and composite test levels. The VAT also offers precise IQ measurement across a broad ability range including the extremes, which are difficult to measure using tests designed with classical test theory. This feature, combined with decreased administration time, makes the VAT appealing for IQ assessment in individuals with ASD and ID, and their family members.

50 **138.050** Assessment of Intelligence in Young Autistic Children: A Comparison of Tests Available Under and over Age 3

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Background: Very early autism diagnosis is often recommended, and DSM-5 autism spectrum diagnosis must specify the presence or absence of accompanying intellectual disability (APA, 2013). However, few tests are available to assess intellectual functioning in children under age 3 years. Further, developmental tests often used in this age range as measures of IQ may not accurately represent the potential of young autistic children, whose developmental paths are highly atypical. 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). Thus it is important to document how the intellectual abilities of younger autistic children would be judged using different available tests.
Objectives: To compare the performance of young autistic and typical children on Mullen Scales of Early Learning and Vineland Adaptive Behavior Scales to their performance on intelligence tests which provide norms for the 3-to-5 years age range
Methods: The complete sample will include 25 autistic and 25 typical children aged 18 months to 5 years. To date, 12 autistic and 16 typical children have been tested on Mullen and Vineland. Those aged 3 or more were also tested on WPPSI-IV (autistic N=6, typical N=10) and Leiter-3 (autistic N=8, typical N=10). Those aged 4 or more (autistic N=4, typical N=8) were administered Raven's Colored Progressive Matrices board form (RCPM).
Results: Performance on Mullen was significantly lower than Vineland scores in autistic children

(p<.05), whereas no significant difference was found for the typical group (p=.18). The autistic group's lowest mean scores were on Mullen (IQ=61, SD=19.2; below the 1st percentile), followed by Vineland (IQ=77, SD=12.3; 6th percentile), WPPSI-IV (IQ=79, SD=19.0; 8th percentile), Leiter-3 (IQ=95, SD=9.6; 37th percentile) and RCPM (raw score=15.25/36, SD=6.29; 66th percentile). For the typical children, lowest mean scores were on Vineland (IQ=102, SD=15.2; 55th percentile), followed by Mullen (IQ=107, SD=18.3; 68th percentile), Leiter-3 (IQ=113, SD=9.6; 81st percentile), WPPSI-IV (IQ =117, SD=14.4; 87th percentile), and RCPM (raw score=23.63/36, SD=3.34; 95th percentile). Conclusions: Preliminary results indicate that the intellectual functioning of young autistic children, and therefore the presence or absence of intellectual disability in this population, may be judged very differently depending on the test administered. Autistic children would be judged as most intellectually impaired on Mullen, a commonly used test in autism research and practice. Data from a small number of children suggest dramatic discrepancies between Mullen and both Leiter-3 and RCPM scores in the autistic group, which in turn would suggest caution in judging autistic potential at very young ages.

51   **138.051**   Autism-Spectrum Quotient (AQ): A Preliminary Study of Its Diagnostic Validity in a Clinical Spanish Sample, More Than a Psychometric Test?

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Background: Autism is defined in terms of abnormalities in social and communication development, in the presence of marked repetitive behavior and limited imagination (American Psychiatric Association [APA], 1994). The cultural background can greatly influence how an individual perceives and presents with psychiatric symptoms, as well as impacts diagnosis and treatment. Establishing who is "affected" and who is not, or the degree to which the accepted standardized diagnostic criteria for ASD condition are applicable to a given patient will lead to better diagnosis.
Objectives: Screening for possibly affected individuals within the typical population, would allow us to refine this diagnostic tool in order to make a diagnosis more consistent with the intrinsic characteristics of ASD.
Methods: This study encompassed two different samples (ASD and TD); they were aged between 17 and 25 years. The first group (TD) consisted of 129 students from the La Laguna University, Tenerife, Spain. During the break of one of their classes, the students were asked to complete the AQ. Students were recruited from the fields of humanities (law and philology; n = 46) and natural sciences (including medicine; n = 83). All participants in the Autistic-high functioning group (n = 21) had a diagnosis and recruited through (APANATE, ALDIS, ASPERTEN). The Autism Spectrum Quotient (AQ) was developed by Baron-Cohen et al. (2001) and translated into Spanish by Betty Trabal, Editorial Amat, S.L., Barcelona, (2005).
Results: The Total AQ score and its subscales were assessed for normality through an examination of absolute skew and kurtosis score for each variable; the data was significant not found to deviate from normality, *P = .04; R^2 = .13 (TD group) and *P = .03; R^2 = .08 (ASD group), respectively (Figure 1) . AQ Total values distribution were analyzed separately for both groups, TD and ASD, which found that was normally distributed, Kolmogorov-Smirnov P > 0.10 respectively (Figure 2). We found that TD individuals had a lower Total AQ score of M = 19 (SD = 7.07), compared to ASD individuals Total AQ score of M = 31.32 (SD = 5.74); this difference was significant, P < .0001 (Figure 3); The discrimination power of the AQ test case and control groups show a significant difference **P = 0.006 and both groups show a Gaussian approximation, R^2 = 0.9955 for TD and R^2= 0.9859 for ASD. The mean comparison for gender and AQ Total score show that TD males scored slightly higher than TD females and that ASD males scored higher than females on Total AQ score (Figure 4). Furthermore our results revealed that was significant difference for gender by diagnosis on the subscales such as social skills, communication, imagination, and attention switching (Figure 5).
Conclusions: The Spanish version of the Autism Spectrum quotient (AQ) has showed satisfactory levels of internal consistency. The results confirmed the AQ Total and Subscale scores. Finally, gender differences were obtained. These findings support the use of the Spanish version of the AQ for the assessment ASD.

52   **138.052**   Child Characteristics As Moderators of Parent-Clinician Agreement on Autism Symptoms

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Background: Gold standard diagnosis of autism spectrum disorder (ASD) is based upon both parent report of child history/behavior and thorough observational assessment by a trained clinician. Marked disagreement between these reporters could result in misdiagnosis, in which parents fail to initiate assessment of a child with unrecognized ASD or clinicians fail to confirm valid parent concerns. Although parent and clinician assessments do often correlate with one another, the degree of correspondence likely varies according to child characteristics. However, these factors have not been

identified, and improved understanding of child or family characteristics influencing symptom agreement could identify families at highest risk for misdiagnosis.

Objectives: Our goal was to explore factors moderating the degree of correspondence between (1) parent report of ASD symptoms on the Autism Diagnostic Interview, Revised (ADI-R), and (2) clinician assessment of ASD symptoms on the Autism Diagnostic Observation Schedule (ADOS). Putative moderators included child age, sex, IQ, adaptive behavior, and comorbid social-emotional difficulties.

Methods: Children and adolescents (ages 4 to 18 years; N = 79) with ASD or a twin with ASD were recruited through two studies encompassing four research sites across the US. Parents completed the ADI-R, CBCL, and Vineland-2, and youth completed the ADOS Module 3 and a standardized cognitive assessment (either DAS-II or WASI). To address parent-clinician correspondence, we created a series of linear regression models predicting ADOS scores. In each model, we entered ADI-R total score, one putative moderator, and their interaction as predictors. Next, significant predictors and their interactions were entered into a new regression model to more directly compare their relative contributions in the prediction of ADOS scores.

Results: The first set of models revealed main effects of ADI-R scores (ß=6.76, $p<.001$), adaptive behavior (ß=-.41, $p=.05$), and CBCL behavior problems (ß=.51, $p<.01$) in the prediction of ADOS scores. Adaptive behavior (ß=.82, $p=.08$) and behavior problems (ß=-2.22, $p<.001$) also interacted with ADI-R scores, indicating that they moderated parent-clinician correspondence on ASD symptoms. Interactions were such that parents and clinicians had better agreement when children had higher levels of adaptive behavior and fewer behavior problems. The subsequent model including ADI-R scores, adaptive behavior, behavior problems, and their interactions was significant ($F(6, 58)=9.28$, $p<.001$) and accounted for 46% of the variance in ADOS scores. Within this model, the interaction of ADI-R scores and behavior problems emerged as the strongest predictor (ß=-1.87, $p=.02$), underscoring the notion that child behavioral symptoms moderate the extent to which parents and clinicians report similar levels of ASD symptoms. See Figure 1.

Conclusions: Comorbid psychological difficulties appear to increase the discrepancy between parent and clinician assessment of ASD symptoms. Such comorbidities are quite common, and this discrepancy likely complicates the diagnostic process and affects families' reception of an ASD diagnosis. More fully characterizing these and additional moderators influencing reporter agreement will be important in improving diagnostic accuracy and family experiences, and future analyses of ongoing data collection will expand to address additional factors such as family socio-economic status, race/ethnicity, and medical comorbidities.

53 **138.053** Classifying Autism Spectrum Disorders By ADI-R: Separate Subtypes or Severity Gradient?

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Background: The recently published DSM-5 comprises DSM-IV TR diagnoses Autism, Asperger´s disorder, and Atypical Autism under the umbrella concept of *Autism Spectrum Disorder* suggesting a continuum of symptoms with different grades of severity. The novel diagnosis *social communication disorder*(SCD) encompasses children comprising persistent social communication impairments without restrictive, repetitive behaviors.

Objectives: By using a cluster analytic approach, and building on results of previous studies (Spiker et al. 2002; Verté et al., 2011), this study aimed at describing empirically derived subgroups based on the Autism Diagnostic Interview-revised (ADI-R) algorithm items. We explored if these subgroups are more similar to the DSM-IV TR/ICD-10 or DSM-5 approach.

Methods: Sample size consisted of n=466 individuals with Autism (n=194), Asperger´s syndrome (n=158), Atypical Autism (n=114), aged 3 - 21 (M=10.43, SD=4.15), IQ≥35 (M=94.70, SD=20.60). Clinical diagnoses were based on ICD-10 criteria using a combination of ADI-R, Autism Diagnostic Observation Schedule (ADOS), Social Communication Questionnaire, and clinical judgement. *Statistical analysis:* A single-linkage procedure identified 2 outliers. The ADI-R algorithm subscales were analysed by hierarchical cluster analysis. Fusions were made by Ward´s method, the Euclidean distance was used as proximity measure. The number of clusters was determined by dendrogram. Adjustment was done by the K-means procedure. MANOVAs with cluster affiliation and algorithm scores were calculated for controlling the cluster solution. Quality was ensured by discriminant analyses. The cluster groups were compared for differences in age, gender, IQ, ICD-10 diagnoses, Vineland-II, ADOS-severity scores, and Child Behavior Checklist by (M)ANOVA.

Results: The hierarchical clustering method resulted in a 3-cluster solution. N=153 individuals were included in cluster 1, n=124 in cluster 2, and n=182 in cluster 3. A MANOVA showed significant differences between the three clusters for the ADI-R subscale scores ($F(26)=54.65$, $p>.000$, $\eta^2=.62$). Impairments in reciprocal social interaction, and communication just like abnormality of development were mostly pronounced in cluster 2, followed by 3, and 1. For the domain of stereotyped pattern only significant post-hoc effects between cluster 2 versus 1, and 2 versus 3 were observed. Cluster 1 and 3 did not differ. Discriminant analysis confirmed that 96.3% of the cases were correctly allocated. The clusters did not differ with regard to age ($F(2)=.241$, $p=.786$), IQ ($F(2)=.338$, $p=.713$), gender ($\chi^2(2)=5.028$, $p=.081$), or ICD-10 diagnosis ($\chi^2(6)=5.837$, $p=.442$). No significant differences were found for CBCL ($F(22)=.992$, $p=.473$), Vineland-II ($F(10)=1.260$, $p=.328$), and ADOS severity scores

(F(2)=.472, p=.624).

Conclusions: The ADI-R algorithm scores for reciprocal social interaction, communication, and abnormality of development were distributed across the clusters with differing severity, supporting the DSM-5 concept of ASD. Only the domain of stereotyped behaviour did not differ between cluster 1, and 3. This might be due to the small number of items in this domain. The ASD phenotype as described by the 3 clusters seemed to be independent of demographic variables and cognitive abilities. Interestingly, there was no cluster group characterized by social-communication problems only, making it unlikely that children with ASD may be "misdiagnosed" having a *social communication disorder*. Findings support the current DSM-5 concept of ASD and SCD as different disorders.

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54   **138.054** Comparing Remote Diagnosis of ASD to Gold Standard, in-Person Assessment

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Background: A telemedicine approach to diagnosis of ASD, the Naturalistic Observation Diagnostic Assessment (NODA) may accelerate the diagnostic process by connecting families with diagnosticians via the internet. Parents download a mobile application and complete a developmental history questionnaire. The NODA app then guides parents to record four 10-minute videos of their child in their home (i.e., mealtime, playtime with others, playtime alone, and parent concerns) and uploads them to a HIPAA-compliant, web-based platform. A diagnostician logs in to the web portal, reviews each video to identify specific behavioral examples of atypical or typical development. Examples are "tagged" from predefined behavior descriptors informed by clinical expertise. Each tag is linked to a specific DSM-5 criterion for ASD. The diagnostician reviews the DSM-5 checklist and determines whether each criterion is satisfied based on the tags, the developmental history, and their own clinical judgment.

Objectives: The goal of this study was to determine the percentage agreement for DSM-5 diagnosis of ASD between the remote method (NODA) and an in-person assessment utilizing gold-standard diagnostic procedures across three participant groups: 30 children referred for an ASD evaluation (ASD), 10 typically developing children (TD), and 10 children with other diagnoses (OTH).

Methods: To date, 44 children have completed both the in-person assessment and the NODA procedure. Of these 44, 30 were in the ASD group (23 males), 9 in the TYP group (6 males) and 5 in the OTH group (4 males). Participants were between 21 and 86 months (M = 50.27, SD = 16.33); there were no significant between group differences in age (p = .21). The in-person diagnostic assessment included the ADI-R, ADOS-2, Vineland, and Mullen. Families returned home and completed the NODA procedure. A blinded clinician completed the NODA diagnostic assessment. For borderline cases (e.g., only one DSM-5 criterion unsatisfied), a second review was conducted.

Results: For each child, the diagnostic decision (ASD, not ASD) between the in-person assessment and the NODA assessment was compared. The same diagnostic decision was reached in 86.42% of the cases. There was perfect agreement in the TD and OTH groups and 80% agreement in the ASD group (24/30). In 20% of ASD cases, NODA did not endorse ASD when the in-person assessment did. However, there were sufficient criteria established within NODA to identify developmental delays.

Conclusions: The results from this study demonstrate that NODA results in a valid diagnosis of ASD in 80% of cases. Approximately 20% of cases may still require an in-person evaluation. NODA represents a key opportunity to increase timely diagnosis for most children with ASD, a critical first step to accessing appropriate early intervention programs. Further, NODA may help alleviate the demand placed on professionals who perform diagnostic assessments as part of their practice and reduce wait lists, thereby allowing families who need an in-person assessment to be seen faster. Additional analyses will explore whether child characteristics (e.g., intellectual disability, language impairment) impact diagnostic agreement, and whether there are differences in expression of autism symptoms in a home vs. a clinical setting.

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55   **138.055** Construct Validity and Measurement Invariance of the Children's Scale for Hostility and Aggression: Reactive/Proactive (C-SHARP)

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Background: Aggression is a serious concern for some children with intellectual and developmental disabilities (IDD), including those with autism spectrum disorder (ASD). Aggression confers greater risk of classroom removal, psychotropic treatment, is a leading cause of residential placement (Tsakanikos et al., 2007), and is also a significant source of parental and caregiver stress (Hodgets et al., 2013). For these reasons, the study of aggression is important to improve the lives of children with ASD/IDD and their families. A major impediment to this research is a dearth of detailed instruments; the most popular instruments measure general oppositionality (e.g., NCBRF) or devote only a short subscale to aggression (e.g., CBCL). The Children's Scale for Hostility and Aggression: Reactive/Proactive (C-SHARP; Farmer & Aman, 2009) is a detailed measure of aggression. The original

factor structure was derived in a heterogeneous sample of children receiving special education services (Farmer & Aman, 2009), but has since been used to compare aggression in children with and without ASD (Farmer & Aman, 2011; Farmer et al., 2014).

Objectives: The objective of this study was to assess the psychometric characteristics of the C-SHARP by replicating the factor structure, assessing factorial invariance, and exploring its convergent validity in a sample of developmental clinic-referred children with and without ASD.

Methods: The C-SHARP is a parent-report instrument comprising 48 items on five subscales: Verbal Aggression, Bullying, Covert Aggression, Hostility, and Physical Aggression. Data were collected from six sites across the United States. The sample consisted of clinic-referred children who were diagnosed with ASD (n=414) and those who were not (n=243). We conducted confirmatory factor analysis on the mean structure of the C-SHARP across groups (ASD versus non-ASD), and then sequentially evaluated configural, strong, and strict factorial invariance using the lavaan package for R (Rosseel, 2012). Convergent/divergent validity was assessed by correlation of the C-SHARP raw subscale scores with selected CBCL Syndrome Scale T-scores. We hypothesized that the externalizing subscales, especially Aggression, would be more strongly correlated with the C-SHARP than the internalizing subscales.

Results: All models [configural, weak, strong, strict 1 (equal residuals), and strict 2 (equal residuals and latent variance/covariance)] had a significant Satorra-Bentler Chi Square (p<.001). However, a combination of fit measures (AIC, BIC, RMSEA, and TLI) except SRMR favored the more restricted model, where the factor loadings, item intercepts, residuals, and latent variance/covariance were fixed to be equal but group means were freely estimated (see Table 1 for factor loadings, intercepts, and residuals). The C-SHARP and the CBCL were significantly (p<.01) correlated across most subscales. The strongest correlations were with CBCL Aggressive Behavior. Consistent with expectations, the Internalizing subscales were generally weakly correlated (r<.30) with the C-SHARP subscales, with the exception of CBCL Anxious/Depressed and C-SHARP Hostility (r=.42).

Conclusions: The original five-factor structure of the C-SHARP was confirmed, and construct validity was supported. Aggression, as conceptualized by the C-SHARP, is invariant across the clinic-referred population, making the C-SHARP an ideal measure for children suspected of having an IDD.

56 **138.056** DSM-IV-TR Criteria That Best Differentiate Intellectual Disability from Autism Spectrum Disorders

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Background: A high proportion of children with Autism Spectrum Disorder (ASD) also have intellectual disability (ID), complicating their symptom presentation. While ID is characterized by global delays in cognition and adaptive skills, children with both ID and ASD additionally show deficits in social interaction, communication, and restricted interests and repetitive behaviors. The somewhat similar characteristics of the two disorders pose a challenge for accurate differential diagnosis.

Objectives: In order to minimize diagnostic confusion, the current study sought to identify the DSM-IV-TR criteria that best differentiate between ID and ASD among children with features of both disorders.

Methods: Population-based surveillance of ASD was conducted in 14 U.S. sites on children who turned 8 years old in 2006 and 2008. Evaluation of clinical and educational records identified 2,816 children who met case definition for ID, with or without ASD. Sensitivity and specificity, logistic regression, and an Area Under the Curve (AUC) Receiver Operating Characteristic analysis were conducted to determine which DSM-IV-TR criteria for ASD best differentiated children with ID and some ASD features (who did not meet criteria for ASD; N = 937) from those with co-occurring ID+ASD (N = 1,879).

Results: DSM-IV-TR Criteria related to social skills deficits, restricted interests and repetitive behaviors showed high sensitivity and specificity in differentiating the two diagnostic groups. AUC analyses indicated that, when considered singly, adherence to routines (AUC = 0.821) and stereotyped and repetitive behaviors (AUC = 0.823) showed the greatest power to discriminate between the two diagnostic groups. Criteria related to communication deficits, such as delay in spoken language (AUC = 0.660) and impairment in conversation ability (AUC = 0.659) showed the least discriminatory power. Results of the logistic regression indicated that a subset of 6 criteria in the areas of social skills deficits, restricted interests and repetitive behaviors was the most effective at differentiating the two diagnostic groups (AUC = 0.923). The specific subset included impaired use of nonverbal behaviors, lack of social reciprocity, stereotyped patterns of interest, adherence to routines, stereotyped and repetitive behaviors, and preoccupation with parts of objects.

Conclusions: Restricted interests and repetitive behaviors appear to be critical in differentiating individuals with ID and some ASD features from co-occurring ID+ASD. This is in contrast to prior assertions that, due to high rates of repetitive behaviors in the ID population, this is not a meaningful method of differentiating global cognitive delays from the specific constellation of behaviors found in ASD. Social skills deficits appear to have less discriminatory power than previously reported. Whereas

deficits in social and communication skills may initially trigger concern regarding the presence of ASD, the *absence* of such skills does appear to as clearly differentiate ID from co-occurring ID+ASD as the *presence* of more unusual behaviors (restricted interests and repetitive behaviors). An understanding of the discriminatory power of different DSM-IV-TR criteria may help clinicians reduce diagnostic confusion when patients have features of both ID and ASD, and may lead to improvements in diagnosis.

57 **138.057** Descriptive Assessment of Problem Behavior in a Large-Scale Randomized Trial in Young Children with Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) exhibit high rates of emotional and behavioral problems. These problem behaviors serve a function for the child: attention, access to a tangible item, escape from demands, or sensory stimulation. Functional analysis (FA), the manipulation of environmental events under experimental conditions, is the gold standard method used to identify the function of problem behaviors. Another less rigorous approach is called descriptive assessment (DA) which involves the direct observation of a target behavior, its antecedents and consequences. FA and DA have been used to assess function of behavior in a wide range of clinical populations and age ranges. However, they typically are administered by experts and in the context of single-subject design studies. The relative ease in implementation of DA makes it a valid option for use by parents and to characterize the function of problem behaviors in large samples. To our knowledge, this is the first study of its kind to use descriptive assessments co-created by parent and therapist in order to characterize the behavior, topography, and function of behaviors in a large group of children with ASD.
Objectives: The purposes of this poster are: 1) to describe the process of co-constructing the function of problem behaviors in children with ASD in the context of a structured parent training program; 2) to describe the problem behaviors and topographies that emerged from the parent – therapist collaboration; and 3) to describe the functions of problem behaviors identified in the parent training program.
Methods: Results were derived from a large-scale multi-site, 24-week, randomized clinical trial of 180 children (age 3 to 6 years, 11 months) with ASD and disruptive behaviors. At baseline, eligible children were randomized to receive either parent training (PT) or parent psychoeducation (PE). 89 children were randomized to PT and 91 children were assigned to PE. Descriptions of the child's problem behaviors were documented in a "behavior support plan" that was co-constructed by the parent and the therapist over the course of PT.
Results: To date, 59 of 89 behavior support plans for PT subjects were available for review. Parents reported tantrums in 78.0% (46/59) of the subjects, aggression in 62.7% (37/59) and noncompliance in 39.0% (23/59). Parents reported a total of 175 behavior problems with 53 topographies (e.g. crying, flailing). Of the 175 behavior problems reported, the most common were tantrums (26.3%), aggression (21.1%) and noncompliance (13.1%). Of the four functions of problem behavior, parents reported that 62.4% of the behaviors had multiple functions followed by access to a tangible (59.4%), attention (47.1%), escape (42.0%), and sensory (11.6%).
Conclusions: This is the first study to identify the behaviors, topography, and functions of disruptive behaviors using co-constructed parent-clinician descriptive assessments in a large sample of well-characterized young children with ASD. These results suggest that teaching parents to conduct DAs is an effective method to identify the functions of disruptive behavior in young children with ASD.

58 **138.058** Developing ASD Screening Criteria for the Brief Infant Toddler Social Emotional Assessment (BITSEA)

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Background: Retrospective and prospective studies have confirmed 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 low socioeconomic statuses, minority groups, and non-native English speaking families (Valicenti-McDermott et al., 2012). With increasing evidence that early intervention significantly improves outcomes for children with ASD, early detection and diagnosis is critically needed (Seida et al., 2009). The AAP and CDC recommend that pediatricians administer developmental screeners at routine visits; universal screening can potentially ameliorate health disparities regarding age of diagnosis. As public awareness of the disorder grows, the number of screening tools available to identify children at risk for developing ASD has also increased. 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. Of the 42 BITSEA items, 17 items reflect behaviors consistent with ASD symptoms.

Objectives: The goal of this preliminary study was to determine the feasibility of developing cut-points on the new BITSEA ASD-Problem, ASD-Competency, and ASD-Total scales that reliably discriminate children with ASD from those without. The new scales are derived from existing BITSEA items.

Methods: Data are presented on 436 toddlers (71.3% male) between the ages of 12 and 48 months. 51% of toddlers were diagnosed with ASD using gold-standard tools and clinical judgment, while the remaining children were typically developing or diagnosed with intellectual/developmental disabilities or non-ASD psychopathology. Mothers of participants completed the BITSEA. Analyses examined the following subscales: ASD-Problem (including nine items focused on ASD negative symptoms), ASD-Competency (including eight items focused on ASD positive symptoms), and ASD-Total (sum of the ASD-Problem and reverse-scored ASD-Competency subscales).

Results: ROC plots were developed for the ASD subscales (see Figure 1). The following cut-points were determined as most effective for the ASD-Problem, ASD-Competency, and ASD-Total subscales respectively: 4.5, 10.5, and 14.5. The cut-points on all subscales evidenced moderate-to-high discriminative power and moderate-to-high sensitivity, specificity, and PPV. Because the analyses yielded fractionated cut-points, optimal whole number cut-points were determined to increase clinical utility. The following whole number cut-points were calculated as the most effective for the ASD-Problem, ASD-Competency, and ASD-Total subscales respectively: 5, 10, and 14 (see Table 1). Of the three subscales, the ASD-Total was determined as the most effective. The clinical cut-point of 14 yielded 82.43% sensitivity, 84.21% specificity, and 80.26% PPV. False positives had significantly lower cognitive and language abilities than true negatives. False negatives showed higher language abilities, than true positives.

Conclusions: The BITSEA ASD-Total scale was shown to be a highly effective screening measure for ASD in toddlers. These findings contribute to the overarching goal of increased early detection and diagnosis of ASD and give pediatric healthcare providers an efficient and effective ASD screening tool within a broadband behavioral health screener. This preliminary work sets the stage for testing cut-points prospectively in early intervention and pediatric settings.

59   **138.059** Development of a New Measure to Identify Fundamental Emotion Regulation Processes Across the ASD Spectrum: Application to the Autism Inpatient Collection

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Background: There is increasing recognition that aberrant emotion regulation is a critical process in autism spectrum disorder (ASD) that may underlie problem behaviors and psychiatric comorbidity (Mazefsky et al., 2013). The lack of emotion dysregulation measures that are appropriate for this unique population is a barrier to advances in this area.

Objectives: The overall goal is to develop a measure of emotion dysregulation, the Emotion Dysregulation Inventory (EDI), which captures the full range of presenting concerns in ASD and is free of verbal loading. Specific aims included: 1) Evaluate the EDI's psychometric properties, including potential verbal ability or nonverbal IQ (NVIQ) biases; and 2) Investigate emotion dysregulation patterns in psychiatric inpatients with ASD.

Methods: The Emotion Dysregulation Inventory (EDI) was developed based on guidelines from the Patient Reported Outcomes Measurement Information System (PROMIS), a NIH-initiative focused on creating measures of health status using modern psychometric methods (see Figure 1). Participants included 88 children (M=12 years) with ADOS-2-confirmed ASD who were admitted to an ASD specialized psychiatric inpatient unit as part of the Autism Inpatient Collection (AIC). The EDI and Aberrant Behavior Checklist (ABC) were completed by a consistent parent/guardian at admission and discharge. Participants had NVIQ standard scores ranging from 30-135 (M=71), and 57% (n=48) have limited verbal skills (ADOS-2, Module 1 or 2). Analyses focused on the total EDI intensity score. The EDI also includes past behavior time course ratings to aid in clinical conceptualization which will be explored in future analyses.

Results: The EDI total score covered a wide range (45-229; M=125; SD=38) and was normally distributed. The EDI was correlated (r=.55) with the ABC Irritability Scale ($p < .000$), suggesting adequate convergent validity without excessive overlap. The EDI was not significantly correlated with age (r=-.06) or NVIQ (r=.07). EDI mean scores did not differ between minimally-verbal (M=121, SD=38) and verbal participants (M=128, SD=37), or between participants with NVIQs of ≤70 (M=124, SD=40) and NVIQs >70 (M=127, SD=36), p>.05. Internal consistency was high (Cronbach's alpha =.95). Discharge EDI scores (M=67) were significantly lower than admission scores (M=125), p<.000. Variability in item-total correlations suggested multidimensionality, though the majority of items loaded strongly on the total score. Items with high item-total correlations captured increased negative affect, emotional reactivity, lability, and other indicators of poor emotion regulation, whereas items that typically indicate comorbid depression and anxiety had low item-total correlations. Exploration of item means suggested that emotion dysregulation in psychiatric inpatients with ASD is characterized by problems with sustained and rapidly escalating emotional reactions, with less frequent endorsement of symptoms of decreased vitality, decreased positive affect, and anxiety.

Conclusions: Initial evaluation of the EDI suggests it will be an informative, change-sensitive measure

of important emotional processes (emotional reactivity and poor regulation) in ASD that can be applied across the spectrum of verbal and IQ abilities. The EDI development process (e.g., PROMIS framework, pilot collection with a sample encompassing all verbal and IQ abilities) provides a model that can be applied to address the dearth of sensitive and valid measures for ASD.

60   **138.060** Development of an Autism Risk Index Using Remote Eye Tracking to Social Stimuli: A Preliminary Proof-of-Principle Investigation

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Background: Deficits in eye gaze are a hallmark characteristic of autism. Previous research has identified gaze abnormalities to a range of social stimuli, with large differences between autism spectrum disorder (ASD) and healthy control populations. Yet, no studies have examined whether eye gaze to social stimuli can sensitively differentiate individuals with ASD versus those with non-ASD diagnoses - the most clinically-relevant comparison.
Objectives: This preliminary investigation used remote eye tracking to identify expected social attention at key time points and spatial locations across distinct stimuli. Using expected social attention patterns, the primary objective was to develop an autism risk index to aide early identification of ASD.
Methods: Participants were recruited after initial evaluation for ASD. Consensus diagnoses were derived by multi-disciplinary evaluation and based on the Autism Diagnostic Observation Schedule and clinical interview. Eye gaze was collected using the SMI Red-m remote eye tracker (120Hz sampling) during viewing of static and dynamic social stimuli: emotive faces, biological point-of-light motion, and scenes eliciting predictive gaze and theory of mind. Regions-of-interest at pre-specified time intervals (temporal ROIs) were identified within each stimulus based on a priori hypotheses regarding eye gaze to the social context. Proportion dwell time was calculated to each temporal ROI. To develop the risk index, we first examined the significance and magnitude of ASD versus non-ASD differences to the temporal ROIs within each stimulus. Next, we aggregated this information across all stimuli using the results of a bootstrapped logistic regression with dwell times to each temporal ROI as predictors and diagnostic status as the dichotomous outcome. Finally, we computed classification accuracy, areas under the curve, sensitivity, and specificity.
Results: The sample included 20 ASD (Mage=4.96, range=1.8-7.9; 75% male; ADOS total score range=6-23; Receptive language SS range=55-150) and 13 non-ASD participants (Mage=4.02, range=2.5-6.7; 69% male). All ASD vs. non-ASD differences were in the expected direction and a substantial proportion (12/38) of temporal ROIs showed significant and large-to-very large differences (Cohen's d=0.62-1.82). Logistic regression identified 8 temporal ROIs as significant unique predictors of ASD status (X^2=31.96, R^2=.84, p<.00001, 87.9% classification accuracy). Aggregating these predictors into a single risk index yielded high diagnostic discrimination (AUC=.98; 95% CI=.93-1.00) with good sensitivity (.90) and specificity (.93) for the optimal cut score (Figure 1). The autism risk index was highly correlated with ADOS scores (r=.62, p<.001) and, as hypothesized, modestly, but not significantly, correlated with language ability (r=-.32, p=.078).
Conclusions: These findings represent an initial step toward development of an early objective autism risk marker in a challenging clinical sample with broad symptom and cognitive levels. Strong validity within individual stimuli highlights the importance of pinpointing expected spatially- and temporally-dynamic social attention patterns rather than using total dwell times across an entire stimulus. The results, while bootstrapped, will require replication in a large (N≥80 per group) validation sample that includes a broad range of ASD severity and cognitive ability. If validated, the eye gaze risk index may be a useful screening tool and adjunct to clinical judgment in the diagnostic process.

61   **138.061** Developmental Changes in the Cognitive Profile of Individuals with Autism Spectrum Disorders

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Background: Individuals with autism spectrum disorders (ASD) often present with variable cognitive profiles. Despite showing deficits in their verbal abilities, many children with ASD have intact or superior nonverbal skills (Joseph, Tager-Flusberg, & Lord, 2002) and a relative strength in their visuospatial reasoning (Green, Fein, Joy, & Waterhouse, 1995). However, some research has shown that Full Scale IQ (FSIQ), Verbal IQ (VIQ), and Performance IQ (PIQ) scores improve with age in children with ASD, with the gap between VIQ and PIQ eventually closing (Mayes & Calhoun, 2003). While such profiles have been relatively well documented in children with ASD, research examining cognitive profiles of ASD across the lifespan is rather limited.
Objectives: The main objective of this study was to examine the cognitive profile (i.e., VIQ, PIQ, and FSIQ) of high-functioning children and adults with ASD, and compare it to typically developing (TD) control participants.
Methods: Participants were high-functioning individuals (i.e., FSIQ > 70) with and without ASD. The current sample consists of 75 children (ages 8 to 18 years; 47 ASD and 28 TD) and 70 adults (ages 19 to 40 years; 31 ASD and 39 TD). All participants completed the *Wechsler Abbreviated Scales of Intelligence (WASI)* to obtain a measure VIQ, PIQ, and FSIQ. Correlational analyses and two-way

between-groups ANOVAs were conducted to explore the impact of age (i.e., child or adult) and diagnosis (i.e., ASD or TD) on FSIQ, VIQ, and PIQ. An independent samples t-test was conducted to compare the PIQ-VIQ difference between children and adults with ASD.

Results: FSIQ, VIQ and PIQ scores were significantly positively correlated with age in both the ASD and TD groups (r = .49, .47, and .34 respectively; $p < .001$). The FSIQ, VIQ, and PIQ of adults were significantly higher than that in children, for both individuals with ASD and TD ($F(1,142)$ = 47.66, 43.71, and 18.17 respectively; $p < .001$). The main effect of diagnosis was only significant for VIQ ($F(1,142)$ = 5.81, $p < .01$), with a greater increase in VIQ scores from the child to adult group for ASD participants (17.16 points) as compared to TD participants (13.38 points). Although PIQ was higher than VIQ in both child and adult ASD participants, these differences were not statistically significant ($t(76)$ = .76, p= .45).

Conclusions: The results of this study revealed that IQ scores increased with age for both ASD and TD participants. However, individuals with ASD showed greater increases in VIQ from childhood to adulthood, perhaps because the verbal skills of children with ASD may have been more likely to be targeted during school interventions than their nonverbal skills. Notably, there were no significant differences between the VIQ and PIQ scores of children or adults with ASD. This suggests that the PIQ-VIQ difference may not be apparent in high-functioning individuals with ASD, or as Mayes and Calhoun (2003) found, this gap may close prior to age 8 (the youngest age in our sample). Further analyses of the data are in progress.

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62 **138.062** Developmental Differences Associated with Early Diagnosis: A Comparison of Toddlers Diagnosed with ASD at Age 2 Versus Age 3

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Background: Early identification of children with Autism Spectrum Disorders (ASD) and thus early intervention are consensually regarded as critical for improving lifetime outcomes of individuals affected by ASD (Warren et al., 2011; Zwaigenbaum et al., 2013). Though ASD can reliably be diagnosed by 24 months of age, the average age of diagnosis in the US is currently 4.5 years (CDC, 2014), after the window of opportunity afforded by early intervention (Dawson et al., 2012). The question remains as to what the quantitative impact is of earlier diagnosis.

Objectives: The goal of the current study was to examine the effect of early diagnosis on cognitive, language, and adaptive functioning one year following an ASD diagnosis. Specifically, this study compared developmental and adaptive profiles of 3-year-old children at initial diagnosis to 3-year-old children with a previous diagnosis.

Methods: Participants included 25 clinically-referred toddlers, who were initially evaluated around age 2 (M=22.89 months, SD=4.38) and again between 36 and 42 months (M=38.2 months, SD=2.3) and 81 clinically-referred toddlers, who were initially evaluated between 33 and 41 months (M=37 months, SD=2.1). All were diagnosed with ASD. A comparison was made between two groups: Children at age 3 who were previously diagnosed around age 2 and children at age 3 with no prior diagnosis. 87% of children diagnosed at 2 years received some type of intervention prior to 3 years of age. Evaluations included assessment of cognitive/developmental abilities using the Mullen Scales of Early Learning, Bayley Scales of Infant and Toddler Development- 3rd Edition, or Differential Abilities Scales- 2nd Edition; adaptive abilities using the Vineland Adaptive Behavior Scales, 2[nd]Edition, Survey Form; and autism symptomatology using the Autism Diagnostic Observation Schedule. Developmental and adaptive scores were converted to standard scores to compare group means.

Results: Groups did not differ for gender and cognitive/developmental profiles at first diagnosis. Significant differences were found between groups for nonverbal IQ, ($t(30)$=-2.61, p=.014), verbal IQ, ($t(92)$=-3.16, p=.002) and adaptive communication skills ($t(79$(=-4.59, $p<.001$). Specifically, 3-year-olds who were diagnosed a year previously had higher mean nonverbal IQ scores, verbal IQ scores and adaptive communication skills compared to those receiving a first time diagnosis at age 3.

Conclusions: Data from the current study suggests that receiving a diagnosis earlier is associated with greater nonverbal problem solving, verbal reasoning, and adaptive communication skills at age 3. Standard scores on measures of nonverbal problem solving and adaptive communication were more than one standard deviation higher for children who received an earlier diagnosis, while verbal reasoning scores were 14 points higher. These gains suggest that early diagnosis has a meaningful effect on development. However, groups did not show differences in the areas of adaptive daily living, social, and motor skills, suggesting that the earlier interventions are not impacting these areas of early development. A limitation of this study is racial disparity, which needs to be further examined. In addition, future research should examine the developmental trajectory of children diagnosed at various ages controlling for varying levels and types of early intervention, race, ethnicity, and socio-economic status.

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63 **138.063** Diagnostic Accuracy of ASRS and SRS in Screening ASD in Chinese Community Children

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Background: National prevalence of Autism Spectrum Disorder (ASD) is unknown in China; research on ASD has started recently. Up to now, very few screening and diagnostic instruments were available for the Chinese population, instruments that require population norms are still very scarce. An important initiative funded by the Ministry of Health was launched in 2013 in China to boost autism awareness and clinical and research expertise. As part of this recent program, a national epidemiological survey of ASD among the school-aged population of China was designed. In order to conduct the screening phase of this survey involving 120,000 children from 8 provinces, we needed an instrument, properly validated and adapted for the Chinese population. Based on a representative community-based reference sample and aged matched clinical ASD cases from 4 cities of China, we re-examined the factor structure that was proposed in the initial US study. We evaluated the modified Chinese version of Autism Spectrum Rating Scale (ASRS) and the existing Social Responsiveness Scale (SRS) to select a better screening tool for the large scale epidemiological survey.
Objectives: The study aimed at comparing the diagnostic accuracy of ASRS and SRS in screening ASD in community children aged from 6 to 12 years old.
Methods: The study sample consist of 1588 normal children from community (ASRS T-score<70) and 190 children with diagnosed ASD by DSM-IV from clinics from 4 cites of China. Parents of selected children were invited to complete the ASRS and SRS scales with 1-2 weeks interval. Two of the sites were randomly assigned to administer ASRS first; the rest of two sites did the SRS first and followed by ASRS with 1-2 weeks interval. Receiver Operating Characteristic (ROC) analysis was performed by using ASD disease status as gold standard (1 for cases, 0 for community controls) and ASRS as well as SRS scores as test variables, respectively. Area under curve (AUC) and 95%CI, sensitivity, specificity, positive and negative predicts value and positive rate were evaluated and compared between ASRS and SRS performances. The optimal cutoff of ASRS was proposed for screening ASD to obtain best sensitivity and specificity.
Results: The study sample averagely aged 8.8 years old (range 6-12 years), with 51.1% and 87.9% males in normal controls and clinical cases ($P<0.001$). 31.2% and 65.2% questionnaires were administered by father and mother respectively. Both ASRS and SRS showed excellent performance in ROC analysis with AUC of 0.95(95%CI: 0.93-0.96) and 0.97 (95%CI: 0.96-0.98), respectively, with some overlap in the 95%CIs. Using the cutoff of 57 for ASRS and 60 for SRS, ASRS and SRS showed similar sensitivity (96.3% vs 94.2%), specificity (82.8% vs 82.0%) and positive predict value (39.0% vs 38.4%) and negative predict value (99.0% for both). The positive rate of ASRS and SRS scales were 17.23% and 17.9% respectively. Father administering the questionnaire or mother doing did not bias the comparison between the two screening scales.
Conclusions: ASRS shows excellent performance in screening ASD from Chinese population aged 6-12 years old, which is comparable with SRS.

64   **138.064**   Diagnostic Trends in an ASD Population

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Background: Research on comorbid psychiatric diagnoses in the field of autism has expanded over the last decade. Comorbid psychiatric diagnoses can manifest differently in individuals, with a wide range of behaviors and specific needs depending on the presence or combination of each disorder. Even with current research, trends over time in comorbid psychiatric disorders have been poorly described. Phenomena such as diagnostic substitution need to be more fully explored, in conjunction with describing the clinical manifestations of these co-occurring diagnoses. Individuals with co-occurring ID and autism, as well as other co-occurring psychiatric diagnoses, are distinct groups and identifying their prevalence or rate as a group is an important next step to further describing their needs. Describing these trends over time, and studying their impact, can inform temporal relationships in diagnosis trends, and inform program planning and policy implications.
Objectives: The primary purpose of this study is to investigate prevalences of comorbid psychiatric diagnosis, examine these trends over time, and identify the diagnosis that most contributes to the increase in co-occurring diagnostic prevalence. We will also describe demographic and other factors that contribute to the differences in comorbid psychiatric diagnoses.
Methods: Data used to identify the population with autism were collected from a large northeastern state from individuals eligible for the state Medical Assistance program. Individuals of all ages were included in the analysis, and were selected if they had any one Medicaid claim associated with an ICD-9 299.XX diagnosis in calendar years 2008-2012. Frequencies and proportions of comorbid psychiatric diagnoses were calculated and tested for significance using chi-square analysis. Multivariable logistic regression was used to determine differences in comorbid psychiatric diagnoses over time.
Results: From 2008-2012 the prevalence of individuals with an autism having any comorbid psychiatric diagnosis increased from 47.9% to 59.4%. Across all psychiatric comorbid diagnoses, the largest increase was seen in intellectual disabilities, increasing from 6.8% to 18.3%. The most frequently diagnosed comorbid psychiatric disorder was ADD/ADHD (23%). Multivariable logistic regression analyses are ongoing to determine and control for explanatory demographic variables.
Conclusions: The prevalence of comorbid psychiatric diagnoses in individuals with autism who are receiving services through Medical Assistance has increased from 2008-2012. This increase in multiple psychiatric diagnoses presents a unique challenge in providing services that fit these individuals' complex needs. As Medical Assistance coverage can depend on funding streams, it is

important to determine whether or not these trends in diagnoses are a result of a better characterization of the patients' behaviors, an increase in occurrence of these disorders, or diagnostic substitution. More research on this issue is needed to determine the extent of these diagnoses in the general population, in order to better inform diagnostic trends and service delivery in this unique population.

65   **138.065** Discriminant Validity of the ADI-R in Latino Families: Identifying Differences Between Autism Spectrum Disorder and Developmental Delay

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Background: The development of culturally and linguistically appropriate diagnostic tools is crucial in the assessment of Autism Spectrum Disorders (ASD). The Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & LeCouteur, 1994) is considered a gold-standard parent interview that captures children's past and current development. Although the ADI-R has been widely used in clinical and research settings in the diagnostic process, few studies have evaluated the use of the ADI-R in distinguishing between children with ASD and children with other developmental disabilities (e.g., Gray, Tonge, & Sweeney, 2008; Lord, Rutter, & LeCouteur, 1994). Even fewer studies have assessed the validity of the ADI-R in Latino populations (e.g., Blacher, Cohen, & Azad, 2014; Magaña & Smith, 2013). Thus, there is a need to appraise the utility of the ADI-R in the accurate identification of children with ASD in the Latino population. This information is critical in identifying the appropriate supports and resources for parents and their children.
Objectives: The current study aims to assess whether the use of ADI-R in a USA based Spanish speaking Latino population demonstrates adequate discriminant validity in distinguishing between children with ASD and children with DD.
Methods: The current study included Spanish speaking Latino parents (primarily mothers) of children and adolescents who were between 4 and 16 years of age and received a clinical diagnosis of ASD or a Developmental Delay (DD). The official Spanish version of the ADI-R was administered by trained interviewers. Medical records were obtained to establish the clinical diagnosis. Children were grouped by the clinical diagnosis and included diagnoses of ASD (n = 28) and DD (n= 21).
Results: Discriminant validity was assessed by comparing scores for the three domains on the ADI-R. Converted scores were used as recommended by the updated algorithms (e.g., Rutter, LeCouteur, & Lord, 2003). Preliminary analyses found that children with ASD had higher scores than children with DD on the Reciprocal Social Interaction domain, $F(1, 47) = 6.61$, $p = .013$, and the Restricted and Repetitive Behaviors domain, $F(1, 47) = 6.78$, $p = .012$. No significant differences were observed between children with ASD and children with DD on the Communication – Nonverbal, $F(1, 47) = 1.26$, $p = .268$, and Communication – Verbal domains, $F(1, 31) = 1.91$, $p= .176$. Means are displayed in Table 1. Additional analyses will evaluate group differences at the subdomain and individual item level to identify specific areas that might be significant in the diagnostic process.
Conclusions: The preliminary findings indicate that the Spanish ADI-R exhibits adequate discriminant validity for the Reciprocal Social Interaction and the Restricted, Repetitive Behavior domains, but not in the Communication (Verbal and Nonverbal) domain. These results are in line with other studies finding that the validity of the ADI-R may not be as strong for certain populations (e.g., very young children; Tsuchiya et al., 2013). Further analyses are needed to determine which behaviors may distinguish between children with ASD and children with DD.

66   **138.066** Early Diagnosis of Autism Spectrum Disorder Via a Transdisciplinary Clinic

ABSTRACT WITHDRAWN

Background:
Currently, there are multiple barriers during the diagnosis and treatment of Autism Spectrum Disorders (ASD). These barriers include prompt referrals from primary care providers to specialists, long waitlists for diagnostic services, and subsequent intervention (Filipek, et al., 1999). As early diagnosis and intervention for ASD are crucial for positive outcomes (Bryson, Rogers, and Fombonne, 2003), alternative diagnostic methods should be explored. One possible alternative method, the Medical Diagnostic Clinic is a transdisciplinary diagnostic clinic, where children birth to age three are evaluated to assess whether there is a medical reason for their delays. The arena-style evaluation is typically a multidisciplinary team, including a physician, a clinical psychologist, a speech and language pathologist, an occupational therapist, and a developmental therapist all of whom have strong backgrounds in diagnosing and treating children with developmental disabilities (Klin, et al., 2005). Though this approach appears promising, little systematic research has been conducted to determine the reliability and accuracy of ASD diagnoses by a transdisciplinary clinic.
Objectives:
To examine the validity and reliability of an ASD diagnosis before the age of three within a transdisciplinary clinic. The study re-assessed 34 children who were evaluated prior to age three by a transdisciplinary team, 20 with autism spectrum disorder and 14 who did not meet criteria during their initial assessment. The Autism Diagnostic Observation Schedule (ADOS; Lord, et al., 2000) and Autism Diagnostics Interview-Revised (ADI-R; Le Counteur et al., 2003) were completed at follow-up. The stability of the diagnosis was examined by comparing the original diagnosis given by the transdiciplinary team and that of the follow up evaluation.

Methods:
34 participants were evaluated by a transdiciplinary clinic with an age range of 13 – 36 months. The same children were re-evaluated after the age of 3, with an average age of 49.35 months. Either the Screening Tool for Autism in Two Year Olds (STAT; Stone & Ousley, 1997) or the Childhood Autism Rating Scale (CARS; Schopler, Reichl, & Renner, 1998) were administered during the transdisciplinary evaluation. Children were then randomly selected from a database and assigned to the ADI-R and ADOS evaluator, who was blind to diagnosis of the child. The diagnoses from the two time points were compared to determine the accuracy and reliability of the diagnosis assigned by the transdisciplinary clinic prior to the age of three.
Results:
Diagnostic accuracy of the transdisciplinary clinic was high compared to the ADOS/ADI-R. Specifically, inter-rater reliability of diagnosis was found to be 82.35% with a Kappa coefficient of .62 between initial diagnosis and follow up.
Conclusions:
Findings of the current study suggest that the transdisciplinary clinic approach is a reliable and valid method of identifying children at risk for ASD prior to the age of 3. This appears to be highly accurate in the identification of ASD in the birth to three population, which may enhance service delivery and developmental outcomes for these youngsters. Transdisciplinary teams could serve as a way of getting children and families connected with targeted intervention while they wait for a formal diagnostic evaluation.

67 **138.067** Early Predictors of Academic Achievement in School-Aged Children with Autism Spectrum Disorders

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Background: Children with autism spectrum disorders (ASDs) commonly experience social and academic challenges within the school setting, often exacerbated by cognitive, language, and motor impairments. Few studies have looked at early predictors of later academic performance in this group, results of which may have important implications for clinical intervention.
Objectives: This study aims to assess early predictors of academic functioning in school-aged children with ASDs.
Methods: Participants were 27 children (23 males) evaluated at three time points as part of a larger study on the early detection of pervasive developmental disorders. ASD diagnosis was established at T1 (mean age 27.2 ± 3.3 months) and confirmed at T2 (mean age 52.8 ± 5.5 months), with diagnoses distributed as follows: 81% Autistic Disorder and 19% Pervasive Developmental Disorder – Not Otherwise Specified (i.e., PDD-NOS). All children continued to meet diagnostic criteria for an ASD at T3 (mean age 119.4 ± 9.7 months), at which time academic achievement was also assessed. As T1 cognitive data was characterized by considerable floor effects, T2 data was used to predict T3 outcomes. Cognitive ability and social functioning at T2 were evaluated by the Mullen Scales of Early Learning (MSEL) and Vineland Adaptive Behavior Scales (VABS), respectively. Academic achievement at T3 was assessed across the domains of reading (i.e., word reading, reading comprehension, and pseudoword decoding) and mathematics (i.e., numerical operations and math reasoning) using the Wechsler Individual Achievement Test. The current study used multiple regression with stepwise entry to determine significant predictors of academic ability at T3 from cognitive and social functioning at T2.
Results: Five T2 variables (MSEL receptive language, expressive language, visual reception, and fine motor; VABS socialization) were entered stepwise to predict T3 achievement. Composite reading skills were best predicted by receptive language ability (R^2 = .68, $F(1,7)$ = 15.089, p = .006). Word reading was best predicted by fine motor skills (R^2 = .45, $F(1,16)$ = 13.109, p = .002), and reading comprehension was best predicted by a combination of receptive language ability and socialization skills (R^2 = .88, $F(2,12)$ = 42.859, p < .001). Pseudoword decoding had no significant predictors ($F(5,4)$ = 1.397, p = .384). In contrast, composite math skills (as well as specific component skills of numerical operations [R^2 = .54, $F(1,14)$ = 16.309, p = .001] and math reasoning [R^2 = .72, $F(1,13)$ = 33.524, p < .001]) were best predicted by expressive language ability (R^2 = .87, $F(1,11)$ = 70.410, p < .001).
Conclusions: This study was designed to determine early predictors of academic achievement in school-aged children with ASDs. The results suggest that, overall, early language skills best predict later academic abilities; specifically, receptive language skills predict reading ability, whereas expressive language skills predict math ability. This study supports the importance of early language interventions for potential improvement of later academic outcomes in children with ASDs.

68 **138.068** Early Temperamental Persistence and Associations with Later Executive Functioning

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Background: ASD is a markedly heterogeneous disorder and Bundson and Happe (2014) suggest that specific phenotypic variants that are relevant to later outcomes can be derived at the cognitive level. Executive functioning (EF) is also diverse in ASD, but typically not measured until later ages. In fact, recent research (Rosenthal et al., 2013) suggests that real-world impairments of executive function increases from childhood to adolescence, with particular impairments in the domains of initiation, working memory and shifting. Identifying precursors to EF dysfunction holds important implications for intervening early and may provide opportunities to limit the increasing discrepancies seen in adolescence. A potential precursor of EF that can be measured in early childhood is persistence, or the temperamental tendency to maintain goal-directed behavior in the face of obstacles. Persistence in early childhood has been associated with both attention and school functioning (Guerin et al., 1994) in typically-developing children; however, little is known about its relevance in children with ASD.

Objectives: To examine if parent report of child's persistence in early childhood is associated with executive function skills and gains in adaptive skills in middle childhood.

Methods: Prior to age 7, 90 parents of children with ASD completed the Carey Temperament Scale (CTS; McDevitt & Carey, 1984), which includes a Persistence Dimension Score. Approximately five years later, they returned for a follow-up visit and completed the Behavior Rating Inventory of Executive Function (BRIEF; Giola, Isquith, Guy & Kenworthy, 2000) and the Vineland Adaptive Behavior Scales (Sparrow, Cicchetti & Bella, 2005).

Results: Current results demonstrate a link between parent report of the child's persistence in early childhood and executive function skills in middle childhood. Significant associations were observed for initiation (r=.39), working memory (r=.41) and plan/organize (r=.32), as well as the global executive composite score (r=.34). Examination of associations between persistence, executive function and adaptive skills are underway.

Conclusions: Preliminary analyses suggest that early temperamental persistence is a potential precursor for later executive problems. Identifying early risk factors from a neurocognitive perspective allows for earlier, and more targeted interventions, as well as studies from a neurobiological perspective.

69   **138.069** Examining the Interaction of Social Function and Language Skills in ASD

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Background: The autism spectrum is associated with significant heterogeneity in terms of etiology, biology, and phenotype and characterizing this heterogeneity is key to development of targeted treatments. In this context, characterization of variability in the language domain has received much attention. Language impairments are a key feature of ASD and predictors of outcome in this population. Moreover, variability in this domain is suggested to be associated with underlying biological mechanisms. Although DSM-5 has deemphasized language ability and removed diagnostic distinctions between Asperger's syndrome and autistic disorder, language impairment remains a "specifier" ASD. One outstanding issue in the area is how this specifier interacts with core ASD symptom domains. Specifically challenging this examination is the confounding effect of communication function on the interaction between language social function in ASD.

Objectives: The objective of this study was to investigate the interaction between structural language ability and social functioning in ASD.

Methods: A sample of children with ASD (n=141, age: 10.2+3.0, 111 male) was recruited. To tease out the confounding effect of communication on the language-social reciprocity interaction, the Reciprocal Social Interaction subtotal from the Autism Diagnostic Observation Schedule (ADOS)-Module 3 was used to characterize reciprocal social function. Language ability was quantified using the Oral and Written Language Scales, respectively. Receptive and expressive language were considered separately and as a composite as recommended by DSM-5. Using a cut-off of 85 in each language domain (one standard deviation below the mean), children were stratified into high and low language groups. This cut-off value also corresponded to the result of clustering the sample based on language ability using the k-means algorithm.

Results: Reciprocal social interaction score decreased significantly as language comprehension, oral expression, and the oral language composite increased (p<0.0001). In all three cases, there was a significant group x language effect on the social interaction scores (p<0.03). In particular, the reciprocal social interaction score decreased significantly with scores on language domains in the "high language" group but not in the "low language" group.

Conclusions: Our results suggest that structural language ability may define two subgroups within the autism spectrum. The interaction between the social and language domains is different between the two subgroups and may be reflective of distinct underlying biology.

70   **138.070** Extension of the PDD Behavior Inventory to Adolescents

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Background:
The PDD Behavior Inventory (PDDBI) is a reliable and valid informant-based rating scale for ASD designed for assessment, diagnosis, and treatment planning. Studies have indicated that scores from the PDDBI are good indicators of response to intervention, diagnosis, and outcome, and are also associated with certain genetic factors. The PDDBI was designed to cover ages ranging from 18 months to 12 years, five months. However, this age range restricts clinicians and researchers to younger children and prevents use of the PDDBI for longer term clinical follow-up as well as research studies of adolescents with ASD.
Objectives:
In a large cohort of adolescents, examine the cross-sectional effects of age on PDDBI raw cluster scores and total scores; compare internal consistency and inter-rater reliability with established measures for the standardization sample; and examine the construct and criterion-related validity of the PDDBI for this older group.
Methods:
PDDBIs were completed by 138 parents and 100 teachers of adolescents with ASD, ages 12 years, 6 months to 18 years, 5 months. The sample was divided into three age groups (years:months): 12:6 to 14:5; 14:6 to 16:5; and 16:6 to 18:5. Raw cluster and raw total scores were compared across age groups using ANOVAs. Internal consistencies were evaluated with alpha coefficients and factorial validity with principal components analyses (PCA). Criterion-related validity correlations for the PDDBI scores were examined against ADI-R domain scores and against the Aberrant Behavior Checklist (ABC) in a subset (n=18) of parents.
Results:
Across age group, significant attrition (>20%) in completion of the Gestural Approach, Social Play, and Imaginative Play item clusters for the Social Approach (SOCAPP) domain was noted. Regression techniques were then used to estimate missing cluster scores based on the remaining clusters. ANOVAs revealed no significant difference in the revised SOCAPP mean score, as well as all other domain mean scores, across age groups. Internal consistencies were high, ranging from 0.77 to 0.98. Parent-teacher agreement, within a 6 month period, was good for most of the domain scores but poor for the RITUAL, SOCPP, SEMPP, and LMRL domains. Factorial validity replicated previous findings of two behavioral dimensions: Approach/Withdrawal Problems and Receptive/Expressive Social Communication Abilities. Agreement between Approach/Withdrawal Problems domain scores and corresponding ABC factor scores was very good and agreement between the PDDBI and ADI-R was remarkably good given that the ADI-R scores were historical in nature.
Conclusions:
These analyses confirm both the reliability and validity of the PDDBI for adolescents with ASD given minor modification in scoring of the SOCAPP domain.

71 **138.071** Factor Structure and Psychometric Properties of the Revised Home Situations Questionnaire for Autism Spectrum Disorder

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Background: The original Home Situations Questionnaire (HSQ; Barkley & Edelbrock, 1987) is a 16-item scale developed to examine the severity of noncompliant behavior in children with disruptive behavior disorders. Previously, we reported on the factor structure of the HSQ in children with pervasive developmental disorders (Chowdhury et al., 2010). Consequently, we further revised the HSQ for use with children with autism spectrum disorder (ASD). To enhance the range of clinical situations covered and to improve reliability, we added seven new items describing home situations where a specific demand is placed on the child.
Objectives: The purpose of the current investigation was to examine the psychometric properties of the revised and expanded 27-item version of the instrument (referred to as the HSQ-ASD). We predicted that the seven new items would factor selectively on the previously reported Demand-Specific subscale. We also predicted clear evidence of convergent and divergent validity with measures of problem behavior, adaptive behavior, and IQ, as well as favorable test-retest reliability.
Methods: Parents completed ratings of 242 disruptive children with ASD (mean age = 5.65 years, SD = 2.21) participating in one of two randomized clinical trials. We used Exploratory Factor Analysis (EFA), with Ordinary Least Squares as the discrepancy function and oblique Crawford-Ferguson quartimax rotations, to assess the factor structure of the HSQ. Pearson correlations were used to assess convergent and divergent validity, and Intra Class Correlations to assess test-retest reliability.
Results: The EFA yielded a two-factor structure similar to that obtained in our previous psychometric examination (2010). These two factors, with 12 items each, were Socially Inflexible (alpha = .84) and Demand-Specific (alpha = .89). The underlying themes of these two factors suggest that Social

Inflexibility is congruent with deficits in social interactions and rigid adherence to routines that are part of ASD, whereas Demand Specific noncompliance appears to reflect oppositional behavior in response to typical daily requests. Three items that did not meet the cut-off factor loading were discarded from the final composition of the HSQ−ASD. Consistent with our prediction, the EFA confirmed that 6 of 7 newly added items loaded on the Demand-Specific factor. One-to-2-week test-retest reliability was statistically significant for almost all items and also statistically significant for the subscale totals (r= .57 for Socially Inflexible and .58 for Demand Specific). The pattern of correspondence between the HSQ–ASD and parent-rated problem behavior scores, clinician assessment of repetitive behavior, adaptive behavior, and IQ provided evidence for concurrent and divergent validity of the HSQ–ASD.

Conclusions: In summary, the modified and expanded 24-item HSQ-ASD provides broad coverage of situations associated with noncompliance, thus supporting its use as an outcome measure for disruptive behaviors in this population. Limitations of this study include limited generalizability of findings since all participants were selected for presence of behavior problems. Future studies will provide a valuable service by evaluating the HSQ-ASD in children with ASD unselected for disruptive behavior and also in *adolescent* populations with ASDs.

72   **138.072** Follow-up ASD Screening Identifies Children Missed at Initial Screening Timepoint

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Background: The M-CHAT-R/F is a valid screening tool for ASD at 18-30 months. However, no screening instrument can identify all potential ASD cases. Children who screen negative at 18-24 months old but later screen positive at 30-48 months old with the M-CHAT-R/F are "potential miss" cases. A longitudinal evaluation of the M-CHAT-R/F provides an opportunity to identify and study these children.

Objectives: This study present preliminary data from a 2-year follow-up screening with the M-CHAT-R/F and examines items that were failed at both or either time points by "potential miss" cases.

Methods: Participants were drawn from a sample of children who screened negative on the M-CHAT-R/F (n=10,504) and the M-CHAT (n=838) when screened at 18-24 months of age. Approximately 2 years after the initial screening, children were rescreened with the M-CHAT-R/F; it was mailed to families with a stamped return envelope. A subset of rescreened children screened positive on the M-CHAT-R/F and were invited to participate in an ASD evaluation.

Results: At rescreening, 29 children were identified as "potential misses" and invited for diagnostic evaluation. Eleven of 17 evaluated children were given developmental diagnoses. Six children received an ASD diagnosis and were identified as "true misses." Seven children received non-spectrum diagnoses, and four received no diagnosis. The average age of "potential misses" at initial screening was 21.6 months (SD=3.2), the average age at rescreening was 45.6 months (SD=5.6), and the average age at evaluation was 48.3 months (SD=3.2). "True misses" and "potential misses" did not differ on the number of items failed at initial screening (M=0.8, SD=0.9) or at rescreening (M=3.6, SD=1.7). At initial screening, failure on Item 13 (walks) and Item 17 (seeks parent attention) were each moderately associated with receiving an ASD diagnosis at 48 months (χ^2 (1, N=10)=1.7, p=.19, φ_c=.41), though sample size precluded significance. At rescreening, failure of Item 1 (follows point) (χ^2 (1, N=16)=1.6, p=.21, φ_c=.31), Item 3 (pretend play) (χ^2 (1, N=16)=1.7, p=.18, φ_c=.33), Item 5 (unusual finger movements) (χ^2 (1, N=16)=1.3, p=.25, φ_c=.29), and Item 15 (imitates) (χ^2 (1, N=16)=1.7, p=.18, φ_c=.33) were each moderately associated with a diagnosis of ASD at 48 months at a non-significant level.

Conclusions: This study presents preliminary data on a sample of screening cases that screened negative as toddlers but later screened positive on the M-CHAT-R/F, including some verified ASD "true misses." 17 children were evaluated, 76% of whom received developmental diagnoses at 48 months; therefore, rescreening did not misidentify many typically developing children with potential concerns. At initial screening, failed items associated with ASD diagnosis were not core ASD features. This is potentially due to inaccuracies in parent reporting, or because core features manifested after the age of first screening. Interestingly, failed items at rescreening associated with ASD diagnosis represented core ASD features. These results emphasize the importance of ASD screening at multiple timepoints, as a single screening may miss cases. Further analyses will compare clinical characteristics and item-level responses in a larger sample of "potential miss" and "true miss" cases identified through additional screening measures.

73   **138.073** From a Heterogeneous ASD Phenotype to Quantitatively Distinct Putative ASD Subtypes

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Background: Although it is accepted that the autism phenotype is variably expressed across cases and that there are likely underlying subtypes of autism (i.e. the "autisms"), it is not clear how best to identify phenotypic subtypes that are truly distinct. In addition, "gene first" (e.g. comparing genetic conditions associated with ASD), and "brain first" (e.g. brain function -symptom correlations) approaches have yielded mixed results suggesting that efforts to parse ASD at the phenotypic level

may still be useful, and could then in turn inform genetic and neuroimaging studies.
Objectives: To develop a quantitative method for isolating distinct ASD phenotypes.
Methods: In the present study we compared a large and diverse sample of children and adolescents with ASD (n = 224, identified by ADOS, ADIR, & expert clinical diagnosis; age range = 2 to 18 yrs; IQ range = 40 – 140; 13% female) to a sample of typically developing children matched on age, IQ, & gender, using a multi-method (parent ratings, observational measures) and multi-measure (SCQ subscales, SRS, RBS-R subscales, CCC subscales, ADOS subscales) approach for mapping the core features of autism. We used a 3 step process to isolate potential phenotypic subtypes: (1) psychometric analyses identified the subset of measures with superior reliability & validity, (2) multivariate techniques (correlation, regression, & PCA) identified measures of core features with maximum between-measure divergence, (3) radar graphs of standardized scores isolated extreme outlier cases for each measure of divergent core feature (social, communication, RRBs).
Results: There was little evidence that the "core" features of autism were strongly related (e.g. correlations of social-communication function with RRBs across several measures were in the range of 0.2 to 0.4). PCA analyses also yielded consistent evidence for divergence into the 3 core features (social, communication, RRBs), and also divergence within the core features into multiple sub-factors.   Radar graphs identified cases that were extreme outliers (> 1.5 SDs) on only 1 core feature: 9% on social impairment, 18% on communication impairment, and 11% on RRBs suggesting that up to one-third of the sample may be "extreme phenotypic outliers" within the ASD spectrum. To investigate the validity of these putative subtypes, we are examining validation of these subgroups using eye-tracking measures of social and nonsocial attention, and fMRI measures of social and nonsocial reward circuitry activation.
Conclusions: Our analyses indicate that there is significant divergence of the 3 core features of autism (social, communication, RRBs) across methods and measures. Further, multi-method, multivariate approaches using psychometrically acceptable measures may be useful to identify "extreme" phenotypic outlier cases within each of the core features. This approach may be useful in helping to identify specific genetic and neurobiologic factors that are associated with each core feature of autism in a way that previous research using a "one size fits all" phenotypic approach (e.g. ASD versus non-ASD) has not been able to do.

74   **138.074**   Gender Differences in ASD Symptoms: Do Women with HFASD Display Fewer Socio-Communicative Difficulties Than Men?

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Background: Girls and women with autism spectrum disorders (ASD) have historically been underrepresented in the literature, but there has been an increased interest in gender differences in the characterization and presentation of ASD. Results from some of these studies suggest that females may present with a different pattern of socio-communicative impairments and restricted interests and behavior than males. However, few studies have examined this pattern in adults.
Objectives: The aim of this project is to examine gender differences in ASD symptoms in adults with high functioning autism spectrum disorders (HFASD) using a standardized observational assessment, as well as self-report and parent-report ASD questionnaires.
Methods: This project is part of a larger study examining gender differences in ASD symptoms, social relationships, and emotions in adults with HFASD. Participants included 56 adults (28 women and 28 men) with a mean age of 26.3 years (SD = 6.0 years). Participants were diagnosed with ASD by a clinician in the community and did not have a diagnosis of co-occurring intellectual disability (ID). Researchers assessed participants with the Autism Diagnostic Observation Schedule (ADOS) and the Wechsler Abbreviated Scale of Intelligence-2nd Edition (WASI-2). Parents of participants completed the high-functioning Autism Spectrum Screening Questionnaire (ASSQ), a screening measure for HFASD adapted for use with adults in this study, and the ASSQ-GIRL, an addition to the ASSQ developed to assess ASD features that may be more applicable to females with ASD. Participants completed the Autism Spectrum Quotient (AQ), a self-report ASD screening measure. Men and women with HFASD did not differ significantly on age, living situation, ethnicity, employment, or WASI-2 verbal comprehension index scores.
Results: Women with HFASD scored significantly lower on total ADOS scores (F = 15.43, p < .001), as well as the Social (F =13.07, p = .001) and Communication (F = 9.32, p = .004) domains than men with HFASD, indicating less severe socio-communicative difficulties. Women with HFASD scored lower than men with HFASD on the RRB domain, but this difference was not significant (F =3.48, p = .068). A smaller proportion of women with HFASD (36%) met the cutoff score on the ADOS than men with HFASD (71%), indicating a diagnosis of "autism spectrum" ($\chi2$ = 7.179, p = .007). There were no significant differences between women and men on the AQ or the original ASSQ. However, women with HFASD scored significantly higher than men with HFASD (F = 11.741, p = .001) on mean ASSQ-GIRL scores.
Conclusions: Results from this study suggest that women with HFASD may display less severe observable socio-communicative deficits than men with HFASD, which supports a previous study examining gender differences in adults with HFASD. There were no differences between men and women on self-reported ASD symptoms and on the original ASSQ scale, although women did score higher on the ASSQ-GIRL than men with HFASD. Further research on gender differences is warranted, as it is important to understand how it may impact the diagnosis and course of ASD.

75   **138.075** Heterogeneity at the Minimally Verbal End of the Spectrum

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Background: Approximately 30% of children with autism spectrum disorders (ASD) are minimally verbal past age 5 (Anderson et al., 2007), and these children are rarely reported in research. Preliminary research suggests that despite limited expressive language, there may be considerable variability in their other abilities, such as non-verbal cognition and receptive language. Better characterization of these abilities can lead to increased understanding of the minimally verbal ASD population, more targeted interventions and better longitudinal outcomes.

Objectives: 1) To describe the range of abilities across domains in a sample of minimally verbal children with ASD, 2) determine how those abilities relate to expressive language, and 3) find common skill profiles.

Methods: Participants included 61 minimally verbal children with ASD from a multi-site intervention study (Kasari et al., 2014), ages 4.5 – 9 years. Data was analyzed from the baseline timepoint. Assessments included the Autism Diagnostic Observation Schedule (ADOS), Peabody Picture Vocabulary Test – 4[th]Edition (PPVT), Natural Language Sample (NLS; Kasari et al., 2014), Leiter-R (non-verbal IQ), Early Social Communication Scales (ESCS) and Repetitive Behaviors Scale – Revised (RBSR). Descriptive and correlational statistics were used to describe ability ranges across domains and their relationships to expressive language. Skill profiles were determined using K-means analysis.

Results: All participants were assessed with the ADOS module 1 (no or very little expressive language). On the ADOS, 44 participants used five or fewer words, 12 used more than 5 words and 5 used short, inflexible phrases. Severity scores ranged from 4 – 10, indicating a variety of ASD symptoms. NVIQ ranged from 36 to 123, with a mean of 68. NVIQ was correlated with receptive language ($r=.50$, $p<.001$), but not with expressive language or any other measure. Receptive language age-equivalent ranged from 1.9 to 4.7 years ($M=2.6$) and was related to expressive vocabulary size ($r=.39$, $p=.002$) but no other variables. Joint attention (from the ESCS) was correlated with ADOS severity score ($r=.36$, $p=.005$). K-means cluster analysis was used to identify 4 participant clusters, based on a variety of measures. Cluster 1 ($N=10$) had low abilities across domains, the highest level of repetitive behaviors and highest ADOS scores. Clusters 2 ($N=5$) had a mix of abilities across domains. Cluster 3 ($N=32$) was the largest group and had the lowest rates of repetitive behaviors with scores near the mean on other measures. Cluster 4 ($N=11$) had a moderate rate of communicative utterances, moderate repetitive behaviors and high abilities across other domains.

Conclusions: In this sample of minimally verbal children with ASD, there was substantial heterogeneity across abilities. Of particular interest, children showed great variability in NVIQ, which was not correlated with most other domains. The skill profiles that emerged from the cluster analysis highlight the dissociations among expressive language, NVIQ, joint attention and repetitive behaviors. These characteristics should be explored further, to see if similar skill profiles can be found in additional samples of minimally verbal children with ASD. Particularly, research is needed to determine if these characteristics can be related to intervention response and longitudinal outcomes.

76   **138.076** How Useful Are the Parent-Completed Ages and Stages Questionnaires for Screening of Motor Problems in Preschoolers with High-Functioning Autism?

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Background:
Comorbidity is common in autism spectrum disorders (hereafter "autism"). For instance: up to 79% of individuals with autism, including those with intellectual disabilities, have concurrent motor problems (Lai, Lombardo, & Baron-Cohen, 2014). Mild motor problems, which are not attributable to medical conditions such as cerebral palsy, are often seen in children with high-functioning autism (HFA). Unfortunately, motor skills of children with HFA are habitually not a priority for early assessment and intervention teams who may focus primarily on social-communication and behavioural concerns (Lloyd, MacDonald, & Lord, 2013). Developmental screening with a broadband screen that is appropriate for parents may help to identify those children who are in need of further profound motor evaluation.
Objectives:
To determine the usefulness of the Ages and Stages Questionnaires (ASQ-2) for screening gross and fine motor problems in preschoolers with HFA in the clinical setting of an autism diagnostic center.
Methods:
Participants:
39 children with HFA between 22 and 54 months of age (mean chronological age 39.5m, SD 8.5m)

with an IQ above 70 (mean mental age 39.8m, SD 11.3m) were diagnosed in University Autism Clinics (Flanders, Belgium) according to DSM-IV-TR diagnostic criteria for autism confirmed by ADOS-G-classification.
Screening: Parents filled in the gross and fine motor domain section of the Ages and Stages Questionnaires-second edition (ASQ-2) (Squires, Bricker, & Potter, 1999). To take into account the different cut-off scores of the ASQ-2 questionnaires, gross and fine motor scores were expressed as a difference score between the raw and cut-off score.
Motor evaluation: Gross and fine motor development were measured with the use of the locomotion and visual-motor integration subtests of the Peabody Developmental Motor Scale-second edition (PDMS-2). PDM-2 standard scores below 7 were considered as indicating motor problems (Folio & Fewell, 2000).
Results:
In this sample, the prevalence of gross motor problems (49%) was higher than of fine motor problems (26%). Specificity analyses revealed an acceptable likelihood of correct identification of children without gross and fine motor problems (specificity of 90%, respectively 93%). However, sensitivity analyses revealed the likelihood of underscreening of motor problems in this population. Only a minority of children with gross motor problems (sensitivity of 32%) and half of the children with fine motor problems (sensitivity of 50%) were correctly identified according to the ASQ-2.
Conclusions:
The capacity of the broadband parental-based ASQ-2 screener to identify children with motor problems appears to be limited. The gross and fine motor domains of the ASQ-2 are not sufficient to identify mild motor problems in high-functioning children with autism in the context of an autism diagnostic center. For further research we suggest to verify how useful the Ages and Stages Questionnaires-third edition (ASQ-3) are for this purpose.

77   **138.077** Identifying Homogeneous Subgroups of Children with ASD, ADHD, and OCD

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Background: There is significant overlap in the presence of repetitive behaviors, social skills deficits, obsessive compulsive behaviors, inattention and hyperactivity across autism spectrum disorders (ASD), attention deficit-hyperactivity disorders (ADHD), and obsessive compulsive disorders (OCD). While the DSM-5 allows for comorbid diagnosis of ASD, ADHD, and OCD, some degree of overlap is expected due to non mutually exclusive diagnostic criteria. The identification of homogeneous subgroups of children who fail to meet the diagnostic threshold for comorbidity may help predict long term functional impairment.
Objectives: To identify subgroups with similar phenotypic profiles within a sample of children with a primary diagnosis of ADHD, ASD, or OCD, and to test for differences in functional impairment across the subgroups.
Methods: The sample consisted of 563 children and youth with ASD (n=231), ADHD (n=231), and OCD (n=101) participating in the Province of Ontario Neurodevelopmental Disorders (POND) Network. Individual-item data collected using four measures, the Social Communication Questionnaire (SCQ), Repetitive Behavior Scale-Revised (RBS-R), Toronto Obsessive Compulsive Rating Scale Parent-Report Version (TOCS), and the Strengths and Weaknesses of Attention-Deficit/Hyperactivity Disorder Symptoms and Normal Behavior Scale (SWAN) were included in a latent class analysis. ANOVA was used to examine the association between primary diagnosis and latent class membership on Adaptive Behavior Assessment System II (ABAS-II) composite scores.
Results: Using a priori criteria, a five latent class model provided the best fit to the data. The largest class (n=183), 85% of whom had a primary diagnosis of ADHD, included individuals with low scores on all but the SWAN scale. A second class (n=93), 80% of whom had a primary diagnosis of OCD, included individuals with high scores on the TOCS only. The majority of participants with a primary diagnosis of ASD were classified almost evenly (n=77, 58, and 77) into the remaining three classes (n=116, 75, and 96), with the balance of class members made up predominantly of individuals with ADHD. Both diagnosis and latent class were significant independent predictors of ABAS composite scores. Among individuals with a primary diagnosis of ASD, significant differences in the ABAS general composite score were seen across all latent classes.
Conclusions: The empirical identification of cross-disorder homogeneous subgroups of children and youth with ASD, ADHD, and OCD seems to be informative in predicting functional impairment, over and above the expected prediction ability of index diagnostic categories. This could have implications for the design of cross-diagnostic intervention trials and aid in genetic studies searching for shared and unique variants associated with these disorders.

78   **138.078** Inter-Rater Reliability of Multi-Disciplinary Autism Spectrum Disorder Diagnoses

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Background: One possible benefit of using multi-disciplinary teams to evaluate children at-risk of autism spectrum disorder (ASD) is the ability to reach consensus. However, the reliability of inter-clinician consensus deserves further examination. Previous studies have suggested modest agreement among clinicians for specific DSM-IV-TR diagnoses - supporting use of a broad ASD diagnosis espoused in DSM-5. However, the level of inter-clinician agreement for the broad ASD diagnosis remains understudied in young, high-base rate samples referred for initial evaluation.
Objectives: The primary aim of the present study was to evaluate diagnostic agreement for broad ASD diagnoses provided by independent clinicians from a multi-disciplinary team. Secondary objectives were to explore relationships between diagnostic agreement for broad ASD, autism severity, demographics, and other clinical factors.
Methods: The population included 229 children ages 13-86 months (78.6% male) referred for evaluation of possible ASD. Three experienced clinicians (psychologist, physician, and speech / language pathologist) provided independent DSM-IV-TR diagnoses as well as the broad ASD diagnosis prior to reaching a final consensus diagnosis. Autism diagnostic observation schedule (ADOS) and Autism Diagnostic Interview-Revised (ADI-R) scores were obtained by independent administrators and only considered for final consensus diagnoses. Child Behavior Checklist, Vineland Adaptive Behavior Scale, and Preschool Language Scale-4 scores were also collected. Kappa coefficients evaluated diagnostic agreement. Relationships between clinician diagnostic agreement, demographics, autism symptom severity, and other clinical measures were computed using Pearson correlation coefficients.
Results: In a young, high base rate sample (Median age =42.4 months, SD=15.6; prevalence of ASD=57.6%), specific DSM-IV-TR categories had poor to fair inter-rater agreement (Kappa=.36-.52). The broad ASD category had better, but not optimal, reliability (Kappa=.54-.68). Age and sex were not associated with agreement after accounting for clinical factors. Agreement was lower for individuals with lower ADOS social and total scores (r=.17, p=.030) and lower ADI-R social and non-verbal communication and total scores (r>.24, p=.007). Restricted and repetitive behavior symptom levels were not significantly associated with agreement on the ADOS or ADI-R (p>.05). Agreement was lower in children with higher expressive and total language scores on Preschool Language Scales.
Conclusions: These findings replicated previous research indicating increased inter-rater reliability with the broad ASD diagnosis, further supporting the shift to DSM-5 from specific DSM-IV-TR categories, and extending previous findings to a high-base rate sample of young children receiving evaluation. However, the reliability of the broad ASD diagnosis - when only based on clinician judgment (not ADOS or ADI-R) - was not optimal, supporting the need for using gold-standard diagnostic instruments to supplement clinical judgment. The lack of relationship between agreement and demographics after accounting for clinical factors is comforting and suggests consensus can be reached even in young children. The observation of poorer agreement with lower social symptom severity and better language ability highlights the need for clinicians to use sensitive instruments, rather than relying on inter-clinician consensus, to identify less socially and language impaired patients. Future research is needed to clarify the value of inter-clinician consensus.

79 **138.079** Links Between ASD and Self-Regulation Abilities on Adaptive Functioning Skills

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Background:
Children with autism spectrum disorder (ASD) often exhibit marked difficulties in adaptive skills (Kanne et al., 2011) compared to peers with typical development (TD) (Williams, Mazefsky, Walker, Mineshew, & Goldstein, 2014). Research suggests poor self-regulation skills may interfere with children's adaptive skills (Buckner, Mezzacappa, & Beardslee, 2009). The delay of gratification (DoG) task, a measure of children's ability to postpone an immediate reward in favor of a more favorable, delayed reward, requires good self-regulation skills (Brock, Rimm-Kaufman, & Wanless, 2014). Research suggests self-regulation difficulties are more prevalent in children with ASD than children with TD (Jahromi, Bryce, & Swanson, 2013). Although children with ASD have pronounced adaptive function and self-regulation difficulties, there is a gap in the literature regarding the potential relations among children's developmental status (ASD vs. TD), performance on a DoG task, and adaptive skills.
Objectives:
The purpose of this study was to test our hypothesis that time waited on a self-regulation task would moderate the relation between children's status and adaptive skills.
Methods:
Participants included 75 children, ages 3:0 to 6:11, and their parents. Thirty-five children had an ASD diagnosis and the remaining 40 were typically developing. Children completed a seven-minute DoG task in a laboratory setting, which was videotaped for subsequent coding. Seconds children waited on the DoG task was the moderator variable of interest. Additionally, parents' ratings from The Behavioral Assessment System for Children – Second Edition (BASC-2; Reynolds & Kamphaus, 2004) were used to evaluate children's adaptive functioning skills.
Results:

To test whether wait time on the DoG task moderated the relation between developmental status and adaptive functioning skills, a hierarchical multiple regression analysis was conducted after controlling for children's verbal skills, age and sex. Developmental status and DoG wait time in seconds, entered on the second step, accounted for significant unique variance in children's adaptability skills, ΔR^2 = .165, $F(2, 70) = 8.87$ $p < .001$. The interaction term between developmental status and DoG wait time, entered on the third step, accounted for significant additional variance in children's adaptive skills, $\Delta R^2 = .099$, $\Delta F(1, 69) = 12.43$, $p = .001$. As shown in Figure 1, children with ASD had adaptive skills at least one SD below the mean whereas children with TD had skills at or above the mean. As can be seen, the adaptive skills of children with ASD were stronger when they had longer wait times rather than shorter wait times. Conversely, adaptive skills of children with TD decreased when they had longer wait times, although these children's skills were all within the average range.
Conclusions:
These findings support our hypothesis that stronger self-regulation skills, as estimated by longer wait times on the DoG, would be associated with better adaptive functioning for children with ASD. For children with TD who already had average or better adaptive functioning, self-regulation did not appear to play a role in their adaptive functioning. These findings suggest interventions targeting self-regulation abilities may also be related to improvements in adaptive skills for children with ASD.

80 **138.080** Long-Term Development of Children with Autism Spectrum Disorders Following Early Intensive Behavioral Intervention: Adaptive Functioning

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Background: Early intensive behavioral intervention (EIBI) is an effective intervention for many children with Autism Spectrum Disorders (ASDs). However, its long-term impact in the development of cognitive, communication, social, behavioral, and academic skills following EIBI has not been widely evaluated.
Objectives: We conducted a 5-year longitudinal study to examine the development of children with ASDs who graduated from a community-based EIBI preschool program. Children's development in a number of domains was monitored during the study. For this presentation, we will focus on developmental trajectories of adaptive behavior, an area important for daily living skills.
Methods: Participants were 10 children with ASDs who graduated from a government funded community-based EIBI pre-school program. Mean age of the children was 6.26 years at the beginning of the 5-year follow-up period.
Adaptive behavior was assessed using the Scales of Independent Behavior – Revised (SIB-R), completed by parents on a yearly basis. Participant's annual SIB-R Broad Independence Age-Equivalent score and chronological age was used to determine the rate of development during each evaluation period. Evaluation periods include: 1) prior to receiving EIBI (pre-intervention), 2) while receiving EIBI (intervention), and 3) after the completion of EIBI for up to 5 consecutive years (post-intervention). SIB-R Broad Independence standard scores were used to determine whether clinically significant gains were achieved (i.e., an increment ≥ 15 standard points).
Results: Participants' mean rate of development during pre-intervention, intervention, and post-intervention periods were M = 0.58, 1.35, and 0.90 respectively; $F(1.431, 12.878) = 6.260$, $p < .05$ (two-tailed). None of the participants achieved typical development rates (i.e., rate ≥ 1) during the pre-EIBI period. 7 out of 10 participants achieved typical rates of development in the EIBI period, and 3 of them maintained typical rates with smaller magnitude during the post-EIBI period. Overall, mean EIBI and post-EIBI rates of development were highly correlated (r = .81).
Participants' mean Broad Independence standard scores during pre-intervention, intervention, and post-intervention periods were M = 57.30, 71.58, and 83.17 respectively; $F(1.133, 10.200) = 5.347$, $p < .05$ (two-tailed).
Conclusions: The results showed that children's developmental rates increased during a preschool EIBI program and following their graduation (post-EIBI periods) compared to pre-EIBI periods. Although statistically significant improvement in the Broad Independence standard scores was observed during both EIBI and post-EIBI periods, the changes were not clinically significant.
The findings begin to address the paucity of data on the long-term development of children with ASDs following EIBI.

81 **138.081** Machine Learning and Autism Diagnostics: Promises and Potential Pitfalls

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Background: Computational methods have immense potential to create novel findings in various target domains. Machine learning is increasingly utilized in autism research, with applications ranging from neurogenetic etiology to population stratification. One evident function of machine learning methods is in creating objective, efficient, robust diagnostic algorithms based on manual phenotypic coding instruments such as the Autism Diagnostic Observation Schedule (ADOS) or Autism Diagnostic

Interview Revised (ADI-R), thereby eliminating a certain degree of subjectivity in algorithm generation. However, application of machine learning (as with statistical techniques in general) presents the potential for misuse and misinterpretation.

Objectives: The objectives of this work are two-fold. First, building on our previous work (Bone et al. in JADD, 2014), we critically evaluate two recent studies that claim to drastically reduce time to diagnose autism via machine learning applied to the ADOS (Wall et al. in Translational Psychiatry 2(4):e100, 2012) and the ADI-R (Wall et al. in PloS One 7(8), 2012), supporting our arguments with empirical studies. Second, we aim to generate robust algorithms for Best Clinical Estimate (BCE) diagnosis through machine learning fusion of multiple diagnostic instruments (i.e., ADOS and ADI-R) across large, independent datasets.

Methods: Our experiments are conducted using three expansive corpora containing in total approximately 3000 ADOS and 3000 ADI-R administration scores: Autism Genetic Research Exchange (AGRE), Balanced Independent Dataset (BID), and National Database for Autism Research (NDAR). In our first study, we utilize the AD-Tree classifier (Weka) to classify instrument diagnosis from instrument codes, as in the Wall et al. studies. We examine the proposed reduced code set for selection reliability and classification accuracy, as well as the effects of including the previously excluded middle-severity diagnostic group for classification. In our second study, we utilize various classifiers including Support Vector Machines to create an automatic algorithm which fuses behavioral codes from multiple diagnostic instruments into a single BCE diagnosis.

Results: In our first study, we assert several conceptual and methodological errors in the Wall et al. studies relating to: (i) interpretation of experimental results; (ii) exclusion of the critical middle-severity diagnostic group, leaving only extreme cases; (iii) classification of instrument (rather than BCE) diagnosis using instrument codes; (iv) inadequate data; and (v) insufficient reliability testing. We demonstrate empirically that the selected codes are highly variable (data-dependent) given the chosen methodology, and that performance degrades dramatically when including the more confusable middle-severity group. In our second study, we examine site-dependent preferences for instrument and instrument codes when making a BCE diagnosis. Essential behavioral codes for differential diagnosis will be reported.

Conclusions: Our experiments suggest both the promise and potential pitfalls of applying machine learning to autism diagnosis. First, our inability to generate comparable findings to those reported by Wall and colleagues using larger, more balanced data underscores the importance of domain and computational knowledge. Second, we report on initial experiments that utilize machine learning to objectively fuse diagnostic instruments. Lastly, we propose certain best-practices and draw attention to especially promising areas for collaboration between computational and behavioral scientists.

82   **138.082** Measurement of Nonverbal and Verbal Abilities in Minimally Verbal Children with Autism Spectrum Disorders

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Background: Cognitive abilities in children with autism spectrum disorders (ASD) vary widely (Fombonne, 2005). More advanced nonverbal and verbal cognitive abilities have been shown to predict positive response to intervention (Harris & Handleman, 2000) and overall outcomes (Howlin, Goode, Hutton & Rutter, 2004). However, many assessments of cognitive and language abilities are not standardized using children with developmental delays. These tests may not capture abilities in the same way for children with developmental disabilities as they do with typically developing children. In particular, minimally verbal children with ASD represent a group for which the validity of testing may be compromised (i.e. difficulty with language demands, atypical skill development, attention difficulties).

Objectives: The aim of this study is test whether different assessments of nonverbal and verbal abilities, specifically the Mullen Scales of Early Learning (MSEL), Leiter-R, Preschool Language Scales (PLS-5), and Vineland Adaptive Behavior Scales (VABS-II), demonstrate convergent validity in minimally verbal children with ASD.

Methods: Participants currently include 20 children (4-8 years of age), with 26 children expected by May 2015, who were assessed prior to the start of a randomized intervention trial. All children were classified as minimally verbal through parent report and a language sample (<20 spontaneous words in 20 minutes). ASD diagnoses were confirmed with the ADI-R and ADOS-2. Nonverbal abilities were measured with the MSEL and Leiter-R. Six children were excluded from the nonverbal analyses because they did not achieve a ceiling on a subscale of the MSEL. Verbal abilities were measured with the MSEL, PLS-5, and VABS-II. Ratio IQs were calculated for the MSEL (nonverbal estimate comprised of the Fine Motor and Visual Reception domains, verbal estimate comprised of the Receptive and Expressive Language domains), PLS-5, and VABS-II (verbal estimate comprised of the Receptive and Expressive Language subdomains). Standardized scores from the Leiter-R Brief IQ screener were used. Paired samples t-tests were used to compare means and examine relationships between measures.

Results: In comparing NVIQ estimates from the MSEL and the Leiter-R, results indicate that scores from the two tests were correlated at $r=.79$, $p=.001$. Notably, scores on the Leiter-R ($M=54.79$, $SD=17.91$) were significantly higher than scores on the MSEL ($M=38.29$, $SD=10.06$), $p<.001$. With respect to language abilities, scores from the MSEL and the PLS-5 were correlated at $r=.65$, $p=.002$. VABS-II language scores and the MSEL language scores were correlated at $r=.41$, showing a trend

towards significance, $p=.088$. Scores on the VABS-II were significantly correlated with scores on the PLS-5 ($r=.60$, $p=.009$). MSEL language scores ($M=25.75$, $SD=7.73$) were significantly lower than scores on both the PLS-5 ($M=29.85$, $SD=8.73$), $p=.016$, and the VABS-II ($M=31.5$, $SD=11.79$), $p=.036$.

Conclusions: These findings demonstrate moderate correlations across multiple measures of nonverbal and verbal ability. Despite these correlations, significant mean differences in scores, particularly the large difference between estimates of NVIQ from the MSEL and Leiter-R, have implications for researchers and clinicians using these assessments. More research is needed to understand these differences and to examine the validity of individual measures for use with specific subgroups of children with ASD.

83 **138.083** Measuring Autistic Traits in the General Population: A Systematic Review of the Autism-Spectrum Quotient (AQ) in a Nonclinical Population Sample of 6,900 Typical Adult Males and Females

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Background: The Autism-Spectrum Quotient (AQ) is a self-report measure of autistic traits. It is frequently cited in diverse fields from neuroimaging to epigenetics and has been used with adults of at least average intelligence with autism and to nonclinical controls. It has also been administered to other clinical groups such as those with schizophrenia, prosopagnosia, anorexia, and depression. However, there has been no systematic review of the AQ since its inception in 2001.

Objectives: The present study reports a comprehensive systematic review of the literature to estimate a reliable mean AQ score in individuals without a diagnosis of an autism spectrum condition (ASC), in order to establish a reference norm for future studies.

Methods: A systematic search of computerized databases was performed, to identify studies that administered the AQ to nonclinical participant samples representing the adult male and female general population. Inclusion was based on a set of formalised criteria that evaluated the quality of the study, the usage of the AQ, and the population being assessed.

Results: After selection, 73 articles, detailing 6,934 nonclinical participants as well as 1,963 matched clinical cases of ASC, were analysed. Mean AQ score for the nonclinical population was 16.94 [95% CI 11.6, 20.0], while mean AQ score for individuals with ASC was 35.19 [95% CI 27.6, 41.1]. In addition, in the non-clinical population, a sex difference in autistic traits was found,(males > females) although no sex difference in AQ score was seen in the clinical population.

Conclusions: These findings have implications for researchers measuring autistic traits in the general population. Here we confirm previous norms with more rigorous data, and for the first time establish average AQ scores based on a systematic review, for populations of adult males and females with or without ASC. The AQ has demonstrated utility for phenotyping in a range of study-types, from genetic to imaging to screening. Future researchers could avoid risk of bias by carefully considering the recruitment strategy for both clinical and non-clinical groups, and could demonstrate transparency by reporting recruitment methods for all participants.

84 **138.084** Measuring Treatment Effect in Children with Autism with the Brief Observation of Social Communication Change (BOSCC)

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Background:
A range of social interaction measures are used when investigating effects of interventions for young children with autism (Bölte & Diehl, 2013). There is a need for a more unified selection of measures to permit comparison across studies. The Brief Observation of Social Communication Change (BOSCC, Lord et al. in press) is being developed as a sensitive measure of treatment effect on core autism features. The requirement of no formal training or certification, and enhancement of coding through decision-trees, should be appealing for researchers. However it is not yet clear how BOSCC will relate to measures more closely tied to the specific intervention target.

Objectives:
1) To explore if BOSCC detects the treatment effect previously identified by the joint engagement (JE) coding scheme, and 2) to investigate if there is a relationship in change from pre to post-test for BOSCC and JE coding.

Methods:
As part of an RCT (N=61 children with autistic disorder (aged 29-60 months)) testing the effect of an eight-week joint attention intervention (Kaale et al., 2012), 10-minute video-recordings of parent-child

play were coded for JE (Bakeman & Adamson, 1984). The same videos were now coded using BOSCC. As for the JE-coding possible treatment effects on the BOSCC-coding were analysed using ANCOVA with BOSCC baseline-scores as covariate. In addition, a reliable change index (RCI; Jacobson & Truax, 1991) was used to compare individual change scores for each measure. The relationship between BOSCC and JE was analysed with Chi-square. Inter-rater reliability for both measures was very good to excellent (BOSCC: weighted Kappa's=.74-1.0, ICCs=.96-99, JE coding: ICC=.80).

Results:

For JE coding there was a statistically significant group difference at post-intervention (*F* (1, 59)=6.271, *p=.015*). The children in the intervention group spent on average 12.2% more time in JE with their mothers compared to the control group. For BOSCC coding the two groups were not significantly different (*F* (1, 59)=2.459, *p=.123*) in the size of this change. The proportion of children obtaining an RCI-score showed no significant association between the two measure (*p=.51*). RCI raw-scores are presented in table 1.

Conclusions:

As reported in Kaale et al. (2012) JE-coding revealed a significant effect of intervention. Still, no significant group effect was found for BOSCC-codings. This indicates that while a short-term intervention may impact on the targeted behaviour, this impact does not necessarily extend to autism symptoms more generally. Also, it is interesting to note that there was no relationship in children's RCI-scores on BOSCC and JE from baseline to post-test. We discuss results in light of their implications for the design of intervention studies and meaningful measurement of outcome.

85   **138.085** Moderating Effects of Spoken Language in the Home on the Relations Between Age at Diagnosis and ASD Symptoms and Expressive Language for Young Children with ASD Screened in Early Intervention

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Background: Racial/ethnic minority children are less likely to receive an early ASD diagnosis (Mandell et al., 2009; Valicenti-McDermott et al., 2012), and more likely to show more severe ASD symptoms and language delays once diagnosed (Liptak et. al, 2008; Tek & Landa, 2012). Lower ASD prevalence rates among racial/ethnic minorities have been examined as a function of parental nativity, SES, education and spoken language (Fountain & Bearman, 2011; Kogan et al., 2009; Thomas et al., 2012). However, little is known about whether symptom presentation and/or other sociodemographic factors (e.g., spoken language) predict age at diagnosis in the context of early screening.

Objectives: To examine main effects and interactions of language spoken in the home with children's ASD symptoms and expressive language on children's age at evaluation.

Methods: Forty-six toddlers (ages 16-33 months) screened for ASD by Early Intervention (EI) providers were referred to our project for a diagnostic assessment due to failing an ASD observational screener and/or EI provider/parental ASD concern. In this socioeconomically-diverse sample (51% with yearly incomes <$35,000), 78% were racial/ethnic minorities and 22% were non-minorities; 65% only spoke English at home, and 35% were English Language Learners (ELL). Children were assessed with the ADOS-2 and the Mullen Scales. Additional participants (~50) will be added to the dataset at time of presentation.

Results: There was a significant interaction between spoken language in the home and ASD symptoms predicting to age at evaluation (β = -.430, t(4) = -3.090, p < .05, ηp2 = .230). ASD symptoms did not contribute to age at evaluation for referred children whose only language exposure was English (r(21) = .024, p > .05). However, ASD symptoms was a significant predictor of age at evaluation for ELL children screened and referred to a diagnostic evaluation (r(9) = -.853, p = .001). ELL children with more ASD symptoms were referred for an evaluation at younger ages than ELL children with fewer ASD symptoms. Expressive language also predicted age at evaluation (β = -.482, t (4) = -3.397, p < .05, ηp2 = .265), explaining 19% of the variance in the model. For all children, higher expressive language scores predicted an earlier age at evaluation. The final model included ASD symptoms, spoken language in the home, expressive language, and the interaction between symptoms and spoken language, and explained 48% of the total variance in age at evaluation.

Conclusions: These findings indicate differences in how ASD symptoms predict age at diagnostic evaluations based on children's ELL status. Biases in the early screening and identification of ELL children may be impacting EI providers' referrals for further diagnostic evaluation. Perhaps, delays in the referral process relate to EI providers' hesitance in referring ELL children due to uncertainty about how children's multiple languages affects their social development, or to their communication challenges when discussing child behavior concerns with ELL families. Regardless, addressing differences in early referrals for diagnostic evaluations between ELL children and children with English-only language exposure is critical to reduce the identification gap among linguistically-diverse children.

86   **138.086** Parent Reports of Social Functioning Provide Evidence of Criterion-Validity for the Social Responsiveness Scale, Second Edition in a High Functioning Sample of Youth with ASD

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Background: The Social Responsiveness Scale, Second Edition (SRS-2; Constantino, 2012) is a parent/teacher-report measure of social impairment associated with Autism Spectrum Disorder (ASD) and is widely used as a screening tool to aid in clinical diagnosis. The SRS has demonstrated strong predictive and concurrent validity. However, we know little about criterion-related validity for the SRS-2.

Objectives: In this study we examined the relations between SRS-2 scores and parent reports of peer relations, social skills, and leadership, as well as child report of interpersonal relations in a sample of high functioning youth with ASD. It was hypothesized that higher scores on these scales (indicating better social functioning) would be associated with lower scores on the SRS (less social impairment) in this sample.

Methods: Data from 60 youth with high functioning autism (i.e., IQ >70) between the ages of 7 and 17 was analyzed. SRS-2 raw score data was correlated with data from a brief parent questionnaire inquiring about the quality of their child's peer relationships, and also with scores from three subscales of the Behaviour Assessment System for Children, Second Edition (BASC-2): Social Skills and Leadership (both parent-rated), and Interpersonal Relations (child-rated). An ordinary least squares multiple regression analysis was also used to examine the predictive relationships between these variables and SRS-2 scores.

*Result*s: Results showed that SRS-2 raw scores were significantly negatively correlated with parent reports of peer relations (r=-.532, p<.000), number of acquaintances the child had (r=-.259, p<.05), number of close friends (r=-.265, p<.05), amount of time in a year spent with a close friend (r=-.270, p<.05), parent rated social skills (r=-.516, p<.000), and parent rated leadership (r= -.662, p<.000). However, child report of interpersonal relations was not found to be significantly correlated with SRS-2 scores. Next, a multiple regression analysis was conducted controlling for age and IQ in block one of the regression model, and predictor variables entered in block two. Ordinary least squares regression analyses show that the variables in Model 1 (age and IQ) did not explain a statistically significant proportion of the variance in SRS-2 scores (R2=.012, F=.316, p=.730>.05). Model 2 which included all the predictor variables accounted for an additional 55% of the variance in SRS-2 scores (ΔR2=.55, ΔF= 8.244, p=.000). T tests show that parent reported peer relations (β=-.312, t=-2.225, p=.03<.05) and leadership scores (β= -.509, t= -3.28, p=.02<.05) have the only statistically significant regression coefficients in the model.

Conclusions: Our prediction that higher scores on parent reports of social functioning would be associated with lower scores on the SRS-2 was confirmed. However, the same was not true for child report of interpersonal relations. These findings provide evidence of criterion-related validity for the SRS-2 among high functioning youth with ASD, at least with regard to parent reports of social functioning.

87 **138.087** Parent and Teacher Perceptions of ASD Severity and Comorbid Emotional and Behavioral Symptoms: Differences for Children with Regressive Onset

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Background: Developmental regression, or a loss of previously acquired skills, is reported in ~30% of children with ASD (Barger et al., 2013). While evidence supports important phenotypic differences between children with or without a history of regression (ASD+regression) (Bernabei et al., 2007; Goin-Kochel et al., 2014), less is known about whether they differ on indices of ASD symptomatology or emotional/behavioral (EB) functioning. Most comparisons between children with ASD±regression rely on parent-reported data, yet teacher perceptions may inform understanding setting-specific differences in symptom manifestation and subsequent treatment planning. Moreover, if children with ASD±regression are distinguished based on teacher reports (i.e., "blinded" to child's regression status), then this adds further evidence attesting to the association between early skill losses and child outcomes.

Objectives: To examine potential differences between children with ASD±regression on *parent and teacher* ratings of children's (a) core ASD symptoms, and (b) emotional/behavioral symptoms.

Methods: Data were analyzed from children (*N*=2695, 86.6% male, *M* age=9.0 years) in the Simons Simplex Collection (Version 15.1). Regression status was ascertained via the *Autism Diagnostic Interview—Revised* and operationalized as language and/or social-engagement losses at <36 months. EB symptomatology was measured via the co-normed Child Behavior Checklist (CBCL; parents) and Teacher Report Form (TRF; teachers). ASD symptoms were measured with the (a) *Social Communication Questionnaire—Lifetime* version (SCQ-L; parents) and *Current* version (SCQ-C; teachers); and (b) *Social Responsiveness Scale*(SRS; parents and teachers). Separate one-way analysis of variance (ANOVA; with Bonferroni correction α=.005) were conducted to explore differences in parent and teacher ratings on these measures, by regression status.

Results: In this sample, 27.4% experienced language and/or social-engagement skill loss. ANOVA results indicated a significant effect (p<.0001) of *skill loss* for all parent ratings across EB (CBCL INT, EXT, TOT) and core ASD symptoms (SCQ-L, SRS-P). Children **with regression** were rated by parents as having significantly *lower* CBCL scores but *higher* SCQ and SRS scores. For teachers, their ratings of children **with regression** were *lower* only on the TRF INT composite than for children without loss, F(1)=8.17, p<.005. However, consistent with findings on parent ratings, teacher ratings of core ASD symptoms were significantly *higher* for children **with regression** (SCQ-C and SRS-T, p<.0001).

Conclusions: Parent and teacher ratings of children's symptoms often differ (Reyes & Kazdin, 2005),

particularly for children with ASD (Kanne et al., 2009). Our findings suggest that early skill loss (i.e., before 36 months) is associated with later phenotypic differences as reported by both parents *and* teachers. Specifically, both informant groups reported significantly greater severity in core ASD symptoms, per the SCQ and SRS, for children with regression. However, while all emotional/behavioral symptoms rated by parents were significantly different by regression status, teachers' ratings only differed for internalizing problems. Overall, our findings suggest that children with developmental regression present differently across settings, even as they age, which may have implications for early treatment planning and ongoing support.

88   **138.088** Predictability of Self-Report Questionnaires (RAADS-R-NL, AQ-28 AND AQ-10) in the Assessment of Autism Spectrum Disorders in Adults

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Background:
Although screening instruments for autism spectrum disorders (ASD) are widely used, none have been simultaneously evaluated in an outpatient setting in which the instruments are commonly used. This is unfortunate because the surge in referrals for ASD assessments in adults highlights the need for diagnostic tools in clinical practice.
Objectives:
To assess if the reported high psychometric properties of screening instruments for ASD in adults also apply to the naturalistic outpatient setting.
Methods:
We tested the Ritvo Autism Asperger Diagnostic Scale (RAADS-R) and two short versions of the Autism Spectrum Quotient (AQ), the AQ-28 and AQ-10 in 210 patients referred for psychiatric assessment and 63 controls. Six specialized outpatient settings in the Netherlands took part. Assessing clinicians were blind to the RAADS-R and AQ scores. At the end of the study, the clinical diagnosis (ASD or no ASD) was related to the RAADS-R and AQ-scores collected prior to the assessments.
Results:
Of the 210 patients, 139 received an ASD diagnosis and 71 received another psychiatric diagnosis. The scores in the clinical groups were higher than in the control group. In addition the scores in the clinical subgroup that was diagnosed with ASD were higher on all three instruments than in the subgroup not diagnosed with ASD. Despite these diffferences, the percentage correct diagnoses was rather low (RAADS-R 68%, AQ-28 and AQ-10 61%). Both the sensitivity and specificity of each of these instruments was insufficient, where the sensitivity of the RAADS-R was the highest (73%) and the AQ short forms had the highest specificity (70 and 72%).
Conclusions:
None of these instruments have a sufficient predictive validity to be used to predict clinical outcome in out-patients settings.

89   **138.089** Predicting and Modeling Distinct Developmental Trajectories of Adaptive Behavior during Pre-School to School-Age in Children with ASD

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Background: Adaptive behavior, frequently measured by the Vineland Adaptive Behavior Scales (VABS-II; Sparrow et al., 2005), is defined as the ability to function adequately and independently in the environment. Data on the developmental trajectory of adaptive behavior generally show that individuals with ASD do not gain skills at an age-appropriate rate (e.g., Anderson et al., 2009), and that increasing impairments are most strongly related to IQ (e.g., Szatmari et al., 2009) and more variably to ASD symptom severity (e.g., Kanne et al., 2010; Perry et al., 2009; Klin et al., 2007). However, samples used have been small, cross-sectional, or not well-characterized. Baghdadli et al. (2012) addressed these concerns, but used few timepoints to cover a wide developmental period, limiting the conclusions. In the current study, we utilize an exciting group-based semi-parametric modeling strategy on a large sample of well-characterized children, with many assessment periods across pre-school to school-age.
Objectives: To identify distinct developmental trajectories of adaptive behavior, and their predictors, across early-to-late childhood in children with ASD. Although individual domain standard scores and age equivalents were analyzed, for brevity, only the Adaptive Behavior Composite (ABC) results are presented in the abstract.
Methods: Participants were 104 children with DSM-IV-TR Autistic Disorder (82% male; NVDQ=58.7±17.5, range 19-109; ADOS calibrated severity score=7.6±1.4, range 4-10; 33% minimally verbal) who participated in a longitudinal observational study. The mean age at first assessment was 4.0±1.3 years (range 1.6-7.0), and subjects returned up to six times (mean assessments 3.8±1.1). Data were divided into 10 epochs (6-month periods before 3.5 years, followed by 12-month periods). Proc TRAJ (Jones, Nagin, & Roeder, 2001) for SAS Version 9.3 was used to identify distinct trajectories in VABS-II standard scores across time. The Bayesian Information Criterion (BIC) was used to select the censored-normal model that best fit the data. Model parameters were estimated using Full Information Maximum Likelihood; therefore, missing data are accounted for. Three time-invariant risk

factors were entered into the best-fitting model: cognitive ability, language level, and autism symptom severity.

Results: Four trajectories best fit the data (Figure 1). All trajectories began with moderately-low to low standard scores (i.e., 70-80), but were characterized as (1) steep decline/very low, (2) moderate decline/very low, (3) steady/moderately low, and (4) low average and rising. Autism severity was not associated with trajectory group membership, but NVDQ and language ability were robust predictors (Table 1). Lower NVDQ was associated with greater likelihood of group membership in the lower-functioning trajectory group in all between-group comparisons. Children who were minimally verbal at initial assessment were at significantly greater risk of belonging to groups 1 and 2 relative to group 3. Conclusions: Distinct trajectories of overall adaptive behavior in individuals with ASD manifest across childhood. Both NVDQ and minimally verbal status were significant predictors of trajectory; importantly, they distinguished even between similar trajectory groups (i.e., the low but steady versus low and declining). The results of the analyses with the domain scores, which showed differential patterns over time, will be presented at the meeting.

90   **138.090** Prediction of Intellectual Impairment By Developmental Assesments in Children with Autism Spectrum Disorder Compared to Globally Delayed Children

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Background: Significant global developmental delay (GD) as assed below age three, is considered a preliminary marker of intellectual disability (ID). However, the trajectory of the gap may be different in children diagnosed of Autism Spectrum Disorder (ASD) as compared to children with delays without ASD diagnosis.

Objectives: To evaluate to trajectory of developmental delay in children with ASD and in children with GD without ASD.

Specific aim: to compare developmental assessment tools to subsequently performed cognitive test results in a population with ASD as compared to GD children.

Methods: Children (n=88) diagnosed with global developmental delay (delay of more than 2 SD in two or more areas of development), and assessed with Bayley 2 developmental test, were followed and reassessed after age four using cognitive tests (WIPPSI, Kaufman and WISC-R). They were divided in two groups according to definite diagnosis of ASD (n= 38, 26 males) or GD without ASD (n=50, 37 males).

Results: As expected, a positive correlation was found between lesser degree of developmental delay as measured by MDI and subsequent IQ, in both groups. From ASD group, 60.1% scored with significant delayed performance on developmental test and 66% from GD group without ASD were significantly delayed. Subsequently, on cognitive tests after age 4 years, 20% of the non-ASD GD group scored with an IQ less than 70 and 28.9% from ASD group scored with comorbid intellectual disability.

Conclusions: MDI score less that 65 on Bayley 2 performed before age 3 years, predicts lower IQ (less than 70), on subsequent cognitive assessments. However, developmental delay trajectory is more stable in ASD group than in globally delayed children.

91   **138.091** Preliminary Analysis of the Function of Self Injurious Behavior in the Autism Inpatient Collection (AIC) Sample

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Background: The functions of self-injurious behavior (SIB) have been under-examined in samples of youth with autism spectrum disorder (ASD) with the full range of intellectual functioning and verbal ability.

Objectives: The Autism Inpatient Collection (AIC) was developed as a resource for the study of the full autism spectrum. Data regarding the occurrence and function of SIB was collected through parent and staff report measures and clinician assessments.

Methods: Youth aged 4-20 years, with an ADOS-confirmed autism diagnosis and admitted to a specialized inpatient psychiatry unit, were prospectively enrolled in a six-site study examining patient phenotypes, including SIB. Participants screened positive for SIB with a two or greater at admission on any item of the parent-reported Repetitive Behavior Scale – Revised, Self- Injury Subscale. For screen positives, the parent also completed the Functional Analysis Screening Tool (FAST) to examine the function of the SIB (i.e., attention, escape, sensory stimulation, or pain attenuation). An inpatient staff member also completed a FAST on subjects who displayed at least daily SIB. Intra-class correlation (ICC) analysis was conducted to examine agreement between parent and staff FAST measures. For subjects with both parent and staff FAST completed, the unit behavioral specialist (behavioral psychologist or BCBA) utilized that data and their own extensive observations to make a final determination of the primary function of the patient's SIB.

Results: Mean age of the first 108 subjects was 12.70 years (*SD*=3.50), 24% female, 77.8% identified as Caucasian and 91.4% Non-Hispanic/Non-Latino. Seventy-three percent of parents (n=79) reported

the presence of SIB at admission, with the majority (59.2%) reporting daily occurrence. On the FAST, parents ranked attention (45.4%) as the most prominent function of SIB, followed by escape (28.8%), sensory (22.8%), and pain (3%). For patients who exhibited SIB at least daily, staff ranked escape (45.5%) as the most prominent function of SIB on the FAST, followed by attention (31.8%), sensory (22.7%), and pain (0%). Level of absolute agreement between parent and staff FAST scores was very low, attention (ICC=0.12, p=0.24), escape (ICC=0.12, p=0.26), sensory (ICC=-0.48, p=0.86), and pain (ICC=0.07, p=0.35). Finally, the unit behavioral specialist reported 26.9% (n=29) of the overall patient population to engage in SIB, and noted multiple functions were present for most patients: escape (97%), attention (93%), sensory (83%) or pain (58%). Using all available information, the behavioral specialist ranked escape as the primary function most frequently, followed by attention, sensory stimulation and pain attenuation.

Conclusions: Preliminary data suggests that 26.9% of children in the Autism Inpatient Collection engage in SIB at least daily, which is most commonly related to an escape function, followed by attention, sensory stimulation, or pain attenuation, as determined by the unit behavioral specialist. There was poor inter-rater agreement between parents and staff on the FAST, which could reflect differences in parent and staff observations or the function of the SIB changing across home and the inpatient setting. Future analyses will examine the impact of verbal ability, IQ and other factors on the presence and function of SIB in this rigorously characterized sample.

92   **138.092** Prevalence and Age-Modulated Presentation of Subthreshold Attention Deficit and Hyperactivity Disorder Comorbidity in Young People with Autism Spectrum Disorders

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Background: There is high prevalence of comorbid Attention Deficit and Hyperactivity Disorder (ADHD) symptoms in Autism Spectrum Disorders (ASD). It is still under debate whether these manifestations represents i) core ASD symptoms, ii) a real ADHD comorbidity or iii) the observable symptoms of another comorbid diagnosis that may mimic ADHD (e.g. anxiety, sleep apnea..). Recently, Gillberg et al., [1] have proposed that the ASD-ADHD co-occurrence may represent a dynamic phenotype that would change according to age. Few studies have investigated differential presentation of ASD subjects with and without ADHD traits.

Objectives: We aim to measure frequency of ADHD traits in ASD clinical population, its evolution depending on age and the clinical factors associated.

Methods: Children and adolescents (2-17 years old) consecutively referred to an ASD specialized outpatient clinic (AMITEA) between January of 2012 and June of 2014 and meeting ASD criteria (DSM-IV-TR) comprised the study sample (N=371). ADHD and ASD diagnoses were based on best clinical judgment of experienced child developmental psychiatrists. Autistic Diagnostic Interview- Revised (ADI-R) and Autism Diagnostic Observation Schedule-Generic ADOS-G were used when clinicians deemed it necessary. Symptoms of inattention and hyperactivity were also recorded. Additional socio-demographic and clinical information (including other psychiatric and medical comorbidities) was also collected. Clinical and socio-demographic features were compared between subjects with (ASD_ADHD) and without comorbid ADHD symptoms (ASD_NoADHD). Chi Square test was used to analyze correlation between comorbidity profile and age (ranges of age). All statistical analyses were performed using SAS (9.0).

Results: 371 patients (371 patients (8.2±3.9 years, 81.9% male) were included. Of them, 44.7% met criteria for typical Autism, 43.4% for Pervasive Developmental Disorder NOS, 10.5% for Asperger Syndrome, three cases met criteria for Rett Syndrome and two for Disintegrative Disorder criteria. Intellectual disability was present in 32.6% of the subjects (N=121).

Ten percent (N=37) of the subjects met diagnosis criteria for comorbid ADHD, and 29.7% (N=110) presented with ADHD traits. The ASD_ADHD group included more patients with a PPD NOS while ASD_ADHD traits group included more patients with typical Autism. No significant differences were found between groups regarding intellectual disability and epilepsy.We found a differential comorbidity profile depending on subject's age. ADHD comorbidity was present in 28% of children between 2 and 6 years (N=118), in 48.7% of those 7-11 years (N=18), and in 37.8% of those 12-17 years (N=14). ADHD symptoms not meeting ADHD full diagnosis were also more frequent in subjects 7-11years (45.5%, N=50) and 2-6 years (48.7%, N=18); 37.3% of subjects aged 12-17 years with ASD and comorbid ADHD (N=41) present with other psychiatric diagnosis.

Conclusions: ADHD traits are highly prevalent in ASD population, especially between ages 7 and 11 years. In addition, our findings support that ADHD symptoms and other psychiatric comorbidity depend on age, thus modeling ASD clinical presentation. Future studies should address how this dynamic phenotype may impact treatment and outcome of ASD population.

93   **138.093** Promises and Limits: Exploring Relationships Between the First Year Inventory (FYI) and Autism Diagnostic Observation Schedule (ADOS) from 12 to 18 Months of Age with Machine Learning

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Background: Machine-learning, when used in combination with clinical expertise, has great potential to enhance diagnostic procedures and to improve our understanding of heterogeneity in autism spectrum disorder (ASD). A recently published study has shown that machine-learning techniques can achieve comparable classification performance on the Autism Diagnostic Observation Schedule (ADOS) compared to pre-existing algorithms (Wall et al., 2012). However, the usefulness of machine-learning for more heterogeneous groups of children, such as infants at high-risk (HR) for ASD, for other instruments including parent reports, and for the more difficult problem of prediction of future clinical presentations compared to concurrent presentations, is not known yet.

Objectives: To evaluate the performance of machine-learning techniques for (1) using the First Year Inventory (FYI), a parent questionnaire given to parents of children 12 months of age, to predict levels of autism symptoms as given by the ADOS-Toddler Module (ADOS-T) at 12 and 18 months; and (2) using ADOS scores at 12 months to predict scores at 18 months.

Methods: Based on 76 HR children, we first examined Pearson's correlation between the FYI totals at 12 months (FYI.12) and ADOS algorithm totals at 12 (ADOS.12) and 18 months (ADOS.18). Then, we used two widely-used machine-learning techniques, support vector machines (SVM) and random forests using variable selection, for the same predictions with all items from both measures (FYI.12–ADOS.12 and FYI.12-ADOS.18). The same methods were repeated to examine the correlation between ADOS.12 and ADOS.18. For machine-learning techniques, we performed 1000 repeated random sub-sampling validations, utilizing 80% of data for training and 20% for testing. We also report results while using all data as training sample [reported in [brackets]].

Results: We found a moderate correlation between FYI.12 and ADOS.12 (r=0.38). Both SVM and random forest resulted in comparable correlations, r=0.47[0.91 for training sample] and r=0.51[0.96] respectively. We found a milder correlation between the FYI.12 and ADOS.18 (r=0.13), but the SVM and random forest improved the correlations significantly, r=0.52[*0.94*] and r=0.58[0.98] (differences significant at p's<0.01). Not surprisingly, we found a moderate correlation between ADOS.12 and ADOS.18 (r=0.53). The SVM and random forest resulted in comparable correlations, r=0.61[*0.88*] and r=0.63[*0.96*].

Conclusions: As the FYI is designed to capture current developmental profiles at 12 months, it was already moderately associated with *concurrent* clinical presentations measured by the "gold standard" clinician observations (ADOS) without implementing machine-learning techniques. Similarly, as the ADOS is designed to assess core autism symptoms that are fairly stable over time, the use of the ADOS algorithm was sufficient to predict clinical outcomes at 18 months. However, the prediction of clinical outcomes measured by clinician observations while using parent reports obtained 6 months earlier was more challenging. For this prediction, machine learning resulted in improved correlations, suggesting that it can be especially helpful when adaptations to measures are needed to make predictions that go beyond what they are designed for. Therefore, understanding the role of machine learning to add to ongoing explorations regarding measurement in ASD requires care, collaboration, open discussion, and humility regarding strengths and limits of statistical tools.

94   **138.094**   Psychometric Properties of a New Video-Referenced Rating of Quantitative Autistic Traits in Toddlers

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Background: The ability to quantify and track autistic traits in early development has significant implications for improving early identification of autism spectrum disorders (ASDs), elucidating developmental mechanisms, and allowing measurement of incremental responses to intervention. Deficits in reciprocal social behavior (RSB) characterize core features of ASD, emerge early in development, and serve as an ASD endophenotype. Previously, we quantified RSB in an epidemiological sample of toddler twins using a video-referenced rating of Reciprocal Social Behavior (vr-RSB), a novel measure in which children are rated by a caregiver on a subset of items in comparison to a socially competent toddler presented on a brief video clip.

Objectives: To investigate: 1) the vrRSB's ability to distinguish typically developing toddlers from those with ASD or suspected ASD, 2) heritability of early social communication (SC) and restricted repetitive behaviors (RRB), the two core ASD symptom domains, 3) sex differences in RSB in toddlers, and 4) developmental course of RSB, SC, and RRB between 18 and 24 months.

Methods: Parents of 252 epidemiologically representative twins [monozygotic (MZ)=31 pairs, dizygotic (DZ)=95 pairs] rated their twins on the vrRSB at 18 and 24 months. This sample included a second wave of enrollment enriched for female twins and parents without college degrees, under-represented groups in the first wave. Parents of an initial contrast sample of toddlers with ASD or suspected ASD (by virtue of parental concern for social delays), aged 18-33 months (n=11), also provided vrRSB ratings. Items on the vrRSB were reviewed and classified as SC or RRB items.

Results: vrRSB scores in this enlarged sample recapitulated a continuous, unimodal distribution and excellent 6-month test-retest reliability (ICC=0.704, p=0.000). Children with ASD/suspected ASD had elevated scores vs. twins in the general population (video-referenced: t=-2.454, df=10, p=.034; RSB Total: t=-4.055, df=10, p=.002). MZ vs. DZ concordances suggested significantly more heritability for

SC compared to RRB (Table 1). Males had higher vrRSB scores than females (video-referenced: t=2.815, df=124, p<.006; RSB Total: t=3.348, df=124, p<.001). Scores on the vrRSB and SC items decreased between 18 and 24 months, whereas RRB scores showed no change. Item level analyses demonstrated that questions with the greatest improvement involved parent-child interaction, pretend play, ability to cooperate, verbal understanding, and initiation of interactions.
Conclusions: An initial sample of toddlers with ASD or suspected ASD displayed lower RSB on both the video-referenced items and full-length vrRSB. RSB and SC appear strongly heritable at the toddler stage, in contrast to RRB. Males have lower RSB than females, paralleling RSB later in life and supporting the vrRSB as a measure of RSB. Maturation of RSB occurred between 18 and 24 months and was attributable to improved SC but not RRB. These results highlight the vrRSB's potential clinical utility, in terms of promoting earlier identification of ASD and tracking response to early intervention, as well as its scientific utility for elucidating behavioral mechanisms of ASD in relation to sexual dimorphisms and distinct contributions of SC and RRB to the development of ASD.

95 **138.095** Quantifying the Behavioural Relationship Between ASD and Nonverbal Learning Disabilities: More Than Social Imperception

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Background: The first description of nonverbal learning disabilities (NLD) highlighted disordered social perception (Johnson & Myklebust, 1967). Social imperception, or the inability to fully understand how oneself and others relate to social environments, is also a defining feature of Autism Spectrum Disorder (ASD). Whether social difficulties in ASD and NLD are the same, either in kind or by degree, is unknown. Clinical reports maintain that social impairments in children and adults with NLD are less severe than in those with ASD, and some researchers separate NLD from ASD according to an absence of stereotyped and repetitive behaviours.
Objectives: The purpose of the present study was to quantify the degree of impairment in social relatedness and other autism symptoms in adults with NLD, and to compare these results to adults with ASD and to those without developmental disorders.
Methods: Two surveys designed to screen for ASD were given to participants, 19 - 44 years, who had a community diagnosis of ASD or NLD, and to controls. Both the Ritvo Autism Asperger Diagnostic Scale – Revised (RAADS-R) and the Social Responsiveness Scale – Adult version (SRS-A) focus on social relatedness, but also have items that address circumscribed interests, repetitive behaviours, and other symptoms defined as specific to autism (DSM-5, 2013). Individual subscales on the RAADS-R that separate social relatedness from other types of symptoms were analyzed for potential group differences.
Results: More adults with ASD scored above the threshold score indicating the presence of ASD on the RAADS-R, a self-report tool, than did adults with ASD on the SRS-A, a survey completed by others who know the participant well. Adults with NLD also had higher than threshold RAADS-R and SRS-A scores, as did a small number of participants who did not have any diagnosis by self-report. The overall RAADS-R and SRS-A score patterns, in which NLD participants as a group scored below the ASD group and above the Control group, also emerged for each of the individual subscales on the RAADS-R. All mean group scores were significantly different. Adults with NLD endorsed sensory and motor impairments, detail-oriented processing, restricted interests, and stereotyped behaviours such as hand flapping, albeit not to the same degree as did those with ASD.
Conclusions: Results quantified a clinical impression that social difficulties in NLD exist but are less severe than in ASD. The second clinical impression tested here, that NLD can be differentiated from ASD according to an absence of stereotyped and repetitive behaviours, was not supported. Rates of specificity and sensitivity for these surveys were lower than expected in the present sample. Potential reasons for these findings were explored, including: endorsement of a broader range of symptoms by NLD participants than anticipated; the possibility of missed diagnoses; use of psychiatric scales rather than autism surveys to compare NLD and ASD; validation of autism surveys with comparison participants with psychiatric but not learning disorders; and the exclusion in other research of participants without clinical diagnoses who nonetheless scored above threshold on the RAADS-R and SRS-A.

96 **138.096** Re-Evaluating the Structure of the Autism Quotient: A Novel 3-Factor Solution

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Background: The Autism Quotient (AQ) is a widely employed 50-item self-report questionnaire that has been used to distinguish between Autism Spectrum (AS) individuals from those not diagnosed, along with assessing autistic behaviors in the general population (Baron-Cohen et al., 2001). The AQ was originally conceived as having five subscales: *social skill*, *attention switching*, *attention to detail*, *communication* and *imagination*. A number of subsequent studies have found better fit with 2-, 3-, 4- or 5-factor models compared with the original subscales; however, these models tend to have poor fit values. Thus, the factor structure of the AQ remains unresolved. Moreover, little research has examined whether individual factors load onto a single factor, which, theoretically, should be the case

if autism reflects a single construct.

Objectives: This study evaluated whether a new factor structure for the AQ could be developed that would have acceptable measures of fit. We also assessed whether the factors loaded onto a single, higher-order factor.

Methods: Participants were 1142 university students recruited from introductory Fall and Spring semester Psychology classes. Participants completed the AQ online as part of a battery of questionnaires. Our model was developed through a series of iterative steps, guided by the core features of autism spectrum disorders in the DSM-5 including deficits in social communication and social interaction along with the presence of restricted, repetitive patterns of behaviors, interests, and activities. A bottom-up construction rather than an elimination process was instituted such that we selected items that seemed most characteristic of each category until fit was no longer acceptable.

Results: Confirmatory factor analyses were conducted to establish the factor structure guided by the DSM-5 categories. A 3-factor model emerged: verbal social communication (4 items, $\alpha = .85$), nonverbal communicative behaviors (4 items, $\alpha = .66$), and repetitive behavioral patterns (3 items, $\alpha = .56$). Moreover, these three factors loaded onto a higher order factor representing autistic behaviors ($\alpha = .83$; see Figure 1). The fit of the model was acceptable ($\chi^2 = 327.103$, $df = 92$, RMSEA $= .047$, CFI $= .928$, TLI $= .896$).

Conclusions: The 3-factor, 11-item model we developed provides an acceptable level of fit and an improvement on other published models. Moreover, this model demonstrates that these three factors load onto a single higher-order factor, consistent with the idea that these factors represent distinctive, core features of autism. This measure will be the first to have both strong statistical properties as well as provide an efficient screen for autistic behaviors through self-report. Although other brief AQ measures exist (Booth et al., 2013; Hoekstra et al., 2011), our measure has the strongest psychometric properties with a model derived from a theoretical framework.

97   **138.097** Reliability of Direct Behavior Ratings – Social Competence (DBR-SC) Data: How Many Ratings Are Necessary?

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Background:

Currently in the field of special education, federal mandates require, the implementation of evidence based practices (EBPs) for students with disabilities (Cook & Cook, 2011). One specific area of education for which the need for clarity regarding appropriate EBPs has been increasingly felt, is for students with autism. As professionals seek to identify and implement strong manualized interventions targeting this population, it becomes increasingly necessary to effectively monitor student's progress, providing implications for tailored dosage to meet individualized needs. Systematic direct observation (SDO) is a common method for ongoing assessment used to monitor behavior and associated intervention effects. While SDOs are generally considered the most appropriate and accepted means of measuring student behavior, SDO produces a number of limitations. A related measure, Direct Behavior Rating (DBR) is a scale that provides a direct rating of behavior(s) immediately following the observation of a student in regard to domains identified as significant moderators of student success. This measure is meant to be brief and immediate in nature, allowing for repeated use over time and implications to inform practice, similar to SDO. As EBP implementation increases, a feasible means of effectively and efficiently monitoring progress and informing practice is vital.

Objectives:

The Social Competence Intervention for Adolescents (SCI-A) is a targeted EBP designed to meet the specific social needs (Stichter, et al., 2010) of youth with ASD or similar challenges. The current study examined the reliability of DBR data, which were used to evaluate student progress in response to SCI-A. Of particular interest was the number of DBR data points required to reach adequate levels of reliability for low stakes decisions (.80).

Methods:

This project examined the reliability of five DBR targets, including disruption, engagement, respect, and appropriate social interaction with teachers and peers. Participants included 57 middle school students participating in a larger RCT evaluating SCI-A efficacy. Classroom teachers completed ratings on a daily basis with regard to student targets. Ratings were at pre, mid, and post intervention.

Results: Findings were in accordance with previous DBR-related research, which suggested a small number of ratings were needed to approximate appropriate levels of reliability (Briesch, Chafouleas, & Riley-Tillman, 2010; Chafouleas et al., 2010). Specifically, results indicated the number of ratings required to reach .80 reliability ranged between 2-6 for engagement, 2-10 for respect, 5-9 for disruption, and 1-7 and 1-3 for social interactions with teachers and peers, respectively. Follow-up analyses revealed reliabilities were not equal across phases for 4 of the 5 targets, with reliability increasing over time.

Conclusions:

The current study holds promise for use of DBR as a brief indicator of student response to a social competence intervention. Specifically, findings suggested only a few ratings were necessary to reliably estimate student behavior within individual intervention phases. Furthermore, reliability was found to increase over time, such that less and less data were needed as student behavior

stabilized. Though the limited sample size suggests the reader exercise caution in interpreting findings, these initial results support continued examination of DBR within this particular application.

98   **138.098** Restricted and Repetitive Behaviors: Restricted By IQ?

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Background:
With the DSM-5, increased attention in autism spectrum disorder (ASD) classification has been given to Restricted and Repetitive Behaviors (RRBs), largely divided into Repetitive Sensory and Motor behaviors (RSM; e.g. rocking, flapping) and Insistence on Sameness (IS; e.g. resistance to change, compulsions). Further delineation of RRB's into Circumscribed Interests (CI) and Self-Injurious Behavior has also been supported. Empirical evidence consistently reveals a strong negative correlation between RSM and Full Scale IQ (FSIQ), yet findings are mixed regarding the interaction of IS, CI, and FSIQ. Additional research is needed to clarify this relationship and the behavioral phenotype of RRB's in ASD.
Objectives:
The primary aim of the present research is to extend analysis of the relationship between IQ and RRBs in a large multi-study sample of individuals with ASD. By elucidating covariates of RRBs, phenotypic patterns may emerge that would aid in the classification and diagnosis of ASD.
A secondary aim of this research is to investigate associated genetic factors that correlate with high levels of RSM, IS, or CI. These genetic factors will be explored using 518 individuals from Utah families (186 with autism and 332 unaffected relatives genotyped with the Illumina HumanExome chip, and 61 with autism and 27 unaffected relatives with whole exome sequence data from Agilent SureSelect and Illumina GAIIx).
Methods:
Subjects for this research were ascertained from ongoing studies under the Utah Autism Genetics Project. The inclusion criteria for the current research are a diagnosis of ASD, a standardized and norm-referenced measure of cognitive ability, and the completion of the Autism Diagnostic Interview-Revised for the RRB scale items. 490 individuals from the Utah Autism Research Database fulfilled the inclusion requirements with the following demographics (mean, standard deviation, range): Years of Age (15.2, 11.8, 1.3-65.8); FSIQ (87.2, 26.3, 25-155); IS (5.8, 3.7, 0-15); and RSM (5.1, 3.6, 0-14). Statistical analyses will be conducted in SAS 9.3 and include descriptive, correlational, and regression analyses. Genetic analyses will be done using PlinkSeq, VAAST, and pVAAST.
Results:
With the exception of Full Scale IQ and IS (r=-0.04, p=0.36), all correlations reveal significant, negative correlations between RRB's (IS, RSM) and cognitive ability (FSIQ, VIQ, PIQ) within at least the 0.01 level. Correlation coefficients ranged from -0.04 (FSIQ, IS) to -0.45 (FSIQ, RSM). Individual correlation between the 11 specific ADI-R RRB items and FSIQ revealed Circumscribed Interests to have the only positive relationship (r=0.12, p=0.006) amongst all items. Genetic analyses are pending and results will be reported upon study completion.
Conclusions:
This current evidence supports previous documentation of a significant, negative relationship between intellectual ability and RRB's, and this relationship appears stronger for RSM behaviors than for IS. Interestingly, the only RRB item showing a positive correlation with IQ was Circumscribed Interests, a finding which supports treatment of this trait as a separate factor of RRBs. Given the current classification criteria of ASD, these findings reveal a potential quandary in the phenotypic presentation and assessment documentation of RRB's in those with higher cognitive ability.

99   **138.099** SASA: A Sensory Reactivity Measure for Severely Affected Individuals with Global Developmental Delay and/or Autism Spectrum Disorder

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Background:
There is no consensus on how to reliably measure sensory reactivity in autism spectrum disorder (ASD), despite the addition of sensory reactivity abnormalities, such as hyperreactivity, hyporeactivity and sensory seeking behaviors, as a new DSM-5 criterion. Tools to identify sensory reactivity abnormalities are especially important in severely affected individuals who cannot verbally report their sensory experiences. One of the more common single locus forms of ASD is Phelan-McDermid Syndrome (PMS), which is caused by haploinsufficiency of the *SHANK3* gene and characterized by global developmental delay and severely delayed or absent speech. Children with PMS also present with significant sensory reactivity abnormalities that have not yet been thoroughly investigated.
Objectives:
The objectives of this study were to (1) develop an objective sensory reactivity measure and (2) test it in individuals with idiopathic ASD and in a single-locus form of ASD; PMS.

Methods:

The Seaver Autism Sensory Assessment (SASA) is a novel assessment, which was administered by a clinician. The SASA is a standardized sensory observation and parent interview, appropriate for severely affected individuals. The SASA consists of five minutes of unstructured play followed by a standardized presentation of various sensory stimuli (e.g. flickering lights). The child's behavioral responses such as discomfort, under responsiveness or seeking behavior are rated by a trained administer. Parents also completed the widely used Short Sensory Profile (SSP) parent report (Dunn & Westman 1997).

Results:

All participants successfully completed the SASA observation. On the Sensory Profile children with PMS (n=5) or idiopathic ASD (n=18) both demonstrate more sensory reactivity issues compared to typically developing children (n=16) (p=.0001). Interestingly, using the SASA, children with PMS showed *more hyporeactivity* compared to children with idiopathic ASD and typically developing (TD) controls (p=.01). Children with idiopathic ASD did not differ from TD children on hyporeactivity or hyperreactivity. However children with idiopathic ASD had higher scores on seeking behaviors compared to children with PMS and TD children (p=.05). In contrast, children with PMS showed no difference on hyperreactivity or seeking behaviors compared to TD children. The SASA total score significantly correlated with the SSP score (r=-.65, p=.004). Data collection is ongoing to further explore the utility of SASA.

Conclusions:

The SASA, a newly developed sensory observation and parent interview, is feasible even in severely affected, minimally verbal children. The assessment allowed us to identify sensory reactivity subtypes (hyporeactivity, hyperreactivity and sensation seeking) and to differentiate between PMS and idiopathic ASD. This is the first study on sensory reactivity abnormalities in children with PMS, which could eventually support diagnosis, aid in treatment recommendations, and serve as a potential outcome measure in clinical trials. The SASA will be useful for ASD and other neurodevelopmental disorders.

100 **138.100** Sensitivity and Specificity of the ADOS 2 Algorithms in a Large German Sample

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Background:

The Autism Diagnostic Observation Scale (ADOS) in combination with the Autism Diagnostic Interview-revised is considered to be the gold standard for
diagnosing Autism Spectrum Disorder (ASD) and Autism. Recently, a new algorithm (ADOS-2) has been proposed with the goal to achieve better sensitivity and specificity
as well as comparability between modules. The description of a new algorithm for module 4 followed in March 2014.

Objectives: Here, we compared sensitivity and specificity of the original ADOS and the new ADOS-2 algorithms in a sample of 448 child psychiatric patients to replicate
ADOS-2 validity in a German sample.

Methods:

447 dataset (modules 3 and 4) were re-evaluated using the revised ADOS-2 algorithms. Diagnosis (BEC, best estimated clinical diagnosis) was established
after the administration of ADOS, ADI-R, SCQ, SRS, CBCL, and IQ-tests by an experienced and independent clinician (psychologist or psychiatrist) according to ICD-10
. N=233 children had a diagnosis of autism, N=124 children had a diagnosis of Asperger Syndrome or atypical autism (Spectrum Diagnosis), and in N=87, ASD was ruled
out, but another psychiatric diagnosis was confirmed. Statistical analysis: Diagnostic validity was examined for module 3 (N=315) and module 4 (N=132) by comparing the
best estimate clinical diagnosis to the results of the
ADOS and ADOS 2 algorithm by receiver operating characteristics curve (ROC). Test accuracy was measured by AUC, and sensitivity and specificity for autism versus
non-ASD and ASD versus non-ASD were calculated. We used the original cut-offs described for the American samples.

Results:

Age at the time of diagnosis ranged from 5 to 16 years for module 3 (mean 10.2. SD 2.1) and from 12 to 40 years for module 4 (mean 18.0. 4.9). For module 3, 89% and
for module 4, 83% of the participants were male. IQ total scores ranged from 41 to 147 for module 3 (mean 98.1. SD 18.4). For module 4, IQ total scores ranged from 44
to 141 (mean 91.3, SD 18.1). For module 3 (non-ASD vs ASD) ADOS AUC was .87 (CI 0.82-0.92) and ADOS-2 .87 (CI 0.82- 0.92). For non-ASD vs Autism ADOS AUC was .91
(0.86-0.95) and ADOS-2 AUC was .90 (CI 0.86-0.95). For module 4 AUC for ADOS algorithm non-ASD vs ASD was .87 (CI 0.79-0.95) and .82 (CI 0.73-0.91) for ADOS 2
algorithm. For non-ASD vs Autism AUC was .92 (CI 0.87-0.98) and for ADOS-2 .87 (CI 0.8-0.95).

Conclusions:

For modules 3 and 4 we found comparable results for the original ADOS and the new ADOS-2 algorithms in this clinical German sample, differentiating
non-ASD patients from ASD and autism patients. The module 3 ADOS-2 algorithm showed for autism versus ASD higher sensitivity and a slight decrease in specificity
compared to ADOS. These results replicate earlier findings concerning the continued validity of ADOS as a diagnostic measure. For module 4 we found similar results as in
the original American sample with a good sensitivity and a slight loss of specificity for ADOS-2. Module 1 and 2 will be evaluated in the next step.

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101 **138.101** Sensory Processing Abnormalities – a Constant Across the Autistic Spectrum

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Background: Sensory processing plays a fundamental role in interpreting and managing a persons social environment. Also sensory processing abnormalities have been well documented in both children and adults with an autism spectrum disorder (ASD). These abnormalities include both hyper-sensitivity and hypo-sensitivity across all sensory modalities, along with unusual sensory-based behaviours. Hence sensory processing symptoms were included in the new Diagnostic Statistical Manual 5th Edition (DSM-5) criteria for ASD. However, it is unknown whether sensory traits are related to the *clinical* severity of core ASD symptoms as measured by the Autism Diagnostic Interview (ADI) and the Autism Diagnostic Observation Schedule (ADOS).

Objectives: We conducted the first study to evaluate the relationship between self-reported sensory traits and clinical ASD severity in a population of adults referred for a diagnosis of ASD.

Methods: We included adults (age 18-63) (N=67) referred to a national specialist ASD outpatient service on account of suspected ASD. The patients received a diagnostic assessment using the ADI-R and/or the ADOS Module 4. The patients also completed the widely used, validated self-report Adult/Adolescent Sensory Profile (AASP) questionnaire which includes four subscales: Low Registration, Sensation Seeking, Sensory Sensitivity, and Sensation Avoiding. An additional healthy control sample of 749 individuals who completed the AASP was used to determine the 'normal range' of scores on this measure..

Results: Sensory scores in the patient sample were highly abnormal - 50.0% of the patient group scored above the 95th percentile of the control group, while 87.8% scored above the control population median. Unexpectedly, however, we found no association between self-reported total AASP sensory scores and either ADOS ($r = 0.02$, $p = 0.93$) or ADI ($r = -0.334$, $p = 0.07$) total scores in the patient group. Nor were there any significant correlations between any of the four AASP subscales, and any ADI or ADOS symptom domain (all $p > 0.1$ uncorrected).

Conclusions: Self-reported sensory symptoms are not related to clinical ASD severity in an adult population. It is possible that they are explained by abnormalities in different neural systems than those underpinning most other core symptoms of ASD. This finding has clinical implications, as it suggests that sensory processing abnormalities, which are known to be associated with distress **(Jones et al. 2003),** should be probed for even in individuals who do not score highly on measures such as the ADI and the ADOS.

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102 **138.102** Simultaneous Administration of an Autism-Specific and General Developmental Screener in an Urban Pediatric Population

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Background: Little data are available on the performance of simultaneous administration of autism-specific and general developmental screeners in pediatric practice.

Objectives: To determine if the addition of an autism specific screener, the Modified Checklist for Autism in Toddlers (M-CHAT), to a pediatric primary care visit where a general developmental screener, the Ages and Stages Questionnaire version II (ASQ II), identifies additional toddlers at risk for neurodevelopmental issues. In addition, the influence of positive screening on referral to EI services was also examined.

Methods: Existing data from a randomized trial of developmental screening conducted in 4 urban

pediatric clinics from December 2008 to June 2010 were reanalyzed. Of 2,092 toddlers <30mos of age participating in the trial, 658 were screened with both the ASQ II and the M-CHAT in the same primary care visit and were included in analyses here. Subjects were categorized as failing the M-CHAT only, failing the ASQ-II only, failing both, or failing neither. In addition, for those failing at least one screener, data were assembled on referral to Early Intervention (EI) services as documented in the medical record. The influence of number and type of screener failure on frequency and timing of EI referrals was assessed via Kaplan Meier analysis.

Results: 170 (25.8%) toddlers failed at least one screener with 46 of these (7.0% overall) failing the M-CHAT. The proportion of children who failed the M-CHAT but who **did not** fail the ASQ-II was 32.61% (95% CI: 19.06% - 46.16%). A total of 91 (53.5%) of children failing at least one screener had a subsequent EI referral. For those failing the M-CHAT only, 30% were referred to EI, similar to the rate for those failing the ASQ II only (46%). The EI referral rate for children failing both screeners was 77%. The χ^2 statistic for the difference in these proportions is 10.1 (p-value=0.006) and the p-value for the log-rank test from a Kaplan Meier analysis of the difference in the time to EI referral across these groups was 0.014.

Conclusions: This study suggests that ASD-specific screening might identify a substantial number of additional children at-risk for neurodevelopmental disorders who are missed by general developmental screens.   Further, children who screen positive on both ASD and general developmental screeners are more likely to be quickly referred to EI services than are children failing just one of these screeners. However, the final diagnostic status of children in this study is not known. Also, the M-CHAT used here did not include the newly recommended follow-up interview and it is likely that fewer children would have screened positive were this interview used. While the ASD positive predictive value of the M-CHAT with follow-up questions has most recently been estimated at just under 50%, the positive predictive value for any neurodevelopmental concern was >95%, so it is reasonable to expect that some children identified with ASD specific screeners who not confirmed to have an ASD still would benefit from EI services.

103   **138.103** Social Communication and Cognitive Profiles: How Do Males and Females Compare?

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Background: The predominance of autism spectrum disorder (ASD) diagnoses among males, with average estimates suggesting a 4:1 ratio (Baird et al., 2006), is one of the most consistent features of the disorder. Previous research examining gender differences in clinical profiles of core social communication symptomatology among individuals with ASD has presented discrepant findings with females having superior, equivalent, or poor social communication skills compared to males (for reviews see Kirkovski et al, 2013, Van Wijngaarden-Cremers et al., 2014). Past research has suggested differences in profiles of cognitive strengths and weaknesses (Ankenman et al., 2014), which may impact the presentation of social and communication symptoms in ASD (Black et al., 2009).

Objectives: The purpose of this study was to examine gender differences in social communication symptoms, profiles of verbal and nonverbal intelligence and adaptive behavior in a community-based clinic sample of individuals referred for an ASD evaluation. This study attempted to overcome past methodological limitations by using a large sample of females including young children (5 years, 0 months) through adulthood (56 years, 4 months).

Methods: Evaluations were conducted across statewide outpatient clinics operated by the University of North Carolina TEACCH Autism Program between January 2001 and March 2013. A total of 679 participants (males=566, females=113) who provided consent for their clinical data to be used for research purposes were selected for analysis. These participants were administered a diagnostic battery including an ADOS-G, a CARS, and an IQ measure and received a DSM-IV clinical diagnosis of Autistic Disorder, Asperger's Syndrome, or PDD-NOS. Approximately 24% of the sample had an IQ score below 70.

Results: Females scored slightly lower on the ADOS-G total algorithm (12.85 vs. 13.58 for males) but this difference was not significant, t(677) = -1.59, p = .11. However, when specific modules were examined, gender differences on the ADOS-G were found on some modules. Specifically, no significant differences were found on modules 1 or 4, but females obtained lower scores on module 2 social, $t(96) = -2.26$, $p = 0.3$, and total, $t(98) = -2.08$, $p = 0.4$, domains and on all domains of module 3, Wilks' $\lambda = .978$, $F (3, 378) = 2.9$, p =. 04, $\eta_p^2 = .022$. No gender differences in Full Scale IQ was found, both genders had average IQ scores of 86. Across both genders, the cognitive profile of Verbal IQ=Nonverbal IQ was most frequently observed (52%). No significant differences in Verbal-Nonverbal IQ discrepancies were noted across gender. However, for females, a higher Verbal than Nonverbal IQ was associated with lower ADOS ratings. This difference was not found for males.

Conclusions: Overall, these results suggest that females, particularly those receiving ADOS modules 2 and 3, have fewer autism symptoms than males. This may point to periods in development, particularly in childhood and early adolescence, when ASD social communication symptoms may present in different or more subtle ways in females. This is particularly true for girls with higher verbal than nonverbal IQ. More research is needed on the subtle expression of ASD in girls.

104   **138.104** Stability of Symptom Severity and Adaptive Function from Preschool to Elementary Age

in Children with Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is a developmental disorder with onset in early childhood, and the individuals diagnosed with ASD would persist in their life course. Literature in the West countries has demonstrated that as they grow up to school age or adolescent, the autistic symptom severity and adaptive behavior may improve. However, there was no report in Taiwan, a country in the East.

Objectives: The purpose of this study was to examine the stability of symptom severity and adaptive behavior from toddler to school age in the children with ASD.

Methods: Twenty seven children diagnosed with ASD between 42 and 64 months of age (at mean age of 48 months) (Time 1, T1) were followed after 3.5 years (Time 2, T2). Autism Diagnostic Interview-Revised (ADI-R) was used to measure autistic symptom severity, and Vineland Adaptive Behavior Scales-II(VABS-II) was used to measure daily adaptive behavior. All of the children were diagnosed with DSM-IV in a multidisciplinary team including child psychiatrist, child psychologist and pediatrician at two time point.

Results: First, the symptom severity score at T1 was compared with the score at T2. The results indicated that the symptom severity score varied by different domains at T2. The ADI-R scores of verbal-communication domain ($p = .014$), repetitive and stereotyped behavior domain ($p = .021$) and total score ($p = .049$) were decreased at T2, while reciprocal social interaction domain was also declined but no significant difference. The logistic regression analysis found that the diagnosis score of ADI-R at T1 could predict the clinical diagnosis at T2 ($p = .00$). Second, the adaptive behavior score also varied by different domain. The VABS-II standard score of social domain was reduced ($p=.019$) but the age equivalent was increased ($p= .00$) at T2; the standard score of other domains were no significant difference between the two time point but all age equivalent were improved at T2. Finally, there was no significant correlation between domains of ADI-R score and VABS-II scores.

Conclusions: This study manifested that as children with ASD grows up, the social deficit would still persist. Although these children with ASD developed some of adaptive behaviors in the school age, the magnitude of improvement couldn't equal to the change of their chronological age. Future studies should be continued to follow these sample to learn the long-term trajectory of symptom severity and social adaptation.

105   **138.105**   The Autism Inpatient Collection (AIC): Methods and Sample Desription

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Background: Individuals severely affected by autism spectrum disorder (ASD), including those with intellectual disability, significant expressive language impairment, and/or self-injurious behavior (SIB) are underrepresented in the autism literature and in current collections of phenotypic and biological data.

Objectives: The Autism Inpatient Collection (AIC) was developed to provide a resource for the study of the full autism spectrum. Rigorous phenotypic and biological data are being collected on a large cohort of children and adolescents with ASD, hospitalized in six specialized inpatient psychiatry units.

Methods: Children and adolescents aged 4-20 years, admitted to specialized inpatient psychiatry units, are prospectively enrolled in a six-site study. Subjects scoring ≥12 on the Social Communication Questionnaire are offered participation in the study. After informed consent, the Aberrant Behavior Checklist (ABC), Repetitive Behavior Scale - Revised, Leiter-3, Vineland-2, Parent Stress Index – Short Form-4, Difficult Behavior Self-Efficacy Scale, Functional Assessment Screening Tool (FAST), Emotion Dysregulation Inventory and Child and Adolescent Symptom Inventory-5 are completed. ASD diagnosis is confirmed by ADOS-2 administration by a research-reliable examiner and extensive inpatient observation by expert clinicians. Additional data, including psychotropic medication usage, co-morbid psychiatric and medical diagnoses and sleep observations are collected. Biological samples from probands and their biological parents are sent to the Rutgers University Cell and DNA Repository, where they are processed for DNA extraction, and creation of induced pluripotent cell lines from the proband.

Results: Mean age of the first 108 subjects is 12.70 years (SD 3.50, range 4.58-20.08); 24% are female; 77.8% self-identified as Caucasian, and 91.4% non-hispanic/non-latino. Mean non-verbal IQ = 70.69 (SD 30.21, range 30-135) with a tri-modal distribution (see Figure 1) and a mean adaptive behavior composite score of 56.9 (SD 21.70, range 27-196). The majority of subjects (55.7%) were

administered Module 1 (single words or less, 47.2%) or Module 2 (phrase speech, 8.5%) of the ADOS-2, indicating very limited verbal ability. Children administered Module 1/2 had a significantly lower mean non-verbal IQ score (M=49.18, SD=17.55) than Module 3/4 (M=94.35, SD=22.52; t=-10.30, p<.001). The mean Vineland-2 expressive communication sub-scale score was 6.36 (SD 3.94, range 1-17), three standard deviations below the population mean. The mean ABC-Irritability sub-scale score was 26.67 (SD 11.91, range 0-45) and 26% of the sample were observed to have SIB by a psychologist or board certified behavior analyst.

Conclusions: Preliminary data on the first 108 subjects enrolled in the AIC indicate that this is a cohort of children and adolescents with ASD with a high level of cognitive and spoken language impairment. More than half the sample has less than fluent speech, the majority have intellectual disability, over one-quarter have self-injurious behavior and their mean adaptive functioning score is three standard deviations below the population mean. The Autism Inpatient Collection is a substantially new resource to advance study of the full autism spectrum, which will augment the wealth of existing data on higher-functioning cohorts. Although it is too early to tell, we hypothesize that the genetic diversity of the AIC cohort may differ substantially from extant patient data collections.

106   **138.106**   The Autism Mental Status Exam: Psychometric Validity of a Brief Screening Tool

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Background: The American Academy of Pediatrics (AAP) recommends screening for autism spectrum disorder (ASD) at 18-month well-child visits, but implementation in pediatric settings is slow with fewer than 10% of pediatricians integrating an ASD-specific screen (Barton et al., 2012; Dosreis, Weiner, Johnson, & Newschaffer, 2006). A multitude of screening tools exist; however, some lack sound psychometric properties, others are cumbersome to integrate into pediatric settings, and the majority are parent-report questionnaires.

The Autism Mental Status Exam (Grodberg, 2011) is an 8-item observational assessment requiring clinician rating of highly predictive ASD symptoms resulting in a global risk score. The AMSE is not intended to add extra work to a clinician's exam, but rather structures the way that data are observed and documented; thus it carries minimal clinical burden. It is intended for use by a variety of health professionals and proposed for many functions, including rapid assessment of ASD profiles for clinical and research purposes, supplement to ASD diagnostic evaluations, and potentially use as a screening tool. An initial validation study indicated the AMSE had high classification accuracy when compared to the Autism Diagnostic Observation Schedule (Grodberg, Weinger, Kolevzon, Soorya, & Buxbaum, 2012).

Objectives: The current study contributes to the psychometric investigation of the AMSE as a tool to assess autism symptomatology in children seen in diverse settings. Specifically, the AMSE's convergent validity will be verified with comparisons to an empirically validated measure of ASD symptoms.

Methods: The study includes children presenting for an initial visit in three community settings: developmental behavior pediatric clinic, an autism clinic, and a preschool program. Participants included were those whose health care provider completed the AMSE during the initial assessment and whose parents completed the Social Responsiveness Scale, 2nd Edition (SRS-2, Constantino & Gruber, 2012). The sample (n=59) was predominantly male (70%), racially diverse (22% Hispanic, 22% Caucasian, 14% African American, and 8% multi-racial), with a median age of 61 months.

Results: AMSE Total Score was significantly correlated with the SRS-2 Total Score (r(56) = .61, $p <$ .01). Furthermore, the AMSE's classification of risk for ASD was significantly related to classification of risk on the SRS-2 (X^2 (1, N = 59) = 18.88, $p <$ .01). Construct validity of specific items on the AMSE was supported through significant relationships with related subdomains on the SRS-2. Specifically, *Interest in Others* on the AMSE was significantly related to SRS-2 subdomain Social Awareness (r(57) = .34, $p =$ .01), *Pragmatics of Language* was significantly correlated with Social Communication subdomain on the SRS-2 (r(57) = .35, $p =$ .01), and the SRS-2 subdomain Restricted Interests and Repetitive Behavior was significantly correlated with both *Repetitive Behaviors/Stereotypy* (r(56) = .49, $p <$ .01) and *Unusual or Encompassing Preoccupations* (r(55) = .40, $p <$ .01) items on the AMSE.

Conclusions: The AMSE demonstrated strong convergent and construct validity with the SRS-2 within a diverse sample. Based on continued evidence of sound psychometrics, further research is recommended to explore its validity and clinical utility as a brief ASD-screening tool in pediatric settings.

107   **138.107**   The Autism Speaks Autism Treatment Network (AS ATN) Registry Data: Opportunities for Investigators

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Background: The Autism Speaks Autism Treatment Network (AS ATN) Registry, which began enrollment in December 2007, is a multi-center clinical registry that includes both retrospective and

prospective data on children ages 2-17 years with ASD.   The AS ATN is the first bi-national network of hospitals, physicians, researchers, and families at 17 centers across the United States and Canada. One of the goals of the AS ATN is to provide opportunities to develop collaborations and partnerships with clinicians and researchers who are external to its current ATN centers. We would like investigators to know what kind of data is available in the registry for their research. In addition to the registry, researchers may also propose to use data from the Autism Intervention Research Network on Physical Health (AIR-P) studies, including nutrition, sleep, metabolism and biomarkers, and neurology and behavioral outcomes, in conjunction with the registry data.

Objectives: To make IMFAR attendees aware of a unique autism-related research resource: the ATN Registry.

Methods: As of December 2013, there were 6854 children enrolled in the AS ATN Registry. Baseline measures including demographics, autism assessment, cognitive, behavioral, sleep habits, quality of life, sensory, and medications were described. Frequencies for categorical variables were tabulated, and descriptive statistics (number of observations, mean, and standard deviation) were generated for continuous variables. The number of observations available varies by measure, as some items have more complete information collected than others. Missing data and forms are currently being resolved with the sites.

Results: The majority of the children in the registry are male (83.9%), Caucasian (80.0%), non-Hispanic (89.8%), have an ASD diagnosis of autism (72.3%), have primary caregiver education level of at least some college (78.8%), and have a mean age at enrollment of 6 years (6.2 ± 3.4). Descriptive statistics are also provided for the calibrated ADOS severity, IQ, Children's Sleep Habits Questionnaire (CSHQ), Pediatric Quality of Life Inventory (PedsQL), Vineland Adaptive Behavior, Short Sensory Profile (SSP), Child Behavior Checklist (CBCL), and medications and parent form questions.

Conclusions: Over 6800 children with ASD have been enrolled in the AS ATN Registry, and the ATN continues to enroll and collect data on measures such as demographics, autism assessment, cognitive, behavioral, sleep habits, quality of life, sensory, and medications. Investigators may explore the registry data using the online query tool (*ASATN.org/asatn-query*) and may propose research analyses by submitting a Request for Data (RFD) to the AS ATN. For more information on the RFD please visit *ASATN.org/request/data*.

108   **138.108** The Broader Autism Phenotype and College Students' Choice of Majors: Validity of the Broad Autism Phenotype Questionnaire (BAP-Q)

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Background: When Individuals have the Broader Autism Phenotype (BAP), they exhibit characteristics of ASD that aren't severe enough to merit a clinical diagnosis. Anxiety, loneliness, and social dysfunction are often associated with these characteristics, and can be debilitating in daily life. Because many individuals with the BAP possess these characteristics, yet don't have a clinical diagnosis, they experience more difficulty qualifying for professional help including academic accommodations. This is true for college students who have the BAP.

Objectives: Our objective was to explore the association between characteristics of Autism Spectrum Disorders (ASD)—known as the Broader Autism Phenotype—and college major choice, and examine the validity of the Broader Autism Phenotype Questionnaire (BAP-Q) and the Autism Quotient (AQ).

Methods: We recruited 1043 undergraduate students (female=56%) from a large, western, private university using convenience sampling by offering course credit and utilizing the university's online research participation system (SONA). We measured the BAP by administering two measures to the participants: the Autism Spectrum Quotient (AQ) and the Broad Autism Phenotype Questionnaire (BAP-Q).

Results: We explored the relationship between the BAP-Q and the AQ by investigating the correlation between the total scores for the two measures. In our sample (n = 1,043), the BAP-Q and the AQ were strongly correlated at r = 0.69 (p < 0.01). We calculated the number of males and females who scored at or above the BAP-Q cutoff scores for the BAP. We found that 9.1% (n = 42) of male students scored above the suggested cutoff of 3.55, while 16.9% (n = 98) of females scored above the suggested cutoff of 3.17. MANOVA and post hoc comparisons revealed that students in the colleges of "mathematic sciences" as well as "engineering and technology" scored significantly higher on both the AQ and BAP-Q than students in other colleges.

Conclusions: The primary purpose of our study was to explore the relationship between The Broader Autism Phenotype and college major choice. Both of our measures—the AQ and BAP-Q—revealed significant differences among colleges. The results from both the AQ and BAP-Q showed that students in physical and mathematic sciences as well as engineering and technology scored higher on The BAP, supporting the preliminary research of Baron-Cohen (1998) and Baron-Cohen et al. (2001). This finding indicates there may be a greater need to provide support to students majoring in these specific fields. Providing better support to such may also include the need for professors to adjust teaching accordingly. A secondary purpose of our study was to assess the psychometric properties of the BAP-Q. We found that the BAP-Q has high convergent validity with the AQ, which further supports the BAP-Q as a good measure of The BAP. Finally the cut scores set in place in the BAP-Q for women seems to be too low, as there were unexpectedly more women who passed the cut score than men. This suggests that the cut score for women may need to be readjusted to a higher level.

109 **138.109** The Food Flexibility Challenge Task (FFCT): Developing an Ecologically Valid Measure of Food Flexibility in Children with Autism Spectrum Disorder

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Background: Food selectivity is often a significant concern for children with autism spectrum disorders (ASD). Assessment tools for measuring feeding problems and treatment gains have generally focused on parent report (e.g., food frequency inventories, dietary recall, ratings of mealtime behavior) and food quantity consumed. Few measures, if any, provide an assessment of the functional, daily impact of food selectivity. A measure of real-world food flexibility is needed to characterize what children will eat, and how they cognitively and behaviorally manage novel or non-preferred food.

Objectives: To develop and test the Food Flexibility Challenge Task (FFCT), an ecologically valid measure of food flexibility. The FFCT was based on and adapted from the Executive Function Challenge Task (Anthony et al., 2014).

Methods: The FFCT was individually administered to 11 males with ASD ages 8-12 years (mean age=9.9; mean FSIQ=109, range 91-132) as part of a small pilot treatment study for food selectivity. The FFCT is a 20-minute, interactive assessment comprised of three tasks: 1) the *Food Scenario Challenge* aasses knowledge of how someone could be flexible in food situations; 2) the *Menu Ordering Challenge* presents the child with a mock restaurant ordering situation that challenges flexibility (i.e., the child is told his preferred meal choice is unavailble), and 3) the *Food Tasting Challenge* measures in vivo willingness to taste foods. Each task has a standardized set of instructions, prompts, and rules for scoring. The FFCT yields three subtest scores and a total score, with higher scores indicating greater food flexibilty.

Scores were compared to parent report measures of flexibility, cognitive set-shifting, insistence on sameness, difficult mealtime behaviors, and anxiety, as well as to age and verbal abilities.

Results: Preiminary pilot data suggest that parent-report of child flexibilty was significantly positively correlated with FFCT total score (r=.70, p<.05) and menu ordering flexibility (r=.70, p<.05). There was also a positive trend for willingness to taste foods (r=.50, p=.12). FFCT performance did not correlate with standardized measures of global cognitive set-shifting, difficult mealtime behaviors, or anxiety. Preliminary findings also sugest no relationship beween FFCT performance and age, but do highlight possible relationships with ASD symptom severity (ADOS Comparison Score r=-.48, p=.17) and with verbal abilities on the more verbally loaded Food Scenario Challenge task (DAS-II Verbal r=.47, p=.15).

Conclusions: Initial pilot data suggest that the FFCT provides an ecologically valid measure of food flexibility that is sensitive to a child's more global, real-world inflexibility. Although limited by small sample size and reduced power, data offer a promising option for a food flexibility assessment tool that can be used for characterization and treatment outcome measurement. Data collection for this study is ongoing through the pilot treatment study; FFCT sensitivity to treatment effect will be examined at the conclusion of the study in December 2014.

110 **138.110** The Mullen Scales of Early Learning: Ceiling Effect Among Preschool Children

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Background: Several specialized tests are available to assess intelligence in young children. One common test for cognitive abilities is the Kaufman Assessment Battery for Children, designed for children ages 3 through 12 years. Another test is The Mullen Scales of Early Learning, which is a developmental test that may be administered to infants and preschool children, from birth through 68 months of age. The MSEL is frequently used in research and clinical evaluations of children with ASD. During comprehensive research conducted in our laboratory, in the context of risk to develop ASDs, we encountered a unique opportunity to compare testing patterns on the MSEL and K-ABC assessments. We soon realized that some children were receiving different development Quotient (DQ) / Intelligence quotient (IQ) scores based on the MSEL and K-ABC. More specifically, the cognitive evaluation obtained by the MSEL was usually lower than the parallel evaluation received using K-ABC, and generally underestimated the child's cognitive abilities. When looking carefully through the norms of the MSEL, we found that the participants at the upper end of the age range demonstrated lower standard deviations due to a ceiling effect.

Objectives: We hypothesized that the ceiling effect of the MSEL may be more significant than indicated by the manual, and that the test might be unsuitable for children with above-average cognitive abilities.

Methods: 256 children (128 females) ranging in age from 36 through 67 months (*M*= 48.27 months) participated. Children were born between 2003 and 2008, and were considered to be at low risk for ASD.

Results: Comparison of the two tests revealed that for the group of children between the ages of 36 to 50 months, the MSEL scores were not different than the scores on the K-ABC. However, for children ranging in age from 51 through 68 months, we found significant ceiling effect. The MSEL scores were significantly lower than K-ABC scores, and with increasing age, the prevalence of children who completed the MSEL without establishing a ceiling level increased (figure 1).

Conclusions: The MSEL has a ceiling effect and therefore underestimates cognitive abilities among

older and more cognitively able children.

111   **138.111** The New DSM-5 Impairment Criterion for Autism Spectrum Disorder in Toddlers and Young Preschoolers

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Background:
In DSM-5 impairment is defined following the International Classification of Functioning, Disability and Health (ICF), thus closely related to adaptive functioning, and is conceptualized as caused by the symptomatology of the disorder. Our knowledge of how the new impairment criterion in ASD could be applied for young children is limited.
Objectives:
To examine the effect of DSM-5's new impairment criterion on ASD frequency in young children diagnosed according to DSM-IV-TR (Autistic Disorder, PDD-NOS), and to analyze the influence of the ASD specifiers intellectual impairment, language impairment and symptom severity as well as age and gender on impairment status.
Methods:
Children (N = 127, 20-47 months) included in the study had a DSM-IV-TR clinical consensus ASD diagnosis and were assessed using the ADOS and the ADI-R. The composite score of the Vineland Adaptive Behavior Scales served as an indicator of impairment and different impairment levels were examined: *mild* (cutoff: 1 SD below the mean), *moderate* (1 ½ SD) and *severe* (2 SDs). Intellectual impairment was defined as NVIQ <70, language impairment assessed by the ADI-R and symptom severity by the ADOS Comparison Scores.
Results:
Children (N = 127, 20-47 months) included in the study had a DSM-IV-TR clinical consensus ASD diagnosis and were assessed using the ADOS and the ADI-R. The composite score of the Vineland Adaptive Behavior Scales served as an indicator of impairment and different impairment levels were examined: *mild* (cutoff: 1 SD below the mean), *moderate* (1 ½ SD) and *severe* (2 SDs). Intellectual impairment was defined as NVIQ <70, language impairment assessed by the ADI-R and symptom severity by the ADOS Comparison Scores.
Results
Applying the *mild* impairment level, 88% of ASD cases fulfilled the impairment criterion, while the proportions were 69% and 33% for the *moderate* and *severe* levels. Intellectual impairment was significantly associated with increased impairment risk applying the *moderate* (OR = 2.92, 95% CI: 1.05-8.12) and *severe* levels (OR = 8.82, 95% CI: 3.20-24.33). Applying the *severe* level, language impairment (OR = 7.10, 95% CI: 2.02-24.98) and being a girl (OR = 3.33, 95% CI: 1.04-10.63) were also significantly associated with increased impairment risk. Symptom severity (ADOS comparison scores) was not associated with impairment status for any cutoff.
Conclusions:
Depending on the chosen VABS cut-off level, DSM-5's new impairment criterion seems to imply that the criteria for ASD is more restrictive than previously for a substantial part of young children. Thus, a strict application of the new DSM-5 impairment criterion in ASD might compromise the possibility of (really) early ASD diagnosis. Intellectual impairment and language impairment tended to be most strongly associated with impairment. The link between symptomatology and impairment as well as the definition/operationalization of impairment in ASD needs more consideration. Impairment might be more closely associated psychopathology with growing age, while more subtle in young age.

112   **138.112** The Role of Internalizing Symptoms on Family Functioning in Adolescents with ASD and Their Families

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Background: Families of children with autism spectrum disorder (ASD) report higher stress than parents of children with chronic medical illness and other developmental disabilities, and their level of stress is associated with their child's level of externalizing behaviors. However, less is known about internalizing symptoms, such as anxiety, depression, and somatization, as they relate to family outcomes. Given the high rates of internalizing disorders in children with ASD and the dynamic relationships among child, parent, and family variables, this relationship warrants attention.
Objectives: The impact of anxiety and depression on family functioning was evaluated in adolescents with autism spectrum disorder (ASD).
Methods: This study was done as a secondary analysis of data collected for a multi-site clinical trial of a school-based social skills intervention. We evaluated the predictive value of internalizing symptoms in 69 adolescents with ASD (ages 11 to 18) on family functioning, after controlling for IQ and externalizing symptoms. Self- reported anxiety and depression were entered into the model together to evaluate the contribution of internalizing symptoms in general as well as the unique contribution of their distinct symptom presentations. Additionally, we examined the correspondence between parent and child ratings of these symptoms.

Results: The results indicated that internalizing symptoms predict family functioning over and above IQ and externalizing symptoms, $\Delta R^2 = 0.013$, $p = 0.03$, although the effect was small. Anxiety did not contribute a significant amount of unique variance to the model. However, depression significantly predicted more positive family functioning (p=.003). Parent ratings of internalizing symptoms were significantly higher than adolescent ratings (p=.0005).

Conclusions: The results are contrary to our initial predictions, and we offer several explanations for this difference. Depressive symptomatology may suppress externalizing behaviors, which strongly interfere with family functioning. In addition, family characteristics that contribute to parents' perceptions of family functioning (e.g., family outings, frequent social interactions) may be difficult for teens with ASD and therefore fuel depressive symptoms. Differences between parent and child ratings of internalizing symptoms is particularly interesting because although adolescent self-report measures were included in the analyses, parents reported even more internalizing symptoms than did the teens. One potential explanation is the overlap between internalizing symptoms and ASD symptoms that appear similar on the surface (e.g., social withdrawal, low motivation); parents may attribute these behaviors to internalizing disorders when they are actually more related to ASD. The differences between parent and adolescent perceptions of internalizing symptoms and the relationship between depression and family functioning suggest that internalizing behavior should be an important target of ongoing treatment. Clinicians should routinely ask specifically about anxiety and depression in their clients with ASD. Psychoeducation for families on assessing for internalizing behavior and how these symptoms may impact their family functioning is also indicated.

113   **138.113** The Social Attention and Communication Study: A School Age Follow-up

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Background: The ability to identify and diagnose Autism Spectrum Disorder (ASD) at increasingly earlier ages offers the opportunity to track their development from toddlerhood. Few longitudinal studies are available that follow children with ASD to school age. The current longitudinal investigation focused on the cognitive development of a cohort of children diagnosed with ASD at 24 months.

Objectives: The overall objective of this study is to explore the continuity and change in each child's cognitive profile from toddlerhood through to middle childhood. An additional aim is to chart severity of ASD symptoms at each of the time points (24-months, 48-months and 7-9 years) and to investigate diagnostic status at school age using the Autism Diagnostic Observation Schedule (ADOS).

Methods: Thirty five children aged between 7 and 9 years comprise the sample, with each child previously assessed at 24- and 48-months of age using the Mullen Scales of Early Learning (MSEL). The Wechsler Abbreviated Scale of Intelligence (WASI) was administered at their school age follow-up. The ADOS was also administered at all three time points to ascertain diagnostic status and determine severity of ASD symptoms

Results: Preliminary calculations of data collected thus far reveal that at 24-months, 65% of children tested with a Developmental Quotient (DQ) < 70 on the MSEL, evidencing a developmental delay. At the 48-month follow-up, 40% of children had a DQ < 70. The school age follow-up reveals that the incidence of intellectual disability (Intellectual Quotient < 70) is only 8%. All 35 children met diagnostic criteria for ASD at 24-months and 48-months on the basis of the ADOS algorithm cut-off. To investigate changes in severity of ASD symptoms over time, Mean ADOS severity scores have been calculated at each time point: 24-months (M=6.21), 48-months (M=5.54) and at school age between 7 and 9 years (M=6.25).

Conclusions: Preliminary conclusions reveal that many children with ASD have made substantial cognitive gains over time; however, the severity of their ASD symptomatology has remained relatively stable from 24-months through to school age. The improvements in IQ may be due to early detection and subsequent access to intervention earlier in the developmental course. Charting children's trajectories provides a greater understanding of the rate and pattern of cognitive development in a cohort of children with ASD from toddlerhood to middle childhood. Additionally, these findings provide an understanding of how the symptom profile of ASD presents at different stages throughout childhood.

114   **138.114** The Social Phenotype of ASD and Parent Report of Joint Attention in School Aged Children

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Background: Joint attention, or the propensity to share a common referent with other people, is a major dimension of the phenotype of ASD. It is central to preschool assessment with modules 1 and 2 of the revised Autism Diagnostic Observation Schedule (ADOS-R) Gotham et al. 2008, 2009). However, joint attention is not included in module 3 and 4 applications of the ADOS-R with individuals with more advanced development. This is not because joint attention ceases to be major feature of ASD as children development. Rather it is because it is unclear how to measure joint attention in older children.

Objectives: The first goal of this study was to develop a theory based measure of joint attention for older higher functioning children with ASD (HFASD). The second goal was to provide data on its sensitivity and specificity for identifying school-aged children with higher functioning ASD.
 Methods: As part of a longitudinal study of higher functioning children with ASD a parent report measure called the Social Development and Joint Attention Rating (SDJAR) scale was developed. This included a pool of sixty items that tapped three subdomains of joint attention in older children: *Nonverbal Shared Experience* (S/he makes eye contact with you when something in the environment interests him/her; *Joint Action* (S/he works cooperatively in groups of more than one other child to achieve a common goal); and *Verbal Shared Experience* (S/he shares exciting events with you that happened in school). Parent report data on SDJAR were collected from 38 parents of children with HFASD (Age = 11.0, SD = 2.1 years; IQ = 101, SD = 13.4) and 36 parents of age and IQ matched comparison group (Age = 11.5, SD = 2.2; IQ = 106, SD = 16.1) that included children with ADHD symptoms (N = 21) or typical development (N = 15). Data were also collected on the ADOS-R, Social Communication questionnaire and the Social Responsiveness Scale.
Results: Forty-nine questions of the SDJAR item pool constituted a scale with significant internal consistency, Chronbach's Alpha = .88, p < .001. Confirmatory factor analysis revealed one factor that explained 56% of the variance across these items. A discriminant function analysis revealed the SDJAR factor score displayed a sensitivity of 82% for the identification of children with ASD and a specificity of 86% for the identification of ADHD and Typical children. Additional analyses indicated that sensitivity and specificity of the SDJAR exceeded those of parent report on SCQ and SRS in this sample. The SDJAR was not significantly correlated with these measure, but was correlated with the ADOS in the both the ASD and ADHD samples (see Figures 1 and 2).
Conclusions: Joint attention remains a prominent dimension of the phenotype of ASD in school-aged higher functioning children. Indeed, in this study, parent report of joint attention related behaviors was more strongly related to ADOS based sample classification of higher function children with ASD versus ADHD and TD controls than was the case for commonly used parent report measures of ASD symptoms.

115 **138.115** The Value of Implementing the First Year Inventory - Lite for Screening in a Healthcare
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Background: Healthcare administrators are debating whether or not to mandate universal infant autism spectrum disorders (ASD) screening. The additive value of implementing a specific ASD screening tool above known risk factors such as preterm birth and parental concerns is unclear. The variance in typical social-communication development requires careful examination of salient predictive markers in low risk infants.
Objectives: To investigate the predictive validity of the First Year Inventory - Lite (brief version of the FYI) for identifying 12-month-old infants with poor social-communication development at 13- and/or 24-months.
Methods: Parents of 583 infants 12 months of age attending 16 well baby clinics (WBCs) in Israel completed the FYI-L. Eight percent had preterm births and for 2% parents reported social-communication concerns at 12 months. This questionnaire contained 24 items from the FYI and its risk status is norm-based. Ten infants who failed the FYI-L and a matched subset of infants who passed the FYI-L (n=12) were evaluated using the Autism Observation Scale for Infants (AOSI) and the Mullen Scales of Early Development (MSEL). Based on this evaluation six infants were referred for an evaluation in the tertiary care system. WBC records of 153 infants were reviewed for social-communication development problems. Records were reviewed only for infants with non-anonymous FYI-L and with WBC information ≥ 24 months.
Results: Relative to research referral for evaluation at 13 months, FYI -L risk status showed a positive predictive value (PPV) of 60% and a negative predictive value (NPV) of 100%. Relative to the presence of social-communication problems at 24 months on medical records, PPV was 60% and NPV 95%. A stepwise logistic regression to predict social-communication problems on WBC records from preterm status, parental social-communication concerns, and FYI-L sensory and social scores resulted in a final significant model including preterm status and FYI-L social-communication score (p=.004). A one unit increase in FYI-L social-communication score increased the odds of having problems on records by nine times. There were five FYI-L items that significantly (p< .05) differentiated infants who had social-communication problems on medical records versus not: imitation of sounds, imitation of body movements, following pointing, gaze avoidance, and prolonged staring at lights.
Conclusions: Implementing a brief specific ASD screener contributes to the identification of infants who later on have social-communication problems. Preterm status and FYI-L social-communication markers were highly associated with social-communication problems on records during the third year of life. Parental concerns may play a stronger role at an older age. The false positive rate of the FYI-L should be weighed against the importance of early diagnosis and intervention. Clinicians may want to pay closer attention at 12 months to the highly differentiating markers identified in this study.

116 **138.116** The "True" Interrater Reliability of the ADOS in Clinical Settings – a Never Ending Story?
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Background:
The Autism Diagnostic Observation Schedule (ADOS; Lord et al., 1999; 2012) is a gold standard diagnostic instrument in both research and clinical practice of ASD. Excellent interrater reliability has been demonstrated for the ADOS under optimal conditions, i.e. with a group of highly trained "research reliable" examiners in a research setting (Lord et a., 1999). However, many inquire about the ADOS' spontaneous interrater reliability among clinically trained ADOS users across multiple sites in everyday clinical routine.

Objectives:
To study the interrater reliability of the ADOS among clinically trained examiners with variable experience in a naturalistic multicenter approach across Sweden.

Methods:
Five raters (at least 4 blinded for diagnosis) per ADOS independently rated 10 video administrations per module (1-4). The filmed administrations represented clear cases with autistic disorder (13/40) as well as milder cases with Asperger's disorder (6/40), PDD-NOS (9/40) and no ASD (12/40). A total of 15 raters from 9 sites across Sweden participated. The raters were clinical psychologists and pediatricians with varying training (all basic clinical training) and experience of the ADOS. Fleiss' Kappa for multiple raters (©μ), IntraClass correlation coefficients (ICC) and exact agreement in percentage (the median of ten pairwise comparisons) were calculated.

Results:
In module 1, agreement was good to excellent for items (ICC = .52– .91) as well as the domain totals (ICC = .60 - .94). In module 2 the agreement ranged from poor to excellent for items (ICC = .31 - .91), but was excellent for domain totals (ICC = .75 - .87). The agreement was lower in module 3, ranging from poor to excellent (ICC = .22 - .89) for items and from fair to excellent (ICC = .58 - .84) for domain totals. Analyses of module 4 showed similar numbers with a poor to excellent agreement on item ratings (ICC = .22 - .97) but excellent agreement on the domain scores (ICC = .81 - .92). For diagnostic classification the (ASD vs non ASD), modules 1 and 2 showed a fair agreement (exact agreement = 80%, ©μ = .50 and exact agreement= 70%, ©μ = .56), module three a borderline agreement (exact agreement = 70%, ©μ = .23) and module 4 a fair to good agreement (exact agreement = 80%, ©μ= .59).

Conclusions:
The interrater reliability of the ADOS on an item, domain total, and diagnostic classification level was overall fair to excellent even among basically ADOS trained clinicians across multiple sites, although lower than those reported for highly trained ADOS users. The results endorse the clinical usage of the ADOS, but also underline the need and value of adequate and continuous training on the instrument.

117 **138.117** Timed Perceptual Tasks: Better Index of Processing Speed in Autistic Children?

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Background: WISC-IV profile in autism is characterized by trough and peaks of abilities. One trough that has been reported is on the subtests of the Processing Speed Index (PSI) (Oliveras-Rentas et al., 2012). Some suggested that this trough might be explained by the timing constraint of these subtests (McGonigle-Chalmers & McSweeney, 2013). However, many perceptual tasks on which autistics excel are timed, such as Children Embedded Figure tests (CEFT) (Jolliffe et al., 1997) or Visual search (O'Riordan, 2001).

Objectives: To document the association between timed perceptual tasks and processing speed in children on the autism spectrum and typically developing children (TD).

Methods: Fifty-three children aged between 6 and 12 years participated in the study. These comprised 26 autistic children (20M and 6 F) and 27 TD children (19M and 8F), closely matched on

chronological age (p= .88). All children were recruited in regular classes and specialized classes for children on the autism spectrum from a public elementary school in Montreal (Canada). Diagnosis of autism spectrum disorder was given by multidisciplinary teams using ADOS-G and/or ADI-R in most cases. All children were assessed using Wechsler Intelligence Scales for children (WISC-IV), CEFT and a visual search task. The three tests were administered in a small isolated room at the school, on separate occasions and in a counterbalanced order.

Results: WISC-IV full scale IQ was significantly lower in the autistic group (p< .001). As found in previous studies, autistic children (M= 77.5, SD=15.5) performed lower than TD children (M= 94.7, SD=12.0) on the PSI of the WISC-IV (p< .001) and on the two subtests comprised in the PSI (coding: p< .001, symbol search: p< .01). For the perceptual tasks, no difference was found between groups on either visual search time (p=.15) or CEFT score (p=.12), while autistic children were significantly faster than TD children on CEFT searching time (calculated for successful trials) (p< .01). The results on these three perceptual indexes were significantly correlated to PSI in the TD group (r from .41 to .64, all p< .05), but not in the autistic group (all p> .07).

Conclusions: Autistic children performed faster than TD children on some perceptual tasks, despite having lower "processing speed" as measured by the Wechsler Scales. Contrary to TD children, their performance in the perceptual tasks was not correlated to their PSI score, suggesting that speed of processing perceptual information would not be responsible for their poor scores on the PSI index. Some motor problems or visuomotor coordination problems are more likely to contribute to poor measured "processing speed" in autistic children. Our data therefore corroborate other findings that one or more NON-processing speed-related factors contribute to lower measured intelligence in autistic children (Wallace, Anderson & Happé, 2009).

118 **138.118** Use of Expressed Emotion (EE) in Assessing the Quality of Parent-Child Relationships: A Comparison of Young Children with and without ASD

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Background: Parenting children with ASD is challenging, as would be expected when bonding with a child who has social communication impairments. Mothers of children with ASD report less gratification from their children and more stress than mothers of children with other developmental disabilities (Hastings et al., 2005). EE is predicated on the assumption that the manner in which parents talk about their children is indicative of the way they treat them (Daley, 2009). Yelland and Daley (2009) report that high parental EE, in particular high criticism, has been shown to be associated with depression, schizophrenia, anxiety symptoms, withdrawal, somatic complaints, self-injurious behavior, delinquency, conduct disorder, oppositional defiant disorder and attention deficit/hyperactivity disorder. Measuring EE in parents of young children with ASD may shed light on their experience.

Objectives: The purpose of this research is to assess the efficacy of information gleaned from parents of young children with ASD who speak about their children for five minutes. The speech sample is subsequently coded for emotional expression (EE). Comparing the resulting profiles with those of parents of children with typical development may enable a deeper understanding of what the parents go through. Finally, by comparing EE scores with scores of parental stress in both groups it may be possible to understand relationships between subjective narrative data and stress.

Methods: Mothers of 3-5 year old children with and without ASD (n = 70), matched on mental age, SES, and gender, were asked to express their thoughts/feelings about their child for an uninterrupted five minutes. Their speech was recorded and later analyzed for both content and tone. This five minutes speech sample (FMSS) was designed as a brief measure of EE (Magnana et al., 1986) with an adaption for young children (Daly, Sonuga-Barke & Thompson, 2003). In preschool children, five variables are analyzed: number of positive comments, number of negative comments, warmth, quality of relationship and emotional over-involvement. In addition, the mothers completed a demographic questionnaire and the parenting stress index (PSI: Abidin, 1995).

Results: Significant differences emerged on the EE scores, with mothers of ASD children revealing less warmth when discussing their children, fewer positive and more negative comments than mothers of TD children. Correlations revealed different patterns of associations in descriptions of their relationships from mothers of children with and without ASD. For mothers of ASD children, significant correlations emerged between warmth and positive comments whereas for mothers of TD children, in addition to those correlations, critical comments were significantly correlated with stress. This is despite the fact that significant group differences revealed that mothers of children with ASD reported significantly more stress in the child domain, (t = 13.540, p < 0.000), but not in the parenting domain of the PSI.

Conclusions: Results suggest that the EE measurement of the quality of parent child relationship is a viable measure for use with this population and can help identify areas which can inform practitioners working with parents of young children with ASD.

119 **138.119** Using Temperament Traits to Identify Subgroups of School-Aged Children with Autism Spectrum Disorder

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Background: Temperament is defined as a set of individual differences in behavioural tendencies. An extensive body of literature establishes the association between temperament and childhood psychiatric disorders and more recent studies have documented specific temperament profiles in infants with Autism Spectrum Disorder (ASD). While previous studies have been informative in distinguishing ASD from non-ASD cases in infancy and early childhood, our understanding of how temperament varies within the ASD population and how that variability is associated with outcome in children with ASD later in life is limited.

Objectives: The primary objective of this study was to identify subgroups of school-aged children with ASD with distinct temperament profiles. A secondary objective was to examine whether children from different temperament subgroups have different outcomes – adaptive functioning skills, social communication deficits, and emotional-behavioural problems – later in life.

Methods: Data came from the Pathways in ASD study, a large Canadian longitudinal study of children with ASD. The sample was composed of 185 school-aged children with ASD (mean age: 7.8 years; 83% males). Temperament was indexed using the Temperament in Middle Childhood Questionnaire (TMCQ). A total of 17 TMCQ dimension scores were used in hierarchical cluster analysis to derive subgroups of children with ASD at baseline (T_1). Analysis of variance (ANOVA) was used to explore subgroup differences on: (1) T_1 (baseline) TMCQ dimension scores; and (2) T_2 (12 months later) outcome on variables of interest –adaptive functioning (indexed by the Vineland Scales of Adaptive Behaviour; VABS II); social communication deficits (indexed by the Social Responsiveness Scale; SRS), and emotional behavioural-problems (indexed by the Child Behaviour Checklist; CBCL 6-18).

Results: A 2-cluster solution was selected as the best fit to the data. At T_1 the two clusters were characterized by distinct temperamental profiles (p<.001 for most TMCQ dimensions). Specifically, compared to children in Cluster 2 (60.5% of sample), children in Cluster 1 (39.5% of sample) had higher scores on activation control, affiliation, assertiveness, attentional focusing, fantasy/openness, and soothability and lower scores on anger/frustration, impulsivity, discomfort, fear, sadness, and shyness. Moreover, at T_2 (12 months later) children in Cluster 1 had better adaptive functioning skills, fewer social communication deficits, and fewer emotional behavioural problems (p<.001 for all).

Conclusions: Study findings show that in school-aged children with ASD distinct temperament profiles are associated with differential outcomes regarding adaptive functioning, social communication, and emotional-behavioural problems over a 12-month period. These findings support the use of temperament traits as a potentially informative approach in disentangling phenotypic heterogeneity in ASD. Since temperament is believed to be linked to genetic factors, such an approach could prove fruitful for the development of nosological models that help bridge the gap between clinical/behavioural symptoms and the biological underpinnings of the disorder.

120 **138.120** Validation and Factor Structure of the 3Di Short Version in a DSM-5 Context

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Background: Validated standardized instruments are important aids in the process of diagnosing Autism Spectrum Disorder (ASD). However, most validated standardized parent interviews currently available are time and resource intensive, which hampers regular use in clinical practice. The short version of the Developmental Diagnostic Dimensional Interview (3Di-sv) is a standardized, 45-minute interview that is increasingly used in clinical settings. Although this instrument has been validated against clinical diagnosis according to DSM-IV-TR criteria, more information is needed regarding its reliability and validity in the light of the DSM-5 conceptualization of ASD.

Objectives: To extend the validation of the 3Di-sv by investigating its association with a diagnosis according to DSM-5 criteria, and test its underlying factor structure against a DSM-IV versus a DSM-5 conceptualization of ASD.

Methods: Data were collected from 198 clinically referred Dutch children who showed significant ASD symptoms (SRS > 75). Sensitivity, specificity, Negative Predictive Value (NPV) and Positive Predictive Value (PPV) for the 3Di-sv classification were determined as compared to a best estimate DSM-5 diagnosis based on 3Di-sv and the Autism Diagnostic Observation Schedule, using the preliminary DSM-5 ASD criteria. Confirmatory factor analysis (CFA) of the 3Di-sv was used to test the model-fit of the instrument against a DSM-IV versus a DSM-5 model of ASD.

Results: The 3Di-sv showed excellent sensitivity (.98) and NPV (.97), moderate PPV (.66) and poor specificity (.52). The DSM-5 model of ASD showed adequate to good fit (RMSEA = .049, CFI=.951, SRMR=.056), and outperformed the DSM-IV model of ASD.

Conclusions: The 3Di-sv performs well when it comes to correctly identifying children with an ASD diagnosis according to the DSM-5. However, it also shows a relatively high rate of false positives. Possible reasons for this relatively high false positive rate will be addressed, including changes in the DSM criteria as compared to the DSM-IV, and related expected changes in ASD prevalence. CFA showed that the data best fit a DSM-5 model of ASD, however, the 3Di-sv does not fully include all symptoms described in the DSM-5. Future adaptations of the 3Di-sv will especially need to address the added criterion on sensory sensitivity, as well as changes in the definitions of existing symptom domains in the DSM-5.

121 **138.121** Validation of Temporally-Sensitive Eye-Tracking Indices of Social Disability As Treatment Endpoints in School-Age Children with ASD

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Background: An important goal for biomedical research in autism is to develop effective treatments for ameliorating social disability in individuals on the autism spectrum. To develop effective treatments for social disability requires effective *measures* of social disability to be used as treatment endpoints. While percentage of time spent looking at socially-relevant, spatially-defined content regions, such as the eyes of other people, can serve as promising quantifiers of social disability (e.g., Rice et al., 2009), a critical feature of typical social interaction is the ability to look not only at socially-relevant content, but to look at the right content at the right moments in time. The goal of the current research is to test the extent to which eye-tracking-based, time-varying measures of visual scanning can serve as successful outcome measures to assess the efficacy of new treatments. These measures quantify both when and at what individuals look when viewing social interaction.
Objectives: This study will assess the reliability and validity of time-varying measures of visual scanning as treatment endpoints in school-age children with ASD.
Methods: We assessed the use of content-based and time-varying eye-tracking measures, collected during free viewing of naturalistic videos of social interaction, in terms of their content, construct, and convergent validity, as well as their general appropriateness for measuring social disability; their reliability, precision, and internal consistency; as well as their interpretability and patient acceptability. Content-based measures quantified looking to eyes, mouth, body, and object regions; time-varying measures quantified the probability of looking at the same location at the same time as typical viewers. To assess the range and distribution of scores found in the general population, we collected normative eye-tracking data from typically developing children (TD, N=42, mean age=9.61 years, FSIQ: 73-140) and also collected comparison values in a large and heterogeneous sample of children with ASD (N=128, mean age=10.12 years, FSIQ: 32-149).
Results: Content-based measures of visual attention demonstrate both high reliability and strong agreement for eyes, mouth, body, and object regions: ICC > 0.5, all $p < 0.001$ for ASD. Time-varying measures of visual scanning are more robust than content-based measures: ICC= 0.719, $p < 0.001$ for ASD. Preliminary analyses show promising convergent validity of ASD individuals' time-varying scores with calibrated severity scores on the Autism Diagnostic Observation Schedule (ADOS) across the entire sample, despite marked heterogeneity in age and FSIQ, $r= -0.357$, $p < 0.001$.
Conclusions: Temporally-sensitive measures of visual scanning during free-viewing of naturalistic scenes of social interaction can serve as effective and valid quantifiers of social disability. In the current analyses, we focused on measures—normed relative to typically-developing peers—of looking to the 'right' content at the 'right' moments in time. Future analyses will explore whether these measures can also effectively stratify subtypes within our heterogeneous ASD sample, and whether analysis of those sub-groups will improve convergent validity with expert-clinician assessments like the ADOS. Rigorous assessment of promising eye-tracking measures will provide us with multiple dimensions with which to assess the effectiveness of treatments aimed at treating social deficits in ASD.

122 **138.122** Validation of a Quantitative Approach of the Application of Autism Diagnostic Observation Schedule (ADOS): A Preliminary Eye-Tracking Study

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Background: Autism Diagnostic Observation Schedule (ADOS) is a semi-structured assessment of communication, social interaction and imagination. It allows to assess and diagnose autism spectrum disorder (ASD) across ages, developmental levels and language skills. However, its use is dependent on the examiner's clinical expertise in neurodevelopmental field and experience with the instrument, which may potentially lead to errors in the diagnostic procedure. Eye-tracking is a powerful tool for

studying visual attention patterns, revealing differences in the way individuals with typical development (TD) and ASD explore images.

Objectives: This study aims to assess the psychometric validity of eye-tracking measures to be used as diagnostic tool, by developing and testing a quantitative approach that may provide a more accurate diagnosis and quantify ASD severity.

Methods: The sample consisted of eighteen school-aged children: eleven with high-functioning ASD (mean age=13 years 6 months) and seven chronological-aged matched TD (mean age=12 years 10 months). ASD patients had ADI-R and ADOS positive results and met ASD DSM-5 criteria. The parents of TD participants completed Social Communication Questionnaire and Social Responsiveness Scale to exclude ASD symptomatology. Associated medical conditions were excluded by experienced neurodevelopmental pediatricians in ASD group. Eye-tracking data were collected with RED eye-tracking system (SMI-SensoMotoric Instruments,Germany) for both ASD and TD participants during the administration of digitalized activities from ADOS: "Description of a Picture","Cartoons"/"Telling a Story from a Book". Eye movement data was recorded with iViewX™ and analysed offline with BeGaze™software where different areas of interest (AOI's) where defined: "faces"/"objects"/"animals". We compared (IBM-SPSS-21) the total fixation count (TFC) and percentage of total fixation duration time (PTFDT) in the defined AOI's within the two groups with Mann-Whitney-U test. Significance level (α)=0.05($p<0.05$).

Results: TFC of "objects" in "Description of a Picture" task significantly differed between the two groups (p=0.015), while for "faces" and "animals" it was not significantly different ($p>0.05$). ASD group had higher number of TFC in "objects" while describing the given picture than TD group. Although not reaching significant statistical difference, the inverse pattern appears in AOI "faces", with ASD group having lower TFC than TD. Concerning PTFDT there were no significant statistical differences between groups ($p>0.05$). In "Cartoons" task both groups did not differ in TFC in the different AOI's ($p>0.05$). Total PTFDT of "objects" AOI significantly differed between the two groups (p=0.027), while in "faces" AOI was not significantly different ($p>0.05$).

Conclusions: Eye-tracking measures of visual scanning, while describing activities from ADOS: "Description of a Picture"/"Cartoons", can discriminate between ASD and TD groups concerning to attention to objects in the pictures. ASD individuals are also showing a trend to decreased attention towards faces. In our analysis, we focused on attention to faces, objects and animals in the pictures from tasks of ADOS thereby providing a quantitative diagnostic measure that is not examiner's dependent. With this strategy, we hope to improve the accuracy of ASD diagnostic evaluation and obtain a quantitative measure of severity, ideally obtaining a spectrum of severity from normal to pathological behaviour. These preliminary findings should be replicated in a larger sample.

123   **138.123** Validation of an Observational Screening Measure of Red Flags of ASD at 18-24 Months

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Background: The American Academy of Pediatrics recommends that all children be screened for autism spectrum disorder (ASD) at 18 and 24 months (Johnson & Myers, 2007), as research indicates early intervention maximizes child outcomes (NRC, 2001; Dawson et al., 2011; Wetherby et al., 2014). Screening tools assessing risk for ASD should provide a time- and cost-efficient method of determining whether further diagnostic testing is warranted. The updated *Systematic Observation of Red Flags (SORF-22)* is a 22-item coding system recently revised to detect symptoms outlined in the new diagnostic criteria (as described in the *DSM-5*), providing a brief screening measure covering both core domains of ASD.

Objectives: To determine the sensitivity and specificity of the *SORF-22*as a screening tool for ASD symptoms at 18-24 months and to identify a cutoff to maximize the efficacy of its use in detecting risk for ASD.

Methods: 18-24 month old toddlers were selected from (1) a primary care sample screened for communication delays, and (2) a sample referred for developmental concerns. Data for the present study were coded based on behavior exhibited in the *Communication and Symbolic Behavior Scales Behavior Sample,* a standardized clinician-administered measure of social communication. Outcome measures of developmental level (*Mullen Scales of Early Learning*; *Vineland Adaptive Behavior Scales, Second Edition*) and autism symptoms (*Autism Diagnostic Observation Schedule – Toddler Module)*were obtained to determine diagnosis at 18-24 months. Children with a confirmed diagnosis were classified into one of three groups (ASD, Developmentally Delayed [DD], or Typically Developing [TD]) based on a best estimate diagnosis using these measures.

Receiver operating characteristic (ROC) curve analyses were used to determine sensitivity and specificity of the *SORF-22*, examining the total score of overall symptoms and the total number of red flags in predicting diagnosis. Further analyses will also be reported, utilizing Item Response Theory techniques to examine item-level performance in order to determine whether fewer items are needed to efficiently measure ASD risk.

Results: The total number of red flags offered the best prediction of diagnosis, providing good discrimination (area under the curve = .80) when comparing non-spectrum children (DD and TD) and children with ASD. Maintaining sensitivity above 80% (i.e., 82%) resulted in a specificity of 63% when using a cut-off score of six red flags. Using a cutoff of 17 for the total *SORF-22*score provided similar discrimination (area under the curve = .78), sensitivity (82%), and specificity (60%).

Conclusions: The *SORF-22* provides a measure of ASD risk with good discrimination when comparing children with ASD and children who are TD and DD at 18-24 months. Prioritizing sensitivity above 80% results in lower specificity, though it reduces the likelihood that children with developmental concerns will be overlooked for further diagnostic testing. Additional analysis will also be discussed, examining symptom scores individually to determine which items are most effective in predicting diagnosis.

124 **138.124** What Could be Driving Phenotypic Heterogeneity? Deep Characterization of Young Children with and without Autism Spectrum Disorder from the Study to Explore Early Development (SEED)

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Background: A number of studies have evaluated phenotypic profiles in samples of children with and without Autism Spectrum Disorder (ASD). Teasing out the influence of developmental function versus symptom severity on assessment measures has implications for screening and treatment recommendations. This study examines the degree that developmental differences drive phenotypic differences on social and behavioral functioning.

Objectives: To examine how developmental level differentiates performance on social, adaptive, and behavioral measures and assess the impact developmental functioning has on heterogeneity among children with ASD on symptom severity, social, and behavioral scales.

Methods: SEED is a multi-site-case-control study of children (2 to 5 years) born 2003-2006, designed to characterize ASD phenotypes and examine genetic and environmental risk factors. Children with possible ASD and developmental delay (DD) were recruited from multiple sources serving children with ASD and developmental problems. Children from the population comparison group (POP) were recruited from birth certificate records. Children of families who expressed interest in the study were telephone screened for ASD using the Social Communication Questionnaire (SCQ) to determine initial group cohort. Children without a prior ASD diagnosis and low risk on the SCQ received a developmental assessment only (Mullen Scales of Early Learning; MSEL). Children with prior ASD diagnosis or high risk screen were evaluated with the Autism Diagnostic Interview-Revised (ADI-R), Autism Diagnostic Observation Schedule (ADOS), MSEL, Vineland Adaptive Behavior Scales – 2nd Edition (VABS), and Child Behavior Checklist (CBCL). Children were classified with ASD in SEED based on ADI-R and ADOS results. All children were classified into three groups based on developmental function measured by the MSEL: Average/Above Average (A/AA), DD (one delay noted on MSEL domains), or Global Developmental Delay (GDD; delays on all MSEL domains). Children diagnosed with ASD were further stratified into: ASD-A/AA, ASD-DD, or ASD-GDD.

Results: 3,899 children were enrolled in SEED and 2,676 (mean age= 4.95 years; SD= 0.57), completed the clinic visit and were classified as ASD or non-ASD, and were included in these analyses. Based on developmental level, non-ASD children were characterized as: A/AA (N=1,333; 56% male), DD (N=459; 67% male), and GDD (N=173; 62% male). Children in the ASD group were stratified as: ASD-A/AA (N=117; 82% male), ASD-DD (N=240; 85% male), and ASD-GDD (N=354; 79% male). Tables 1, 2 depict significant correlations resulting from Spearman correlations comparing SCQ, VABS, and ADI-R Domain Scores to the CBCL Internalizing (INT) and Externalizing (EXT) scores by developmental level and diagnostic group.

Conclusions: Children in SEED represent a heterogeneous group with various levels of developmental functioning. These correlations demonstrate a pattern suggesting more autism symptoms measured by the SCQ and ADI-R were associated with more behavior problems on the CBCL, for certain groups. In contrast, better adaptive functioning was correlated with fewer behavior problems, for certain groups. Analyses are ongoing and future results will be presented regarding the influence of developmental functioning by developmental and diagnostic group on measures of socialization and behavior. The ASD group will be stratified based on symptom severity to explore the interplay between developmental function and symptom severity.

125 **138.125** "Making Sense of It All." Sensory-Processing Sensitivity, Negative Affect, Extraversion and Effortful Control in Children with and without ASD

S. D. Boterberg, H. Roeyers and P. Warreyn, Department of Experimental Clinical and Health Psychology, Ghent University, Ghent, Belgium

Background: Recently, hypo- and hypersensitivity to sensory stimuli became part of the diagnostic criteria for autism spectrum disorder (ASD) in DSM-5. Further, previous research in temperament has shown that children with ASD show more Negative Affect, less Extraversion and less Effortful Control (inhibition control and attentional focus). In addition, regardless of clinical diagnosis, children with high levels of temperamental sensory-processing sensitivity (SPS) may exhibit ASD-like behaviour, such as social withdrawal and strong adherence to routines. This may lead to diagnostic difficulties.

Objectives: The first purpose of the present exploratory study was to further examine the characteristics of the temperamental construct of SPS in children. Second, relationships and differences between ASD-symptoms, characteristics of SPS and the other temperamental constructs were explored.

Methods: Data from 409 children (3-16 years) with and without a clinical diagnosis were collected through an online survey. Parents reported on ASD symptoms (SCQ, SRS), SPS (Highly Sensitive Person Scale; HSPS) and other temperamental constructs (CBQ, TMCQ, EATQ-R).

First, the factor structure of the HSPS was explored. Second, group differences between ASD-symptoms, SPS, Negative Affect, Extraversion and Effortful Control were examined between children with ASD (*N*=37), highly sensitive children (HSC; *N*=60) and a non-clinical control group (non-HSC; *N*=259).

Results: Factor analysis demonstrated a two-component structure of the HSPS. The first component consisted of Overstimulation, Emotional intensity and Sensory sensitivity, reflecting *Overreaction to stimuli*. The second component reflected *Depth of processing*.

Regarding the group comparison on the HSPS, children with ASD only scored higher on the first component (Overreaction to stimuli) compared to children in the control group.

Further, HSC scored higher on some typical characteristics of ASD (e.g., repetitive and stereotyped behavior and a restricted social cognition and motivation) compared to non-HSC. However, children with ASD still scored higher on most typical ASD-symptoms compared to HSC. Difficulties in distinguishing HSC and children with ASD were only seen for social motivation.

In accordance to previous research, children with ASD showed more Negative Affect, less Extraversion and less Effortful Control compared to children from the control group.

HSC exhibited more Negative Affect and less Extraversion compared to non-HSC. They did not differ in this from children with ASD. However, HSC showed more Effortful Control compared to children with ASD and control children.

Conclusions: In contrast to previous findings in adults that the HSPS measures a unidimensional construct, our data support a two-factor structure in children. Only the first factor (*Overreaction to stimuli*) was associated with ASD, which implies that high scores on this component could be an indication of ASD.

Overall, the present study offers suggestions for differentiating children with a highly sensitive temperament from children with ASD, who could also react in a hypersensitive way to sensory stimuli. Despite similarities in repetitive and stereotyped behaviour, restricted social motivation, high Negative Affect and low Extraversion, the two groups can be discriminated on typical social and communicative ASD-symptoms and temperamental Effortful Control.

Poster Session
139 - Interventions Pharmacologic
11:30 AM - 1:30 PM - Imperial Ballroom

126   **139.126**   A Randomized, Placebo Controlled Trial of Omega-3 Fatty Acids in the Treatment of Young Children with Autism

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Background:
Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder affecting more than 1% of children. It is characterized by social communication deficits and repetitive behaviors / restricted interests. In the absence of any medications known to improve core symptom domains, parents often use complementary alternative treatments, including omega-3 fatty acid supplements.

Objectives:
The primary objective of this study was to assess whether omega-3 fatty acids (NutraSea-HP) are effective in improving symptom severity and externalizing symptoms in young children with ASD. The

secondary objective was to evaluate the effect of omega-3 fatty acids on adaptive functioning and language development and to provide further safety data for the use of omega-3's in preschool aged children.

Methods:

We conducted a 6 month, randomized, placebo controlled trial of omega-3 fatty acid supplements (1.5 grams) vs placebo in children 2-5 years of age with ASD. Primary outcome measures included the Autism Composite Score of the Pervasive Developmental Disorders Behavioral Inventory (PDDBI) and the externalizing problems score of the Behavior Assessment System for Children (BASC-2). In a secondary fashion we examined global improvement (CGI-I), adaptive function (Vineland Adaptive Behavior Scale, VABS-II) and language gains (Preschool Language Scale, PLS-4), as well as safety. Exploratory analysis investigated potential correlations between changes in cytokine profiles and treatment response.

Results:

Thirty eight participants were randomized in a 1:1 fashion. There was no significant difference between groups on the 0-24 week change in PDDBI autism composite scores (p=0.5). There was a significant group by week interaction on the BASC-2 externalizing problem score, with participants randomized to the treatment group demonstrating worsening scores (p=0.02). There was no statistically significant week by group effect on either adaptive function (p=0.09) or language (p=0.6). Omega-3's were relatively well tolerated. Changes in cytokines during the study did not correlate with treatment response.

Conclusions:

Based on this study, there is no evidence supporting high dose supplementation of omega-3 fatty acids in young children with ASD.

127 **139.127** Atomoxetine Tolerability and Adverse Events in Autism Spectrum Disorders in the Multisite Charts Study

*J. A. Hellings[1], **S. L. Hyman**[2], B. L. Handen[3], T. Smith[4], P. Corbett-Dick[5], R. Tumuluru[6], L. E. Arnold[7] and M. G. Aman[8], (1)Psychiatry, The Ohio State University Nisonger Center McCampbell Hall, Columbus, OH, (2)Pediatrics, University of Rochester School of Medicine, Rochester, NY, (3)University of Pittsburgh School of Medicine, Pittsburgh, PA, (4)601 Elmwood Ave, Box 671, University of Rochester, Rochester, NY, (5)Neurodevelopmental and Behavioral Pediatrics, University of Rochester Medical Center, Rochester, NY, (6)Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, (7)Nisonger Center, The Ohio State University, Columbus, OH, (8)The Nisonger Center UCEDD, Ohio State University, Columbus, OH*

Background:

Symptoms of attention deficit hyperactivity disorder (ADHD) occur in up to one third of children with autism spectrum disorders (ASD). Children with ASD are more prone to irritability, insomnia and gastrointestinal (GI) problems than TD children, and show a much lower response to, and tolerance of, stimulant treatment than TD children. Atomoxetine, a non-stimulant ADHD treatment, in typically developing (TD) children showed a response rate of 60%, and effect size 0.65 for ADHD (Correll & Schwartz, 2014), and has shown promise for ADHD symptoms in ASD in preliminary studies.

Objectives:

The Children with Hyperactivity and Autism Research Treatment Study (CHARTS) includes a multisite, 10-week, randomized, double- blind, placebo-controlled, 2x2 trial of ATX versus placebo (PBO) in groups randomized to Parent Training (PT) or No PT, with a 24-week open ATX extension. PT comprised up to 9 weekly sessions of 1 to 1.5 hours of outpatient training. ATX was used at up to 1.8mg/kg/day. Response rates were higher in ATX than PBO in both PT and No PT groups (p= 0.015, Fisher exact test). We examine adverse events (AEs) and tolerability between the groups acutely (by 10 weeks), longer term (34 weeks), and for drop- outs.

Methods:

AEs were ascertained using an ATX-specific side effect review scale (parent-rated) at each visit. Clinicians established whether AEs were new or ongoing, rated their severity and developed an action plan. Tolerability was monitored with physical examinations at each visit, as well as EKG and laboratory tests at baseline, Week 10, and Week 34. Using Fisher exact tests, we compared the frequency of AEs and dropouts across groups at Week 10. In our poster, we will also present group comparisons at Weeks 10 and 34 for (1) cardiovascular, growth, and laboratory results, (2) AEs relative to dose, and (3) concomitant medications.

Results:

Irritability was less frequent in the ATX+ PT group than in the ATX group (*p*= 0.04), and in PT than No PT (*p*=0.007). Appetite decrease (*p*=0.04), and possibly abdominal pain (*p*=0.07) were more common in ATX than PBO. No other statistically significant group differences in AEs were observed.

One SAE occurred in the ATX group in the first 10 weeks: a child with a known seizure disorder and low antiseizure drug concentration had a seizure and ED visit at week 8; this child continued in the study with antiseizure medication dosage adjustment, neurologist and clinician monitoring.

More subjects dropped out of PBO and PBO+PT than the ATX and ATX+PT groups. Fewer subjects dropped out in Drug versus No Drug (*p*=0.20); fewer dropped out in PT versus No PT (*p*=0.05).

Conclusions:

ATX was well tolerated acutely in children with ASD, and was not related to more dropouts or SAEs.

More comprehensive and longer-term data will also be presented.

128 **139.128** Atomoxetine, Placebo, and Parent Training in Autism

T. Smith[1], B. L. Handen[2], M. G. Aman[3], L. E. Arnold[4], S. L. Hyman[5], X. Pan[6] and K. A. Buchan-Page[4], (1)601 Elmwood Ave, Box 671, University of Rochester, Rochester, NY, (2)Psychiatry, University of Pittsburgh Medical Center, Pittsburgh, PA, (3)The Nisonger Center UCEDD, Ohio State University, Columbus, OH, (4)Nisonger Center, The Ohio State University, Columbus, OH, (5)Pediatrics, University of Rochester School of Medicine, Rochester, NY, (6)Center for Biostatistics, The Ohio State University, Columbus, OH

Background: Children with ASD often have co-occurring behavior problems such as inattention, hyperactivity, irritability, anxiety and noncompliance. However, available research provides little guidance on whether to select a behavioral intervention, medication, or both for treatment of an individual child with ASD.
Objectives: This three-center randomized clinical trial evaluated relative efficacy of psychosocial treatment (parent training; PT) and atomoxetine (ATX) for treating ADHD symptoms and noncompliance in children with ASD.
Methods: We enrolled 128 children (age 5-14 years) with ASD and ADHD symptoms in a 10-week, double-blind trial with a 24-week extension (M age = 8.14 years, SD = 2.08; 108 males). Subjects were randomized in equal numbers to: a) ATX+PT, b) ATX alone, c) placebo+PT and d) placebo alone, balanced by site and mental age (<6.0 vs. >6.0 years). Atomoxetine was optimized over the first six weeks (to a maximum of 1.8 mg/kg) and PT occurred weekly, involving nine core sessions and a home visit. During the Extension, responders continued double-blind; non-responders had the blind broken and received an open trial of atomoxetine or an alternative medication. Primary outcome measures were the parent-rated SNAP-IV and Home Situations Questionnaire (HSQ), and the Clinical Global Impressions Scale (CGI), completed by an independent evaluator blind to group assignment. Responders were identified based on parent ratings (SNAP-IV for ADHD and HSQ for noncompliance) and ADHD CGI-Improvement rating of "much" or "very much" improved. We compared response rates using Fisher Exact Tests.
Results: By preliminary analyses, at Week 10, the highest *ADHD response rates*, occurred in the groups that received ATX (ATX alone = 47%, ATX+PT = 44%), followed by PT+Placebo (28%) and Placebo Alone (19%). *Noncompliance response rates* were highest in the groups that received either ATX or PT Alone (ATX Alone = 44% and PT+Placebo = 38%), compared to ATX+PT = 22% and Placebo Alone = 16%).
At Week 34, both ADHD and noncompliance response rates, based upon original group assignment even though double-blind nonresponders at that point were receiving different pharmacotherapy, were higher in all three groups originally assigned active treatment than in the group originally assigned Placebo Alone. *ADHD response rates* were ATX Alone = 63%, PT+Placebo = 59%, ATX+PMT = 56%, Placebo Alone = 31%. *Noncompliance response* rates were ATX Alone = 59%, PT+Placebo = 56%, ATX+PMT = 53%, Placebo Alone = 34%.
Conclusions:
Both ATX and PT appeared effective in treating ADHD and noncompliance in this sample of children with ASD. However, the combination of the two treatments did not result in greater gains on primary outcome measures. In addition, ATX may have led to a more rapid improvement in ADHD symptoms than did PT. Analyses of secondary measures may yield additional information about the relative efficacy of ATX, PT, and ATX+PT compared to placebo and help explain the somewhat idiosyncratic impact of PT within the combined treatment. Based upon our preliminary analysis, both ATX and PT appear to be reasonable options for treating symptoms of overactivity, inattention, and noncompliance in children with ASD.

129 **139.129** Citalopram Treatment of Young Children with Autism Spectrum Disorder (ASD): Correlation with Maternal History of Depression

ABSTRACT WITHDRAWN

Background: Serotonin is essential for normal brain development in early childhood. Altered serotonin levels during early development are speculated to lead to abnormal brain circuitry and symptoms of autism spectrum disorder (ASD). Low plasma serotonin levels have been reported in children with ASD and their mothers and may be critical for early brain development.
Objectives: To report anecdotal clinical experience of behavioral improvements during treatment with low-dose citalopram in boys with a diagnosis of ASD, all of whom had a strong maternal and family history of depression.
Methods: Prospective treatment and followup of 8 boys with ASD who were treated with citalopram. All had a history of maternal depression, and 2 mothers received SSRIs during pregnancy. All had normal genetic/ metabolic testing. Citalopram was started at 0.5-1 mg/day and increased weekly by 0.5-1 mg/day as tolerated, avoiding overstimulation as the dose was increased; it was decreased to the previous level if the child showed increased excitation, difficulty with sleep or decreased appetite. Children were treated for up to 1 year and then citalopram was tapered in the same manner as it was started. Ohio Autism Clinical Impressions Scale – Improvement(OACIS-I) was used to evaluate improvement in behavior over time.

Results: Within 3 months of treatment all 8 patients were much improved on most subscales of the Autism Clinical Global Impression-Improvement (Autism CGI-I) scale. Two patients maintained developmental gains following discontinuation; 2 regressed during weaning and were restarted; 4 are still on initial treatment and doing well.

Conclusions: Although citalopram has limited effects in older children with ASD, our experience suggests that it may be effective in promoting brain development in young children, especially in those with a maternal and family history of depression and treatment with SSRIs. There are likely to be specific differences in serotonin synthesis, transport or receptors in these families.

130 **139.130** Developing and Testing an Intervention to Reduce Challenging Behaviors within Community and School-Based Mental Health Services

ABSTRACT WITHDRAWN

Background: Publicly-funded mental health (MH) services play an important role in the treatment of behavioral issues and co-occurring psychiatric problems for school-age children with ASD. AIM HI ("An Individualized Mental Health Intervention for ASD") was developed in response to a lack of "implementable" intervention protocols for MH service settings. AIM HI is a package of evidence-based strategies designed to target challenging behaviors in children with ASD. Data from a large-scale community effectiveness trial of the AIM HI clinical intervention and corresponding training model provide important information about the impact of implementing evidence-based strategies in community service settings and information on the clinical characteristics of children receiving publicly-funded mental health services.

Objectives: Describe the development of the AIM HI; provide an overview of a large-scale community effectiveness trial; report initial data on the clinical presentation of children served in MH settings; and discuss preliminary outcomes associated with therapist training.

Methods: AIM HI was developed based on a systematic needs assessment of the community service context and collaboration with community stakeholders to package evidence-based strategies. The current effectiveness and implementation study uses a wait-list randomized controlled trial in which community and school-based MH programs are randomized to one of two intervention training waves: immediate AIM HI implementation and usual care/delayed AIM HI implementation. Therapist and child/parent participants are recruited from participating programs. Therapists practicing in programs during the immediate and delayed AIM HI implementation are trained to deliver the intervention to participating families over a six month intervention and training period. Child and family outcome measures are collected at baseline, 6, 12, and 18 months. The current sample of child/family participants includes 103 children (86% male) ages 5-14 (M = 8.83 years; SD = 2.51) recruited from the caseloads of 91 participant MH providers. Therapists (85% Female and 33% Hispanic) range in age from 23-58 (M=34) and represent multiple mental health disciplines.

Results: Data on child clinical characteristics from the current sample indicate that cognitive functioning is in the average range (M=88.9; SD=16.9; Range=41-139). 88% of children meet diagnostic criteria for at least one non-ASD psychiatric diagnosis based, most frequently ADHD. Sixty percent of children used psychotropic medication within the six months prior to the baseline assessment. The most commonly reported challenging behaviors endorsed by parents are perseveration (65%) and noncompliance (60%). Preliminary data on implementation outcomes indicate that most therapists who complete the AIM HI training and consultation reach fidelity. Further, significant differences in therapist practice and attitudes between AIM HI and Usual Care therapists are observed.

Conclusions: The preliminary results from this ongoing study provide important information about the characteristics of children with ASD served in usual care MH settings. Data also suggest that it is feasible to train MH providers who are not ASD or behavioral intervention specialists to deliver evidence-based intervention strategies for children with ASD. Overall, this study has the potential to advance the science on the effectiveness and implementation of delivering interventions in community service settings for ASD.

131 **139.131** Effect of Treatment with OMEGA-3 Polyunsaturated Fatty Acids on Behavioural Measures in Children and Adolescents with Autism Spectrum Disorders

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Background: Although there are some promising results, controversy regarding efficacy of polyunsaturated fatty acids (PUFAS) on clinical improvement of ASD remains (James et al, 2011). Recent developments suggest the existence of oxidative stress disturbances affecting lipid composition of neuronal membranes in ASD (James et al, 2006), mostly structural phospholipids rich on PUFAS. Most studies have also found low levels of PUFAS in autism (Chauhan et al, 2004). These alterations could potentially be reverted with oral PUFAS administration and yield, in turn, improvement on ASD clinical symptoms.

Objectives: To evaluate the effect of PUFAS ω-3 on behavioural measures in a sample of children and adolescents with ASD, and to test whether clinical effect correlates with biochemical outcomes.
Methods: Seventy-nine subjects with ASD were recruited from 3 centres in Spain. Inclusion criteria were: DSM-IV Pervasive Developmental Disorders (SCQ, clinical evaluation +/-ADOS); 5-17 years; and written informed consent. Exclusion criteria were: other Axis I DSM-IV Disorder; previous treatment with PUFAS or antipsychotics; modification of other psychopharmacologic treatments; liver disease; coagulation problems/anticoagulant treatment; pregnancy; breastfeeding. Study design: Crossover multicenter randomized double-blind clinical trial controlled with placebo. In phase I participants were randomized to receive 8-weeks of experimental treatment or placebo. Following a 2-week wash out phase, in phase II patients switched treatments for other 8-weeks period. Experimental treatment was fish oil with high concentration of PUFAS ω-3 (EPA + DHA) and vitamin E as stabilizer. Doses were adjusted by age: 5-11 years old EPA 577.5 mg/day + DHA 385 mg/day+ vitamin E 1,6 mg/day; 12-17 years old EPA 693 mg /day + DHA 462 mg /day + vitamin E 2,01 mg/day (tid). Placebo was liquid paraffin and vitamin E (same doses than in experimental treatment). Efficacy assessments were performed before and after phases I and II, and included behavioural (change in Social Responsiveness Scale (SRS) and Aberrant Behaviour Checklist (ABC-C)) and biochemical measures (level of PUFAS on erythrocyte membrane, total antioxidant oxidative stress in plasma, and plasma level of glutathione). Analyses were conducted in the per protocol sample: comparison of the change in any given outcome measure between phase on active treatment and on placebo (Student t-tests), intra-subject changes (repeated measures t-tests), and inter-subjects changes (mixed between-within analysis of variance, using age, baseline vitamin E and total dose of PUFAS ω-3 as covariates).
Results: 77 patients completed at least one visit (ITT) and 68 completed the whole protocol (PP). Both samples were comparable in terms of baseline characteristics. Mean age was 9.72 (SD 3.64) years. Treatment with PUFAS ω-3 did significantly improve SRS-total (p=0.046) and SRS-social motivation (p=0.001) scores from baseline to endpoint, with non-significant improvement on ABC-C scores. An increase in the ω-3 / ω-6 (p=0.003) in the erythrocyte membrane without changing plasma global antioxidant capacity was also found for PUFAS ω-3. There was no correlation between change in biological and behavioral measures.
Conclusions: 8 week treatment with a combination of EPA and DHA significantly improved SRS total and SRS-social motivation scores in children and adolescents with ASD. Correlation between biological and behavioral measures was not demonstrated.

132 **139.132** Effect of Two Doses of Basimglurant on Behavioral Symptoms in Adolescent and Adult Patients with Fragile X Syndrome; Results from Fragxis, a Double-Blind, Placebo Controlled Study

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Background: Recent research in Fragile X syndrome (FXS), an X-linked condition caused by a CGG-repeat expansion in the *FMR1* gene, has focused on the metabotropic glutamate receptor 5 (mGlu5) antagonism as a mechanism to treat the behavioral and cognitive impairments observed in FXS. Preclinical evidence has shown that chronic treatment of *FMR1* knockout mice with an mGlu5-negative allosteric modulator (NAM) rescues a broad range of phenotypes associated with FXS. Basimglurant, a potent, selective mGlu5-NAM, has previously shown a trend for improvement in a placebo-controlled study of 40 adult patients with FXS, warranting further investigation.
Objectives: To evaluate the efficacy, safety and tolerability of basimglurant MR 12-week treatment versus placebo in patients with FXS.
Methods: Adolescents and adults (age 14 to 50 years) with FXS were randomized to basimglurant 0.5 mg, basimglurant 1.5 mg, or placebo for 12 weeks. The primary efficacy endpoint was the change from baseline to week-12 in the ADAMS total score. The secondary efficacy endpoints were Clinical Global Impression–Severity and Improvement Scales (CGI-S and CGI-I), Aberrant Behavior Checklist (ABC) total and factor scores, ADAMS factor scores, Social Responsiveness Scale (SRS), Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)–Immediate Memory, Vineland Adaptive Behavior Scale II (VABS) total and domain scores, Clinical response (ABC total improvement ≥25% + CGI-I ≤2) and the Visual Analog Scale (VAS)-Most Troubling Behavioral Symptoms. Safety outcomes included the incidence of spontaneously reported adverse events (AE), clinical assessment of suicidality, clinical laboratory tests, vital signs, weight, Tanner staging, menstrual status and ECGs. Efficacy in biomarker subgroups (either *FMR1* methylation status, *FMR1* mRNA delta count, or Fragile X Mental Retardation Protein (FMRP) concentration) and subgroups based on age and sex were also explored.
Results: A total of 185 patients were randomized from 39 centers in North America, Latin America and Europe: 60 to basimglurant 0.5 mg, 62 to basimglurant 1.5 mg and 63 to placebo. 63 were adolescents (14 -17 years) and 122 were adults (18-50 years). Basimglurant treatment groups showed no improvement over placebo in the primary efficacy endpoint. Basimglurant did not demonstrate meaningful improvement over placebo in any of the secondary efficacy measures and biomarker subgroups. Neither subgroup analysis, males versus females nor adolescents versus adults, showed any improvements for basimglurant over placebo. The incidence of AEs was similar across treatment groups and they were mostly mild to moderate in severity. The most common AEs were vomiting, nasopharyngitis, and headache. A higher number of patients discontinued due to psychiatric adverse events in the basimglurant 0.5 and 1.5mg groups (n=4 for both groups) as

compared to placebo (n=1). No clinically relevant changes in any of the other safety outcomes were observed.

Conclusions: Basimglurant showed no improvement over placebo in either the primary and secondary efficacy endpoints or the biomarker subgroups. Treatment with basimglurant was generally safe and well tolerated in adolescents and adults (aged 14 to 50 years) with FXS.

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133 **139.133** Effectiveness of Over-the-counter Therapies for Autism
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Background: Many parents of children with autism provide their children with over-the-counter (OTC) therapies for autism often based on recommendations by complementary and functional medicine practitioners. Existing medical literature is available on many of these therapies.

Objectives: Identify therapies for autism that have been examined in the literature and determine which have the best risk-adjusted efficacy.

Methods: A literature search was conducted to identify OTC therapies for autism. Each therapy was then evaluated for biochemical rationale, efficacy, possible side-effects, risk, possible indications, and possible contraindications. A composite assessment was also made for each therapy taking these factors into account.

Results: Thirteen therapies were identified in the literature. Three of the therapies rated "Excellent" on a risk-adjusted composite assessment: methylcobalamin & folinic acid, omega-3 fatty acids, and probiotics. Three of the therapies rated "Good" on a risk-adjusted composite assessment: carnitine, CoQ10, and NAC. Some of the therapies that were shown to have modest or excellent efficacy did not score as well on the composite assessment due to risk, side-effects or other issues. Two therapies were shown to have no efficacy based on placebo controlled trials: pyridoxine & magnesium and inositol.

One may object that the methylcobalamin & folinic acid trial run by James included methylcobalamin as injections, which are not available over-the-counter. However, the literature and anecdotal evidence suggests that methycobalamin is absorbed orally even in those with digestive conditions. Therefore this therapy may be applied orally where it is available over-the-counter.

Three of the therapies with significant promise based on efficacy alone are sulfur containing compounds: NAC, DMSA, and sulforaphane. This likely is not coincidental given that high sulfur excretion and low cysteine levels are common in autism. These therapies did not score as well on the composite measure as all three may have significant side effects based on current literature. This suggests a potential area of research in autism: identification of sulfur containing compounds that are efficacious with negligible side-effects.

Some therapies that are widely used did not score well on a composite basis. These therapies include pyridoxine & magnesium, multivitamins, and vitamin D. Pyridoxine & magnesium had poor efficacy. Multivitamins and vitamin D were both determined to have a mixed biochemical rationale: literature suggests that excessive levels of monoamine neurotransmitters, sulfation deficits, and excessive growth in infancy are common in autism. As multivitamins and vitamin D both tend to exacerbate these conditions, they are mixed on this measure of rationale.

There are known or inferred indications and contraindications with most of the therapies identified. Therefore in the hands of a careful and educated practitioner who is willing to run preliminary tests of biochemistry such as organic acid tests, it is possible to further mitigate risk by selecting therapies that appear to fit with an individual's biochemistry.

Conclusions: The literature suggests three of the OTC therapies have excellent risk-adjusted efficacy and three have good risk adjusted efficacy. Practitioners have a number of OTC therapy options currently available for treatment. They should take advantage of them.

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134 **139.134** From Experimental to Investigational: The Potential for Eye Tracking As a Biomarker for Outcome in Clinical Trials
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Background: There is a need for biomarkers of baseline behavioral deficits and response to therapeutic intervention in clinical trials for individuals with ASD. Eye tracking is a prominent experimental modality with potential to serve as a measure indexing clinical dimensions. However, eye tracking studies typically focus on theoretical constructs with ASD vs. non-ASD differences as the primary outcome measure. Establishing eye tracking as potential biomarker for monitoring treatment response requires demonstration of discriminant validity, acceptable test-retest reliability, and characterization of relationships to outcome variables and phenotypic heterogeneity.
Objectives: To characterize discriminant validity, test-retest reliability, and relationships with functioning/clinical dimension of eye tracking measures in adults with ASD across a wide range of eye-tracking paradigms.
Methods: Participants were high functioning adult males with ASD from 2 different studies, study 1, (n=19, mean age = 23years, median FSIQ=104) and study 2 (n=19, mean age= 25 years, median FSIQ = 102) and typically developing (TD) adult males (n=19, mean age = 26 years, median FSIQ = 118). Eye tracking tasks included biological motion preference (BioPref), social versus geometric movies preference (SocGeo), gaze direction discrimination (GazeDiscrim), gender discrimination (GenderDiscrim), activity monitoring (ActMon), and complex social movies (ComplexSoc). Overall saccade rates and pupil diameters were also computed as was an a priori defined manual composite score (Composite; computed as a linear combination of other eye-tracking variables). Participants saw the 30-minute eye-tracking battery twice, separated by two hours. Additional assessments included an affective speech recognition (ASR) task, the state component of State-Trait Anxiety Inventory (STAI), the Reading the Mind in the Eyes Test (RMET), a Smell Test (Smell), and Autism Quotient (AQ).
Results: The AQ was significantly different between groups (ES=2.6, p<0.001). In eye tracking tasks the largest differences between groups were observed in Activity Monitoring and Biomotion paradigms. The ASD group looked less at people (p=.011, ES=-0.9) and heads (p<.01, ES=-1.0) during Activity Monitoring and showed diminished looking preference at biological motion task (p=.0.035, ES=-.7). Pupil size was significantly larger in the ASD group across all eye tracking tasks (ES=.7 to .9)). Test-retest reliability within ASD for most eye-tracking measures and all pupil size measures was acceptable to excellent (eye tracking: ICC~0.7 to ~ 0.8; pupil size: ICC ~ 0.8 to ~ 0.9. Patients scored higher on the STAI and showed worse performance on RMET, ASR and Smell Test, but none of these differences reached statistical significance. Overall, correlations with clinical dimensions were low.
Conclusions: Comparisons suggest that the eye tracking battery shows comparable or better ASD-TD differentiation than other tasks meant to examine non-core features associated with ASD (STAI, ASR, Smell, RMET), but inferior differentiation compared to autism-specific questionnaires (AQ). Between group findings validate many prior research results. ICCs showed eye tracking variables exhibit good to excellent test-retest reliability, a critical feature for use in monitoring of treatment effects. In summary, this study suggests eye tracking may have good properties for monitoring clinical outcomes.

135 **139.135** Glutathione, Vitamin C and Cysteine Use in Children with Autism and Severe Behavior Concerns: A Double Blind, Placebo-Controlled Crossover Study

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Background: Autism is a complex neurodevelopmental disorder characterized by severe social communication deficits and limited range of interests and activities. While the specific etiologies of autism are unknown, one of the proposed mechanisms leading to autism has been oxidative stress. Glutathione is a tripeptide which protects against oxidative stress and which has been found to be decreased in children with autism spectrum disorder (ASD).   Anecdotal reports have suggested that glutathione supplements may result in improved behavior in children with ASD and severe behavior disorder.
Objectives: To determine the efficacy of 1) glutathione, 2) glutathione, vitamin C and N-acetylcysteine, or 3) placebo in remediating severe behavior concerns in children with ASD.
Methods: Twenty-four children with ASD between the ages of 5 and 16 were randomized to receive intrvenous 1) glutathione, 2) glutathione, vitamin C and N-acetylcysteine or 3) placebo over an 8 week period in this double-blind, placebo-controlled study. After a one week washout period, they received the alternate regimen for the subsequent 8 weeks. Pre and post behavioral measures and glutathione blood levels were obtained.
Results: Clinically significant improvement in overall Aberrant Behavior Checklist (ABC) scores and Repetitive Behaviora Scales (RBS) were noted for the Trio (2) group as compared to the placebo and glutahione groups. No group effects was observed for the other four behavioral instuments. No significant adverse side effects were reported during the study.
Conclusions: This pilot study suggests that the combination of glutathione, vitamin C and N-acetylcysteine may result in behavioral benefits and decreased repetitive behaviors in children with ASD and severe behavior disorder. Additional large scale randomized controlled studies are needed

to verify these results.

136   **139.136** Irritability, Agitation and Agression in Persons with ASD: The ATN Pathway for Evaluation and Individualized Treatment Planning

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Background: Irritability, agitation, and aggression (IAA) are the most common of the concerning problem behaviors that may develop in persons with autism spectrum disorder (ASD). Given the serious adverse impact of IAA on learning, social development and community participation, the human cost of delayed or ineffective treatment for IAA in ASD is high. The Autism Speaks Autism Treatment Network (AS-ATN) Psychopharmacology Committee, composed of specialists in the treatment of ASD and co-occurring conditions, was charged with the task of developing a practice pathway for planning the treatment of IAA behavior in a person with ASD.
Objectives: The goal is to maximize the efficiency and effectiveness of treatment for IAAwhile minimizing risk for the individual patient.
Methods: Systematic literature review, monthly to biweekly committee teleconferences for discussion. The committee noted that until recently, treatment approaches to IAA has been mostly either psychopharmacological or behavioral. The basic premise of the psychopharmacological approach has been that IAA reflects underlying CNS dysfunction which can be alleviated by medications that affect neurotransmitters. The basic premise of the behavioral approach has been that IAA reflects learned behavior that can be diminished by removing reinforcers of that behavior and where needed substituting more adaptive behaviors. Both approaches have made important contributions to the treatment of IAA, in ASD but are not successful in all cases. The committee noted that work over the past decade has suggested a third possible approach, whose basic premise is that IAA is a natural nonspecific, human behavioral response to a perceived danger (threat) to the self. The threat can be in the form of change/uncertainty (psychosocial stressors) unmet needs (due to skills deficits of the individal or a deficient environment), or physical or mental pain/discomfort (medical or psychiatric conditions). Growing evidence, to be reviewed in this presentation, suggests that effectively removing the threat (by addressing the underlying problem) can result in rapid and sustained remission of IAA in some persons with ASD.
Results: The consensus view of the Committee was that the most efficient and effective treatment plan for IAA in a given individual with ASD logically flows from a systematic assessment of all factors potentially contributing to IAA in that person. The evaluation pathway assesses factors in five domains (psychosocial stressors, functional communication deficits, medical conditions including medication side effects, psychiatric conditions and maladaptive patterns of reinforcement). The treatment plan then aims to address all the relevant factors either sequentially or simultaneously in order to effect the most rapid and enduring remission possible. The pathway is designed to ensure that all potentially treatable factors contributing to IAA behavior in a given person are systematically considered before psychotropic medication or behavioral treatment is used, but does allow that in some circumstances psychotropic medications or behavioral interventions should be used first.
Conclusions: This ATN pathway has the potential to maximize the efficiency and effectiveness of treatment for IAA while minimizing risk for the individual patient.

137   **139.137** Maladaptive Behavior in Autism Spectrum Disorder: The Role of Emotion Experience and Emotion Regulation

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Background: Autism Spectrum Disorder (ASD) is a pervasive neurodevelopmental disorder that is characterized by abnormalities in social and communication abilities, as well as restricted interests, repetitive behavior, and sensory deficits. In addition, maladaptive behavior including irritability, poor anger control, temper tantrums, self-injurious behavior, and aggression are commonly observed in ASD and recent studies suggest that more than 50% of children and adolescents exhibit one or more of these symptoms. Interestingly, a few studies have investigated emotion dysregulation in ASD and suggested that children and adolescents with ASD less frequently and less effectively use adaptive emotion regulation strategies (such as cognitive reappraisal), but tend to more frequently use maladaptive strategies (such as expressive suppression). Therefore, there is a great need to increase our understanding of the pathophysiological mechanisms underlying emotion dysregulation and related behaviors, such as irritability and aggression, since maladaptive emotional responses

may contribute to impaired functioning and could affect long-term outcome.

Objectives: The factors that give rise to maladaptive behavior are not yet well understood in individuals with ASD. The present project examined the role of emotion experience and regulation in maladaptive behavior in individuals with ASD.

Methods: The present study examined the role of emotion experience and emotion regulation in maladaptive behavior in individuals with ASD and typically developing (TD) participants. Thirty-one individuals with ASD and 28 TD participants and their parents completed questionnaires assessing emotion experience (Positive and Negative Affect Schedule), regulation (Emotion Regulation Questionnaire), and maladaptive behavior (subscale of the Vineland Adaptive Behavior Scales, 2nd Edition). The relationships among group, emotion experience, emotion regulation, and maladaptive behavior were examined via path analyses of 2- and 3-path mediation designs. Four 2-path models were tested to examine whether group membership was linked to maladaptive behaviors via positive emotion, negative emotion, cognitive reappraisal, and expressive suppression. In addition, two 3-path models were tested to examine the sequence of effects as indicated from the 2-path model results.

Results: This is the first study to examine the sequential effects of emotion experience and regulation on maladaptive behavior in children and adolescents with ASD. More specifically, we wanted to better understand whether patterns in positive and negative emotion experience as well as adaptive and maladaptive emotion regulation function as a link between group (ASD vs. TD) and maladaptive behavior. The findings suggest that individuals with ASD use cognitive reappraisal less frequently, which is an adaptive emotion regulation strategy, resulting in increased negative emotions, and in turn leading to elevated levels of maladaptive behavior. By decreasing negative emotions, treatments targeting adaptive emotion regulation may therefore reduce maladaptive behaviors in individuals with ASD.

Conclusions: The current study suggests that interventions targeting the ability to use cognitive reappraisal may improve emotion experience as well as decrease maladaptive behavior in individuals with ASD. Novel interventions that target emotional experience and regulation are crucial to decrease maladaptive behaviors and improve long-term outcome.

138 **139.138** Meta-Analysis of Pharmacotherapies for Treating Irritability, Agitation and Aggression in ASD

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Background:
Children with ASD have core deficits in social communication and reciprocity as well as restricted and repetitive behaviors. They often experience irritability, which may manifest as temper tantrums, and aggression toward others or to self. These symptoms cause significant distress to the children themselves, and may be a burden on their families and others involved in their care. Risperidone and aripiprazole are, perhaps, the most commonly used medications for the treatment of IAA in individuals with ASD. A wide range of other pharmacologic agents spanning different classes, targeting various mechanisms of action, with many potential adverse events, have also been studied for the reduction of IAA. Therefore, there is a compelling need to systematically analyze these studies to identify agents that may be most effective and safe in reducing these symptoms in children with ASD.

Objectives:
(1) To systematically review and quantitatively analyze the evidence for the efficacy of pharmacologic treatments used to target irritability, agitation and aggression (IAA) in children and adolescents with autism spectrum disorder (ASD). (2) To examine the safety of these compounds in the treatment of IAA in ASD.

Methods:
Systematic search was performed from MEDLINE/PubMed, Embase, and PsycINFO from inception to September 2013. Eligibility of studies included: randomized controlled trials (RCTs), study population of ASD, mean age of participants <18 years, sample size >10, and written in English. Only studies employing aberrant behavioral checklist – irritability subscale (ABC-I) were included in the meta-analysis. Effect sizes (Cohen's d) for efficacy were calculated from the means and standard deviations at the end of treatment (placebo and medication) reported in the manuscripts.

Results:
A total of 36 RCTs with 1686 participants were identified. Twenty-six of these employed ABC-I to assess IAA and were included in the meta-analysis. These trials represented 19 compounds, with risperidone being the most studied (5 trials). Compared to placebo, 11 compounds [risperidone, aripiprazole, methylphenidate, valproate (1 of 2 studies), citalopram, clonidine, haloperidol, NAC, naltrexone, tianeptine, and venlafaxine] were shown to result in significant improvement in ABC-I at the end of treatment. Seven of them showed a moderate to large effect size [risperidone (d=0.9), aripiprazole (d=0.8), N-acetylcysteine (d=0.7), clonidine (d=0.6), methylphenidate (d=0.6), and

tianeptine (d=0.5)]. Among the 26 RCTs, 18 of them were non-crossover studies representing 11 compounds. Haloperidol, risperidone, amantadine, and aripiprazole were found to cause somnolence/sedation. Risperidone, haloperidol, and aripiprazole were shown to cause EPS. Finally, compared to placebo, aripiprazole (d=3.1), risperidone (d=0.8), and valproate (d=0.3) were found to cause the most weight gain.

Conclusions:

Current literature suggests that risperidone and aripiprazole have the strongest evidence for reducing IAA in children and adolescents with ASD. However, these compounds have potential adverse events including somnolence/sedation, weight gain and EPS. Methylphenidate may be a useful agent to treatment IAA when inattention, hyperactivity, and/or impulsivity are co-morbid symptoms. Other medications such as NAC, clonidine, and tianeptine may be potentially effective agents to reduce IAA with fewer adverse events, but replication of these findings is warranted.

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139 **139.139** Nutritional and Dietary Interventions for Autism Spectrum Disorder – a Randomized, Controlled 12-Month Trial of a Combination of Six Treatments

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Background: Previous studies have suggested that several nutritional and dietary interventions may be helpful for individuals with Autism Spectrum Disorder (ASD).
Objectives: Determine the effect of a combination of six nutritional/dietary interventions on children and adults with ASD
Methods: This study involved a randomized, controlled, single-blind 12-month treatment study of six nutritional and dietary treatments. Participants were children and adults ages 3-60 years in Arizona with Autistic Spectrum Disorder (ASD), n=67. Treatment began with a special vitamin/mineral supplement, and additional treatments were added sequentially, including essential fatty acids, Epsom salt baths, carnitine, digestive enzymes, and a healthy gluten-free, casein-free, soy-free (GFCFSF) diet. Autism severity, related symptoms, and biomarkers were evaluated at the beginning and end of the study. Some evaluations were done by clinicians (single-blind), some by parents (unblinded), and some involving a clinician interview of the parents (semi-blinded). Biomarkers were compared with non-sibling, neurotypical controls (n=49) of similar age, gender and geographical area.

Results: The treatments were generally well-tolerated with good compliance and few adverse effects. There was a significant improvement in nonverbal intellectual ability in the treatment group compared to the non-treatment group (9 +/-12 vs. 1 +/-12 IQ points, p <0.05) based on a blinded clinical assessment. The treatment group, compared to the untreated group, had significantly greater improvement on the Vineland Adaptive Behavior Scale (20 +/- 19 months vs. 5 +/- 19 months, p<0.05), and a marginally significant greater improvement in the Childhood Autism Rating Scale (CARS) (-4.4 +/- 7 vs -1.6 +/- 5, p=0.09) and the Severity of Autism Scale (-0.9 +/-1 vs -.3 +/- 1, p=0.08), all based on semi-blinded assessment. There were many other statistically significant improvements in autism and related symptoms in the treatment group compared to the non-treatment group, based on unblinded parent evaluations.
    Parents reported that the vitamin/mineral supplement and the essential fatty acids were the most beneficial, followed closely by the healthy GFCFSF diet, with the others being less beneficial.
Conclusions: The positive results of this study suggest that certain nutritional and dietary interventions are effective at improving some symptoms in some individuals with ASD, with the vitamin/mineral supplement, essential fatty acids, and healthy GFCFSF diet reported by parents to be the most beneficial.

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140 **139.140** Pharmacological Modulation of Excitatory/Inhibitory Balance in Autism Spectrum Disorder

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Background: There are currently no pharmacological treatments for the core symptoms of Autism Spectrum Disorder (ASD). However, accumulating evidence indicates an imbalance between excitatory (E) glutamate and inhibitory (I) GABA in ASD. Therefore modulating E/I balance may constitute a tractable treatment approach for this condition and this may explain the early promise of proGABA and anti-glutamate drugs such as riluzole.
Objectives: 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: We used MEGAPRESS proton magnetic resonance spectroscopy ($[^1H]$-MRS) to measure

concentrations of Glx (glutamate + glutamine) and GABA in unmedicated adult men with and without ASD diagnosis. Individuals were scanned twice, one week apart. Fifty mg of riluzole or matched placebo was administered in a randomised, double blind, crossover design, 1 hour before spectra were acquired from the left basal ganglia and bilateral prefrontal cortex. An inhibitory index was calculated as GABA/(GABA+Glx) for both treatment conditions.

Results: Preliminary results show that, in the basal ganglia, riluzole increased the inhibitory index in both groups (drug effect p=0.015). However, in the prefrontal cortex, riluzole increased the inhibitory index in the ASD group only, although the result did not reach statistical significance (ASD prefrontal Inhibitory Index: placebo = 0.69; riluzole = 0.74; drug*group effect p=0.1). Post-hoc testing suggested that increases in inhibitory indices in both groups were mainly driven by an increase in GABA, (and not a reduction in Glx).

Conclusions: Data acquisition is ongoing. If confirmed, these preliminary findings bring us closer to Proof of Concept that individuals with ASD have differences in E/I responsivity. By validating the glutamate-GABA system as a tractable treatment target in ASD, we hope this work will both support trials of existing drugs (such as riluzole), and facilitate the development of new drugs that act on this system. Our MRS approach may also provide a safe, non-invasive tool to help fractionate the sample and predict who will be responsive to glutamate-GABA treatments in a 'personalized' medicine approach to ASD

141   **139.141** Physician Practices in Management of Second Generation Antipsychotic (SGA) Medications and Their Side Effects in Children and Adolescents with Autism Spectrum Disorders

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Background:
 Physicians prescribing second generation antipsychotic (SGA) medications to pediatric autism spectrum disorder (ASD) patients should monitor potential metabolic and neurologic side effects for optimal outcomes and quality of life. An increase in SGA prescribing has raised questions concerning how physicians monitor for and manage metabolic and neurologic SGA side effects.

Objectives:
The objective of this study was to determine how physicians monitor and respond clinically to metabolic and/or neurologic side effects of SGA prescribed to pediatric ASD patients and to determine if an effective and evidence based standard of care might be formulated based on patterns in side effect occurrence and appropriate monitoring and management.

Methods: A data query at a large children's hospital resulted in 151 inpatient and outpatient pediatric patients diagnosed with Autism, Asperger's, PDD-NOS, Autism Spectrum Disorder, or Pervasive Developmental Disorder seen between August 2010 and July 2014 who received SGA medications (Risperidone, Olanzapine, Aripiprazole, Paliperidone, Quetiapine, and Ziprasidone) for over 30 days. A chart review was performed to analyze neurologic and metabolic adverse effects of SGA (BMI, glucose and lipid panel values, and Abbreviated Abnormal Involuntary Movement Scale (A-AIMS)) throughout the time these patients received SGA. Documentation regarding patient status and complaints, the clinician's management plan, and responses to adverse effects was reviewed.

Results:
We reviewed 151 patients and 1053 visits. BMI was measured at 986 visits and the A-AIMS performed at 775 visits. 135 patients had labs drawn during their care. Physicians reported positive A-AIMS in 9 patients and metabolic concerns of increased BMI and/or abnormal lipids in 83 patients. At 11 visits with positive A-AIMS, 27.3% weaned SGA, 18.2% decreased the dose, 36.4% continued the dose, and 9% switched to a different class of medication. At 63 visits with abnormal lipids providers chose to refer to nutrition specialists (28.6%), discuss exercise (19%), discuss diet (19%), continue SGA with no change in care (19%), ordered repeat labs (14.3%), refer to a cardiology lipid clinic (9.5%), prescribe metformin (9.5%), wean patient off SGA (6.3%), recommended diet counseling (4.8%), increase the dosage (4.8%), and change to a different SGA (3.2%). At 112 visits for increased BMI, 41% ordered labs, 35.71% gave advice on diet, calories and food selection, 33% continued SGA with no change, 25.9% referred to nutrition, 24% recommended physical activity, 11.6% decreased the dose, 8% changed to a different SGA, 7.1% prescribed metformin, 6.3% stopped the SGA, 5.4% increased the dose.

Conclusions:
 In our institution, SGA monitoring for adverse effects was done in the majority of patients. Clinician management of these effects was variable and reflected risk-benefit decisions made with patient and family input. Development of best practices may help promote better outcomes for these patients.

142   **139.142** Preliminary Characterization of Medication Use in a Multicenter Sample of Pediatric Inpatients with Autism Spectrum Disorder

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Background: Inpatient psychiatric hospitalization is indicated for youth with autism spectrum disorder who have serious emotional or behavioral disturbances. Little is known regarding the phenotypic and biological profiles of these patients. Here we present preliminary pharmacological utilization data from an ongoing multisite study of psychiatric inpatients with autism, the Autism Inpatient Collection (AIC)

Objectives: To describe medication use in youth with autism spectrum disorders (ASD) who were admitted to six specialized inpatient psychiatry units for serious emotional or behavioral disturbances.

Methods: One-hundred and eight children were prospectively enrolled from February 2014 to August 2014. Inclusion criteria were a Social Communication Score of ≥ 12 and autism diagnosis by a research-reliable examiner using the ADOS-2. Psychotropic medications were coded and classified. Descriptive statistics were calculated to characterize medication profiles for all subjects, as well as subgroups based on verbal ability.

Results: Ninety-eight subjects who had completed basic demographic characteristics, behavioral profiles, and medication data at admission and discharge were included in this analysis of medication profiles (Table 1). The mean age was 12.75 (SD 1.24, Range 4 to 20),24% were female and approximately 18.5% were identified as having current or past seizures. The majority of subjects (56%) were administered Module 1 (single words or less, 48.9%) or Module 2 (phrase speech, 7.1%) of the ADOS-2, indicating very limited verbal ability. The mean ABC-Irritability subscale score decreased from 29.62 (SD 8.01) on admission to 20.92 (SD 8.98) on discharge (t=5.65,p<.001). Subjects were taking on average 2.65 (SD 1.24) psychotropic medications on admission and 2.80 (SD 1.15) on discharge (t=1.2, p=0.23). Psychotropic medications were utilized at admission by 98% of the sample, most commonly a neuroleptic (63%), sleep aid (40%), antidepressant (35%), mood stabilizer (34%), psychostimulant (26%) or a non-stimulant ADHD medication (24%)(see Figure 1).

Conclusions: This preliminary data on 98 subjects demonstrates that the vast majority of youth with autism spectrum disorders who are admitted to inpatient psychiatry units are treated with more than one psychotropic medication upon admission, including 67% on a neuroleptic. Despite no change in the mean number of medications, there was a significant improvement in irritability at discharge. Future analysis of the complete AIC data set will include examination of specific agents, dosing trends and correlations with clinical outcomes.

143 **139.143** Repetitive Transcranial Magnetic Stimulation over the Dorsolateral Prefrontal Cortex and Posterior Superior Temporal Sulcus Improves Core Symptoms of Autism

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Background:
Effective biological interventions for autism have remained elusive and repetitive transcranial magnetic stimulation (rTMS) is considered a promising approach. Previous studies demonstrated that repetitive transcranial magnetic stimulation (rTMS) over the dorsolateral prefrontal cortex (DLPFC) decreased repetitive behaviors in autism, however, there was no obvious response in improving social impairments in autism. Efficacy of rTMS over other brain areas is unknown in autism.

Objectives:
To test whether rTMS over (1) the bilateral posterior superior temporal sulcus (pSTS) and (2) the bilateral DLPFC could improve core symptoms and neuropsychological functions of autism

Methods:
25 adults with autism (mean age: 21.2 years old, 20 males) participated in a randomized, sham-controlled, *cross-over trial* of rTMS, and 19 of them completed the study. Every participant randomly accepted the single-session rTMS over the bilateral DLPFC, bilateral pSTS and inion (as Sham control) with one-week interval. A modified rTMS paradigm, intermittent Theta-Burst stimulation, which has been shown to produce a long lasting excitation of the cortex, was applied in our study. The stimulus intensity over the DLPFC and pSTS was 80% active motor threshold (AMT) and over inion was 60% AMT with reverse of the coils. Locations of the DLPFC and pSTS were determined via a three-dimensional brain reconstruction provided by a TMS-dedicated navigation system from individual magnetic resonance imaging data. Behavioral outcomes were measured with Yale-Brown Obsessive Compulsive Scale (Y-BOCS) and Social Responsiveness Scale (SRS), rated by participants themselves and their parents before and after every course of stimulation (8 hours and 2 days later, respectively). Neuropsychological functions were indexed by the Conners' Continuous Performance Test and Wisconsin Card Sorting Test (WCST) before and after every course of stimulation (practiced within one hour after stimulation).

Results:
In comparison to sham stimulation, total scores of the Y-BOCS rated by parents and total scores of the SRS rated by participants significantly decreased 8 hours after pSTS-stimulation. Besides, total scores of the Y-BOCS and scores of social awareness in the SRS rated by parents also significantly decreased 2 days after pSTS-stimulation. As for neuropsychological outcomes, commission errors in CPT significantly increased but there was no significant difference in performance of WCST after pSTS-stimulation. In comparison to sham stimulation, scores of social communication in the SRS rated by participants significantly decreased 8 hours and 2 days after DLPFC-stimulation, respectively. Scores of autistic mannerism in the SRS rated by parents significantly decreased 2 days after DLPFC-stimulation. As for neuropsychological outcomes, hit reaction time in CPT significantly decreased after

DLPFC-stimulation, but there was no significant difference in performance of WCST after DLPFC-stimulation.
Conclusions:
We found that single session rTMS over the bilateral DLPFC and pSTS improved social functions and repetitive behaviors in autism. Beyond consistency in effects of DLPFC-stimulation, the efficacy of rTMS over the pSTS needs to be investigated and replicated by future multiple-sessions rTMS studies.

144 **139.144** Results from a Phase I Proof-of-Mechanism Study with a Vasopressin 1a Receptor Antagonist in ASD

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Background: The hypothalamic neuropeptide vasopressin (anti-diuretic hormone) is involved in higher brain functions, including learning and memory, emotional control, social behavior and interaction. In particular, animal and human studies have implicated this neuropeptide in the modulation of both core and associated symptoms of autism spectrum disorders (ASD). Specific alleles of the arginine vasopressin 1a receptor (AVPR1A) gene have been associated with a higher risk for ASD. V1a receptor antagonism may offer therapeutic benefits in ASD. In this proof-of-mechanism (PoM) study the effects of the V1a receptor antagonist RG7713 on behavioral and physiological biomarkers of social communication were investigated to establish early evidence of potential therapeutic effects.
Objectives: To investigate the effects of the V1a receptor antagonist RG7713 on behavioral and physiological biomarkers of social communication.
Methods: 19 high-functioning adults with ASD (mean age=23.4 ± 5.16 (SD) years (range: 18-40), full scale IQ (FSIQ)=99.95 ± 14 (78-136), Vineland Adaptive Behavior Composite (VABS) score= 62 ± 12.9 (29-77), ABC-full Total score = 27±19.9 (7-94) and ADOS Total score 12±4.8 (4-23)) participated in randomized, double-blind, placebo-controlled, cross-over study. A single dose of the V1a receptor antagonist RG7713 or placebo was administered intravenously to each subject on two different days separated by one week wash-out. Effects on measures of eye-tracking in established paradigms (gender and gaze discrimination, activity monitoring, detection of biomotion), affective speech recognition (ASR), the "reading the mind in the eye" test (RMET) and olfactory recognition were evaluated. A composite score for all eye-tracking measures was calculated.
Results: Administration of RG7713 was associated with a slight improvement on the eye-tracking composite score (effect size = 0.2) and in orienting for biological motion (ES=0.8), smell recognition (correct recognition after RG7713: 79%; after placebo administration 76%; ES = 0.2) and the RMET (correct answers after RG7713 administration: 64%, after placebo administration 61%; ES=0.2), but a small decrement in ASR total performance (correct answers after RG7713 administration 54%, after placebo administration 57%; ES=-0.1). This effect of RG7713 on overall ASR performance was largely driven by a decreased ability to detect the emotion 'lust' and 'fear' (ES = -0.7 for both), consistent with a potential anxiolytic effect of a V1a receptor antagonist bringing the performance closer to levels observed in healthy volunteers. The ability to detect the emotions 'happy' and 'surprise' was increased following RG7713 dosing (ES = 0.2 for both). None of the reported differences reached levels of nominal statistical significance.
Conclusions: After a single administration of the V1a receptor antagonist RG7713 some evidence of an ameliorating effect on physiological and behavioral measures of social communication was observed in high functioning ASD adults. The results of this small PoM study support the further clinical exploration of V1a receptor antagonism as a therapeutic approach in ASD.

145 **139.145** Safety and Exploratory Efficacy of Basimglurant in Pediatric Patients with Fragile X Syndrome: A Randomized, Double-Blind, Placebo-Controlled Study

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Background: Fragile X syndrome (FXS) is the most commonly inherited cause of mental retardation due to a mutation on the 5'-untranslated region of the *FMR1* gene in the X chromosome. It has been hypothesized that metabotropic glutamate receptor 5 (mGlu5) antagonism may revert the pathophysiological abnormalities observed in FXS. Preclinical evidence showed that chronic treatment of *FMR1* knockout mice with an mGlu5-negative allosteric modulator (NAM) rescues a broad range of phenotypes associated with FXS. Basimglurant is a potent, selective mGlu5 NAM with good oral bioavailability, brain penetration, and high in-vivo potency.

Objectives: The primary objective was to evaluate the safety and tolerability of modified release basimglurant in comparison with placebo in pediatric patients with FXS. The secondary objective was to explore the efficacy and pharmacokinetics of 12-week treatment of basimglurant.

Methods: This is a phase IIa, randomized, double-blind, parallel arm, 12-week study of basimglurant or placebo, once daily, in children 5 to 13 years old with FXS. Doses of basimglurant were selected to target exposures in the pediatric population to match the adult steady state exposures at 0.5 mg (dose A) and 1.5 mg (dose B). Safety outcomes assessed included the incidence of spontaneously reported adverse events, clinical assessment of suicidality, clinical laboratory tests, vital signs, weight, Tanner staging, menstrual status and ECG assessments. Exploratory efficacy assessments included the Anxiety, Depression, and Mood Scale, Clinical Global Impression – Improvement and Severity scales, Aberrant Behavior Checklist, Repeatable Battery for the Assessment of Neuropsychological Status – Immediate Memory, Visual Analog Scale – Most Troubling Symptom, Global Behavior Assessment Scale, and Expressive Language. Blood samples were collected to explore the drug effect in the biomarker subgroups (*FMR1* methylation, RNA and FMRP). Pharmacokinetic was also explored.

Results: A total of 47 patients at 14 centers in the United State were randomized to basimglurant dose A (n=15), basimglurant dose B (n=15) or placebo (n=17). Overall, the incidence of adverse events (AE) were similar across treatment arms except for aggression which was more frequent in the basimglurant arms and headache which occurred more in the placebo arm. The most common AEs were upper respiratory tract infection, aggression, vomiting, headache, and pyrexia. The majority of AEs were mild or moderate in intensity. There were no serious AEs, no reports of suicidality and no AEs that led to withdrawal of study treatment. No clinically relevant changes in any of the other safety outcomes were observed. The statistical analyses of the mean change from baseline at week 12 for basimglurant dose A and dose B compared with placebo did not reveal relevant differences on any of the exploratory efficacy measures or within any biomarker subgroups.

Conclusions: Basimglurant was generally safe and well tolerated in children age 5 to 13 years old with FXS. The overall incidence of AEs was similar across treatment arms except for aggression which occurred with higher frequency in the basimglurant dose arms compared to placebo. In the exploratory efficacy analyses, basimglurant dose A and dose B were not statistically different from placebo.

146   **139.146** Study of Beliefs of Parents of Children with Autism Regarding Traditional Medicine in 4 Middle-East Countries

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Background: Many studies have suggested that over half of the families of children with autism spectrum disorders in Western countries use alternative and natural medicine. Over the Middle East, the use of traditional medicine seems to be very common too. There is a wide-spread of recommendations for uses of traditional medicine or recipes on Arabic autism related websites and forums. This study investigates the use of traditional medicine and reports on family beliefs and experiences

Objectives: To assess the family beliefs about use of traditional medicine over the Middle East across multiple countries and different social and economic backgrounds

Methods: A total of twenty families (n=20) of children who have been diagnosed with autism spectrum disorders from Jordan, Palestine, United Arab Emirates, and Saudi Arabia participated in this study, with five families from each country. The families answered a questionnaire and participated in a follow up interview with the researchers. Quantitative and qualitative data were collected and analyzed

Results: Results suggested the wide spread of using traditional medicine across all countries of the participating families. In addition, it is suggested that traditional medicine are widely prescribed by physicians and often by pediatricians, along with additional prescription and sometimes experimental drugs. Family's responses also suggest uncertainty of the impact of using such medicine on their children. We also identified an association between the use of traditional medicine and practices and the belief of the possibility of healing from autism. The affordability of traditional medicine compared to other treatments has also been identified as an additional drive for using it.

Conclusions: A wide range of traditional medicine and practices were identified in this study. The belief of the possibility of healing from autism seems to drive the families to try it. There is a need for more awareness of the benefits and possible harms.

147   **139.147** The Treatment of Refreactory Agression and Self Abusive Behaviors with Proporanolol

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Background: Although not the core signs of the ASDs, aggression and self abusive behaviors are often the most disturbing and dangerous symptoms for affected individuals and their families. These symptoms can sabotage school, work and other treatment programs, and is often is the cause of hospitalization or residential placement. Currently two antipsychotics are approved for this use in the ASDs and despite their documented efficacy, in many cases they provide inadequate benifit and in other cases, side effects limit their use. High dose proranolol has been used for the treatment of aggression in various disorders and has been best studied in aggression associated with brain injury. A Cochrane Database review found propranolol the most effective medication for this indication. The literature on the use of propranolol in ASD is very limited and includes only a few anecdotal cases.

Objectives: This submission presents the results of 30 cases of individuals with ASD treated with high doses of propranolol. All subjects had inadequate responses to at least one antipsychotic and also after trials on many psychotropic medications.

Methods: This is a retrospective chart review of one clinician's cases over approximately 10 years. Each subject was reviewed for diagnosis, age, gender, symptoms being targeted, and general observations of the cases being presented. Their CGI –S (Clinical Global Impression Severity) score is presented before and after the treatment with propranolol and their CGI- I (Improvement) rating is also presented. . In all cases the propranolol was used as an "add on" medication to other medications which showed at least partial benefit and clinically needed to be continued.

Results: Approximately 30% of the subjects were rated as extremely ill and 50 % were rated as severely ill on the CGI –S scale prior to the administration of the propranolol. Approximately 80% of the cases reported were either very much improved or much improved on the CGI-I after treatment. Nearly all of the subjects were followed on propranolol for greater than one year thus suggesting that the results were long lasting. Only one of the subjects discontinued propranolol due to side effects (bronchiospasm) The other side effects observed were lethargy and lowering of blood pressure and these side effects were rare and clinically minor. Other symptoms such as hyperactivity and repetitive behaviors showed a great deal less improvement on the propranolol. Of the 20% who showed less improvement or no improvement on the CGI-I, approximately three quarters had ongoing poorly controlled seizures and had an ongoing adjustments of antiseizure medications while being studied

Conclusions: In a group of subjects who had very severe symptoms of aggression and self abusive behaviors, the use of propranolol was extremely efficacious with minimal adverse affects. This suggests a novel and safe treatment for this very difficult to treat group. Although this review is methodologically limited, (being a retrospective report of one clinician' cases), the large number of cases presented and the outstanding efficacy reported makes this important preliminary data justifying more rigorous study of this medication's potential for ASD.

148 **139.148** Trichuris Suis Ova (TSO) As an Immune-Inflammatory Treatment for Repetitive Behaviors in ASD

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Background: Inflammatory mechanisms have been implicated in Autism Spectrum Disorders (ASD) and immunomodulatory interventions, such as Trichuris Suis Ova (TSO) may be an experimental therapeutic option. ASD patients have dampened Th2 anti-inflammatory cytokine response, and increased Th1 proinflammatory cytokine response, and some improve in response to fever, suggesting a possible role of immune-inflammatory factors. Helminth worms, specifically TSO, have been studied in autoimmune disorders in part from the hygiene hypothesis, which suggests that a rise in hygiene is associated with less protective microbes in humans and an increase in autoimmune inflammatory disorders and that stimulation of the immune system by microbes is protective against the development of inflammatory diseases.

Objectives: To assess the effect of TSO vs placebo on irritability, repetitive behaviors and global functioning in adults with ASD.

Methods: A 28 week double-blinded, randomized crossover study of TSO vs. placebo in 10 adults, aged 17.5 to 35, with ASD was completed, with a 4 week washout period between each 12 week phase. ASD diagnosis was confirmed by DSM-IV criteria supported by the ADOS. Subjects had a personal/family history of allergies, baseline Yale-Brown Obsessive Compulsive Scale (Y-BOCS) score of ≥ 6 and an IQ ≥70. Eligible subjects returned every two weeks to receive 2500 TSO ova, and to complete subject, parent (Aberrant Behavior Checklist [ABC], Social Responsiveness Scale [SRS], Repetitive Behavior Scale-Revised [RBS-R]) and clinician (Y-BOCS) assessments in addition to safety monitoring, clinical labs and stool sampling.

Results: This exploratory safety and efficacy study to determine effect sizes for future trials included young adults with high functioning ASD, normal intelligence and good verbal skills. Scores on the ABC-Irritability subscale were low at baseline. Patients demonstrated improvement in the repetitive behavior domain. Large effect sizes were seen on (1) the Montefiore-Einstein Rigidity Scale (MERS), a scale of behavioral rigidity, (d = 0.79); (2) the RBS-R Sameness Behavior subscale (d = 1.0) and (3)

the RBS-R Restricted Behavior subscale (d = 0.82). There was also a large effect size on the ABC – Irritability subscale (d=0.78). No changes were observed in the social communication domain of ASD. As in previous studies of TSO, the side effect profile is low.

Conclusions: The results of our proof of concept pilot study demonstrate the feasibility of completing a 28 week study of TSO in an ASD population, the safety of TSO in this population, and the potential efficacy, with moderate to large effect sizes, for improvement in repetitive behaviors/ rigidity and irritability in patients. TSO was tolerated well by subjects, with mild limited side effects which resolved without medication or action taken to the study drug. Flatulence, stomach cramping and nausea/vomiting were more common with TSO, while loose stool, weight loss and knee pain were more common with placebo.

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149   **139.149** Uptake 2 Transporter Blockade Can Ameliorate Sociability Deficits

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Background: Impaired social behavior is a persistent core symptom of autism that is generally treatment-resistant. Clinical findings and basic studies in rodents demonstrate that serotonin (5-HT) transmission is often disrupted in the socially-impaired brain. While selective 5-HT reuptake inhibitors (SSRIs) such as Prozac (fluoxetine) enhance sociability in limited subpopulations of patients, their efficacy is diminished when 5-HT transporter (SERT) function is compromised. Aside from SERT, auxilliary transporters of 5-HT in the brain include organic cation transporters (OCTs) and the plasma membrane monoamine transporter (PMAT) among others collectively known as "uptake 2". Uptake 2 transporters typically have lower affinity for 5-HT, but remove it from extracellular fluid with greater capacity than SERT. Our hypothesis is that if uptake 2 is blocked, impaired social behavior may improve.

Objectives: Our goal was to characterize the acute and sub-chronic effects of blocking uptake 2 transporters on the social behavior of two mouse lines with impaired sociability: BTBR T[+ltpr3]tf/J and SERT -/- mice, in three-chamber sociability tests. Only male mice were examined in these studies, since autism incidence is higher in males than females.

Methods: We utilized the pseudoisocyanine decynium-22 (D-22) to block uptake 2 transporters, and administered it to mice via acute interperitoneal injection or sub-chronic (2 weeks) delivery of D-22 via surgically-implanted osmotic minipumps. Subsequently behavioral performance in three chamber sociability tests was assessed. In vitro uptake of [^{3}H] 5-HT, [^{3}H] citalopram binding and their competition with D-22 was performed in cortical and hippocampal synaptosomes or membranes to compare relative blockade capacity and affinity to the SSRI fluoxetine. Pharmacokinetics of D-22 in serum and brain were assessed by i.p. injection and HPLC.

Results: Acute injections of D-22 (at 0.1 – 0.01 mg/kg) enhanced social interaction preference in both BTBR and SERT -/- mice, in terms of sniffing behavior and chamber dwelling time. Inherent social novelty preference was not diminished by D-22 treatment in BTBR mice. Furthermore, sub-chronic administration of D-22 improved social interaction preference in both mouse lines, with no apparent adverse effects. D-22 blocks 5-HT uptake in mouse brain in vitro with Km = 90 ± 10 nM, and has little affinity for SERT (Ki > 3000 nM). D-22 also appears to cross the blood-brain barrier.

Conclusions: Blockade of uptake 2 transporters appears to be an effective short or long-term treatment strategy for impaired social behavior in mice. However, clinical effects of uptake 2 blockade remain to examined, and a search for more selective uptake 2 blockers is warranted.

Poster Session
140 - Communication and Language
11:30 AM - 1:30 PM - Imperial Ballroom

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150   **140.150** A Study of Siblings of Individuals with ASD: Comparison of Pragmatic Language Ability

V. Y. Kang[1], *K. Levesque*[1], *A. Anderson*[1], *A. Kresse*[2], *S. Faja*[3], *E. E. Neuhaus*[4], *R. Bernier*[1] *and S. J. Webb*[2,5], (1)University of Washington, Seattle, WA, (2)Seattle Children's Research Institute, Seattle, WA, (3)Boston Children's Hospital/Harvard School of Medicine, Boston, MA, (4)PO Box 5371, Seattle Children's Research Institute, Seattle, WA, (5)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA

Background:
Deficits in pragmatic language are commonly observed, not only in individuals with ASD, but also in siblings of individuals with ASD (Bishop, 1997; Baron-Cohen, 1988). These findings suggest pragmatic language impairment could be a heritable trait. Aside from shared genetics in siblings, environmental and gene x environment interactions could influence the development of pragmatic language. Specifically, having a sibling with ASD (who has general language impairment and specifically pragmatic language deficits) may influence the language environment of the sibling and their

pragmatic ability. Examining pragmatic language in siblings of children with ASD is also critical because impairment in pragmatic language influences behavioral problems at school, mood, and willingness to engage in social interactions (Donno et al., 2010; Gilmour et al., 2004).

Objectives:
This study compared the overall score and the subscale scores on a measure of pragmatic language in a twin sample. Three comparison groups were included, which differed by the concordance of diagnosis with the proband: (1) ASD concordant twin (ASD Sib of ASD), (2) TD disconcordant twin (TD Sib of ASD) and (3) a reference group of TD siblings of TD probands was also included.

Methods:
Groups included: 10 ASD Twin of ASD (Male=7, Female=3), 10 TD Twin of ASD (Male=2, Female=8) and 10 TD Twin of TD (Male=2, Female=8) between the ages of 7 and 16. Additionally, data from 10 ASD Sibs of ASD, 10 TD Sib of ASD, and 10 TD Sibs of TD have been collected but not analyzed. Groups were matched for age. Coders trained for reliability and blind to diagnosis viewed video-recordings of a child-experimenter interview to assess subjects' pragmatic language using the Pragmatic Rating Scale-Modified (PRS-M) (Ruser et al., 2007). The PRS-M scored the subjects on verbal (e.g., clarity, referencing emotions, grammar) and non-verbal (e.g., eye contact, gestures) aspects of pragmatic language.

Results:
In the TWIN groups, there was no difference in PRS Sum of Scores between TD Twins of ASD (M = 8.90, SD = 3.54) and TD Twins of TD (M=7.60, SD=2.37). For the PRS-M subscale of Expressiveness, TD Twin of ASD (M=3.80, SD=2.35) had marginally worse PRS than TD Twin of TD (M=2.10, SD=1.20) (p=.086), but did not differ from ASD Twin of ASD (M=4.20, SD=1.75).

Conclusions:
TD twins of children with ASD were impaired in Expressiveness, but not in overall pragmatic language or other subscales. The Expressiveness sub-domain of the PRS-M includes items such as facial expressions, discussing and empathizing emotions, and reference to unfamiliar objects with sufficient explanation. To extend our results, we will be including siblings (non-twins) to examine the shared environment effect of having a sibling who is the same versus different in age.

151 **140.151** ASD and FXS: Vocalization Differentiation in the First Year of Life

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Background: Prelinguistic behaviors are foundational for later language skills. The canonical babbling stage emerges around five months and marks the shift between prelinguistic skills to adult like speech (Oller, 2000) with a delay strongly suggesting a developmental disability (Oller et al. 1999; Stark et al. 1988; Stoel-Gammon 1989; Patten et al., 2014). Autism Spectrum Disorders (ASD) and Fragile X syndrome (FXS) are two neurodevelopmental disorders associated with language impairment. A recent retrospective study (Patten et al., 2014) reported infants later diagnosed ASD are delayed in achieving the canonical babbling stage and demonstrate reduced volubility (total syllables) in comparison to typically developing infants. However, no previous studies compare the early vocalization skills of infants with ASD to those of infants with other neurodevelopmental disabilities such as FXS.

Objectives: The purpose of this study is to determine whether there are differences in the vocalization behaviors between infants with ASD and those with FXS-no ASD in the first year of life. This information has the potential to inform our understanding of the derailment in speech and language acquisition in the neurodevelopmental disorders. About 15-33% of children with FXS go on to have an ASD diagnosis, and previous studies have found the communicative functioning of children with FXS+ASD to be very similar to other children with ASD-only and different from children with FXS-no ASD (Klusek, Martin, & Losh, 2014). Thus, our focus in this study is to determine whether children with ASD-only can be differentiated from those with FXS-no ASD based on quantitative and qualitative features of their vocalizations.

Methods: Home videos of infants (9 - 12 months) later diagnosed with FXS-no ASD (CARS scores less than 30) are being analyzed to compare to the frequency of infant produced canonical babbles and noncanonical syllables produced by infants later diagnosed with ASD, or infants with typical development; comparable home videos for the ASD and typical samples were previously coded, with results reported in Patten et al. (2014).

Results: Preliminary results from the study indicate 3/8 participants with FXS, 12/21 with ASD and 10/14 with TD having produced at least one canonical babble in a ten-minute video. Average syllables produced in 10 minutes was 51.5 for FXS, 79.8 for ASD, and 119 for TD. Recruitment for additional participants with FXS is ongoing. We expect to have at least 15 participants in five months.

Conclusions: Characteristics of canonical babbling and volubility may serve as markers to differentiate ASD from other neurodevelopmental disorders such as FXS-no ASD. These characteristics may also inform our understanding of the origins of speech and language impairment.

140.152 An Examination of Narrative Abilities in Individuals with ASD and Their Family Members

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Background:
Narrative ability is a core element of pragmatic language and a primary mode of thought and communication (e.g. Bruner, 1986; Ochs & Capps, 1996, 2001). Individuals with ASD consistently demonstrate deficits in narration (e.g., reduced narrative coherence and limited use of causal and emotion words), particularly during unstructured contexts (Losh & Capps, 2003). Parents of individuals with ASD also demonstrate subclinical differences in narration (Landa et al., 1991), which may index genetic liability to ASD. To date, no study has directly compared narrative performance of individuals with ASD and their parents on the same measures and in both structured and semi-structured contexts.
Objectives:
To examine narrative ability in individuals with ASD and parents of individuals with ASD across structured and unstructured contexts, and explore associations with cognitive and clinical phenotypes.
Methods:
Participants included high functioning adolescents and young adults with ASD (n=31), parents of individuals with ASD (n=96), and typically developing control groups (proband controls, n=29; control parents n=58). Participants completed two narrative tasks – a structured wordless picture book, *Frog, Where Are You?* (PB) and a semi-structured task employing images from the Thematic Apperception Test (TAT). Narratives were analyzed using Linguistic Inquiry Word Count (LIWC; Pennebaker, 2001), a computational tool that identifies the use of different lexical categories and previously used as an index of emotional expression and social connectedness in communicative interaction (Kahn et al., 2007). Measures of executive functioning and social cognition were examined as correlates. All analyses controlled for verbal IQ.
Results:
Results indicated differences in social word use and grammatical devices, particularly during the semi-structured context in both the ASD and ASD parent groups (p values <.05). Parents of individuals with ASD more often produced expressions of anxiety in both tasks (TAT: $t(158)=5.5$, p<.05; PB: $t(129)=2.2$, p<.05). Executive function correlated with indices of grammatical complexity in individuals with ASD across tasks (ps<.05), and with expressions of anxiety in ASD parents during the semi-structured task (p<.04). On the PB task, parent social cognitive ability was associated with the use of affective words (p<.04). Finally, several significant parent-child correlations emerged in the use of specific lexical categories.
Conclusions:
Building on prior research demonstrating more pronounced narrative differences in unstructured contexts among individuals with ASD (Losh & Capps, 2003), findings indicate that both the ASD and ASD parent groups encounter more challenges in the unstructured narrative contexts that are more typical of daily communicative interactions. Results underscore the contributions of executive functioning and social cognition to narration, highlighting these domains as possible underlying sources of narrative differences related to ASD. Expressions of anxiety noted among parents of individuals with ASD further suggest that narration may be a skill impacted in both ASD and unaffected relatives who are at increased genetic liability. Parent-child correlations highlight the need for future research exploring relationships between genetic and environmental influences on the social language development of individuals with ASD.

140.153 Attentional Cues to Support Word Learning Among Children with ASD and Typically Developing Children

E. Tenenbaum, D. Amso and S. J. Sheinkopf, Brown University, Providence, RI

Background: Orienting attention to a speaker's mouth predicts successful word learning and higher language ability among children with autism spectrum disorders (ASD) and typically developing children (Tenenbaum, Amso, Abar, & Sheinkopf, 2014; Young, Merin, Rogers, & Ozonoff, 2009).
Objectives: To test whether word learning can be facilitated by drawing attention to the mouth of a speaker by pointing (Experiment 1) or holding the object close to the mouth (Experiment 2).
Methods: Experiment 1: Participants were children with ASD ($n = 19$, 14 male, $M = 47.67$ months, $SD = 12.73$) and language matched typically developing (TD) children ($n = 17$, 12 male, $M = 20.29$ months, $SD = 6.89$). Trials included baseline in which two objects appeared on the screen, familiarization in which the speaker provided a label for the target (e.g. "Look at the dax!"), and test in which the two objects reappeared after the instructions, "Look at the dax!" Participants saw 6 trials. On half the trials, the speaker pointed to her mouth while labeling the object. Experiment 2: Children with ASD ($n = 6$, 5 male, 1 female, $M = 67.32$ months, $SD = 11.76$) and language matched TD children ($n = 7$, 5 male, 2 female, $M = 33.00$ months, $SD = 8.79$) saw two trial types. On Far Trials, the speaker held the object as she had in Experiment 1, off to the side. On Near Trials, the speaker held the object close to her mouth.
Results: Results did not differ between groups, so we collapsed across groups for the following analyses. In Experiment 1, pointing to the speaker's mouth hindered word learning among children

with ASD and typically developing children. Difference scores between proportion of time spent fixating the target at test and baseline were lower in the pointing than no-pointing condition (Point: M =- .03, SD = .19; No Point: M = .06, SD = .24; $t(33)$ = 1.93, p = .06). In Experiment 2, holding the object close to the speaker's mouth facilitated word learning. On Far Trials, attention to the target did not increase from baseline to test (M = .01, SD = .12, one sample t-test for difference scores > 0, $t(11)$ = .01, ns). For Near Trials, there was an increase (Difference Score Near: M = .17, SD = .31, $t(12)$ = 1.99, p = .07).

Conclusions: Manipulating social cues during object labeling had either detrimental (pointing to the speaker's mouth) or facilitative (holding the target object near the mouth) effects on novel word learning. These findings have implications for refining language therapies for infants and children with emerging speech.

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154 **140.154** Characteristics of Speech Motor Functions in Two Low-Functioning Individuals with Autism

ABSTRACT WITHDRAWN

Background: The reasons why some individuals with autism may have only limited speech production have been debated. Deficits at the level of social pragmatics and linguistic functions are evident in many, but these individuals often seem to have accompanying motor deficits as well across many domains. In the oral domain, speech motor difficulties are sometimes characterized as "developmental apraxia of speech." However, comprehensive examinations of the speech motor functions of such individuals have rarely been documented.

Objectives: To obtain a more comprehensive profile of LFA speech production, using a combination of perceptual rating, transcription, acoustic analysis and weighted error coding

Methods: Two verbal LFA (autism diagnosis confirmed by ARI-R and ADOS, in their mid-20s) with severely unintelligible speech were administered the *Goldman-Fristoe Test of Articulation*-2 (GFTA-2) and a battery of motor speech profile(MSP) tests via the MSP program from KayPentax CSL. Assessment recordings and acoustic analysis were carried out using the CSL4150 model at 44.1 kHz 16-bit with a Shure SM48 microphone. The GFTA-2 was given multiple times and target words (both standard and modified) were perceptually rated and transcribed. Articulation errors were coded and an overall accuracy/intelligibility score generated using the Upper LIPP system with the Weighted Speech Sound Accuracy program (courtesy of Dr. J.L.Preston).

Results: Subjects' raw scores on the GFTA-2 placed their performance at 2-0 to 2-5 age-equivalent level, indicating severe sound acquisition delay. Common major speech errors included cluster simplification, final consonant deletion and palatal fronting. MSP analysis showed significant deviation from normal production range in tasks that examined vowel elongation (e.g. 0.34±0.03 seconds in LFA vs. 28.7±7.20 for the norm), repetitive motion rate (e.g. 1.30±1.39 syllable/second in LFA versus 5.97±0.46 for the norm); reduced loudness and pitch variations (e.g. 8.1% frequency and 28.1% amplitude variability in LFA vs. 20.3±4.8% frequency and 40.5±5.3% amplitude variability for the norm). Perceptual intelligibility rating (PR) on target words, which the subjects demonstrated adequate semantic knowledge, revealed less than 10% met screening criteria for intelligibility (≥75%). Additionally, multiple productions of the same word on different trials showed great baseline variation (e.g. up to 38.8% in standard deviation (SD)) with the greater SD values (15-38.8%) coming from words with mean baseline intelligibility (MBI) between PR of 15 to 60% and smaller SD (≤15%) from words with MBI either above 60% or below 15%.

Conclusions: 1) The significant deviation in MSP values captures and confirms clinical observations of speech features of our LFA subjects (i.e slow, soft, and monotone) in addition to articulation errors characterized by GFTA-2. This suggests a strong motor component to the inaccuracy in their speech production. 2) Tremendous variability (measured by PR) in subjects' repeated production of the same target word, especially in the low-mid intelligibility range, implies instability in the underlying motor function that brings about production of words not yet mastered. These data should serve as one foundation for further characterizations of speech production in LFA, and as a basis for guiding therapy and improving performance both on general principles, and on an individual basis.

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155 **140.155** Characterizing the Minimally Verbal: A Pilot Investigation of the Low-Verbal Investigatory Screener for Autism (L-VIS-A)

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Background: Approximately 30% of children with autism are considered minimally verbal (Tager-Flusberg & Kasari, 2013). At present, we lack a reliable predictor of which of those children are simply *preverbal* and which will *remain* minimally verbal. Further, there is minimal research on this population, in part because of the difficulty evaluating language skills in individuals who do not respond to language, and in part because IQ and language skills are often confounded. When research does include minimally verbal children, they are not typically characterized beyond an arbitrary cutoff such as "more or less than 5 words."

Objectives: The goal of this pilot project, which was the product of an IMFAR Special Interest Group (SIG) discussion, was to develop and test a brief, simple, yes/no parent questionnaire to better characterize minimally verbal children with autism.

Methods: Researchers and clinicians who work specifically with minimally verbal children with autism

compiled a set of 30 yes/no questions to be included in a brief parental screening form. The goal of these questions was to capture the range of communicative abilities of minimally verbal children and to determine the subset of questions that best delineated those with productive communication skills from those without. This screener was administered as an interview to parents of 12 children with ASD [8 males; age $M(SD)$ = 3.67(1.30)].

Results: In this pilot sample, 9 of the 12 children had been labeled "non-verbal" by a professional. Only four of the children were said to produce fewer than 5 words (n = 3, "5-10 words"; n = 5, "More than 10 words"). Twenty of the thirty questions focused on ways children might communicate (e.g. Does your child use gestures? Does your child use pictures? Does your child follow directions? Does your child respond to his name?). For each child, the proportion of those items for which the parent responded "yes" was calculated to determine the child's "communicative ability." This value was reliably higher among children with more than 5 words, $t(10)$ = 3.55, p < .05. Even within groups, there was a significant range in communicative abilities. Children with fewer than 5 words: M = .38, range .13 - .60; children with more than 5 words: M = .82, range .42 - 1.0.

Conclusions: These results represent a proof of concept for a screening tool to characterize in detail the communication skills among minimally verbal children. The range of communicative approaches used within a group of children largely defined as "non-verbal" supports the claims that this population is highly heterogeneous. Though it cannot replace formal language testing, a brief screening form has significant potential utility for researchers attempting to better characterize minimally verbal participants and for clinicians making recommendations regarding speech and language services. When sufficient data are available, principle component analyses will be used to identify which questions have the greatest utility for characterizing children with minimal verbal abilities. Ultimately, this screener will provide a low-cost but effective tool for predicting risk for remaining minimally verbal.

156   **140.156** Computational Semantic Analysis of Restrictive and Repetitive Behavior in Language Samples of Children with Autism

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Background:
Restrictive and repetitive behavior (RRB) is a core symptom of autism spectrum disorder (ASD). We investigate whether RRB is also present in language behavior, specifically whether children with ASD talk about fewer topics more repeatedly during their conversations. We hypothesize a higher semantic overlap ratio (SOR) between dialogue turns in children with ASD compared to those with typical development (TD). Few studies have tested this hypothesis since manual analysis is exceedingly labor-intensive. However, computational text analysis tools can be adapted for quantitative characterization of RRB in ASD at the semantic level.

Objectives:
(1) To develop computational text analysis tools for automatically assess SOR between dialogue turns. (2) To apply these tools to transcripts of ADOS conversations involving children with ASD or TD.

Methods:
Participants. Participants were children ages 4-8, 44 with TD and 25 with ASD without language impairment (CELF Core Language Score above 85). Age, VIQ and NVIQ were matched between ASD and TD groups. ASD diagnosis utilized the ADOS revised algorithm, the Social Communication Questionnaire, and DSM-IV-TR-based clinical consensus.

Context. In order to calculate the semantic similarity at different turn intervals, for each child, we compare every turn pair i and j in the following distance windows: a) W≤3: j is up to 3 turns after i, b) 3<W≤9: j is within 3 to 9 turns after i, c) 9<W≤27, d) 27<W≤81.

Measure. To calculate the similarity between a pair of turns, we use a word overlap measure based on the Jaccard similarity coefficient, which is defined as the number of common words in both turns, relative to the sum of the maximum number of each word in either turn. To assign a higher weight to words specific to a particular child, and a lower weight to the words used frequently by a large number of children (such as function words), we use an inverse document frequency (IDF) term weight. Finally, we compute the SOR for each child by averaging the similarity of every turn pair in the four distance windows.

Results:
The ASD group had a significantly higher SOR than the TD group in the four windows using one-sided Mann-Whitney's U test:
a) W≤3: Mdn(ASD) = 0.166, Mdn(TD) = 0.142, U = 301, p = 0.013, R = 0.27;
b) 3<W≤9: Mdn(ASD) = 0.073, Mdn(TD) = 0.068, U = 397, p = 0.028, R = 0.23;
c) 9<W≤27: Mdn(ASD) = 0.056, Mdn(TD) = 0.048, U = 323, p = 0.002, R = 0.34;
d) 27<W≤81: Mdn(ASD) = 0.044, Mdn(TD) = 0.041, U = 417, p = 0.049, R = 0.20.

Conclusions:
The ASD group has significantly higher inter-turn semantic similarity than the TD group, at various turn distance windows. These results support our hypothesis, and could provide a convenient and robust ASD-specific behavioral marker.

157   **140.157** Detailed Gesture Analysis Reveals Relationships of Gestures with Language and ASD Risk in Children with Language Delays

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Background: Deficits in nonverbal communication, including use of gestures, are one of the required criteria used to diagnosis autism spectrum disorder (ASD). However, little is known about gesture use and its relation to language and ASD symptoms in children at risk for ASD. The comparison of gesture measurement approaches may be particularly useful in examining these relationships.

Objectives: The purpose of this study was to examine the relationship among gesture use, language, and risk for ASD.

Methods: Thirty-six toddlers enrolled in a study focused on language delay as a risk-factor for ASD. Children were categorized into two groups (n=18 at-risk; n=18 TD) based on an evaluation at 18 months of age. Language delay was defined as ≥2 SDs below the mean in receptive and expressive language on the Mullen Scales of Early Learning (MSEL; Mullen, 1995). All children were administered the Communication and Symbolic Behavior Scales Developmental Profile Behavior Sample (CSBS BS; Wetherby & Prizant, 2002), a face-to-face evaluation of the child interacting with a parent and clinician. Gestures were scored from videotaped CSBS BS sessions using standard scoring (BS SS), which included a weighted raw score based on the presence/absence of 8 gestures along with the use of distal gestures (out of 6 possible). A newly created detailed gesture analysis scheme was also used to code gestures, by creating a total gesture score based on all deictic (e.g. point, show, reach, give) and representational (e.g. conventional gestures such as waving, clapping; signs) gestures coded using ELAN, a computer-based coding software. Gesture use was examined in relation to ASD symptoms and expressive and receptive language measured concurrently on the ADOS and MSEL.

Results: Children in the at-risk group used significantly fewer gestures compared to children with TD (Table 1). Almost all correlations between gesture use and language were larger when the detailed gesture analysis was used, compared to the BS SS. For the at-risk group, both gesture measurement schemes were significantly correlated with receptive but not expressive language (Table 2). After controlling for nonverbal developmental level, a significant relationship remained between the detailed gesture analysis (but not BS SS) and receptive language. Strong negative correlations between both gesture measurement schemes and ADOS algorithm scores were found in at-risk children with and without controlling for nonverbal development.

Conclusions: In a unique sample of children at-risk for ASD based on language delay, a reduction in early gesture use across two measurement schemes was observed, indicating the importance of gesture measurement in early identification, for both ASD symptoms and for language development. The two methods of quantifying gestures were differentially related to language and ASD symptoms, with detailed gesture analysis more specifically related to receptive language and not nonverbal ability, compared with the BS SS. These findings suggest that obtaining a detailed measure of a child's gesture use may help determine risk for ASD.

158 **140.158** Differences in Fingerspelling Praxis Performance Between Deaf Children with Autism and Deaf Typically Developing Children Between 5 and 14 Years of Age

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Background: Fingerspelling – spelling out English words using hands – is an important part of American Sign Language (ASL) acquired early on by deaf children (Padden, 1991). Fingerspelling is a complex motor skill requiring high-levels of praxis, the ability to perform complex movement sequences. Children need to learn a different handshape for each letter of the alphabet and produce these handshapes in the correct order to accurately produce a fingerspelled word. Some deaf children with Autism Spectrum Disorder (ASD) have been shown to acquire fingerspelling in ASL by 5 years of age (Shield & Meier, 2012). However, children with ASD demonstrate significant impairments in motor coordination and praxis (Jansiewicz et al, 2006, Mostofsky et al, 2006). Therefore, these impairments may affect fingerspelling performance in children with ASD.

Objectives: In the present study, we compared the fingerspelling abilities of deaf school-age children with and without autism using a range of spatio-temporal errors described in the praxis literature.

Methods: 22 deaf children between 5 and 14 years of age (11 typically developing (TD) children and 11 children with ASD) were videotaped during a finger spelling task involving a set of 15 common words. Children in both groups were matched on age and nonverbal intelligence measured by the Test of Nonverbal Intelligence (TONI; Brown et al., 2010). A blinded and trained ASL signer coded all videos using a coding scheme based on the current praxis literature (Dewey et al., 2007). We evaluated the various spatio-temporal errors produced during the fingerspelling sequences for each word. Specifically, we coded the fingerspelling time and errors in pace, accuracy, sequence precision, movement modulation, and body part use. We also correlated praxis performance (time and total errors during finger spelling) with the children's nonverbal intelligence and receptive language based on a standard ASL comprehension measure (Enns et al., 2013).

Results: TD deaf children fingerspelled words more quickly (Mean (SD) - TD: 1.23 (0.43), ASD: 2.38

(0.98)) and produced fewer errors in pace (TD: 3.18 (4.45), ASD: 11.09 (7.76)), sequence precision (TD: 1.73 (1.42), ASD: 4.91 (4.16)), and body part use (TD: 0.09 (0.30), ASD: 3 (3.90)) compared to deaf children with ASD ($p$values < 0.05). We found that total praxis errors correlated strongly with receptive language abilities (Pearson's r = -0.74) but not intelligence (Pearson's r = -0.20) in children with ASD, with no clear correlations seen in TD children.

Conclusions: Our findings suggest that praxis errors during fingerspelling are three-fold in high-functioning deaf children with ASD compared to age- and IQ-matched TD deaf children. These findings add to the current body of literature on motor planning and coordination impairments of children with ASD by describing a novel research population. Our results highlight the persistent motor deficits in school-age children with ASD and a clear need for motor interventions in this population. The fingerspelling system of ASL, with its complex motor demands, provides a unique opportunity for motor intervention in deaf children with ASD.

159 **140.159** Distinct Language Improvements of Minimally Verbal Children with ASD inside and Outside Episodes of Engagement As Response to Treatment

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Background: Communication impairment is a defining feature of Autism Spectrum Disorder (ASD). Despite increased attention to early intervention, nearly 30% of children with ASD remain nonverbal at school-age (Tager-Flusberg & Kasari, 2013). In addition to language deficits, children with ASD exhibit a core deficit in joint engagement, or the ability for a child to share attention with others around an object. Research has demonstrated that joint-engagement based interventions are associated with significantly better language outcomes and joint engagement in children with ASD (Kasari, Paparella, Freeman, & Jahromi, 2008; Kasari, Gulsrud, Wong, Kwon, & Locke, 2010). Thus, the associations between joint engagement and language outcomes for children with ASD make this an important topic to investigate further.

Objectives: 1) Does language used during episodes of joint engagement change over the course of intervention for minimally verbal children with ASD? 2) Are there observable changes in language abilities over time of minimally verbal children when they are not jointly engaged with an interventionist?

Methods: Participants included 18 minimally verbal school-aged (4.5 to 8 years old, M=6.56, SD=1.16) children diagnosed with ASD. Children received 6 months of an evidence-based intervention that combined elements of Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER) and Enhanced Milieu Teaching (EMT). Entry and exit intervention sessions were videotaped and ten-minute clips of the therapist-child interactions during sessions were later coded for child language abilities inside and outside episodes of joint engagement. These recorded interactions were first transcribed using SALT conventions. Joint engagement episodes were coded during a second viewing of the sessions; episodes of engagement were defined as the time the child and therapist coordinated their play around an object or activity. These two coding systems were combined to create two separate transcripts: one for language while inside episodes of joint engagement and one for language used outside. These transcripts were then analyzed using SALT Software. Language abilities involving frequency were divided by the appropriate amount of time to yield per-minute rates.

Results: Paired samples t-tests were conducted to examine changes in children's language abilities while jointly engaged in play. Results reveal that children use significantly more different words (p<.01), social communicative utterances (p<.01), longer utterances (MLU; p<.1) at trend level, spontaneous comments (p<.05), and spontaneous requests (p<.05) at exit as compared to entry as a result of receiving JASPER+EMT. In examining language used when children are not engaged in play, children also use significantly more different words (p<.05), social communicative utterances (p<.01), and spontaneous requests (p<.05) at exit as compared to entry as a result of receiving JASPER+EMT.

Conclusions: Children increased their spoken language production in sessions with an interventionist during JASPER+EMT over six months. However, only during joint engagement did children significantly increase their commenting language with a trend towards greater MLU inside as well. This topic should be further investigated with a larger sample.

160 **140.160** Does Parental Input during Joint Attention Differ for TD Children and Children with ASD?

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Background:
Joint attention (JA) occurs when two individuals focus simultaneously on a particular object—and know that each is included the interaction. JA has been reported to play a role in later language abilities in both typically developing (TD) children and children with ASD (Mundy et al., 1986; Tomasello & Farrar 1986). Previous research has found deficits in JA in children with ASD relative to their age- or language-matched TD peers (Mundy, Sigman, & Kasari, 1990; Lewy, & Dawson, 1992); moreover, parental input and responsivity have been found to be vital for the early facilitation of language for both TD children and children with ASD (Naigles 2013). However, little research has investigated

parental linguistic input specifically during episodes of JA, and compared this across groups.
Objectives:
We investigate the speech of parents to their TD children or children with ASD during episodes of JA.
Methods:
The sample includes 15 typically developing toddlers (TD_{MA} = 19.82 months, 13 males) and 15 children with autism (ASD_{MA} = 34.93 months, 12 males) who were matched on expressive vocabulary (MacArthur CDI) at Visit1. Children and their parents engaged in a 30-minute play session; the sessions were coded for each JA episode that was parent-initiated (i.e., RJA, with the child responding to parental bids). Parental language input measures included Mean Length of Utterance (MLU), Word Tokens, Noun Types, and Verb Types, adjusted as a function of the number of RJA episodes. Children were administered the ADOS-G to confirm diagnosis. Data are reported at 2 time points: 16 months apart.
Results:
We report preliminary data from 5 TD children and 5 children with ASD. Table 1 presents the mean scores. As expected, the TD children engaged in more RJA episodes than the children with ASD at the first visit (which occurred shortly after diagnosis). Moreover, parental MLU was significantly higher in the TD group than the ASD group at V1 (p = .017), and marginally significantly higher at V2 (p = .076). Word tokens, noun types, and verb types in parent input did not differ between groups at V1, but were marginally significantly higher in the TD group at V2 (ps < .10).
Conclusions:
Even controlling for the number of RJA episodes, parental input varies somewhat across groups. MLU, a measure of sentence complexity, especially varies with age and group. When the full sample is coded, we expect that additional measures will show significant differences across groups. It appears that parents of children with ASD may speak differently during episodes of RJA than parents with TD children, which may account for some of the observed differences in children's later language abilities.
435 words

161 **140.161** Dynamic Assessment of the Looking Patterns of Toddlers with ASD during Teaching

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Background:
Tek and colleagues' (2008) investigation of the emergence of early language learning biases in toddlers with ASD revealed that, although both toddlers with ASD and their typically-developing (TD) peers demonstrated a noun bias (that novel words refer to objects rather than actions), the toddlers with ASD did not demonstrate a shape bias (that novel labels are extended to objects of similar shape).
Objectives:
In this study we compare the dynamic looking patterns of toddlers with ASD during the teaching trials of the noun and shape bias experiments to determine (a) whether there are differences in the average number or duration of fixations during teaching and (b) whether these differences are related to performance at test.
Methods:
This sample (from Tek et al. 2008) consists of 17 toddlers with ASD (MA = 33.10 months) and 16 TD toddlers (MA = 20.69 months) matched on expressive language. The participants were seen for 2 visits, 4 months apart. The experiments were presented using the Intermodal Preferential Looking paradigm (Naigles & Tovar, 2012). Children's frame-by-frame eye movements were coded during the teaching trials. The average number of fixations (fixations) and length of the longest fixation (duration) were calculated.
Results: Repeated Measure ANOVAs were conducted. For the noun bias experiment the dependent variables were fixation and duration and the independent variables were group and time. There was a main effect of group for the fixations (F (1, 29) = 6.61, p=.02); the ASD group produced significantly more fixations than the TD group.   No other results were significant. For the shape bias experiment the dependent variables were fixation and duration and the independent variables were group, time, and condition (name versus no name). There was a main effect of time for the fixations (F (1, 30) = 8.95, p<.01) with fewer fixations at Time 1 than 2, and for duration (F (1, 30) = 35.96, p<.001), with shorter durations at Time 2 than 1. There was also a condition by group interaction (F (1, 30) = 6.2, p=.019); the TD group demonstrated a larger difference in looking durations across conditions as compared to the ASD group.   Correlation and regression analyses were conducted to investigate whether looking patterns were related to shape bias test performance. For the TD group a significant correlation emerged between fixations and duration during teaching and test at Time 1; however, neither fixations nor duration predicted test performance. For the ASD group there was a significant correlation between duration during teaching and test performance at Time 2. The regression trended towards significance.
Conclusions:
Although differences in fixation during teaching were noted across experiments, only differences in duration were observed in the experiment testing the shape bias (the bias the ASD group did not demonstrate at test). The group by condition interaction suggests that for the TD group hearing a label directs their attention to relevant information, which yields more efficient processing of stimuli.

Labels do not appear to have the same facilitative effect for the ASD group.

162 **140.162** Early Receptive and Expressive Language Skills: A Joint Attention Intervention for Young Children with ASD

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Background: Joint attention skills include the ability of young children to share focus on an object with another individual using eye-gaze, verbal utterances, pointing or other nonverbal gestures (Moore & Dunham, 2014). Previous studies have shown that mediated joint attention opportunities between parents and young children are critical for early language development and social communication skills (Delinicolas & Young, 2007; Kasari et al., 2010). Young children diagnosed with autism demonstrate pivotal deficits in joint attention skills that are directly and significantly correlated with deficits in both receptive and expressive language development (Adamson et al., 2009). However, in targeted interventions that focus on structured opportunities and parent-mediated engagement activities, both joint attention and language skills can have significant positive outcomes for these young children. These interventions provide learning opportunities for the development of pivotal skills in effective intercommunication such as turn-taking, social reciprocity, and theory of mind (Vaughan Van Hecke et al., 2012).
Objectives: To document the impact of a joint attention parent-mediated intervention on subsequent targeted language skills in young children with autism.
Methods: A sample of (N=11) children, 9 males and 2 females recently diagnosed with autism participated in the current study. Children ranged from the ages of 24 to 44 months (M= 33.2, SD= 5.98) with mental ages ranging from 14 to 51 months (M= 22.5, SD=10.69). The 16-week parent-mediated intervention included weekly parent-reports that documented the relative frequency of joint attention skills, eye contact, gestures, pointing, turn taking, sharing, and showing (α = .75). The item scores ranged from "very often to "none." Children's receptive and expressive vocabulary, phrases understood, and total gestures scores were measured pre-and post-intervention from the *MacArthur-Bates Communicative Development Inventories* (CDI; Fenson et al., 1993).
Results: Data were analyzed using longitudinal regression panel models in order to assess inter-individual differences in joint attention and language abilities prior-to and post-intervention. The analyses indicated a significant relation between joint attention pre-and post-intervention (β = .56, p < .05), even after controlling for language abilities prior to the implementation of the intervention (β = .53, $p < .05$). Additionally, children with ASD who scored higher on language abilities prior to the intervention also scored higher on language skills post-intervention (β = .93, p < .01). Future analyses will expand these results by including mixed-multilevel models for repeated measures that includes the 16-weeks parent-reported changes in joint attention and language development in order to explore the between-and within-person differences found during this parent-mediated intervention.
Conclusions: Findings from the current study suggest significant between-person differences in joint attention and language abilities following participation in a 16-week parent-mediated intervention. These targeted interventions, have recently gained much support (e.g., Kasari et al., 2010). The current study was designed to determine if parents, taught to provide targeted joint attention opportunities could mediate the language outcomes of their young children with autism. These results suggest promising outcomes for parent-mediated interventions with strong adherence to the intervention, as well as emergence of generalization to other language routines in everyday contexts.

163 **140.163** Effective Way to Improve Competence in Answering Questions Among Children with ASD: Repeat Your Question or Gesture?

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Background:
Children with Autism Spectrum Disorders (ASD) have problems in responding to Wh-questions (e.g., Curico & Paccia, 1987). Fail to answer questions may exclude children from taking part in social interaction (Paul, 1985). A few studies have examined ways (e.g., visual cues, additional probes, repeated questioning) to improve question-answering skills among children with ASD in an experimental setting (e.g., Krantz et al., 1981; Jahr, 2001; Scean, et al., 1989). However, very little is known about the way to promote question-answering skills among children with ASD in naturalistic contexts. In a naturalistic setting, caregivers spontaneously move their hands (i.e., gesture) when interacting with their children (e.g., pointing to a cookie while asking, "What is it?") (McNeill, 1992). So and Lim (2012) reported that typically-developing children were more likely to respond to caregivers' questions if those gestures were accompanied by gestures, possibly because gestures can help children to identify referents in the questions. The question of interest is whether producing gestures while asking questions would promote question-answering skills among children with ASD.
Objectives: The present study examined whether asking questions with gestures or simply repeated questions would increase response rate to wh-questions among children with ASD.
Methods:

The participants were 8 Chinese-speaking caregivers (aged 35 or above) and their six- to eleven-year-old children (all males) with low-functioning ASD. Caregivers were invited to engage in a conversation with their children for 15 minutes. A toy set (farm blocks) was provided to facilitate the interaction. Speech produced by caregivers was transcribed and their gestures were coded by native Chinese speakers. We focused on wh-questions asked by caregivers. Each question was classified to two categories based on its information status: novel and repeated. Questions were considered to be novel if they were not asked in the preceding 20 utterances and to be repeated if they were asked in the preceding 20 utterances. We calculated the proportion of appropriate answers provided by children immediately to those questions (on the basis of whether speech contents were appropriate in a particular context).
Results:
On average, caregivers asked wh-questions 43.25% of the time (SD=.17). Among all wh-questions, 36.18% of them (SD=.15) were accompanied by gestures (mainly pointing gestures) and 76.18% (SD=.13) were novel questions. Figure 1 shows the mean proportion of appropriate response to the questions. Children with ASD were more likely to respond appropriately to repeated questions than to novel questions, $F(1,7)=11.02$, $p<.013$. However, the proportion of appropriate response to questions with gestures was comparable to that to questions without gestures, $F(1,7)=.35$, $p<.58$.
Conclusions:
As opposed to typically-developing children, producing gestures while asking children with ASD questions does not increase their chance to respond to those questions appropriately. This is possibly because children with ASD have deficit in integrating gesture and speech in comprehension (Silverman, 2010). Rather, repeated questioning would enhance the possibility of giving appropriate response. Caregivers should teach their children with ASD to answer questions by simply repeating them.

164 **140.164** Examining the Spontaneous Communication of Minimally Verbal Children with ASD in Supported Versus Unsupported Contexts

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Background: Despite access to early intervention, up to 30% of children diagnosed with autism spectrum disorder (ASD) are classified as nonverbal or minimally verbal at age five. Being non-verbal or minimally verbal can have a significant impact on adaptive skills and social behaviors for children with autism (Anderson et al., 2007). Previous research has shown increases in child spontaneity and frequency of language for this population with interventions that are focused on responsive interactions (Kasari et al., 2014). Further research is needed to identify key behaviors in responsive communication partners to better treat this population.
Objectives: The purpose of this study is to examine differences in spontaneous communication for minimally verbal children with ASD in supported and unsupported contexts for communication.
Methods: Twenty-five minimally verbal children with ASD participated in the study (males=21, age= 4.5-8.5 years) as a part of an ongoing study comparing the effects of a naturalistic, play-based intervention to a behavioral intervention (AIM-ASD #426-230-0013). Minimally verbal was defined as a participant displaying fewer than 20 words in a 20-minute language sample. We compared the spontaneous language of participants across two contexts during initial screening assessments: unsupported and supported. In the unsupported context, an adult interacted with the participant using a pre-determined set of toys, but did not model language relevant to the child's actions or expand on child language utterances. In the supported context, the adult interacted with the child using a pre-determined set of toys and was highly responsive to the child's communication attempts (mean responsiveness above 90%). The adult contingently imitated the child's actions and modeled language relevant to the child's actions. All assessments were video recorded and child utterances were transcribed, verified, and coded for spontaneity. Two-sample, within subject t-tests were completed to analyze the number of different spontaneous words (NDW), the number of total spontaneous words (NTW), and the number of spontaneous utterances using spoken language (NSU).
Results: No measures of spontaneous language showed significant differences in a supported interaction compared to an unsupported interaction across three measures: NDW (p=.164), NTW (p=0.872), and NSU (p=0.617). Overall, spontaneous language was low across both contexts: the mean NDW was 10.16 in a supported context (range 0-46) and 7.84 in an unsupported context (range 0-26). The mean NTW was 18.72 in a supported context (range 0-128) and 19.2 in an unsupported context (range 0-121). The mean NSU was 12.08 in a supported context (range 0-74) and 10.96 in an unsupported context (range 0-58).
Conclusions: Minimally verbal children used few spontaneous utterances in both supported and unsupported contexts. The non-significant results of this analysis show that access to a supportive and engaging communication partner does not show an immediate effect on spontaneous language for this population, which is important in considerations of intervention strategies. For minimally verbal children, extended periods of rich intervention involving a supportive partner is necessary for increasing spontaneity of speech. Analyses will be conducted to evaluate specific behaviors of a supportive partner that may have functioned to increase spontaneous use of language.

165 **140.165** Expectations of Social Isolation for Children with HFA

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Background: Individuals with high-functioning autism (HFA) have difficulty with social communication and integration, despite preserved cognitive and language skills. Typical adults naïve to diagnostic differences rate children with HFA as more awkward than typically developing (TD) peers after exposures as brief as one second (Grossman, 2014).

Objectives: Using online crowdsourcing (Amazon's Mechanical Turk, MTurk), we examined if naïve adults' first impressions of awkwardness relate to their judgments of social integration and engagement of children with HFA compared to TD peers.

Methods: We collected data from 125 participants in two weeks using MTurk, an online crowdsourcing service where people complete short tasks for pay. We presented 24 short (2-4 seconds) video clips of children with and without HFA re-telling a sentence from a story. Participants used a slider bar to provide their judgment on how likely the child in each video was to 1) start a conversation with others, 2) have a lot of friends, 3) get along well with other people and 4) spend a lot of time by themselves. Participants also rated the awkwardness of the children in the videos using the same slider bar. Task instructions did not include any references to autism, ensuring that participants were naïve to the general context of the task and the diagnostic status of the children in the videos. Each video was presented as an independent MTurk task, accompanied by the same five questions. Participants could choose to respond to as few as one video or up to the entire set of 24 videos.

Results: Our MTurk script was programmed to exclude participants if they responded to questions without viewing the video. To maintain homogeneity of the sample, we also excluded participants who were non-native English speakers or lived outside the United States, resulting in 98 included participants. We calculated the average slider response (0-100) for each of the five questions across all videos, within diagnostic category of the child (HFA vs. TD). We conducted paired t-tests, corrected for multiple comparisons, for the average response to each question. Children with HFA were perceived as more awkward than TD peers ($p<.0001$). Compared to TD peers, children with HFA were rated less likely to start a conversation with others ($p<.0001$), less likely to have a lot of friends ($p<.0001$), less likely to get along well with other people ($p<.0001$), and more likely to spend time by themselves ($p<.0001$).

Conclusions: Participants naïve to diagnostic differences between the children in the videos judged children with HFA to be more awkward and less socially integrated than TD children. These results demonstrate the possible social implications of perceived awkwardness in children with HFA and could explain why TD individuals may be less likely to incorporate children with HFA into social interactions.

166 **140.166** Missing the Mark: Dynamic Differences in the Facial Expressions of Children with HFA

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Background: Individuals with high-functioning autism (HFA), despite preserved IQ and language skills, have significant deficits in social communication, and often experience bullying by their peers (Sterzing et al. 2012). Many of these social communication deficits are based on an inability to use non-verbal cues, such as reading others' facial expressions (Klin et al. 2002, Wang et al. 2007), or producing expressions that are unusual (Yirmiya et al. 1989, Grossman et al. 2008), and are perceived as awkward by TD individuals after just one second (Grossman 2014). Despite this clear deficit in the quality of facial expression production, we do not yet understand the underlying mechanisms for this perceived awkwardness.

Objectives: To quantify facial expression awkwardness by analyzing the dynamic movement patterns of facial expressions in children with HFA and how they differ from the more canonical movement patterns of TD adults (video model) and TD children (control group).

Methods: Participants were 62 children (33 with HFA, 29 TD) aged 9-18. We affixed 32 reflective markers to the face of each participant (see Figure) and asked them to mimic expressions (anger, disgust, fear, joy, sadness, surprise) from the Mind Reading corpus (Baron Cohen et al. 2002). Marker movement was recorded by six infrared motion-capture cameras at 100 frames per second. For analysis, we grouped markers according to facial features (e.g. three markers of the right eyebrow) and developed algorithms to analyze feature movement characteristics. We used these data to calculate how well participants matched the temporal-spatial movement characteristics of the video model, and the divergence of movement patterns between the two participant groups. We compared the relative movement intensity across face regions of the video model with the relative movement intensity across face regions of participants. We also established time series vectors for the movement dynamics of participant expressions and computed the divergence of these vectors in the expressions of the HFA cohort compared to the TD control group.

Results: In all expression types, participants with HFA significantly dampen the intensity differences between upper and lower face compared to the video model. In contrast, TD participant reflect those natural across-face intensity differences accurately (p = 0.0005). Participants with HFA also have greater left-right asymmetry than TD peers (p = .05). Overall, the dynamic contours of facial expressions produced by children with HFA diverged significantly from those of their TD peers. This difference was most pronounced in the regions of the eyes (p < .00001) and eyebrows (p < .00001). Conclusions: Children with HFA struggle to coordinate dynamic movement across different face regions, resulting in left-right asymmetry and inadequate variation of movement intensity between upper and lower face. Children with HFA also diverge significantly from the natural dynamic contours of basic emotional facial expressions. These dynamic facial movement and coordination difficulties might be causal to the often cited appearance of awkwardness in the non-verbal expressions of children with HFA.

167   **140.167** Freespeech: Large-Scale Data from a New AAC Application Characterizes Usage for Young Children with ASD – One Size Does Not Fit All

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Background: A recent search for Android and Apple autism applications (apps) yields approximately 1802 results and a search for alternative and augmentative communication (AAC) apps returns 553 hits. The current proliferation of apps designed to help children with autism has largely stemmed from research and pragmatic observations that children with ASD tend to be motivated by computer apps. However, very little research exists which methodically identifies the features of AAC apps that are most useful for this population and, as importantly, provides a definitive characterization of how very young children with ASD tend to use AACs most.
Objectives: This evaluative study represents one of the largest usage-based statistical surveys of a computer app designed to augment and promote communication. User and usage data collected over a period of approximately 2 years was analyzed to develop a characterization of usage patterns to deliver an evidence-based model of users and their activities. We classify usage between users with ASD and users with other communication impairments (e.g., dysarthria, apraxia, etc.), analyze comparative data for usage of young children (0-5 years) with ASD and their same-aged counterparts with other communication impairments and provide an illustrative case study of young children with ASD at an individual level using massive data.
Methods: We conducted a comprehensive analysis to characterize word selection frequency, breadth of vocabulary used, and frequency of functional and social language usage across a large set of FreeSpeech users. Data from over 2.7 million events, representing more than 6,000 anonymous users was examined to determine general usage patterns for specific app features provided. Further, member events recorded for over 230 individual users, who provided information pertaining to age, gender, medical diagnosis, speech and language disorder, were evaluated to investigate common usage traits among children with ASD and distinguishable linguistic preferences between young children with ASD and other age-matched children without ASD.
Results: Highest frequency content was almost equally divided between functional and social words ("I want" and "hello", respectively). Although young children with ASD comprise a relatively small percentage of users who completed the survey (<10%) this age group represents approximately 23% of all events, averaging 3,134 events per user compared to 448 for other groups. Among frequent users with ASD, significantly fewer unique words and a higher rate of repetition (27.95 to 7.27) was indicated compared to their age-matched non-ASD counterparts. However, case studies of longer-term users (>6 months and >15,000 events) reveal that usage frequency increases and content is often supplemented with proper names, specialized activities and feelings after an introductory period.
Conclusions: Outcomes from this study provide evidence that young children with ASD using AACs may have characteristically different usage needs compared to their age-matched counterparts with other communication disorders. Significant changes in usage trends are also apparent in young users, providing evidence that AAC apps fulfill diverse roles. This preliminary study motivates further investigation into how AAC apps are used by young children with ASD and offers valuable insight for designing improved apps which are most beneficial to this population.

168   **140.168** Gender Differences in Communication in School Aged Children with Autism Spectrum Disorder (ASD): Preliminary Results

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Background: Autism Spectrum Disorder (ASD) is diagnosed in a 4:1 male:female ratio. Reasons for this imbalance are unclear, but one possibility is that females may present a different symptom profile that could lead to male biased ascertainment. A recent systematic review and meta-analysis examining gender differences in ASD concluded that males and females did not differ regarding communication (Van Wijngaarden-Cremers, et al., 2014). Unfortunately however, none of the studies reviewed were specifically designed to measure communication, largely basing their conclusions on ADOS or ADI-R scores. A more specific measure of communication ability, rather than symptomatology, might be sensitive enough to reveal gender differences. Narratives measure higher-level language because they require the speaker to integrate cognitive, linguistic and social skills. The Expression, Reception and Recall of Narrative Instrument (ERRNI) (Bishop, 2004) is a standardized test that examines participants' ability to tell and understand a story. Standard scores (SS) are calculated for Ideas (how much of the story was relayed in the narrative) and Comprehension (how well the story was understood).

Objectives: (1) To determine if using the ERRNI would reveal communication differences between a small sample of school-aged boys and girls with ASD; (2) To examine the nature of any differences found.

Methods: Thirteen 8-year-old boys and 13 girls, all with ASD, were closely matched on Wechsler Intelligence Scale for Children 4th ed. Perceptual Reasoning Index (WISC-4 PRI; boys M=94.00: girls M=94.08) and chronological age (CA; boys M=8.74; girls M=8.64). Groups did not differ on average CELF-4 Core Language SS (boys M=87.08, girls M=91.62; t(24)=0.642, p=0.53). At age 8, the ERRNI was administered along with other measures. Follow-up detailed transcript analysis, modelled on Norbury, et.al. (2014), provides indices of syntactic complexity, story macrostructure, pragmatic difficulties and semantic enhancement. Semantic enhancement includes linguistic devices that add richness to the story, such as mental state words and character speech. Coding was blind to gender. Preliminary results from three boys and three girls are presented.

Results: Significant group differences (n=26) were found on the mean ERRNI Ideas SS, [t (20.07; adjusted degrees of freedom due to unequal variances) =2.48.p=0.02] where girls (M=82.39, SD=12.39) included more salient story elements than boys (M=72.36, SD=7.70). No other significant differences were found. Preliminary results from transcript analysis (n=3 each sex) reveal that girls used more semantic enhancement devices than boys (Semantic enhancement index: girls M = 0.53, SD = 0.12; boys M = 0.04, SD = 0.07) and were more proficient at story macrostructure. Boys showed more difficulty than girls on the Pragmatic Index where a higher number indicates more impairment [boys (M = 0.74, SD = 0.14) girls (M = 0.45, SD = 0.06)]. Even with n=3 per group, these differences are significant (t(4)=3.48, p=0.03).

Conclusions: Mean ERRNI Ideas score was significantly better in girls than boys and preliminary detailed analysis suggests that semantic enhancement, pragmatic difficulty and story macrostructure may be the source. If these results hold in the whole sample, detailed narrative analysis may be useful to examine gender differences in language in ASD.

169 **140.169** How Multitalker Environments Affect Speech Understanding in Autism

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Background: Individuals with ASD have well-documented language deficits, including difficulties with speech processing (Ceponiene et al., 2003; Tager-Flusberg, Paul, & Lord, 2005). One factor that may contribute to these deficits is difficulty focusing on a sound while filtering out irrelevant sounds in the environment (Teder-Sälejärvi et al., 2005). Compared to neurotypical (NT) adults, adults with ASD have trouble recognizing speech in noisy environments (Alcántara et al., 2004). Typically-developing infants and adults use the speaker's face to help them separate streams of speech in these environments (Sumby & Pollock, 1954). Yet presentation of the speaker's face does not facilitate perception of speech in noise for adults with ASD, as it does with NT adults (Smith & Bennetto, 2007). It is unclear at what age these differences between groups emerge.

Objectives: We explored (1) whether children with ASD show greater difficulties than NT children understanding familiar words with background noise present, and (2) whether children with ASD benefit from concurrent visual and auditory cues.

Methods: To date, participants include 13 NT children and 11 children with ASD aged 2–5. ASD diagnosis was confirmed with the ADOS-2 and SCQ, and receptive language ability was assessed with the Mullen. In a preferential-looking paradigm, participants sat on a parent's lap viewing a screen. On each trial, two familiar objects (e.g. ball, flower) appeared while children heard audio that named the target object (e.g., "*Look at the ball. Where's the ball*?"). The 24 test trials were divided into four conditions: in half of the trials a woman's face was presented concurrently with the audio, with no face in the other trials. Half of the trials occurred with background noise (a woman reading from a book) presented concurrently; the other trials had no background noise. Visual stimuli and the location of the target object were counterbalanced across conditions (*face quiet*, *no-face quiet*, *face noise*, *no-face noise*). Looking time to the objects was coded frame-by-frame.

Results: Averaging across conditions, NT and ASD children looked proportionally more towards the target than distractor object, suggesting that both groups understood the task (NT: *t*(12) = 12.65, *p*

< 0.0001, ASD: $t(10) = 2.11$, $p = 0.06$). However, for children with ASD, the only condition with significantly longer looking to the target than distractor was *face quiet* ($t(10) = 2.73$, $p = 0.02$). In contrast, NT children showed a significant difference in looking time to the target vs. distractor in all four conditions ($ps < 0.001$). Trends toward poorer performance in noise and with no face did not reach significance with the small sample size. NT children performed better than children with ASD (i.e., looked significantly more towards the target) on both *face quiet* and *blank quiet* ($ps < 0.05$) trials, with *face noise* approaching significance ($p = 0.06$).

Conclusions: Preliminary results suggest that children with ASD are most successful comprehending language in quiet environments when given both visual and auditory information. Children with ASD and NT children appear to be affected in a similar way by background noise.

170   **140.170** Implicit Measures of Receptive Vocabulary Knowledge in Low-Functioning Individuals with Autism

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Background:
Assessment of the cognitive operations responsible for language and thought are typically quantified using overt behaviors such as response time or verbal reports. However, such explicit measures assume an understanding of task goals and an ability to execute the required response. In certain populations, such as low-functioning, nonverbal individuals with autism, such measures might be difficult or impossible to obtain. In such cases, it would be helpful to have implicit measures of cognitive abilities, ones that do not require explicit understanding and cooperation. We have previously shown that eye movement monitoring (EM), pupillary dilation (PD), and event-related potentials (ERPs) can estimate receptive vocabulary knowledge in normal adults (Ledoux et al., accepted pending revision). However, the degree to which these implicit measures can serve as reliable indices of vocabulary knowledge in low-functioning individuals with autism (LFAs) is unknown.
Objectives:
The aim of the current study is to demonstrate whether three implicit measures (EM, PD, and ERPs) can be used to assess receptive vocabulary knowledge, on an individual basis, in LFAs.
Methods:
Participants were five LFAs. Stimuli were high-frequency "known" words (e.g. *bus*, *telephone*) and low-frequency "unknown" words (e.g. *cherimoya*, *agouti*). Participants completed two tasks on two separate sessions. In the forced-choice task (during which EM and PD data were recorded) four pictures were presented together, followed by an auditory word that matched one of the pictures. In the picture-word congruity task (during which ERP data were recorded) participants viewed a picture then heard either a matching or mismatching auditory word. Importantly, behavioral responses were not required.
Results:
In the EM data (Figure 1a), known words showed longer average fixation durations and a greater proportion of fixation and dwell time on the target picture relative to unknown words, indicating that participants spent a greater amount of time looking at the target picture when the word was known. Known trials had fewer fixations compared to unknown trials, suggesting that participants' eyes moved more directly to the target picture in response to known words. These findings replicate those of normal adults (Ledoux et al., accepted pending revision). In the PD data (Figure 1b), the average change in PD was greater for unknown words compared to known words, suggesting greater recruitment of resources for unknown words. In the ERP data, known trials elicited an N400 effect (reduced N400 amplitude for congruent picture-word pairs compared to incongruent pairs) over centro-parietal scalp (Figure 1c). Although there were also congruency differences in the unknown words (Figure 1d), these effects were sustained over the entire trial and did not correspond to an N400 effect.
Conclusions:
Overall, LFAs showed similar patterns of EM, PD, and ERPs responses to known and unknown vocabulary as did normal adults, although there was significant individual variation. Thus despite the inevitable heterogeneity in this population, these implicit measures can be used to assess receptive vocabulary knowledge in the absence of behavioral responses. These techniques hold great potential for assessment of linguistic and other cognitive capabilities in low-functioning populations.

171   **140.171** Improved Communication Outcomes Using a Socially Assistive Robot

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Background: Recent research has employed socially assistive robots (SAR) as a tool for promoting communication and socialization skills in young children with ASD (Greczek et al, 2013, Bekele et al, 2013, Welch et al, 2010). A number of studies describe observed therapeutic outcomes such as increased speech, social interaction, joint and directed attention (Robins et al, 2009, Feil-Seifer et al, 2008), but few quantify communication increases with assessment instruments accepted by autism and speech therapy interventionists. Even fewer provide a between-group statistical analysis of outcome measures achieved with an added robot intervention compared to a control group not receiving it.

Objectives: To evaluate the efficacy of a robot-assisted intervention by quantitatively (1) assessing the effectiveness of a robust, interactive robot for increasing spontaneous speech, communication and social skills in children with ASD and (2) comparing communication and social skills increases obtained through therapies augmented with a robot-assisted intervention to speech therapy as usual.

Methods: Study participants (*N=8; 8 males; age M = 4.83 years, SD =0.83 years*) diagnosed with ASD and a speech deficiency as confirmed by the ADOS and a speech pathologist. Each child participated in two, 30-minute robot-assisted interventions per week for six weeks. A control group (*N=3; 2 males, 1 female; M = 4.39 years; SD=0.38*) with an ASD diagnosis and a documented speech delay were also recruited to compare outcomes obtained through speech therapy alone. A low-cost robot prototype (CHARLIE) with safety features such as a snap-off head, two snap-off arms and a camera for face and hand detection was used for the intervention (Boccanfuso et al, 2011). The study group received pre- and post-intervention measures including the Vineland Adaptive Behavioral Scale II (VABS-II), the Mean Length Spontaneous Utterance Determination (MLSUD), Motor Imitation Scale (Stone et al., 1997), Unstructured Imitation Assessment (UIA) (Ingersoll et al., 2010) and the Expressive Vocabulary Test 2 (EVT2) (Williams, 2007).

Results: Paired-samples *t*-test statistic were performed to determine the therapeutic effect of CHARLIE of on adaptive functioning, imitation, and basic language skills. The results indicate the CHARLIE intervention improved adaptive functioning in the VABS-II Socialization (*p<0.0184*) and Communication (*p<0. 0348*) Domains. The results also showed improvement in MLSUD (*p<0.0092*), UIA Social Interaction (*p<0.0193),* UIA Requesting (*p<0.0068*), and UIA Joint Attention (*p<0.0145*). An independent samples t-test, performed to compare treatment and control groups, showed significance in VABS-II subdomains Play and Leisure (*p<0.0469*), and Receptive Language (*p<0.0421*). There were trends toward significance on the VABS-II subdomains Coping Skills (*p<0.0667*), and Interpersonal Scale (*p>0.0618*).

Conclusions: While this is a pilot with a relatively small *N*, the results suggest one can achieve measured improvements in communication and social interaction using an augmented intervention with a low-cost robot. This study provides critical insight as to the viability and efficacy of using a simple robot as a tool for various autism interventions. Our technique employs a robot that is widely-accessible, robust, can withstand some physical manipulation by children and is easily operable by therapists, teachers and parents.

172 **140.172** Item Response Theory Analysis Suggests Word-Level Lexical Differences in Children with Autism at 12 Months of Age: A Multisite Infant-Sibling Study

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Background: Parent-report communication inventories have found that language development in toddlers with autism is similar to that of language-matched controls in terms of semantic categories, common nouns, predicates, and closed-class terms (Charman et al. 2003, Weismer et al. 2011, Rescorla and Safyer 2013). Two studies have analyzed word-level lexical development in toddlers with autism. While Rescorla and Safyer (2013) found similar word-level production, Bruckner et al. (2007) found 25 words were either more or less likely to be understood by toddlers with autism.

Objectives: To determine if word-level lexical differences in production and understanding could be detected at 12 months of age in infants who later developed autism, compared to infants who did not.

Methods: The 346 participants included in this cross-sectional analysis were part of four larger longitudinal studies of infants with an older sibling either with ASD (high risk – HR) or without (low risk – LR). 43 HR siblings were later diagnosed with ASD at 36 months based on the Autism Diagnostic Observation Schedule and independent review/clinical confirmation. 170 HR and 133 LR siblings did not receive a later ASD diagnosis. Item Response Theory was applied to determine the relative probability of understanding and producing each of the 396 words on the McArthur-Bates Communicative Development Inventories (CDI). Word-level Differential Item Functioning (DIF) was calculated to determine which words were more or less likely to be understood or produced by the autism outcome infants when equated for language ability (theta).

Results: At 12 months of age, autism outcome infants were more likely to use words in a statistically unexpected or improbable manner (producing certain less probable/more difficult words earlier, relative to their overall level of lexical development). The mean number of words produced by the non-ASD outcome HR and LR infants was five. The HR infants with later ASD produced a mean of 2.7 words and a total of 23 different words. Six of these words, or 26 percent of the total, were produced in a statistically unique way by the infants with later ASD (DIF>1.0 and p<0.05). Relative to their overall language ability on the CDI, they were more likely than expected to produce "baabaa," "block," and "bye" when compared to LR infants and "baabaa," "uncle," "hello," and "bite" when compared to HR infants without later ASD. No words for the infants without later ASD were statistically unexpected. A similar pattern was found with words understood.

Conclusions: Qualitative language differences were measured at 12 months of age on the CDI in infants who later developed autism. The interpretation of word-level DIF is limited because the instrument did not reveal a word's accuracy, context, frequency, or range of extension. The differences may reflect 'early' linguistic manifestations of reduced social communication, restricted/repetitive interests or impaired language. Next Step: Analyze 18-month CDI when there is more variability in the measure.

173 **140.173** Language Disfluency and Cognitive Load in Children with ASD

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Background: Higher-functioning children with autism (HFA) may display language on par with typical controls (TD) on standardized measures, yet not use language fluently insocial contexts. Previous observations suggest problems in language fluency may have significant impact on the social communicative interactions of children with HFA. However, little is known about the extent of language disfluency and its clinical specificity to the syndrome.

Objectives: A virtual reality public speaking paradigm was used to compare rates of disfluency in children with HFA, children with ADHD, and TD children. In addition, the attention demands were varied to examine the effects of differences in cognitive load on language disfluency.

Methods: Eighty children, divided into younger 8-11 and older 12-16 age groups were assessed. The sample included four groups of children: 17 HFA with low ADHD symptoms scored on the Conners 3 parent report, 21 with high ADHD symptoms who were called ASD/ADHD comorbid (T-scores > 70), 21 children with ADHD symptoms but no symptoms of ASD, and 21 children with typical development. ASD diagnosis was confirmed with the ADOS. Groups were matched in their Full-scale IQ level with a minimum IQ of 75 necessary to participate in this study. Children viewed a virtual classroom through a head-mounted display. They were asked to answer different questions about their interests and daily activities while viewing 9 targets seated around a large table in a VR classroom. 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 at the table; in the Social Attention Condition children talked to avatar "peers", and in the High-Demand Social Attention Condition they talked to avatars that faded if children did not fixate them every 15 seconds. . Their speech was audiotaped, transcribed, and then analyzed for seven measures of disfluencies ('um', 'uh', false starts, repetitions, revision, non-completion of a word, and sighs).

Results: Analyses revealed a significant interaction between Diagnostic Group, Age Group, and Cognitive Load Condition, $F (3, 71) = 2.89$, $p < .05$, $eta^2 = .11$. Post hoc analyses revealed that more disfluencies were evident with changes in the cognitive load conditions and that diagnostic group difference were more apparent in the condition with the highest cognitive load in the older age groups, $F (3,71) = 3.96$ $p < .015$, $eta^2 = .14$. Across diagnostic groups children in ASD/ADHD comorbid group displayed the highest frequency of disfluencies in the most demanding public speaking condition (See Fig. 1).

Conclusions: The results indicated that as the attention demands of the public speaking task increased the frequency of language disfluency increased. Children in ASD/ADHD comorbid group were especially susceptible to this type of language and communication difficulty as task demands increased. This pattern of results suggests that within ASD the presence of ADHD symptoms may be related to greater risk for social-communication disturbance as the attention demands of social interactions increase.

174 **140.174** Lexical Characteristics Account for Vocabulary Size in Toddlers with ASD: A Comparison of Comprehension and Production

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Background: Despite wide variability, vocabulary is a domain of challenge for many children with autism spectrum disorder (ASD), with particular weakness in comprehension (Hudry et al., 2010). Recent research suggests that characteristics of the words contained in children's lexicons may illuminate vocabulary acquisition processes. That is, lexical characteristics (i.e., phonological

neighborhood density, word frequency, word length) may explain differences between comprehension and production, as well as differences in vocabulary size between successful language-learners and individuals with language-learning problems (Gray et al., 2014; MacRoy-Higgins et al., 2013). For example, toddlers with smaller vocabularies produce words with higher phonological neighborhood density (i.e., words that sound like many others), presumably reducing processing demands by taking advantage of the phonological distribution of language input (Stokes, 2014). Lexical characteristics predict expressive vocabulary size for toddlers with ASD (Kover & Ellis Weismer, 2014), but a comparison of their role for comprehension and production is necessary to inform explanations of acquisition for each.

Objectives: This study examined the effects of lexical characteristics in relation to comprehension and production in toddlers with ASD. We asked: (1) Do neighborhood density, word frequency, and word length differ between receptive and expressive vocabulary for toddlers with ASD?, and (2) Do lexical characteristics differ for those with smaller versus larger vocabularies?

Methods: Toddlers with confirmed clinical best-estimate diagnoses, including the ADOS and ADI-R (LeCouteur et al., 2006; Lord et al., 2000), were drawn from a larger study (N=129). Parents completed the MacArthur-Bates Communicative Development Inventories Words and Gestures form, yielding receptive and expressive vocabulary size.

Lexical characteristics were coded for each toddler's lexicon. Using an online calculator (Storkel & Hoover, 2010), neighborhood density was the count of words differing by a single sound; frequency was the log-base-10 of raw frequency; length was number of phonemes. Toddlers with ≥20 coded receptive and expressive words, following Stokes (2014), were included (n=26; ages 24-38 months). Matched-samples t-tests compared comprehension and production. Independent-samples t-tests compared lexical characteristics for toddlers with vocabularies smaller or larger than the sample medians.

Results: Expressive vocabularies were composed of words with higher neighborhood density, t(25)=-4.37, p<.001, d=.86, and shorter length, t(25)=6.04, p<.001, d=1.21, than receptive vocabularies (Table 1). Only for production did toddlers with smaller vocabularies have higher neighborhood density, t(24)=-2.90, p=.008, d=.85, higher word frequency, t(24)=-2.49, p=.020, d=.81, and shorter word length, t(24)=4.39, p<.001, d=1.35, relative to those with larger vocabularies (Table 2).

Conclusions: These findings have implications for theories of lexical acquisition in ASD, including the role of phonological processing. As in other populations with language impairment (Stokes, 2014; MacRoy-Higgins et al., 2013), toddlers with ASD may show effects of lexical characteristics that are most pronounced for production. Those with smaller vocabularies first produce words with reduced processing demands (e.g., short, many phonological neighbors). Given recent evidence of strong phonological processing of novel words for some with ASD (Norbury et al., 2010; Henderson et al., 2014), this research sets the stage for experimental tasks that address whether lexical characteristics might be harnessed to support both comprehension and production.

175   **140.175**   Native Exposure to Sign Language Does Not Attenuate the Social-Cognitive Deficits of ASD

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Background: Many studies have investigated the relationship between language development and non-linguistic social cognition, particularly theory of mind (ToM). Two populations in particular have been found to have delays in ToM: the deaf children of hearing parents (Courtin & Melot, 1998; Courtin, 2000; Peterson & Siegal, 1999, 1995; Remmel, Bettger, & Weinberg, 2001) and children with autism spectrum disorders, ASD (Baron-Cohen, Leslie, & Frith, 1985; Happé, 1994). Native-signing children, who are exposed to sign from birth by their deaf parents, show no such delay (Courtin, 2000; Schick, de Villiers, de Villiers, & Hoffmeister, 2007), suggesting that early language exposure is key to ToM development. To date, no research has investigated language and ToM development in native-signing children with ASD. Since the visual modality of sign provides rich opportunities for perspective-taking (Courtin, 2000), might native exposure to a signed language privilege the development of social cognition in children with ASD?

Objectives: To investigate the relationship between language, non-linguistic social cognition (ToM and visual perspective-taking), and non-linguistic spatial cognition (mental rotation) in a novel research population, native-signing children with ASD.

Methods: Sixteen native-signing children with a confirmed ASD diagnosis (12 male, 4 female; M_{age} = 9.91, SD = 2.43) and 18 typically-developing (TD) native-signing children (8 male, 10 female; M_{age} = 9.3, SD = 1.77) were tested. Groups were matched for chronological and mental age using the Test of Nonverbal Intelligence (TONI; Brown, Sherbenou, & Johnsen, 2010). Children were tested on the ASL Receptive Skills Test (ASL RST; Enns, Zimmer, Boudreault, Rabu, & Broszeit, 2013), two minimally-verbal social-cognitive tasks: false-belief (Pyers & Senghas, 2009) and visual perspective-taking, and a minimally-verbal mental rotation task (Martin, Senghas, & Pyers, 2013). All responses were coded by a trained coder fluent in ASL and blind to participant group.

Results: Native-signing children with ASD scored significantly lower than native-signing TD children on the receptive language task (ASD M = 85.6, SD = 10.9; TD M = 108.7, SD = 6.3; p <.001), false-belief ToM (ASD $M_{accuracy}$ = 0.55, SD = 0.35, TD $M_{accuracy}$ = 0.82, SD = 0.19; p = .01), and visual

perspective-taking tasks (ASD $M_{accuracy}$ = 0.24, SD = 0.4, TD $M_{accuracy}$ = 0.71, SD = 0.42; $p < .01$). However, there was no significant group difference in mental rotation (ASD $M_{accuracy}$ = 0.75, SD = 0.22, TD $M_{accuracy}$ = 0.86, SD = 0.14; $p = .23$, ns).

Conclusions: Compared to TD deaf children, deaf children with ASD showed evidence of significant language, ToM, and visual perspective-taking delays, but intact mental rotation skills. Language delays in ASD are thus implicated in the development of social cognition, but not spatial cognition. These results fill gaps in the literature on the role of language in the development of social cognition, and provide additional evidence for deficits in language, ToM, and perspective-taking skills in ASD. We conclude that native exposure to sign is not sufficient to overcome the social-cognitive impairments implicated in ASD, and that signing children with ASD show a similar profile to speaking children with ASD.

176 **140.176** Lexical Semantic Impairments in ASD Are Associated with Difficulties in Serial Order Memory

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Background:
Besides widespread impairments in language pragmatics, ASD is also often associated with varying degrees of structural language impairment that remains poorly understood. Comprehension is typically more compromised than articulation and language semantics tends to pose greater difficulties than syntax and grammar (e.g., Boucher, 2012). Several studies suggest that poor phonological short-term memory (p-STM) contributes to structural language impairments in ASD but this issue remains somewhat controversial (see Williams et al., 2008 for a review). Most studies have approached this topic by comparing groups of ASD and non-ASD children who either do or do not have additional structural language impairments. This approach inevitably raises a number of complicated issues concerning how best to select and match participant groups. A complementary approach is to look at associations between measures of structural language and p-STM in larger samples participants that are not selected for specific inclusion criteria.
Objectives:
To examine the association between p-STM and lexical as well as broader conceptual semantic knowledge in adults and children with ASD.
Methods:
Study 1 we examined the correlations between the WAIS Digit Span (p-STM), Vocabulary (lexical semantics) and Similarities (conceptual semantics) subtests of 95 ASD and 105 TD adults whose full-scale IQ ranged from 75 to 150. In Study 2, we examined the same correlations in 45 ASD and 26 TD children who also completed a test of non-word repetition (p-STM). Many of the children in experiment 2 had significant language impairments.
Results:
Step-wise regression analyses for both samples of participants showed that p-STM, over and above measures of fluid intelligence (PIQ in Exp 1; Raven's in Study 2), significantly predicted lexical semantic knowledge in ASD (Exp 1: B = .265; Exp 2: B = .349) but not TD groups (Study 1: B = .057; Study 2: B = -.156). In experiment 2, broader conceptual semantic knowledge was also predicted by p-STM over and above fluid intelligence in ASD (B = .308) but not TD participants.
Conclusions: Data from two large samples of adults and children with ASD lend support to the notion that individual differences in p-STM are associated with variability in semantic aspects of language ability, over and above what one might expect on the basis of participants' fluid intelligence

177 **140.177** Linguistic Aspects of Prosody Is Intact in Children with Autism Spectrum Disorders

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Background: It has long been known that the speech of people with autism spectrum disorders (ASD) has atypical prosodic features [1]. Yet how their prosody differs from that of typically developing persons has not been well-understood. Only recently, an attempt has been made to develop an assessment procedure to evaluate the prosodic skills of those with ASD -- Profiling Elements of Prosodic Systems in Children (PEPS-C) -- which primarily assesses para-linguistic and emotional aspects of prosody [2]. A high-functioning ASD group was found to score significantly lower than a typically-developing group in almost all test items of PEPS-C [3]. The prosody of an utterance, however, has a hierarchical structure (Fig 1), which reflects both linguistic and paralinguistic factors. In Japanese, for example, the intonation structure is determined by lexical pitch-accent, accentual phrases (AP), and intonation phrases (IP) [4]. Given that the lexical and grammatical ability of people

with high-functioning ASD are high, it is likely that those aspects of their prosody that are determined by lexical and grammatical factors are intact. If true, it would suggest that the core problem with ASD prosody is likely to be found in the discourse and emotional functions of prosody, which reflect inter-personal communication.

Objectives: The goal of the present study is to examine whether the linguistic aspects of prosody that are determined by lexical and syntactic features are intact in high-functioning ASD.

Methods: 12 children (10 males, ages 7-17) diagnosed with high-functioning ASD, and 14 typically developing children (8 males, ages 7-16) were tested in an elicited production task. Participants were asked to name one of three pictures on a screen. The pictures were objects and animals which could be labeled with one AP (e.g., "Gorira-dayo" It's a gorilla), two APs ("Pinku-no doresu-dayo" It's a pink dress), or three APs ("Pinku-no doresu-no gorira-dayo" It's a gorilla with a pink dress). Participants' utterances were recorded, and the minimum, maximum and mean fundamental frequency (F0) of each AP in each utterance were measured. Half of the stimuli consisted of accented words while the other half were unaccented.

Results: In Japanese, the pitch of an utterance drops at each accented word, as shown in Figure 2. Whether this decrease occurred appropriately, pitch ranges were appropriate for each utterance length, and whether or not intonation for accented and unaccented words were appropriately produced were analyzed. The results revealed that there were no differences between ASD and TD in any measurements.

Conclusions: The results revealed that ASD participants' production of lexical and syntactic aspects of prosody is intact. It suggests that people with ASD are able to produce fundamental prosodic structure, suggesting that their difficulties may lie in using prosody appropriately in interactive communication.

[1] Kanner, L., 1943, Nervous Child, 2, 217-250.[2] Peppé & McCann, 2003, Clinical Linguistic and Phonetics, 17, 345-354.[3] Peppé et al., 2007, Journal of Speech, Language, and Hearing Research, 50, 1015-1028.[4] Igarashi et al., 2013, JASA, 134(2), 1283-1294.

178 **140.178** Familiar Speech Sounds Elicit Reduced Brain Activity in the Reward Circuit and Amygdala in Children with Autism

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Background:
The human voice is a critical communication signal for children: speech serves as a primary source for language learning, provides emotional comfort to young listeners and promotes bonding between parents and children. Children with autism spectrum disorders (ASD) often have difficulty orienting to speech in their environment, including highly familiar voices, and it is thought that this deficit plays a key role in communication deficits in this population. Our recent study showed that children with ASD have weak brain connectivity between voice-selective regions of cortex and the distributed reward circuit and amygdala, and the strength of these speech-reward brain connections predicts social communication abilities in these children (Abrams et al., *PNAS*, 2013). These results provide novel support for the Social Motivation Hypothesis, which states that deficits in representing the reward value of social stimuli, including speech, impede children with ASD from actively engaging with these stimuli, and consequently impair social skill development.

Objectives: To further test the Social Motivation Hypothesis in the context of speech perception, we examined brain structures and networks that become active in response to familiar and rewarding speech sounds in children with ASD compared to typically developing children (TD). The Social Motivation Hypothesis predicts that familiar and rewarding speech sounds would elicit reduced neural activity in the brain's reward circuitry in children with ASD compared to control children.

Methods: We used fMRI to measure brain activity in high-functioning children with ASD (n=23) and TD children (n=23) matched for age, gender and IQ. Participants listened to brief (< 1 sec), meaningless speech samples produced by their mothers ("Mother's voice") and two control mothers whose voices were unfamiliar to the participants. We also measured the children's ability to identify their mother's voice using these brief speech samples.

Results: All children included in the study were able to identify their Mother's voice with a high degree of accuracy. In TD children, brain responses showed greater activity for Mother's voice compared to unfamiliar mother's voices in voice selective superior temporal cortex, the amygdala, which is crucial for processing of social and affective information, the ventral tegmental area, nucleus accumbens, orbitofrontal cortex, and medial prefrontal cortex of the reward circuit. Preliminary results from children with ASD indicate that Mother's voice elicits significantly reduced neural activity in voice-selective cortex, structures of the reward circuit, including bilateral ventral tegmental area, and structures of the "social brain," including the amygdala and insula.

Conclusions: Results suggest that impaired signaling between voice-selective areas of the brain and the reward circuit plays a role in the ability of children with ASD to experience speech as a pleasurable stimulus, which may impact social skill development in this population. Results strongly support the Social Motivation Hypothesis by showing that Mother's voice, a familiar and rewarding sound source to TD children, elicits reduced brain activity in the reward circuit and amygdala in children with ASD.

179 **140.179** Moderators of Language Outcomes in Randomized Controlled Esdm Intervention Trial for Toddlers with Autism

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Background: As more children are diagnosed with ASD during the infant-toddler period, the availability of efficacious interventions that can be delivered at a young age is a significant priority. In addition, establishing core treatment targets, delineating the developmental trajectories of those targets, and further elucidating certain child characteristics that moderate treatment response are essential to the clinical impact and dissemination of these interventions.
Objectives: The purpose of the current study is to address two primary questions: "What are the effects of ESDM intervention on language outcomes in toddlers with ASD, using intent to treat analysis to account for study attrition?" and "How do individual child characteristics moderate the relationship between language and intervention?" The current study examined social orienting, response to joint attention, and object use as moderators of treatment response.
Methods: Forty-eight children diagnosed with ASD between 18 and 30 months of age were randomly assigned to: (1) ESDM intervention, based on developmental and applied behavioral analysis principles and delivered by trained therapists and parents for 2 years; or (2) referral to community providers for intervention commonly available in the community. Linear regression was employed to determine whether Time 1 child social orienting, response to joint attention, or object use moderated the effect of ESDM intervention on child outcomes at Time 2 and Time 3 (i.e., one and two years after ESDM was initiated). When moderation was observed, regions of significance were derived to specify the upper and lower values of the moderator at which the ESDM and comparison groups were significantly different.
Results: Compared with children who received community-based intervention, children who received ESDM showed significantly greater improvements in receptive language outcomes at Time 2 and Time 3, as well as expressive language outcomes at Time 3. Moderation analysis revealed that ESDM was more effective than the community intervention at promoting language gains for children with higher Time 1 levels of social orienting, response to joint attention, and object use. Social orienting moderated expressive language gains at Time 2 and Time 3, while object use moderated only Time 2 expressive language gains, and response to joint attention moderated only Time 2 receptive language gains.
Conclusions: This randomized, controlled trial provides a rich source of longitudinal information demonstrating the effectiveness of the ESDM for improving language gains for young children with ASD and further examines certain child characteristics that moderate treatment response. Future research investigating the relationship between such endophenotypes and treatment will contribute important information regarding the individualization of treatment and the impact of early intervention on brain function and organization. Within the ESDM, certain intervention targets for language may include activities incorporating early social communication skills, with those children with higher levels of these skills benefitting more from the ESDM curriculum. For example, improved social orienting may augment the capacity of children with ASD to appreciate stimulus-reward associations and, therefore, display enhanced speed and maintenance of learning within a behavioral intervention paradigm.

180 **140.180** Mutual Exclusivity in Young Children with ASD

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Background:
Typically developing children assume that a novel label describes an unfamiliar object, as opposed to a familiar object with a known name—a phenomenon called mutual exclusivity (Markman, 1990). Mapping novel words to novel objects may help children learn new words, suggesting that deficits in mutual exclusivity could be related to the early vocabulary delays experienced by many children with ASD. Although there is evidence that older children with ASD show mutual exclusivity (de Marchena et al., 2011; Priessler & Carey, 2005), this question has not been investigated in young children with ASD.
Objectives:

1. To determine whether young children with ASD demonstrate mutual exclusivity by attending to a novel image when they hear a novel word.
2. To compare how quickly and accurately these children process novel versus familiar words.

Methods:
Participants were 18 children with ASD between 26 and 36 months old (M = 31, SD = 3); 10 additional children participated but were excluded due to excessive missing data. Bayley-III composite scores

ranged from 55 to 105 ($M = 86$, $SD = 13$), and parent-reported receptive vocabulary ranged from 20 to 316 words ($M = 165$, $SD = 87$).

Children completed an eye-tracking task on a Tobii T60-XL. Each trial simultaneously showed one familiar image (e.g., cat) and one novel image (e.g., wombat). The real-word (RW) condition presented a familiar label (*Find the cat*), and the novel-word (NW) condition presented a novel label (*See the vafe?*). Trials were eliminated if children were not reported to understand the familiar word. Looks at each time point between 200ms and 1300ms after noun onset were categorized as looks to target or distracter.

Results:
A binomial logistic mixed-effects model was constructed with time and condition (RW vs. NW) as the independent variables and looks (target vs. distracter) as the dependent variable. The model included participant*condition random effects for intercept and slope.

In the NW condition, there was a significant non-zero slope; although children showed a strong baseline preference to look at the familiar image, they significantly increased their looking to the novel image after hearing the novel word. Even 1300ms after noun onset, however, children spent approximately the same amount of time looking at the familiar and novel image in the NW condition. Accuracy was considerably lower in the NW than the RW condition; children looked significantly more to the target in the RW than the NW condition. There was also a time*condition interaction, which reflected a significantly greater slope in the NW than the RW condition.

Conclusions:
Young children with ASD increased their looks to a novel image after hearing a novel word, suggesting that they may use mutual exclusivity to determine the referents of new words. Nevertheless, they continued to look at the familiar object about half of the time. This demonstrates the impact of baseline visual preferences on attention allocation in a language-based task. Additional research is needed to investigate the relationships among visual attention, language processing, and language learning in children with ASD.

181 **140.181** Lexical Processing By Toddlers with ASD

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Background:
Few studies have examined lexical processing in young children with autism spectrum disorders (ASD) and none have directly tested whether weak central coherence can explain the early comprehension delays of toddlers with ASD. Applied to the context of lexical processing, the weak central coherence account (Happé & Firth, 2006) predicts that toddlers with ASD will focus more closely on lower-level perceptual details (e.g., similarity of visual referents) than their typically developing (TD) peers, potentially at the expense of higher-level, global integration (e.g., semantic relatedness of referents). This study focused on word-object mappings to explore whether lexical processing in toddlers with ASD would be more disrupted, compared to TD peers, by perceptual similarities between pictures while being less disrupted by semantic similarities.

Objectives:
Using an implicit eye-gaze paradigm, this study assessed real-time comprehension (lexical representations) in toddlers with ASD relative to typically developing controls and examined the role of vocabulary size in lexical processing.

Methods:
Toddlers with and without ASD (TD $n=29$, ASD $n=30$) participated in this study; groups were matched on Bayley cognitive raw scores. An experienced clinician made ASD diagnoses by integrating results from the ADOS, ADI-R, and clinical experience. A looking-while-listening task (Fernald et al., 2008) was employed in which each trial presented two pictures on a screen (e.g., sock, dog) with audio describing one of the images (e.g., *Where's the dog?*). An adaptation of the Arias-Trejos & Plunkett (2010) task was used in which the two images were unrelated (baseline condition), semantically similar (e.g., hat, boot), or perceptually similar (e.g., crescent moon, banana). Gaze location was hand-coded offline from video.

Results:
Results were analyzed using growth curve analysis (Mirman, 2014); the outcome was log odds of looking to target. Two models were constructed; each contained linear, quadratic, and cubic time terms and included participant and participant by condition random effects. The first model revealed that the TD group looked to the target significantly more than the ASD group (Figure 1). A condition effect was found such that lexical processing was significantly better in the baseline condition (unrelated images) than the perceptually similar or semantically similar conditions. There was no significant group by condition interaction. A second model of the ASD group alone revealed two significant three-way interactions among condition, linear slope, and vocabulary size. As vocabulary size decreased, children's processing speed (i.e., linear slope) was more disrupted by perceptually-similar distracters as compared to the other conditions (visualized as a median split in vocabulary level in Figure 2).

Conclusions:
Although toddlers with ASD performed more poorly than the cognition-matched TD toddlers, lexical processing in both groups was affected by the semantic and perceptual similarity of distracter

images. Toddlers with ASD who had smaller receptive vocabularies were more disrupted by distracter images that looked similar to the target than images that were semantically related or unrelated. These results provide partial support for weak central coherence but suggest that how toddlers process lexical information is dependent upon vocabulary size.

182 **140.182** Parent-Child Mutual Responsiveness, Language Development, and Peer Relationships in Young Children with Autism Spectrum Disorder

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Background: Parental responsiveness has been shown to relate to language development in children with ASD. However less is known about how child behavior contributes. Mutual responsiveness, a two-part interaction, in which both parent and child initiate and respond, may also relate to language abilities and peer relationships in children with ASD.
Objectives: 1) Characterize mutual responsiveness patterns in preschool children with ASD and their parents, 2) Examine the relationship between mutual responsiveness and concurrent language ability 3) Investigate the relationship between mutual responsiveness and concurrent peer relationships.
Methods: 41 preschool-age children with ASD and their parents were part of a larger study on early intervention, the Early Start Denver Model. The parent-child dyads completed a 15-minute video-recorded play interaction that was coded by highly-trained coders. Measures included 1) a global interaction rating scale to characterize mutual responsiveness following the play interaction, in which coders rated behaviors on a scale of 1-9, with higher scores indicating higher frequency of interactive verbal and nonverbal behaviors throughout the task. Items include "does the parent consistently respond to the child's interests or initiations?" and "does the child vocalize in response to the parent?" 2) Micro-analytic codes using the Relationship Affect Coding System for verbal, nonverbal, and affective behavior including talk, orienting, and positive affect of children and parents during the play interaction, which will be used to characterize mutual responsiveness, 3) a standardized, norm-referenced language test, the *Preschool Language Scale, 4th Edition (PLS-IV),* and 4) selected items from the *Autism Diagnostic Interview-Revised (ADI-R)* describing peer relationships.
Results: The first mutual responsiveness pattern detected was a range of global impressions ratings (mean=6.2, SD=1.01, range=3.72-8.2). Additional analyses will investigate mutual responsiveness patterns using micro-analytic coding. Global interaction ratings were significantly related to better language ability (r (41) = .47, $p < .01$.). Global interaction ratings and peer relationships were not significantly related (p=0.59). Additional analyses will investigate the relationship between micro-analytic coding of mutual responsiveness and peer relationships.
 Conclusions: Preliminary results suggest global ratings of parent-child mutual responsiveness show a range (from less to more frequent responsiveness) and are significantly related to concurrent language abilities in preschool children with ASD.   This has implications for parent-implemented interventions which could be enhanced by targeting frequent responsive behavior verbally, nonverbally, and affectively in parent-child interaction to improve language development in children with ASD.

183 **140.183** Perceptual Binding and Audiovisual Speech Perception in Autism Spectrum Disorders

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Background: Social communication, one of the core areas of symptoms in autism spectrum disorders, is intrinsically reliant on sensory perception. Communicating with others requires auditory and visual perception, and recent work has led to the hypothesis that atypical sensory perception may contribute to difficulties in speech communication. Specifically, an individual's ability to integrate multiple sensory inputs into a single coherent percept (i.e., perceptual binding) may impact their speech perception abilities.
Objectives: Our goals were to (A) measure differences in speech-perception abilities between individuals with and without ASD, (B) determine if perceptual binding abilities were related to speech perception in ASD, (C) determine if this relationship was specific to speech in ASD, and (D) determine if this relationship was multisensory specific, or if it was also present in unisensory visual binding in ASD.
Methods: Participants (N(ASD)=19, N(TD)=36, data collection ongoing, mean age=12) completed four commonly-used perceptual binding tasks (see figure), and a speech perception in noise task. The paradigms used include: the McGurk paradigm (audio-visual, social communicative), the sound-induced flash illusion (audio-visual, non-social communicative), the composite face task (visual-visual, social communicative), and the global-local composite letter task (visual-visual, non-social communicative). These binding paradigms varied according to modality (audio-visual or visual-visual binding) and inclusion of social communication (socially communicative or non-socially communicative). In the speech-perception task, individuals performed an audiovisual single-word recognition task where the auditory word was embedded in background noise (word=66 dB,

noise=72 dB).

Results: Results to date show a significant difference in audiovisual speech perception between individuals with and without ASD (ASD=40% accuracy, TD=52% accuracy, p<0.002). Furthermore, we examined the degree to which performance on the speech-in-noise task could be predicted by performance on the four other binding tasks. Individuals with ASD showed a strong relationship between audiovisual speech binding, measured with the McGurk effect, and speech perception accuracies (r=0.68, p=0.003). However, individuals with ASD did not show a significant correlation between binding of audiovisual non-speech, measured with the sound-induced flash illusion, and speech perception (r=0.11). Furthermore, neither of the visual-visual binding tasks were correlated with speech perception rates (r's<0.10).

Conclusions: These data provide evidence of impairments in speech perception in individuals with ASD relative to individuals without ASD. Importantly, the strong correlation between performance on the McGurk paradigm and speech recognition rates suggests that the reduced ability to accurately perceive audiovisual speech may be due, in part, to a reduced ability to perceptually bind the auditory and visual components of speech. The concurrent lack of relationship between non-speech audiovisual binding and speech perception suggests that this effect may be specific to social-linguistic processing, reflecting the core symptomology of autism. Finally, no relationship was seen between visual-visual binding abilities and speech perception, implying that the differences between groups leading to reduced speech perception accuracies is specifically a multisensory issue. These data support the hypothesis that low-level differences in sensory perception, specifically perceptual binding, contribute to speech perception impairments. These effects are specific to speech, and specific to perceptual binding across sensory modalities.

184   **140.184**   Pitch Perception in Autism Is Associated with Superior Non-Verbal Abilities

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Background: Many individuals with Autism Spectrum Disorders (ASD) have atypical auditory perception and concurrent language impairments. Studies have reported enhanced abilities in ASD for both low-level pitch discrimination (Bonnel, 2010) as well as higher-level global-local pitch processing (Heaton, 2005), resulting in heterogeneous auditory profiles. Despite this, auditory perception in ASD remains poorly understood and it is unclear how performance on these different auditory tasks interacts with development of verbal and non-verbal cognitive abilities in ASD.

Objectives: The objectives of the present research were to examine the effect of verbal and non-verbal cognitive abilities on both low-level (pitch direction) and higher-level pitch processing (global-local pitch perception) tasks in children with ASD and typically developing (TD) controls.

Methods: Participants were 17 children with high-functioning ASD and 19 TD children who had no neurological or psychiatric history, and were recruited from the NeuroDevNet ASD Project (Zwaigenbaum et al, 2011). Groups were matched on age (mean age 13.3 years, range 9-18 years) and IQ (mean IQ 113.5, SD 13.6). Verbal and non-verbal cognitive abilities were measured using verbal IQ and performance IQ of the Wechsler's Abbreviated Scale of Intelligence (WASI). Additionally, in the ASD group ADI-R, ADOS and CELF-4 were used to assess language abilities. In the low-level pitch task (Foster et al., 2014), participants heard two tones of different frequencies on each trial and judged whether the pitch rose or fell. In the higher-level global-local task (Ouimet et al., 2012), stimuli consisted of 9-tone melodies, each comprising three triplet (3-tone) sequences. Participants discriminated between ascending and descending pitch direction at the global (across triplets) or local (within triplets) level. In all tasks, the relationship between task performance (percent accuracy) and verbal/ non-verbal abilities was assessed using linear regression.

Results: Performance on each of the pitch tasks was not related to verbal ability in ASD or TD (all P>0.05). However, performance across participants on both low- and high-level pitch tasks was significantly related to non-verbal ability (both P<0.05), primarily the 'Blocks' subtest of the WASI (both P<0.05). For the high-level global pitch task alone, there was a significant interaction between group and non-verbal (performance) IQ (P=0.05), predominantly for the 'Blocks' subtest (P=0.05). This interaction was driven by the fact that TD showed a positive relationship between performance on global pitch judgments and the 'Blocks' subtest, whereas ASD showed a negative relationship between these measures (Figure 1).

Conclusions: The present findings suggest that verbal abilities do not predict performance on low or higher-level pitch tasks in TD or ASD. However, non-verbal abilities (especially the 'Blocks' subtest) predict better auditory perception in general, and particularly on higher-level global-pitch tasks in TD. These findings suggest that previously reported superior auditory perceptual skills in ASD might be observed only in a subset of individuals with verbal impairments. However, in IQ-matched, high-functioning ASD individuals without a language delay, pitch discrimination abilities are comparable in ASD and controls, and more related to non-verbal rather than verbal skills.

140.185 Quality of Communication in Young Adults with Autism during a Simulated Employment Interview
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Background:
Many adults with autism spectrum disorder have difficulty finding a job. Even when they are not intellectually disabled and are therefore "high functioning" (HFA), many are un- or under-employed. Communication skills play a key role in obtaining a job and one concern is that interviewers may judge the communication of adults with HFA negatively.   If so, adults with HFA may not advance beyond an interview despite being qualified.
Objectives:
Our objectives were to determine: (1) Whether listeners judge the language quality of adults with HFA differently than that of matched controls in a simulated employment interview? (2) What dimensions of communication (i.e., semantics, syntax, pragmatics or prosody) influence community listeners' judgments of language quality in the simulated interview? We expected that average ratings of quality would be poorer for the adults with HFA and that pragmatic items would most influence quality ratings in the HFA group.
Methods:
Fifty-nine university students rated the "quality" of audio-recorded interviews collected from 20 young adults with HFA and 20 matched controls. Quality was defined as: a) the amount of information conveyed b) the ease of understanding interviewee responses and c) how easy it seemed for the interviewee to participate in the interview. Second-by-second reactions to communication quality were recorded electronically using an interval scale ranging from 0-100. Following each interview, a 14-item questionnaire was administered to assess which dimensions of communication influenced listeners' judgments of language quality. Listeners rated each item on a 7-point sliding scale (1 = no influence and 7= significantly influenced).
Results:
Average communicative quality of the adults with HFA was judged as poorer (M=45.00) than communicative quality of the controls (M=73.63, $t(27.23)= 7.76$, p = .001). On the questionnaire, multivariate analyses for each communication domain revealed significant group differences on all dimensions; pragmatic, $F(6,33)= 12.23$, p<0.01; syntactic, $F(2,37) = 6.70$, $p=0.003$; vocabulary, $F(2,37) = 17.70$, p<0.01 and prosody $F(4,35) = 7.55$, p<0.01. Follow up ANOVAs revealed that specific pragmatic features, such as providing irrelevant or inappropriate details, using overly formal language, shifting topic unexpectedly, repeating topics, excessively talking about an event and providing limited responses were influential as were grammatical errors, vague vocabulary, use of unusual words, unusual voice quality, excessively fast/slow speech, and excessive use of pauses/interjections.
After listening to each interview a 'yes/no' question was posed to the listeners about whether or not they would proceed with a second interview or offer a job to the interviewee. A Fisher's exact test was conducted comparing the number of participants in each group where more than 70% of the listeners for each interview would recommend a second interview or offer the interviewee a job. Only 30% in the HFASD group compared to 75% in the control group would be offered a second interview or job (p < .01).

Conclusions:
Listeners readily recognize differences in communicative quality and they can have a negative impact on judgments made by conversational partners. These results may help explain why adults with HFA sometimes fail to advance beyond a job interview, despite being well-qualified.

140.186 Quantifying the Use of Gestures in Autism Spectrum Disorder

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Background: Autism Spectrum Disorder (ASD) is characterized by difficulties in communication and social interaction. In the absence of a biomarker, a diagnosis of Autism Spectrum Disorder (ASD) is reached in settings such as the ADOS (Lord et al., 2000) by observing disturbances of social interaction such as abnormalities in the use of gestures or flow of conversation. These observations rely exclusively on clinical judgement and are thus prone to error and inconsistency across contexts and clinicians. While studies in children show that co-speech gestures are fewer (e.g. Wetherby et al., 1998, Sowden et al., 2013) and for different use (Camaioni et al., 2003), de Marchena and Eigsti (2010) found that in adults some gestures are used with similar frequency in ASD and TD populations, but that their timing and their beneficial impact on the quality of communication are impaired. This may indicate that abnormal temporal processes contribute to impaired social skills in ASD (Allman, 2011).
Objectives:
-        Quantify the production of gestures in ASD in naturally occurring language
-        Characterise the temporal dynamics of speech and gesture coordination in ASD using two

acoustic indices; pitch and volume
Methods:
The context of a previously published study of memory in ASD (Maras et al., 2013) provided the opportunity to examine video recordings of 17 ASD and 17 TD adults attempting to recall details of a standardised event they had participated in (a first aid scenario). The videos were segmented to identify single gestures and their timing and linguistic type (iconic, metaphoric, deictic, beat) were documented. In addition the quantity of movement as well as the pitch and volume of speech over time were extracted. Recurrence quantification analysis was then used to examine whether gestures were time-locked to speech similarly in ASD and TD individuals and whether patterns of recurring behaviour would emerge similarly in both groups.
Results: Overall, our results indicated no main group difference in the use and coordination of speech and gesture: both groups produced the same quantity of movement over time (t(33)=-0.165, p>.8), and gestures were produced within the same time window and with a temporally similar distribution by ASD and TD individuals (η^2_p=.042). However we found that the recurrence rate of quantity of movement and intensity of speech was marginally higher in the TD group than in the ASD group (t(34,2)=2.075, p=.052), which indicates that changes in movement and intensity of speech were more often time-locked in typical then ASD individuals.
Conclusions:
The current data suggest that ASD adults use conversational gestures as often as TD individuals, and when they do so the temporal coordination of speech and gesture is on average no different. However, typical individuals demonstrate a stronger temporal synchronisation of their speech volume and co-speech movements. The somewhat looser coordination of speech and co-speech movement in ASD could contribute to the clinical observation of abnormal flow of conversation and use of gesture.

187   **140.187** Quantitative Analysis of Disfluency in Children with ASD

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Background: Difficulties with pragmatic language, including conversational reciprocity, are common in children with autism spectrum disorders (ASD). Compared to non-affected children, children with ASD have difficulty initiating conversation (Tager-Flusberg 1996), responding to the initiations of others (Capps et al. 1998), taking turns (Botting & Conti-Ramsden 2003), and staying on topic (Losh & Capps 2003, Paul et al. 2009). Another element of conversational reciprocity is the use of disfluencies, which act as interpersonal signals between speaker and listener. On hearing a disfluency, a listener may infer that the speaker is experiencing difficulty planning or delivering speech (Clark & Fox Tree 2002) or that the speaker wishes to correct earlier speech (Clark 1994). We hypothesized that this element of conversational reciprocity would be another area of difficulty for individuals with ASD. Indeed, several studies find that children and adults with ASD produce different patterns of disfluency than nonaffected individuals (Lake et al. 2011, Shriberg et al. 2001, Suh et al. 2014, Thurber & Tager-Flusberg 1993), though these studies report conflicting results concerning the exact nature of these differences.
Objectives: We conducted a large-scale exploratory study to better quantify disfluency use in children with ASD.
Methods: 110 children ages 4;0-9;0 participated, in three groups: ASD (n = 50), specific language impairment (SLI; n = 17) and typical development (TD; n = 44). All children were high functioning monolingual English speakers. Diagnoses were verified by best-estimate clinical consensus. A clinician administered the Autism Diagnostic Observation Schedule (ADOS; module 2 or 3) to each child. These sessions were recorded and transcribed, and all disfluencies (n = 12,888) were annotated and tabulated. Disfluencies were either categorized as "fillers" ("uh", "um", "mm", etc.) or "content mazes", including repetitions (e.g., "...and these---and these too"), revisions (e.g., "He's waterskiing with a balloon---with a parachute."), and false starts (e.g., "He got like---it was this finger.").
Results: Disfluencies were analyzed using mixed effects logistic regression; covariates included chronological age, full-scale IQ, mean length of utterance in morphemes (MLU), maze position (i.e., utterance-initial vs. non-initial), and ADOS activity. The three groups exhibited comparable overall rates of disfluency. However, there were significant group differences in the relative frequency of fillers vs. content mazes (p < .001). Post-hoc tests revealed that children with ASD produced a higher rate of content mazes (compared to fillers) than children with SLI (p = .030) or typical development (p < .001). There was also a significant interaction between group and maze position: typically-developing children tended to produce content mazes initially and fillers non-initially, but children with ASD showed the opposite pattern. Disfluency type was not associated with age, IQ, or MLU.
Conclusions: Children with ASD (but not children with SLI) produce different patterns of disfluencies than TD children, including significantly higher rates of content mazes. If confirmed, this result may provide clinicians with a novel feature distinguishing ASD, and may ultimately be a promising target for intervention in verbal, high-functioning children with ASD.

188   **140.188** Relationship Between Autism Spectrum Disorder Education and Clinical Decision-Making in Early Intervention

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Background: The American Speech-Language-Hearing Association (ASHA; 2006) emphasizes the critical role of speech-language pathologists (SLPs) in the early identification of and intervention for autism spectrum disorder (ASD). Speech-language intervention for children under the age of three typically focuses on the development of social communication skills. These skills, including prelinguistic communication such as the use of eye contact, gestures, and joint attention, have been shown to predict later language outcomes (Laakso et al., 1999; Rowe, Özçaliskan, & Goldin-Meadow, 2008; Watt, Wetherby, & Shumway, 2006). Thus, early intervention that targets social communication can have a cascading impact on language development. It is important to evaluate the knowledge and use of evidenced-based intervention practices by SLPs providing early intervention for children with social communication deficits including ASD.

Objectives: This study used survey responses from SLPs working in early intervention settings with children with social communication delays to determine how clinician educational experiences impact their clinical practices.

Methods: The investigators created a web-based, 25-item Qualtrics survey to obtain information about the respondents' academic preparation, continuing education, and clinical practices in the area of early intervention for children with social communication delays. SLPs who work in an early intervention setting were contacted through two methods—ASHA Community listservs and direct member emails— and were invited to complete the survey. The survey was available for six weeks; 425 surveys were initiated and 282 respondents answered all questions for a completion rate of 66%. Respondents had worked as SLPs for an average of 16.5 years (SD = 10.9) and worked specifically with children under three for a mean of 12.3 years (SD = 9.0). 56.6% of respondents were working in state-funded birth-to-three settings; the remainder worked in preschools, elementary schools, clinics, hospitals, home health agencies, or other agencies. Participants responded from 38 US states and Canadian provinces.

Results: Approximately half of the respondents (49.8%) reported participation in more than 30 hours of continuing education related to autism, while only 11.7% had a graduate level class on ASD. A medium, negative correlation was observed between respondents' years working as an SLP and coursework covering ASD such that SLPs who had been working fewer years were more likely to have had graduate level coursework in ASD. Additionally, ASD coursework was observed to be negatively correlated with using personal clinical experiences to make decisions and positively correlated with using recommended practice guidelines to structure intervention. Significant, medium positive correlations were observed between continuing education in ASD and use of own clinical experiences and recommended practices. Further analyses will be performed to explore the relationship between ASD education and specific clinical practices.

Conclusions: While SLPs who have recently graduated may be more likely to complete ASD coursework, SLPs are more likely to learn early social communication intervention strategies through continuing education than coursework. Intervention strategies learned during graduate and continuing education impact use of treatments that adhere to recommended practice guidelines.

189   **140.189** Relationship Between Handedness and Language Function in Autism

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Background:
Language impairment is an important core symptom in autism spectrum disorder (ASD). It is imperative to understand its biological mechanisms in order to find early predictors of language dysfunction *(1)* and devise early treatments. Handedness-language relations may give insight into biological mechanisms of language in ASD. Handedness and language may be linked in various ways. *First,* the hemispheres used for cognitive and motor aspects of language depend on handedness. In right-handers, structural language is strongly left-hemisphere dominant *(2,3)*, but in left-handers is weakly hemisphere-dominant *(4)* and frequently bi-hemispheric *(3)*. Language prosody is typically right-hemispheric *(e.g., 5,6,7)*. In contrast, covert/overt motor speech output uses left premotor/motor areas in right-handers, and vice-versa *(8)*. Thus, depending on handedness some aspects of language may require interhemispheric connectivity and information flow, which may be compromised in ASD. *Second,* the presence/absence of hand preference may indicate degree of hemispheric specialization. Decreased hemispheric specialization may be a cause of language impairments in ASD. Thus, handedness-language relationships may provide a window into two possible mechanisms of language impairment: decreased interhemispheric connectivity, and decreased hemispheric specialization. There are few studies of handedness-language relationships in autism *(9-11)*, which are typically limited by too few left-handers.

Objectives:
Test for associations between handedness (right/left/ambiguous) and language in a large sample of children with well-verified ASD from simplex and multiplex families.

Methods:
We analyzed data from the Autism Genetic Resource Exchange (AGRE) database. Because handedness presents at ~5 years *(12)*, we chose a minimum age of 7 (to reduce effects from any handedness delay) and a maximum age of 17. Our sample was N=403 children with ASD. Children

were grouped into normal (OLANG=0) and abnormal (OLANG>0) language on the basis of the ADOS Overall Level of Non-Echoic Language. Children with inadequate language for assessment (OLANG=8) were excluded. Handedness was coded as left (N=35) vs right, and then as ambidextrous (N=30) vs hand-dominant. The non-independence of observations inherent with familial data was accounted for using PROC SURVEY procedures (SAS v9.4).

Results:
Among children with ASD, right-handers had 2.18 times the odds of abnormal language compared to left-handers (odds-ratio=2.18; 95%-confidence-interval 1.07-4.44; p=0.03). There was no association between language and ambidexterity (odds-ratio=0.65; 95%-confidence-interval: 0.31-1.58; p=0.30). The decreased language function in right-handers could be explained by decreased connectivity from right-hemispheric (prosodic) language areas to left-hemispheric motor speech areas (consistent with lack of prosody in ASD). In contrast, in left-handers, language areas are more commonly bilateral, and language areas can thus access right-hemispheric motor speech areas without interhemispheric transfer.

Conclusions:
Decreased language function in right-handers versus left-handers with ASD suggests decreased interhemispheric connectivity as a mechanism. The lack of ambidexterity effect suggests that reduced hemispheric specialization is a less likely mechanism. These results show the utility of hand preference data for interpreting interhemispheric connectivity and hemispheric specialization.

References:
[1]Stone & Yoder (2001); [2]Knecht et.al (2000a); [3]Pujol et.al (1999); [4]Knecht et.al (2000b); [5]Shapiro & Danlye (1985); [6]Behrens (1989); [7]Pell (2007); [8]Longcamp et.al (2005); [9]Tsai (1983); [10]Escalante-Mead et.al (2003); [11]Lindell & Hudry (2013); [12]McManus et.al (1988).

190   **140.190** Say What?: Toddlers' Vocabulary Growth Trajectories Differ By Word Features

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Background: Infants and toddlers later diagnosed with ASD often experience significant language delays, and concern about language is one of the first reasons parents seek evaluation. It is unknown whether these delays affect certain vocabulary types more than others, which might lead providers to target specific word types for intervention. Recent research suggests that words labeling concrete and image-able referents like 'cup' are easier for typical children to learn, whereas words for abstract concepts like 'later' are not learned as readily. Given prior research suggesting that children with ASD tend towards a concrete and perceptually driven worldview, we hypothesize that difficulty learning abstract words may partially account for previously observed overall depressions in language development early in life in ASD.

Objectives: To test whether vocabulary growth from 12-24 months differs according to word abstractness in high-risk siblings that went on to develop ASD, and high-risk and low-risk siblings that did not develop ASD.

Methods: Our sample included 365 high-risk (HR) and low-risk (LR) children with the MacArthur-Bates Communicative Development Inventory (CDI; Words and Gestures) completed by a parent at 12, 18, and/or 24 months. Children were assessed for ASD at 24 months using ADOS and DSM criteria, and categorized as HR-ASD (n=57), HR-non-ASD (n=203), and LR-non-ASD (n=105). Words from the CDI were grouped into "concrete" (e.g., words for food and drink; toys) or "abstract" (e.g., words for time; pronouns) categories. We calculated total words understood as a measure of receptive vocabulary and total words understood+said as a measure of expressive vocabulary. Linear mixed models were used to compare growth trajectories.

Results: There was a main effect of Group in overall receptive vocabulary from 12-24 months, $F=3.62$, $p=.03$, LR-non-ASD>HR-non-ASD>HR-ASD, and no GroupxTime interaction. There was no main effect of Group in overall expressive vocabulary, but there was a GroupxTime interaction, $F=6.03$, $p=.003$, LR-non-ASD>HR-non-ASD>HR-ASD. Similarly, concrete expressive vocabulary (e.g., toys) did not differ by Group, and there was no GroupxTime interaction, all ps=n.s. (Figure 1). In contrast, growth rates in abstract expressive vocabulary (e.g., words for time) differed by Group, $F=10.15$, $p<.001$, and there was a GroupxTime interaction, $F=41.77$, $p<.001$, LR-non-ASD>HR-non-ASD>HR-ASD (Figure 2).

Conclusions: This pattern of results suggests that concrete words are spared in the expressive vocabularies of HR-ASD, while abstract word vocabularies are impaired. Furthermore, abstract word learning may be difficult even for high-risk siblings that do not meet diagnostic criteria for autism. On-going analyses include parsing concrete vocabulary into social and non-social categories, including effects of mental age at each time point, correlating semantic category growth with autism symptoms, matching on overall vocabulary to account for this effect, and examining possible

language disorders in the high-risk sibling group.

191 **140.191** Some Wh-Questions Really Are Hard for Children with ASD to Understand

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Background: Wh-questions are problematic 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 children with ASD compared to their typical peers (1, 2). However, earlier comprehension studies may have been limited because their stimuli included unfamiliar verbs (e.g., *hit*, produced by few children with ASD) and actions with inanimate agents and patients (e.g., an apple and a flower). The current study addressed both of these issues, testing wh-question comprehension with videos showing animate characters engaged in well-understood actions.
Objectives: We investigate the degree to which including familiar verbs and animate characters will elicit robust comprehension of wh-questions by children with ASD.
Methods: Fourteen children with ASD (MA = 33.42 months) and 17 TD children (MA = 19.74 months) were assessed every four months for two years in this longitudinal study. At visit 1, the children with ASD did not differ from the TD children in either Mullen Expressive (M_{ASD}=16.29, SD=6.64; M_{TD}=20.35, SD=5.70) or Receptive (M_{ASD}=19.64, SD=10.37; M_{TD}=22.76, SD=3.87) raw scores. At visits 1-2, children demonstrated understanding of SVO word order using intermodal preferential looking (IPL) videos in which a costumed horse and bird engaged in familiar actions (e.g., distinguishing 'bird washes horse' from 'horse washes bird' (3)). At visits 3-6, children watched the Wh-Question video, in which each horse-and-bird action was followed by three types of trials in which the horse and bird appeared side by side. The audios were e.g., "Where is the bird/horse?" for Where/Control 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. To show reliable comprehension, children should look longer at the named item (i.e., horse or bird) during the "where" questions than during the Subject-wh and Object-wh questions.
Results: Starting at 32 months of age, TD children looked significantly longer at the named item during the "where" trials than during both the object-wh and subject-wh-questions trials (ts(16) > 3.65, p< .002). The ASD group showed no significant differences between 'where' and subject-wh or object-wh questions even by Visit 6 (i.e., 53 months). Two (2 (group: ASD, TD) X 2 (trial: where vs. subject-wh or object-wh)) ANOVAs with the visit 4 data revealed a significant group x trial interaction for the 'where' vs. 'subject-wh' comparison (F(1,29) = 4.25, p= .048), indicating that the two groups showed different patterns of looking at this visit. Some children with ASD did show good wh-question comprehension at visit 3; these had higher Mullen Receptive and Expressive scores at visit 1. However, standardized test scores did not predict wh-question comprehension at later visits.
Conclusions: Using highly familiar actions/verbs and animate characters as stimuli did not result in better wh-question comprehension by the children with ASD. In fact, they performed less consistently than their mental-age peers had in previous studies (2). We conclude that wh-questions present linguistic challenges to children with ASD that go beyond issues of stimuli.

192 **140.192** Spoken Language in School-Aged Children with ASD and ADHD in a Virtual, Public Speaking Task

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Background: Standardized language measures for Higher-Functioning children with autism (HFA) and Higher-Functioning children with ADHD may be on par with their typically developing peers (TD); however, the language that they produce seems qualitatively different, particularly in their ability to communicate effectively and in a social context (Losh & Capps, 2003). In the current study, we investigate the particulars of these group differences, comparing the more obvious measures of noun and verb usage and sentence complexity with more subtle indicators such as discourse markers, which not only 'glue' conversational turns together (e.g.,'so', 'like', 'uh', 'um'; Shiffrin, 1988) but also shape and uniquely characterize how a person speaks.
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: 150 children aged 8-16 are currently participating in a longitudinal study of attention, social, and academic development in children with HFA. Here preliminary data are presented on 12 HFA, 15 TD, and 14 ADHD Age- (Ms = 11.85, 12.33, 11.96, respectively) and Verbal IQ- (M= 99, 108, 93 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 "targets" 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 Utterance (MLU), noun types and tokens, verb types and tokens, discourse marker types and tokens).

Results: ANOVAs revealed no significant group effect of MLU; however, children with ADHD and HFA tended to produce shorter utterances than TD children (Ms= 9.6, 11.23, 16.38 words respectively), $F(2, 38)= 2.976$, $p = .063$. Groups differed significantly in verb token production $F(2, 38)= 4.147$, $p = .023$ (see Figure 1); the TD group produced significantly more verb tokens than the HFA group especially during the High-Demand Social Attention Condition ($p<.05$). In addition, across groups total discourse marker use varied by phase, $F(1, 38) = 14.193$, $p = .001$, $\eta^2= .272$, with children producing more discourse markers during the phases with greater cognitive load (see Figure 2).

Conclusions: The VR paradigm reveals subtle language differences between groups: children with HFA produced fewer verbs than controls, possibly because their replies were generally terse. Moreover, their language use appears to be affected by social and high attention demand contexts. Future analyses will compare the specific discourse markers used most frequently—or avoided—by each group.

193   **140.193**   Study of Communication Deficits in the Siblings of Children with Autism Spectrum Disorders Using the Children's Communication Checklist-2: A Pilot Initiative from India

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Background: Researchers have reported an increased risk for Siblings of children with Autism Spectrum Disorders (S-ASD) to have subtle characteristics of Autism Spectrum Disorder (ASD), known as the Broad Autism Phenotype (BAP). Though Pragmatic Language Deficit (PLD) is a hall mark feature of ASD, both PLD and structural language deficits have been reported in S-ASD. However studies are few and have not been convergent. Use of the Children's Communication Checklist (CCC-2 Bishop, 2003) in the S-ASD has been reported in literature (Bishop, 2006; Taylor, 2013) to identify heritable ASD phenotype. The current pilot study attempts to explore communication deficits among S-ASD who belong to a different cultural background, thereby contributing to the existing literature. Such a study could allow one to gain further insight into the understanding of cross cultural phenotypic variations, if any.

Objectives: To compare the CCC-2 scores in siblings of children with ASD (S-ASD), Down's Syndrome (S-DS) and siblings of typically developing (S-TD) children.

Methods: The study comprised a total of 63 participants divided into 3 groups; S-ASD (n=17), S-DS (n= 18) S-TD (n=28). They were assessed on the CCC-2, a questionnaire that was filled by parents. Group differences were assessed on the two composite scores, the General Communication Composite (GCC) and the Social Interaction Deviance composite (SIDC) and also on a CCC-2 total score (total of all 10 subscales). Further each subscale was examined. Nonparametric tests with Bonferroni corrections were used to examine group differences.

Results: Kruskal-Wallis test showed significant differences between groups on the GCC (p=<0.001), SIDC (p=<0.05), CCC-2 total (p=<0.001) and 7 of the 10 subscales (p=<0.05). While there were no differences on the speech, syntax and semantics subscales- all three assessing structural language, there were differences on the sub-scales that assess i) pragmatic language (inappropriate initiation, stereotyped language, use of context, non-verbal communication) ii) behavioural domains relevant to ASD (social relations, interests) and iii) only on one subscale that assesses structural language (coherence). Thus the present study demonstrated that S-ASD have significant PLD over structural language deficits as measured by the CCC-2. In contrast to the previously reported studies (Bishop, 2003; Taylor 2013), the present study has demonstrated poor SIDC scores, an index sensitive to pragmatic impairment, in S-ASD. Mann-Whitney test indicated no group differences between the S-DS and S-TD indicating that differences in S-ASD cannot be attributed to presence of a sibling with disability alone.

Conclusions: This study lends support to the presence of mild forms of PLD in S-ASD and suggestive of CCC-2 being a sensitive tool to pick up the same. It is also important to identify such PLDs in S-ASD early and initiate appropriate interventions. The present study warrants further exploration on a larger group supported by direct observations.

194   **140.194**   Testing the Validity of the Pictorial Infant Communication Scale in Preschool-Aged Children with Autism Spectrum Disorder

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Background: Joint attention is a crucial milestone in the development of communication and a notable area of deficit in children with autism spectrum disorder (ASD; Sigman & Ruskin, 1999). While valid parent-report measures of communicative abilities are available, assessment of joint attention is primarily limited to semi-structured, examiner-led interactions, which are time consuming and laborious to score. The Pictorial Infant Communication Scale (PICS; Delgado, Mundy, Venezia, & Block, 2003) addresses the need for an efficient parent-report measure of joint attention. The PICS is a brief (sixteen item) parent-report measure of nonverbal communication for use with infants and toddlers.

Pictures are presented next to each item to aid parents' understanding of the specific behaviors of interest. While preliminary analyses suggest strong construct validity and reliability with ASD samples (Ghilain et al., 2014), associations with established measures of joint attention and language skills have not yet been evaluated.

Objectives: To investigate the concurrent validity of the PICS, a parent-reported measure of joint attention abilities, in preschool-aged children with ASD.

Methods: Participants included 197 children with ASD who were recruited as part of a larger study examining the comparative efficacy of public school-based intervention models for preschoolers with ASD (Boyd et al., 2014). Children were between the ages of 3 and 5 years (M = 47.60 months, SD= 7.49 months) at enrollment, and were assessed twice during the school year (pre- and post-test). Parents completed the PICS at pre-test. The PICS yields subscale scores for Initiating Joint Attention (IJA), Initiating Behavioral Requests (IBR), and Responding to Joint Attention (RJA), as well as a Total Score. To obtain a direct clinical measure of child joint attention and language skills, a subset of children (n = 25) were administered the Early Social Communication Scales (Mundy et al., 2003), the Mullen Scales of Early Learning (MSEL; Mullen, 1995), and the Preschool Language Scale, Fourth Edition (PLS-4; Zimmerman, Steiner, & Pond, 2002) at pre-test. Pearson r correlations among scores on the PICS and ESCS, and the PICS and PLS-4 and MSEL were calculated.

Results: PICS Total, IJA and RJA scores were significantly and positively correlated with ESCS RJA (ps < .01; see Table 1). In addition, PICS IJA scores were significantly associated with ESCS IBR scores (p < .05). Additional analyses indicated that Total Score on the PICS was significantly and positively correlated with both receptive and expressive language scores on the PLS-4 and the MSEL (ps < .05; see Table 2). Language scores were strongly correlated with PICS IJA and RJA scores (ps < .01) but not IBR scores.

Conclusions: Taken together with previous reports of strong psychometric properties (Ghilain et al., 2014), findings suggests that the PICS is a valid tool for measuring joint attention skills in preschool-aged children with ASD. Future research examining the PICS' ability to distinguish between children with and without ASD may be useful in clarifying its role in screening and/or treatment efforts.

195 **140.195** Thai Lexical Tones in Children with Autism Spectrum Disorder

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Background:
One of a core deficit for individuals with Autism spectrum disorder (ASD) is communication impairments. Studies found that some children with ASD have unusual or odd-sounding prosody, i.e. abnormal stress, rate, affect, and intonation.

Lexical tones are a phonetic contrast necessary for conveying meaning in many languages. Thai language is one of the tonal languages which lexical tone dictates meaning. Various speech and language disorders affect the ability to produce lexical tone, thereby seriously impairing individual's communicative abilities. To the best of our knowledge, there has been no study regarding lexical tones production in children with ASD. This study compares lexical tones production between Thai children with ASD and typically developing (TD) children.

Objectives:
To study acoustic parameters of lexical tones production in Thai children with ASD in comparison with typically developing children.

Methods:
Sixty-three children aged 6 to 12 years old were participated, 30 children with ASD and 33 TD children matched for age and sex. The children were asked to name each 25 newly developed picture cards of animals, objects and people that covered all 5 Thai lexical tones and their sound were recorded. The PRAAT software was used for the acoustic measurements, i.e. fundamental frequency (f0), fundamental frequency range (f0 range) and tone duration.

Results:
The children with ASD produced higher f0 than TD children but there was no significant difference. For f0 range, the children with ASD produced smaller f0 range than TD children in tone 2, 3 and 5 but larger f0 range in tone 1 and 4. There were significant differences among two groups in tone 2, 3 and 4. All TD children produced slightly longer tone duration than that of children with ASD. There were significant differences among two groups in tone 1, 3 and 5

Conclusions:
This study revealed the different acoustic characteristics of the five Thai lexical tones produced by the children with ASD and TD children. It is hoped that this study will shed light on future research in perceptual measurements and lead to specific speech therapy.

196 **140.196** The Ability to Use a Picture As a Symbol in Children with ASD

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Background: Although understanding picture-referent relations is a very important skill, it is also an extremely complex process to master. Despite the frequent use of pictures in the communication with children with ASD, understanding of picture-referent relations in this group is hardly ever investigated.

Objectives: In this study, we first compared referential understanding of pictures between children with ASD and a control group of typically developing children. Second, we studied the influence of iconicity on symbolic picture use. Third, we explored possible associations with chronological age, nonverbal mental age, response to joint attention, language skills, and severity of ASD.

Methods: We compared a group of 28 children with ASD (ASD-group) to 28 typically developing children (TD-group) individually matched on nonverbal mental age (2-5 years). Diagnosis of ASD was confirmed by using the ADOS. The use of pictures as a symbol was based on an object retrieval procedure with pictures developed by DeLoache (1991) and adapted by Bebko, McCrimmon and McFee (McFee, 2006). Pictures with varying degrees of iconicity were used to study the influence of visual resemblance on the symbolic picture use.

Results: Overall, children with ASD achieved lower levels of pictorial competence on the symbolic search tasks than the control group ($X^2_{(1)}$ = 9.22, p = .002). More than half of the children with ASD (57%) did not understand and use the pictures in a symbolic way, compared to only 18 percent in the control group. The children with ASD were less successful than the comparison groups on most of the symbolic retrieval tasks (p < .05). However, the variance in scores was much higher in the ASD-group. In the ASD group, the scores on the different tasks were comparable ($F_{(2,54)}$ = 0.20, p = .82), whereas in the control group, a small influence of iconicity was found ($F_{(2, 54)}$ = 2.64, p = .08). There is a clear relationship between nonverbal mental age and errorless retrievals in the TD-group ($r_{(26)}$ = .78, p < .001), with strong increase in errorless retrievals between 24 and 30 months. The correlation is also significant in the ASD-group ($r_{(26)}$ = .79, p < .001), but the pattern is different in comparison with the control group. After controlling for nonverbal mental age, several other skills are related to performance on the symbolic search tasks in the ASD group, such as response to joint attention, receptive and expressive language, and severity of ASD characteristics.

Conclusions: One of the main conclusions to be drawn from this study is that children with ASD have more difficulties in understanding and using pictures in a symbolic way compared to the control group. The most common communication strategies, naturalistic as well as augmentative, presume symbolic abilities. The findings from the current study suggest that clinicians would benefit from evaluating symbolic understanding of pictures, especially in young, lower functioning or minimally verbal children with ASD.

197 **140.197** The Autism Inpatient Collection (AIC): Problem Behaviors and Communication Difficulties

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Background: Problem behaviors are linked to the level of language/communication skills in children with autism spectrum disorders (ASD). Previous studies, however, have primarily included school-enrolled children with limited representation of children with a range of skills. The Autism Inpatient Collection (AIC) provides rigorous phenotypic and biological data on a large cohort of children and adolescents with the full spectrum of ASD characteristics, allowing a more full examination of the relationship between problem behaviors and communication skills in ASD.

Objectives: The language/communication profile and problem behavior rates of inpatients with ASD were examined based on verbal level.

Methods: Participants were 105 children and adolescents aged 4-20 years, admitted to six specialized inpatient psychiatry units and prospectively enrolled in a study performing phenotypic assessment and collection of biological samples. All subjects scored ≥12 on the Social Communication Questionnaire (SCQ) before study enrollment. ASD diagnosis was confirmed by ADOS-2 administration by a research-reliable examiner and extensive inpatient observation by expert clinicians. Other measures included the Aberrant Behavior Checklist (ABC), Repetitive Behavior Scale - Revised, Leiter-3, and Vineland-2.

Results: Participants were categorized based on the administered ADOS module [Modules 1/2 = Low Verbal (LV), n=58; Modules 3/4 = Verbal (V), n=47]. The groups did not differ significantly in age [LV Mean age 12.58 years (SD 3.61), range 5.77-20.08; V Mean age 12.77 (SD 3.37), range 4.58-17.92, t(103)=-.272, p=.787]. They were similar in gender (LV=25.9%; V=23.4% female), race (LV=77.6%; V = 78.7% Caucasian), and ethnicity (LV=92.2%; V=90.0% non-Hispanic/non-Latino). The groups were significantly different in mean non-verbal IQ [LV Mean 49.47 (SD 17.65), range 30-99; V Mean 94.35 (SD 22.52), range 35-135; t(81)=-10.15, p<.0001]; mean SCQ total score [LV Mean 26.36 (SD 5.34); V Mean 21.52 (SD 5.89); t(90)=4.13, p<.0001]; and, mean Vineland-2 receptive communication score [LV Mean 6.29 (SD 2.89); V Mean 8.13 (SD 1.85), t(69)=-3.09, p=.003] and expressive communication score [LV Mean 4.10 (SD 2.78); V Mean 9.50 (SD 3.07); t(67)=-.759, p>.0001]. Initial analyses of measures of problem behavior indicated that the groups did not differ on mean ABC-Irritability scores [LV Mean 28.13 (SD 10.87); V Mean 24.93 (SD 13.17), t(99)=1.34, p=1.85] but did differ significantly on mean ABC-Stereotypic behavior scores [LV Mean 10.15 (SD 6.36); V Mean 6.04 (SD 5.87), t(99)=3.34, p=.001] and mean for self-injurious behavior subscale from the RBS-R [LV Mean 9.75 (SD

6.02); V Mean 7.00 (SD 5.41), $t(88)=2.24$, $p=.028$]. Sixty-three percent of the children who were Low Verbal were reported to use a communication system; 55.2% of these used the Picture Exchange Communication System (PECS); 24.1% used sign language; and, 37.3% used a voice output device. Conclusions: This cohort of children and adolescents with ASD have a high proportion of significant cognitive and spoken language impairment. Children with more limited verbal skills had more stereotypical and self-injurious behaviors as compared to children with fluent speech. In addition, only about half of the participants with limited verbal skills were reported to use a method of augmented communication, a variable that should be further examined with respect to problem behaviors.

198 **140.198** The Development of Co-Speech Gesture and Its Semantic Integration with Speech in Six-to 12-Year-Old Children with Autism Spectrum Disorders

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Background:
Children gesture when they talk. Co-speech gestures are spontaneous hand movements accompanying speech (McNeill, 1992). Initially, children gesture to reinforce the semantic information conveyed in speech ("cookie" while pointing to a cookie), followed by disambiguating speech ("I like this" while pointing to a cookie) and supplementing speech ("I eat" while pointing to a cookie). In early childhood, disambiguating and supplementary gestures are produced more often than reinforcing gestures (e.g., Pizzuto & Capobianco, 2005).
Young children with autism spectrum disorders (ASD) have slow understanding and development of gestures (e.g., Mastrogiuseppe et al., 2014). Previous work leaves open the question of whether school-aged children with ASD (aged six to 12) still have delay in producing gestures compared to their typically developing (TD) peers and whether they integrate speech and gesture in their speech production.
Objectives:
This study examined gestural production among school-aged children in a naturalistic context and how their gestures are semantically related to the accompanying speech.
Methods:
Sixteen Chinese-speaking children diagnosed with ASD (two female; aged from 6.93 to 12.15), and 14 age- and IQ-matched TD children (eight female; aged from 6.38 to 11.58) participated this study. Caregivers interacted naturally with the children. A farm blocks play set was provided to facilitate communication. All conversations between children and caregivers and their gestures (iconic gestures; pointing gestures; emblems; speech beats) were transcribed by Chinese-speaking research assistants.
Results:
On average, children with ASD produced 5.13 gestures of all types (SD=4.24), and TD children produced 17.50 gestures of all types (SD=10.29), U=29.50, $p<.001$. Among different types of gesture, TD children produced a significantly higher proportion of markers (e.g., CLAPPING HANDS referring to happiness) than children with ASD, U=50, p<.01. Table 1 shows the results of different types of gesture in both groups of children.
We then examined the semantic relation between speech and gesture by looking at the utterances combining speech and gesture in both groups (see Figure 1). We found a non-significant main effect of group, $F(1, 28)=.35$, $p=ns$, but significant effects for semantic relation, $F(2,56)=31.91$, $p<.001$, and interaction between group and semantic relation, $F(2,56)=3.88$, $p<.03$. Mann-Whitney tests were conducted for each semantic relation. Children with ASD produced a lower proportion of utterances containing supplementary semantic relations than TD children, U=40, $p<.002$. There was no significant difference in the amount of reinforcing gestures, U=97.5, p=ns, or gestures disambiguating semantic relations, U=94, p=ns, produced by children with ASD and TD children.
Conclusions:
Our findings showed that delay in gestural production is still found in children with ASD through their middle to late childhood. Compared to their typically developing counterparts, children with ASD gestured less often and used fewer types of gestures, in particular, markers, which carry culture-specific meaning. Gesture impairment also included the failure to integrate speech with gesture: supplementary gestures are absent in children with ASD. The findings extend our understanding of gestural production in school-aged children with ASD during spontaneous interaction. The results can help guide new therapies for gestural production for children with ASD in middle and late childhood.

199 **140.199** The Effects of a Comprehensive Intervention Model on Functional Communication, Speech, and Language in Preschoolers with ASD

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Background: Comprehensive Treatment Models (CTM) address core deficits of ASD to facilitate positive outcomes for children with ASD and their families. Research evaluating the effectiveness of CTMs for children with ASD found evidence of greater skill development for children who participated in CTM than those who received standard community care (Dawson et al., 2010; Drew et al., 2002;

Smith et al., 2000; Strain & Bovey, 2011); however, measures of functional social-communication were notably absent. Measures of language development alone do not accurately reflect the development of communication skills, including the use of alternative or augmentative modes of communication, the development of a variety of communicative functions, and child initiated communication. A retrospective pilot conducted on archived data (Booker & Leew, 2011) indicated significant changes occurred in children's communication and language skills following 12 – 18 months of intervention at Society for Treatment of Autism (STA).

Objectives: The overall objective of this study was to assess the efficacy of an individualized comprehensive treatment program on functional communication, speech, and language in preschoolers with ASD.

Methods: A convenience sample of four boys with ASD, aged 38 to 42 months, participated in this study. All children received standard-of-care individualized social-pragmatic behavioral intervention from a STA trans-disciplinary treatment team for ten months. Pre-post performance on standardized assessment measures and single subject across subjects and behaviors design provided individual and group evidence of treatment effects.

One treatment session per week per child and every generalization session were digitally recorded and subsequently coded using an observational code (raw counts and rates of behavior) developed for the study. Intervention effectiveness was determined using percentage of data points exceeding the median (PEM), as it reflects effect size (Ma, 2006). Further qualitative data was collected through parent/caregiver surveys.

Results:

- Intake language levels (CSBS) for all children surpassed prelinguistic communication development;

- Significant group changes in functional verbal skills, positive affect sharing, and three-point gaze shifts (CSBS);

- Significant group changes in MSEL Developmental Quotients and PLS-5 language composite and subscale raw scores;

- No change in VABS standard scores;

- Moderate to high treatment effects for all participants in reducing the rate of interfering behaviors and increasing adequacy of verbal communicative acts; communicative mode treatment effect appeared to be dependent on participant intake characteristics;

- All parents indicated their child's behavior and communication to be slightly or significantly improved, and indicated a positive to very positive effect on their family functioning and parental stress level.

Conclusions: Comprehensive interventions need to be dynamically examined to determine effectiveness and to see if achieved gains are actually meaningful and functional for children with ASD and their families. Language and communication interventions for preschool children need to especially address evidence-based predictors so that the potential of social-communication development may be used to support subsequent language learning and social language use. Clinical implications and future studies will be discussed.

200 **140.200** The Effects of an Interactive Robot on Increasing Communication Skills for Children with Autism Spectrum Disorders

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Background: Research has shown that an effective teaching method when working with children with an autism spectrum disorder (ASD) is discrete trial instruction (DTI). DTI is a process of simplifying a skill into smaller parts to enhance the child's learning. Research has also suggested that children with ASD 1) excel in treatment programs that contain visual stimuli, 2) are more intrinsically motivated when the treatment interventions involve technical or robotic components, and 3) are more response to feedback when given by a form of technology.   This study proposes the use of a Nao, a 23-inch tall humanoid robot, during discrete trial sessions to increase communication skills in children with ASD.

Objectives: To assess the effectiveness of an interactive robot during discrete trial instruction to increase communication skills by a child with ASD.

Methods: The Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP) was implemented to determine current level of functioning and specific skill deficits in the areas of manding, tact, listener responding, and intraverbal skills. Goals were developed based on the results. Baseline data was collected across four consecutive days. Once a stable baseline was established, a total of 16 sessions were implemented. Discrete trial instruction was implemented by the therapist during all sessions. Prior to intervention, a probe, consisting of ten trials, was given to assess the child's skill level on the target skill. No prompting or corrective feedback was provided during probe trials, nor was the robot present during this time. The percentage of accuracy was

graphed at the end of each probe session. During intervention, prompting, corrective feedback, and reinforcement were provided by either the therapist and/or robot. Eight of the 16 sessions included the therapist, child, and the Nao Robot; the other eight of sessions included only the therapist with the child.

Results: Sessions including the Nao robot resulted with a faster rate of acquisition of targeted skills compared to sessions with only the therapist and child. Generalization of these skills was also observed across environments and instructors.

Conclusions: Preliminary results suggest that the use of an interactive robot during discrete trial therapy sessions increases the rate of acquisition of targeted communication goals. Positive results were observed also in the motivation of students. This data suggests that the use of an interactive robot may be an effective means of increasing communication skills in children with ASD.

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201 **140.201** The Function of Gesture: Socially-Oriented Vs. Process-Oriented Gestures in Autism Spectrum Disorder

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Background: Diagnostic criteria for autism spectrum disorder (ASD) specify the presence of deficits in the understanding and use of gestures. While some research suggests that individuals with ASD gesture less frequently than typically developing (TD) peers, other reports suggest that gestures in ASD occur as frequently, but are poorly synchronized with verbal referents. This discrepancy in findings may reflect differences in the *function* of gesture: some gestures have a primarily social-communicative function, while others are process-oriented (i.e., assisting the speaker with lexical access or other cognitive functions). Given the sociocommunicative deficits in ASD, we might expect deficits in socially-oriented gestures in ASD, but no differences in process-oriented gestures.

Objectives: Our objective was to compare production of socially-oriented gestures on the ADOS and process-oriented gestures in a picture naming task, in ASD.

Methods: Adolescents with ASD (n = 13) and TD (n = 14) completed two tasks: the ADOS (Module 3 or 4) and a modified version of the Boston Naming Test. Groups did not differ in age, gender, full scale or verbal IQ, or receptive vocabulary.

Participants named each of 20 picture stimuli on the Boston Naming Test (BNT). Gestures elicited by this task were coded by a trained research assistant. Item A9 from the ADOS, which measures "Descriptive, Conventional, Instrumental or Informational Gestures," was rated by a research-reliable clinician. Gesture rates were compared by group; we also examined correlations between gesture performance and symptom severity on the ADOS and SCQ.

Results: While ASD and TD groups differed on gesture scores on the ADOS (ASD M = 0.571, TD M = 0.154, $F(1, 25)$ = 5.738, p = 0.024, h^2 = 0.187), gesture frequency on the BNT did *not* differ (ASD M = 5.000, TD M = 4.077, $F(1, 25)$ = 0.310, p = 0.583, h^2 = 0.012). There were also no differences for gesture subtypes (iconic, beat, or conventional gestures, all p's > 0.237). That is, the groups differed in production of socially-oriented gestures (on the ADOS), but did not differ in process-oriented gestures (on the BNT). Furthermore, gesture rates on the BNT were uncorrelated with symptom severity on the SCQ or on the ADOS (combined communication + social interaction domain scores), all r's< .45, all p's > .17.

Conclusions: Adolescents with ASD and TD produced comparable numbers of gestures during a lexical access task, suggesting no group differences in production of process-oriented gestures. In contrast, youth in the ASD group had noticeably different gestures during the ADOS. The ADOS likely elicits more socially-oriented gestures; in addition, this measure collapses the dimensions of gesture *frequency* and *quality* onto one item. Results suggest that separating gesture performance into more specific categories such as process-oriented vs. socially-oriented gestures or quality vs. frequency of gesture on the ADOS may help to refine our understanding of gestures and, more broadly, social interaction in ASD.

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202 **140.202** The Impact of Child Variables on the Amount of Teacher Verbal Input on Children with Autism

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Background: Language is often delayed in children with ASD (Howlin et al., 2014). Both longitudinal and concurrent studies have demonstrated positive effects of supportive parental interaction on the language ability of children with ASD (Hart & Risley, 1995; Haebig et al., 2013; McDuffie & Yoder, 2010; Siller & Sigman, 2002). Compared to the amount of observational studies of parent-child dyads, teachers-child dyads, especially children with ASD, has been a relatively neglected area of study.

Objectives: The current study intends to understand teacher-child interaction in school settings involving preschoolers with ASD. It address the following research questions: (1) what are the amount of verbal inputs provided by the teachers to children with ASD in preschool classrooms during free play, (2) to what extent do child language ability, IQ, and autism severity influence the amount of teacher verbal input?

Methods: The present study included 55 students (5 female and 50 male) with a clinical diagnosis of

ASD between 3 and 5 years of age and 52 special education teachers. Videotape samples (15 minutes for each child) were obtained in a mixture of inclusive and self-contained classrooms during free play. The following measures were administered: Autism Diagnostic Observation Schedule (Lord et al., 1999), Mullen Scales of Early Learning (MSEL; Mullen, 1995), Preschool Language Scales, 4th Edition (PLS-4; Zimmerman et al., 2002). Three research assistants transcribed all the videos. The IOA based on 30% of the videos was 88.24%. Dependent measure in this study was total utterances said by the teachers to students.

Results: the average total utterances delivered by the teacher to students within 15 minutes was 65 with a range from 2 to 148(SD=39). In the linear regression model, the dependent measure was the total number of teacher utterance for each student. Four predictors were Mullen Ratio IQ, PLS-4 receptive language scores, PLS-4 expressive language scores, and ADOS severity scores. Regression analysis showed that both Mullen Ratio IQ (t= -3.157, p=.003) and expressive language scores (t=2.03, p=.048) were significant predictors at a significant value of .05. Teacher seemed to speak more to children who have higher IQ scores and expressive language ability. The eta square for ratio IQ was .16, indicating a large effect size based on Cohen's criteria (Cohen, 1977). The eta square for expressive language was .076, indicating a medium effect size. ADOS severity score was not a significant predictor of total number of utterances (t =. 81, p=.42)

Conclusions: The amount of interaction between the teacher and the child with ASD differed depending on the language and cognitive level of children with ASD. Special education teachers seemed to speak more to children with ASD who have higher cognitive and language ability. However, this study does not permit any causal effect of child's language and cognitive ability on teacher's behavior. Further, it did not specify the relationship between the child's variables on the type of interactive behavior of the teacher (directives vs. commenting).

203   **140.203**   The Language-Cognition Interface in ASD: Complement Sentences and False-Belief Reasoning

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Background: Theory of Mind (ToM) is often affected in individuals with Autism Spectrum Disorders (ASD). Previous work on ASD has identified links between ToM abilities and knowledge of sentential complements, with the hypothesis that this component of language provides a tool for children with ASD to figure out solutions to ToM tasks. However studies on ASD are yet to show if the impact of complementation on ToM performance carries over to instances where ToM is assessed nonverbally. As such, the links identified between ToM and complementation tasks may stem from linguistic difficulties that impact scores across the measures used, rather than from the role played by sentential complements in mental representation.

Objectives: The goals of this study were to assess (1) if links between ToM and sentential complements are still present when ToM tasks are non-verbal (2) if complements play a special role in ToM reasoning as compared to other language abilities in ASD.

Methods: 34 children with ASD (mean 8.2 years) and 24 TD children (mean 10.5 years) with similar non-verbal mental age (mean 8.5 years) and general language abilities (vocabulary and morphosyntax) were asked to complete False Belief (FB) tasks following the classical Sally-Anne procedure (verbal ToM), and a picture sequencing task by Baron Cohen, Leslie, & Frith (1986) which relied on the imputing of a FB (non-verbal ToM). Children were also assessed for their comprehension of complements with a French adaptation of de Villiers & Pyers (2002) memory for complements' task.

Results: Consistent with previous studies, significant correlations were observed between sentential complements and verbal FB success in TD children (τ(21)=0.50, p=0.01), as well as in children with ASD (τ(21)=0.50, p=0.006). In both groups, these links persisted after controlling for mental age (τ(21)=0.47, p=0.003; τ(21)=0.41, p=0.01), morphosyntax (τ(21)=0.47, p=0.003; τ(21)=0.33, p=0.04) and lexical abilities (τ(21)=0.44, p=0.005 and τ(16)=0.42, p=0.02). However the correlation between measures of sentential complements and non-verbal ToM was significant only in the ASD group (τ(31)=0.38, p=0.009), and this remained when controlling for mental age (τ(31)=0.32, p=0.009) or general morphosyntax (τ(31)=0.34, p=0.006), however not when controlling for vocabulary (τ(20)=0.27, p=0.10). One explanation is that vocabulary development may be an indication of how rich a conversational experience children have had and how much they have been in tune to it.

Conclusions: Our results show that links between complement sentences and ToM carry over to instances where ToM is assessed nonverbally uniquely in our ASD group, thus providing new evidence in favour of the view that complementation may provide a means for FB representation for individuals on the autistic spectrum. Moreover this study provides support for the view that, as compared to general morphosyntax, complement sentences play a privileged role in FB success.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1986). Mechanical, behavioural and intentional understanding of picture stories in autistic children. *British Journal of developmental psychology*, *4*(2), 113-125.

De Villiers, J. G., & Pyers, J. E. (2002). Complements to cognition: A longitudinal study of the relationship between complex syntax and false-belief-understanding. *Cognitive Development*, *17*(1), 1037-1060.

140.204 The Local Bias in ASC: Weak Central Coherence or a Deficit in Executive Control?

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Background:
"Weak central coherence" refers to a processing bias in autism spectrum conditions (ASC), involving enhanced local processing and reduced global integration of information. In language this has been demonstrated in sentence completion tasks: people with ASC make more local completions then controls, even when globally inappropriate. Since autism is known to involve a deficit in executive function, the question arises whether the local processing bias can be encompassed within executive dysfunction.
Objectives:
To examine whether the local processing bias as evidenced on sentence completion tasks can be explained by a deficit in executive function or whether it represents a separate cognitive style.
Methods:
The study was part of a larger project which tested boys with ADHD (n=30), ASC (n=31) and a matched control group (n=31), aged 8-16, on a battery of tasks including sentence completion, IQ and tests of verbal fluency. The sentence completion tasks involved two variants: generation and suppression. In generation participants were asked to provide a coherent completion, e.g., "light" after hearing "When you go to bed, turn off the...". In suppression participants were asked to provide a completion that did not make sense, e.g. "swimming" to the above example. There were two types of sentence: those whose completion was determined globally or locally. In the above example "turn off the..." provides most of the information needed, so the completion is 'local'. Conversely, in "Most cats see very well at..." information must be incorporated from earlier in the sentence, so this item was classified as 'global'. We hypothesized that if weak central coherence in autism is separate from executive dysfunction, ASC children will find it easier to inhibit meaningful completions if they are globally meaningful, while those with ADHD will experience similar difficulty inhibiting both types of completion.
Results:
All groups produced more meaningful completions to local than global items in the generation task, and more failures to suppress local than global completions in the suppression task with no difference between the ADHD and ASC groups (F < 1). However, group differences were evident in response times (RTs) to produce correct (i.e., non-meaningful) completions in the suppression task: ADHD correct RTs were slower for global than local items, whereas ASC correct RTs were slower for local than global items (as predicted by a local processing bias). An ANCOVA controlling for WISC vocabulary scale, revealed a significant interaction between ADHD/ASC and global/local, F (1, 52) = 4,68, p < 0.5. Also, ASC was the only group in which overall accuracy on the generation and suppression tasks correlated with verbal fluency (r = 0.61, p < 0.001) and age (r = 0.54 , p < 0.05).
Conclusions:
The findings suggest weak central coherence explains cognitive bias on the present task better than executive dysfunction, given the difference in performance between ASC and ADHD groups. Differences in the reaction time distribution, as well as the correlation with verbal fluency and age, suggest that people with ASC may be using a different strategy to complete the meaning suppression task.

140.205 The Origins of the SLI Phenotype in the Early Language Development of Children with ASD

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Background:
Researchers have proposed that a subgroup of children with ASD have a specific language impairment (SLI); that is, their nonverbal functioning is unimpaired but their structural language is below the normal range.[1,2] It is unclear how commonly this phenotype is observed in ASD. Moreover, it is unclear whether indications of SLI can be observed in children younger than 4 years of age. 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.
Objectives:
To examine the prevalence of SLI in a large group of 5-year-olds with ASD, and to investigate behavioral precursors when these children were three years of age.
Methods: 98 families of children with ASD participated in a large-scale study of autism phenotypes at two ages, including three years old (M_{age}=37.61 months; $M_{MullenVR\ T-score}$=30.11 (SD=13.71) and five years old (M_{age}=68.63 months; $M_{DAS\ NV\ SS-score}$=81.39, SD=27.51). Three-year-olds were administered the Mullen and Vineland; 70 were also administered the EOWPVT and PPVT. Five-year-olds were administered the ADOS, DAS Verbal Comprehension task, EOWPVT and PPVT.

Results:

The 5-year-olds were divided into four exhaustive subgroups: *V/NV<70* (both Verbal and Nonverbal below 70; *n*=34), *V/NV>80* (both Verbal and Nonverbal scores above 80; *n*=36); *V/NVnotdiscrepant* (Nonverbal above 70, Verbal lower than Nonverbal BY LESS THAN 10 points; *n*=19); *Possible SLI* (Nonverbal above 70, Verbal AT LEAST 15 POINTS BELOW Nonverbal; *n*=9). Table 1 shows the mean scores. One-way ANOVAs revealed that the groups differed significantly on all measures (Fs>35.0, ps<.001). Post-hoc Scheffe tests indicated that on the ADOS and Nonverbal scores, the Possible SLI group differed significantly from the V/NV<70 and V/NV>80 groups, but not from the V/NVnotdiscrepant group. On the Verbal scores, all groups differed significantly from each other. The performance of these four subgroups two years earlier (at 3 years of age) was then examined for evidence of behavioral precursors. One-way ANOVAs revealed significant effects of group for the ADOS, Mullen VR, Mullen RL, and Mullen EL (Fs>35.0, ps<.001). Post-hoc Scheffe tests indicated that the Possible SLI group differed significantly from the V/NV>80 and V/NVnotdiscrepant groups on the Mullen EL (p<.01), and from the V/NV>80 group on the Mullen VR (p<.001). However, the Possible SLI group did not differ from the V/NV<70 group on any score at 3 years of age. None of the groups differed on Vineland Socialization score at 3 years of age.

Conclusions:

At five years of age, approximately 10% of the sample met criteria for SLI if language scores on the available standardized tests were considered. Possible SLI children at age 5 did not differ from V/NVnotdiscrepant children at the same age on their nonverbal or ADOS scores, supporting the argument for an impairment that is language-based. However, two years earlier, Possible SLI children did not differ from V/NV<70 children on Mullen, Vineland, or ADOS scores. It remains difficult to predict which children, at diagnosis, will manifest an SLI. Moreover, language impairment in ASD may encompass both lexical and grammatical functioning.

206 **140.206** The Temporal Structure of the Autistic Voice: A Cross-Linguistic Investigation

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Background: Individuals with autism spectrum disorder (ASD) tend to have atypical modulation of speech and voice, often described as awkward, monotone, or sing-songy [1-3]. These anomalies may constitute one of the most robust and fast signals of social communication deficits in this population [4, 5]. However, it has proven difficult to determine a consistent set of acoustic features that can account for these perceived differences. Using Recurrence Quantification analysis of acoustic features, Fusaroli et al. [6] demonstrated a high efficacy of identifying voice patterns characteristic of adult Danish speakers with Asperger's syndrome.

Objectives: We systematically quantify and explore speech patterns in children with and without autism across two languages: Danish and American English. We employ traditional and non-linear techniques measuring the structure (regularity and complexity) of speech behavior (i.e. fundamental frequency, use of pauses, speech rate). Our aims are (1) to achieve a more fine-grained understanding of the speech patterns in children with ASD, and (2) to employ the results in a supervised machine-learning process to determine whether acoustic features can be used to predict diagnostic status within and across languages.

Methods: Our analysis was based on previously-acquired repeated narratives (TOMAL-2 [7]) in Danish, and a story retelling task [1] in American English). We tested 25 Danish and 25 US children diagnosed with ASD as well as 25 Danish and 16 US matched controls. Age range was 8-13 years with no significant difference between language groups. Transcripts were time-coded, and pitch (F0), speech-pause sequences and speech rate were automatically extracted. For each prosodic feature we calculated recurrence quantification measures, that is, the number, duration and structure of repeated patterns[8]. The results were employed to train a linear discriminant function algorithm to classify the descriptions as belonging either to the ASD or the control group, 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). Algorithms were trained on Danish data only, American English data only and the combined group, to investigate the presence of cross-linguistic features of prosodic patterns in ASD.

Results: Voice recordings within each language group were classified with balanced accuracy, sensitivity and specificity all > 77% (p<.000001), The cross-linguistic corpus was classified with balanced accuracy, sensitivity and specificity all >71% (p<.000001). Voices of individuals with ASD can be characterized as more regular (that is, with patterns regularly repeated) in their pitch and pause structure and more irregular in speechrate.

Conclusions: Non-linear recurrence analyses techniques suggest that there are quantifiable acoustic features in speech production of children with ASD that distinguish them from typically developing speakers, even across linguistic and cultural boundaries.

207 **140.207** Voice Patterns in Adult English Speakers with Autism Spectrum Disorder

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Background:
Individuals with Autism Spectrum Disorder (ASD) often display atypical modulation of speech described as awkward, monotone, or sing-songy (Shriberg et al., 2001). These patterns are a robust signal of social communication deficit (Paul et al., 2005) and contribute to reaching a diagnosis of ASD. Using Recurrence Quantification analysis of acoustic features, Fusaroli et al. (2013 ; IMFAR 2014) demonstrated a high efficacy of identifying voice patterns characteristic of adult Danish speakers with Asperger's syndrome and trained machine learning algorithms to accurately (80-86%) discriminate autistic from non-autistic speakers in both adult and children Danish speakers with ASD.
Objectives:
Our first aim was to replicate the results obtained by Fusaroli et al. (2013, 2014) in a sample of English speakers, i.e. (1) characterise the speech patterns of adults with ASD and (2) employ the results in a supervised machine-learning process to determine whether acoustic features predict diagnostic status and severity of the symptoms.
In addition we were interested to evaluate how valid the model built based on Danish data would be on English data, i.e. which parameters were dependent and which were independent of the speakers' language.
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 attempting to recall details of a standardised event they had participated in. 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 sample of English speakers suggest similar results to those obtained in a Danish population: individual with ASD produce highly regular speech patterns organized in short sequences (200-400 ms) being frequently repeated, which support clinical reports of monotony. While features are similar across Danish and English language, the coefficients discriminating individuals with ASD and controls need to be re-trained.
Conclusions:
The current data suggest than ASD adults produce highly regular patterns of speech (as measured by pitch and pause distribution). Importantly this provides a quantifiable measurement to capture some of the clinical reports which contribute to reaching a diagnosis of autism. Further analysis will establish whether voice patterns can be a tool in the diagnostic process or to follow language development in an individual and reliably distinguish autistic- and non autistic-like speech.

Poster Session
141 - International and Cross-Cultural Perspectives
11:30 AM - 1:30 PM - Imperial Ballroom

208 **141.208** A Collaborative Community Awareness Screening Program on Autism in Lagos Nigeria: Lessons Learnt

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Background: Community-based with need-tailored care has been pointed out as the preferred approach for children with neurodevelopmental disorders (CNDs) such as autism. Paucity of data on specific diagnoses, pattern of mental impairment and psychosocial needs in CNDs is a major constraint for development of policy and evidence based intervention programs in developing countries. Collaboration is needed among all sectors of any community in improving awareness and ensuring service development

Objectives: To illustrate a collaborative effort between Guaranty Trust Bank (GTBank) Lagos, the College of Medicine University of Lagos (CMUL) and a non profit group from the USA,Blazing Trail International Centre, aimed at creating community awareness and ascertaining the diagnosis of autistic spectrum disorders in Lagos, Nigeria

Methods: Data was obtained during the 2014 annual 2 week GTBank / CMUL autism awareness program in partnership with Blazing TrailS, USA. All participants that attended the one-week consultation part of the program were enrolled into the study following their informed consent and that of their caregivers. Questionnaire-based assessments were done to collect relevant data on socio-demographic, clinical and psychosocial need parameters. In addition, screening with the MCHAT and CAST were carried out, and then a clinical evaluation using the DSM-V criteria was done. Data analyses were done using SPSS-18

Results: A total of 95 participants, aged between 2- 28 years. Mean age of participants was 9.14 years (sd+/-6.2). Though majority were aged between 3-10 years being 57 (58.6%) in number. All were accompanied by their parents. While 78 (82.1%) were currently attending school, with 33(41.8%) in special schools and 45 (47.4%) attending normal schools. After an initial screening with the MCHAT and CAST, and a clinical evaluation using the DSM V criteria, 30 (31.7%) of the participants met the diagnosis of autistic spectrum disorder. Among those diagnosed with autism, 24 (80%) were male while 6 (20%) were female. Nine (42.9%) of which were first born children. Majority, 19(65.5%) were aged between 3-10 years. Most of them 17(70.8%) were attending regular schools, while 6(25.0%) were attending special schools. Seven (24.1%) had participated in the Gtb-CMUL autism consultation program in the past, while others were attending for the first time. The three main health concerns as elaborated by the parents during the consultation were poor language development in all of the children with autism (100%), out of which 11(40.7%) were completely non verbal; gaze avoidance in 14(46.7%) and challenging behaviour in 12 (41.4%). Comorbid seizure problems were reported in 5 (19.2%) and attention deficit hyperactivity in 2 (6.7%). Further clinical evaluation of areas of need provided direction for caregivers to the few scattered services within the community.

Conclusions: There is need for large scale screening of children with developmental disorders in developing countries to clearly determine diagnosis. Such innovative collaborative effort between financial, nonprofits and academia can be successful in providing awareness and improving diagnosis in resource poor settings. Parents of Children with autism must be encouraged to engage in services and should be guided based on need to available service options in their immediate communities.

209 **141.209** A Cross-Cultural Study of Self- and Other-Descriptions By Individuals with ASD in New Delhi, India and Los Angeles, USA

R. S. Brezis[1], N. Singhal[2], T. C. Daley[3], T. Weisner[4] and M. Barua[2], (1)Interdisciplinary Center, Herzliya, Jerusalem, Israel, (2)Action For Autism, New Delhi, India, (3)Westat, Durham, NC, (4)UCLA, Los Angeles, CA

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 example, previous research has shown that when describing themselves, Caucasian-Americans use more abstract, decontextualized descriptions than Indians from Bhubhaneshwar (Shweder and Bourne, 1984), in line with a theory of independent (vs. interdependent) self-concepts (Markus and Kitayama, 1991). 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 Indians with ASD are more interdependent (i.e., more concrete and contextualized) than those of Americans with ASD, as would be predicted from their cultural context (Shweder and Bourne, 1984); and whether both groups have more physical than psychological descriptions, as would be predicted from their ASD diagnosis (Brezis et al., unpublished).

Methods:
Twelve high-functioning adults with ASD (2 females; M=25.1) were interviewed in New Delhi; data were compared with that of 35 high-functioning youth with ASD (6 females; M=12.4) interviewed in Los Angeles. Participants were asked to describe themselves in as many ways possible, starting with "I am…"; and then to describe their favorite fictional character. Transcripts were parsed into phrases and coded for whether the description was (a) physical or psychological; (b) abstract or concrete; (c) contextualized or decontextualized.

Results:
When describing themselves, Indian individuals with ASD made significantly more concrete ($t(40)=2.47$, $p=.02$) and more contextualized descriptions ($t(40)=4.71$, $p<.0001$) than American individuals with ASD; but groups did not differ in their degree of physical (vs. psychological) descriptions ($t(40)=1.45$, $p=.15$).

By contrast, when describing their favorite fictional character, groups did not differ on any coded measure of description (physicality, $t(38)=.17$, $p=.87$; abstractness, $t(38)=.02$, $p=.98$; contextualization, $t(38)=1.94$, $p=.06$).

Conclusions:
Our findings confirm the hypothesis that individuals with ASD *are* sensitive to their cultural contexts, with Indian individuals with ASD describing themselves in more concrete and contextualized ways than American individuals with ASD. Both groups have a similar tendency to provide more physical than psychological descriptions; probably due to their ASD characteristics, rather than their cultural backgrounds. Importantly, there were no cross-cultural differences in descriptions of fictional characters, which may be due to the fact that fictional characters are embedded within a pre-structured narrative, which is less affected by cognitive style. Our study is limited by a relatively small ASD sample and no control group in New Delhi, and no proper matching on age and IQ with the ASD group from Los Angeles. Nevertheless, our results present a first step towards a better understanding of the subtle ways in which ASD varies cross-culturally, and the cultural skills that individuals with ASD *do* acquire.

210 **141.210** A Parent-Implemented Autism Intervention Among Underserved Families in Taiwan

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Background:
There is compelling evidence that access to early behavioral intervention is associated with positive cognitive, adaptive, behavior, and language outcomes for children with autism spectrum disorder (ASD). There is a lack of existing infrastructure and an absence of resources to deliver clinic- or school-based interventions for children with ASD in some regions of southern Taiwan. Parent-mediated intervention and behavior management are particularly suitable for these families to implement at home. Pivotal Response Training (PRT) is an evidence-based, naturalistic, behavioral intervention with a clear structure that can be used to target a variety of goals. These characteristics make PRT a good fit for the target population.
Objectives:
The objectives are: 1) to develop a culturally sensitive ASD intervention by adapting PRT; 2) to train clinicians to train parents in delivering the program at home; 3) to train parents in implementing the program at home; and 4) to evaluate this program's efficacy and effectiveness.
Methods:
A culturally modified version of PRT with emphasis on behavior management and communication was adopted to address concerns of Taiwanese parents. Local clinicians were trained to fidelity by PRT experts. Fifteen families who have a child diagnosed with ASD participated in the study, which consists of 20 sessions: 1) 3 group-education sessions (3-5 parents) on ASD, 2) 3 group-education sessions on PRT, 3) 1 group-education session on behavior management, and 4) 13 one-on-one at-home coaching sessions. Program efficacy and effectiveness were measured by the changes between enrollment (baseline) and the last at-home session (post-intervention) in parental stress on parent-child interaction and child behaviors (measured using Chinese version of Parenting Stress Index), and the child's problem behaviors (measured using the Chinese version of Child Behavior Checklist). Parental satisfaction with the program, including training materials, procedures, clinicians' expertise, was measured post-intervention. Qualitative information was also obtained throughout study sessions to obtain in-depth input from parents and clinicians.
Results:
Of 15 enrolled families, 13 completed all study sessions. All child participants were boys, ages 36-75 months (mean: 57.8, SD: 18.6) at enrollment. Eleven parents reached fidelity in PRT by the end of study. Parents rated the intervention highly, with 100% reporting their child made satisfactory or highly satisfactory improvement (rated 4-5 on a 1-5 scale) in getting along with others, language, learning new skills, and attention. Similarly, 100% of parents reported their own improvement in understanding their child's behaviors, communicating with their child, knowing how to handling their child's problem behaviors, solving problems for their child, and knowing how to use learned skills in daily life.
Conclusions:
Our preliminary findings are promising and very encouraging. Beneficial effects of the intervention for the families were observed by our clinicians as well as reported by parents. The developed program could become a model for efficiently and effectively providing evidence-based behavioral intervention to families with low resources in Taiwan and for populations that share a similar cultural background. Changes measured between baseline and post-intervention in parental stress and child behaviors will be discussed.

211 **141.211** ASD Knowledge and Stigmas in Tanzania

A. J. Harrison[1], B. L. Cochran[1] and K. K. Blane[2], (1)University of Georgia, Athens, GA, (2)Alpert Medical

School of Brown University, Providence, RI

Background: Research suggests limited knowledge of mental illness or low mental health literacy (MHL) is a meaningful barrier to care (Wang et al., 2007), particularly in many low- and middle-income countries (Saxena et al. 2007). More specifically, in many African regions, individuals with autism spectrum disorders (ASD) have a diminished quality of life due to reduced awareness and prominent stigmas. While preliminary research has helped to document the minimal understanding of the symptoms and etiology of ASD in Nigeria (Bakare & Ebigbo, 2008; Bakare et al., 2009), this is restricted to one African country. Anecdotal information reveals that low ASD knowledge and concerning stigmas pervade many parts of Africa; however, there has been little research to systematically document the problem.

Objectives: We conducted a preliminary investigation of ASD-knowledge in Tanzania, a country greatly in need of improved ASD services (Manji et al., 2014). Given that many disorders develop in childhood (Kessler & Amminger, 2007), parents are often responsible for an even greater degree of MHL; therefore, this study specifically examines ASD knowledge among Tanzania caregivers of children with ASD utilizing both quantitative and qualitative methods.

Methods: We examined quantitative differences in the level of autism knowledge among caregivers with at least one child diagnosed with ASD in Tanzania as compared to the United States. Group comparisons were based on data collected using a revised version of the Autism Knowledge Survey (AKS; Stone, 1987), which quantitatively assesses ASD knowledge through the use of 21 Likert-style questions about ASD diagnosis, treatment, and etiology (Sweizy, 2007). We also employed a qualitative survey previously used in Iran (Samadi et al., 2012) to assess the experiences of parents of children with ASD in Tanzania.

Results: The AKS revealed that caregivers from the United States (n = 30) had significantly higher levels of ASD-knowledge as compared to Tanzanian caregivers (n = 19), $t(47) = 7.84$, $p < .001$ on AKS scores. We will describe themes emerging from the subset of six Tanzanian parents who completed the qualitative survey. 83% (n=5) of parents reported limited verbal communication as a prominent concern for their children and listed this as a primary reason for seeking an initial diagnostic evaluation. 67% (n=4) reported knowing nothing or very little about ASD before receiving a diagnosis for their child and 100% of families requested more information. 100% of parents reported community members in Tanzania ubiquitously had limited ASD-knowledge and held misconceptions or stigmas about ASD (e.g., attributing the etiology of ASD to witchcraft or parenting).

Conclusions: Current results confirm anecdotal reports of low ASD knowledge in Tanzania. Given that reduced MHL and stigmas area significant barriers to care, research should prioritize understanding these deficits and developing targeted interventions to increase community-wide ASD knowledge and minimize stigma in low- and middle-income countries. Interventions designed to augment knowledge about ASD is an important first step towards providing better care globally to children with ASD; therefore suggestions for individual and community-wide interventions will be discussed.

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212 **141.212** Challenges to the Development of Culturally Sensitive ASD Interventions for Latino Families

ABSTRACT WITHDRAWN

Background:
Latino families come later than White, non-Latino families to ASD diagnosis and treatment, and disproportionately utilize treatments that are not evidence-based (Mandell & Novak, 2005; Levy, et al., 2003). Disparities exist even after controlling for socio-economic status and availability of local diagnostic providers (Palmer, et al., 2010). This study addresses these differences by describing the characteristics of Latino children who received autism diagnostic services at a publicly funded screening clinic, where approximately 56% of clients identify as Latino. Interviews with parents identified beliefs about the definition and cause of autism that may inform treatment.

Objectives:
This study aimed to: (1) describe Latino children who participated in an autism diagnostic screening clinic; (2) examine parents' beliefs about definition and cause of autism; (3) identify challenging daily activities where culturally sensitive interventions can be implemented.

Methods:
Participants were 67 Latino mothers (M age = 33; Education level = 86% less than BA; Main Language: English) and their children (M age = 5 years; 77% male; M IQ = 80) suspected of ASD. Assessors trained in the gold standard ADOS conducted assessments. A subset of 10 parent interviews were analyzed to examine how parents described their beliefs about the definition and cause of autism. Two researchers coded the interviews; mean kappa = .80.

Results:
Almost half (46%) of the families were referred to our clinic by their school or service provider. Parent reports of child behavior and social skills showed: (a) 25% in the clinical range for behavior problems (CBCL; M = 88.57), (b) 14% exhibited ASD symptomology (SRS; M = 114.40), and (c) 28% exhibited below average social skills (SSIS; M = 43.57). Half of these children received ASD diagnosis (53%). In qualitative interviews, most parents were unclear about the definition of autism (e.g., "I'm not too sure,") or were partially correct (e.g., "[it's] a mental disorder where brains function differently."). When asked about the cause of autism, some parents attributed the cause to vaccinations or genetics (e.g., "they say vaccinations, hereditary, who knows.") Others attributed the disorder to

their religion (e.g., "Christian...God has a reason he makes people the way he does,"). Most challenging for parents were key times during the child's day that involved transitions (e.g., getting dressed in the morning, bedtime). These specific moments seem to be good places to implement interventions that accommodate the families' cultural beliefs and routines (Skinner & Weisner, 2007). Conclusions:

On the positive side, these families were connected to the service system; they brought their children to the screening clinic; while age 5 is late for initial diagnosis, it is still below the mean age of diagnosis for Latino children. Parents reported behavior problems and social skills challenges consistent with ASD. However, parents' ideas about the definition and cause of autism do not reflect current science. It is critical that more information be available and disseminated to this group. Understanding autism within a sample of Latino families allows researchers and service providers to adapt interventions to be culturally sensitive for these families.

213 **141.213** Changing College Students' Conceptions of ASD: Benefits of an Online Training for Undergraduates in the United States and Lebanon

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Background: Despite evidence that ASD may be increasing in prevalence internationally (Elsabbagh et al., 2012), misconceptions (e.g. Japan: Koyama et al., 2008; Nepal: Kharti et al., 2011; Nigeria: Bakare et al., 2009; Saudi Arabia: Alqahtani, 2012) and stigma associated with ASD are apparent worldwide (e.g. Australia: Gray, 2002; Iran; Dehvani et al., 2011; South Korea: Grinker & Cho, 2013). Cross-cultural comparisons of knowledge and stigma towards autism have not previously been published. We used an online survey to compare baseline conceptions of ASD, and changes in knowledge and stigma following an online training, among undergraduates in Lebanon and the U.S. These two cultural contexts vary widely in available services for people with ASD (Daou, 2014).
Objectives: (1) Compare knowledge of and stigma towards ASD among college students in Lebanon and the U.S; (2) Evaluate effects of an online-training on knowledge and stigma associated with ASD in both countries.
Methods: Participants recruited from universities in Lebanon (N=387) and the U.S. (N=561) completed a demographics questionnaire, pre-test, online training, post-test, and the Broader Autism Phenotype Quotient (Hurley et al., 2007). The pre-test/post-test included an adapted version of Stone's (1987) Autism Awareness Survey, a social distance scale assessing stigma towards autism (Bogardus, 1933), and an open-ended opportunity to define ASD. Definitions of ASD were coded into non-mutually-exclusive categories by independent coders after they achieved reliability. Chi-square tests were used for categorical variables and Wilcoxon tests were used for ordinal variables (Jamieson, 2004).
Results: In both countries, women (but not nuclear family members of people with ASD) exhibited less stigma toward ASD than men (ps < .008). Lebanese students had less knowledge and more stigma towards ASD than U.S. students at pre-test (ps<.001). Stigma decreased and knowledge increased in both groups after training (Figure 1 and 2; ps<.001). Lebanese students (21.7%) more frequently attributed ASD to negative parenting than U.S. students (6.8%; p<.001), but were also more likely to indicate that ASD diagnosis is affected by disparities in access to care (Lebanon: 34.3%; U.S: 13.5%; p < .001). More U.S. students (22.0%) confused ASD with other disorders (e.g., ADHD or cognitive difficulties) than Lebanese students (11.2%; p<.001). Lebanese students more often correctly defined ASD in terms of social-communicative difficulties (Lebanon: 51.6%; U.S: 32.5%, p<.001), but more often incorrectly stated that people with ASD lack social interest (15.8%) than U.S. students (3.0%, p<.001). Both Lebanese (5.8%) and U.S. (3.9%) students infrequently defined ASD in terms of restricted interests and repetitive behaviors (p=.25).
Conclusions: While stigma towards ASD was higher in Lebanon than the U.S., specific misconceptions were more common in each country. In Lebanon, where fewer resources are available to support those with ASD, students were more aware of how disparities in access to care contribute to differences in diagnosis. Mirroring findings in South Korea (Grinker & Cho, 2013), Lebanese students more often defined ASD in terms of social differences and less often in terms of cognitive difficulties than U.S. students. Findings suggest that online training could reduce misconceptions about ASD internationally.

214 **141.214** Cross-Cultural Comparison of College Students' Stigmatizing Attitudes Towards ASD Between the United States and Japan

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Background:

Despite evidence that the prevalence of ASD is increasing worldwide (Elsabbagh et al., 2012), ASD is often misunderstood in various cultures (Japan: Koyama et al., 2008; Nigeria: Bakare et al., 2009; Saudi Arabia: Alqahtani, 2012). Moreover, while stigma associated with ASD is apparent worldwide (Australia: Gray, 2002; Hong Kong; Ling et al., 2010; Iran; Dehvani et al., 2011), perception of individuals with ASD may vary depending on the culture. For instance, compared to Caucasians, Asians tend to perceive those with mental disorders as more dangerous (Whaley, 1997), which might lead them to hold more stigmatizing attitudes, including greater desire for social distance (Griffiths et al., 2006). Within country variability may provide important insights into differences between countries. Given that women and students in fields emphasizing understanding of others may exhibit more acceptance towards ASD in the US (Gardiner & Iarocci, 2013), cross-cultural similarities or differences in associations between gender, major and stigma towards ASD may elucidate mechanisms underlying potential cross-cultural differences in stigma.

Objectives:
1) Compare stigma towards ASD among students in the US and Japan;
2) Examine between- and within-country predictors of stigma.

Methods:
Students were recruited from American and Japanese universities: US sample (N = 369; 201 women, 168 men), Japanese sample (N= 220; 119 women, 101 men). Following a pretest assessing knowledge about ASD (adapted from the "Autism Awareness Survey" by Stone, 1987) and stigma associated with ASD (adapted from the "Social Distance Scale" by Bogardus, 1933), participants completed an online training about ASD, followed by a posttest identical to the pretest.

Results:
American students indicated less stigma towards ASD than Japanese students across all items of the social distance scale (see Table 1). In both countries, mean scores tended to increase (i.e., indicating less willingness to engage with an individual with ASD) with closer social distance (i.e. participants indicated less willingness to marry than to spend an evening with someone on the spectrum).

American women reported lower stigma than men (see Table 2). However, there were no significant differences in stigma between women and men in the Japanese sample. In both countries, students who majored in "helping majors" (e.g., Psychology, Education, Nursing [PEN]) reported less stigma towards ASD than students with other majors (see Table 2).

Autism knowledge was lower in Japan than the US, Z = -3.31, p = .001. In Japan, r (217)= -.19, p = .004, and the US, r (367)= -.26, p< .001, more knowledge was associated with less stigma. However, no differences in knowledge based on gender or major were observed in either country.

Conclusions:
As expected, Japanese college students exhibited higher levels of stigma towards ASD than US students. While students in helping majors exhibited less stigma than their counterparts in both countries, women reported less stigma towards ASD in the US but not in Japan. Differences in ASD knowledge may contribute to cross-cultural differences between Japan and the US in stigma. However, other factors (such as empathy, desire to conform or quality of contact) likely underly within-country variability.

215 **141.215** Cross-Cultural Comparisons of Children's Theory-of-Mind and Executive-Function Development in Typical and Atypical (ASD) Samples

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Background: Previous studies have found differences in children's performance on theory-of-mind and executive-function tasks across 'Eastern' and 'Western' cultures (e.g., Lewis et al., 2009; Shahaeian et al., 2011). However, this body of research has so far been confined to typically-developing (TD) samples. In addition, while the authors of these studies have cited differences in parents' socialisation priorities as possible reasons for the discrepancies in task performance across cultures, these hypothesised differences have yet to be empirically studied.

Objectives: The first aim of this exploratory study was to investigate if differences in TD children's task performance across the 'East' (Malaysia) and the 'West' (UK) would also be observed in samples of children with Autism Spectrum Disorders (ASD). The second aim was to investigate if there were indeed cross-cultural differences in parents' beliefs about children's sociocognitive development, and if these differences were observed in both TD and ASD samples. The third and final aim was to investigate if the links between the children's task performance and the parents' beliefs were similar across cultures and across diagnostic groups.

Methods: To this end, a sample of 142 TD (73 Malaysian) preschoolers and a sample of 90 children with ASD (44 Malaysian) aged 4-15 and their parents were recruited. The children in both countries were given a battery of theory-of-mind and executive-function tasks. A parent questionnaire containing a list of 27 behaviours taken from various measures of children's social competence was distributed to the parents in Malaysia and the UK. Each item in the questionnaire was related to theory of mind, executive function, or general social competence. Parents were asked to rate how important they thought it was that their children showed the ability to exhibit each behaviour.

Results: The main findings were that, statistically controlling for any differences in relevant background variables (e.g., age, verbal ability, maternal education):
1. The Malaysian TD children outperformed the British TD children on the executive-function tasks, but

there were no differences in the children's performance on the theory-of-mind tasks. There were no cross-cultural differences in the ASD samples' task performances across the two countries.
2. In the TD samples, there were no cross-cultural differences in the parents' ratings of the importance of theory-of-mind or executive-function-related behaviours. However, in the ASD samples, the Malaysian parents rated both sets of behaviours as more important than did than the British parents.
3. In the TD samples, the executive-function task and questionnaire data were significantly related, but not the theory-of-mind task and questionnaire data. In the ASD samples, however, there were no significant relationships between the task and questionnaire data.
Conclusions: Together, these findings highlight the importance of including different diagnostic groups in future research in order to gain a more complete understanding of how child characteristics and social influences interact to impact children's sociocognitive development.

216 **141.216** Distribution of Autism-Associated Behaviors in a General School-Aged Population: Findings from a Population-Based Study in Taiwan

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Background: Heterogeneity in the severity of autism-associated traits and behaviors across individuals with autism spectrum disorder (ASD) has led researchers to suggest the disorder forms a continuum that extends into general populations. Little is known about the distributions of these ASD-associated traits and behaviors in general populations. If the spectrum of the disorder exists, as many researchers agree, it would be critical to establish a population reference level of the associated traits and behaviors, and to examine the distribution of the disorder's severity in a general population. The Social Communication Questionnaire (SCQ) is a widely used screening tool for ASD, with established reliabilities and validities from samples with higher risk of ASD. However, to our knowledge, there is no report on how SCQ-measured traits and behaviors are distributed in the general population.
Objectives: To obtain a population reference of SCQ measured ASD-associated traits and behaviors; and to examine distributions of these measured behaviors by gender in a large population of school age children.
Methods: A population-based epidemiologic study of autism in children aged 6-8 years involving a multi-stage case identification design was conducted in PingTung, Taiwan from 2008-2010. The SCQ was used as a screener to identify children at high risk for ASD. On the SCQ, 36 of 40 items have been classified into 3 domains: social interaction, communication, and restricted/repetitive/stereotyped behaviors (RRB). Studies from Western countries recommend a cut-point of 15 on the SCQ for differentiating between likely ASD and non-ASD diagnoses. Rather than only administer the SCQ on children with higher risk of ASD, for this study it was administered on all children who attended any of 130 schools in the study catchment area. This analysis includes a total of 2279 primary caregivers (60.0% mothers, 17.5% fathers, 22.5% grandparents and others) who completed the screener on their child (1083 boys and 1156 girls).
Results: Overall, the prevalence of SCQ measured traits/behaviors vary in this school aged population, ranging from 3.8% (cannot have a to-and-fro conversation) to 34.1% (no use of gestures). Boys and girls have similar patterns of item score distributions; however, RRB item scores are significantly higher in boys. Very similar proportions of boys and girls have SCQ>=15 (9.14% for boys, 9.08% for girls).
Conclusions: Boys are not at higher risk than girls of meeting the SCQ clinical cutoff (>=15) in this defined population. In other words, our results do not support the observations that more boys than girls are meeting ASD clinical thresholds. While the majority of reports on SCQ are from higher risk populations, this study uniquely demonstrates the distribution of SCQ measured behaviors in a "general population". While the global autism research community has made every effort to find causes of ASD, it is necessary to examine the extent to which ASD-associated traits and behaviors are distributed in general populations. Such understanding may help shed light on finding etiologic factors of the disorder.

217 **141.217** Faith and Respect: Parenting the Urban African American Child with Autism

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Background: Accessibility to health care for urban African American children is undercut by racial and economic differences that can delay families' seeking and receiving health care for their child, putting the African American child with autism at higher risk for preventable delays to interventions and poorer long-term outcomes. Cultural factors such as access to health care and cultural knowledge of autism within the African American community have been implicated as barriers to timely interventions. Mindful of these factors, researchers and clinicians have proposed that therapeutic interventions have been underutilized by those who need it the most, such as low-income African American children with autism.

Objectives: The objective of this study was to conduct an in-depth exploration to discover the cultural care meanings, values, beliefs, practices and cultural ways of urban African American families caring for their child with autism, with the focus of this abstract on parenting beliefs, values and practices.

Methods: An ethnonursing qualitative study was conducted to discover and systematically analyze meanings of care and cultural ways of urban African American families caring for their child with autism. Fifty-two participants were interviewed and in-depth field observations conducted in the environmental context of their homes, schools and community events. Participants included 24 family members of children with autism from 8 African American families and 28 health and school professionals. Data were analyzed and findings reported as they emerged from the patterns as themes.

Results: Parenting the urban African American child with autism meant that families drew on their faith in God and faith in their family as a means to gain strength, receive support, maintain hope and coping with their daily stressors. Faith in God and family was challenged when other family members demonstrated disbelief about an autism diagnosis or when coping with expressions of "bad parenting" as the cause for their child's behavior. Parenting also meant that giving and receiving respect was first learned at home including respect for the multigenerational traditions in parenting and child discipline. While respecting generational practices, families negotiated disciplinary ways differently for their child with autism. Families also blended traditional and non-traditional ways in home-tailoring therapeutic interventions often broadly framed by clinicians, therapists and educators. Diversities in parenting among single versus dual parent families and maternal versus paternal parenting offered variable strategies and styles to the African American child with autism.

Conclusions: The findings substantiated that faith in God and faith in the family combined with respect for multigenerational disciplinary ways and creation of new ways was core to parenting urban African American children with autism. When clinicians, therapists and educators have knowledge and understanding of cultural parenting practices and act on that understanding in respectful and culturally sensitive ways, they have the potential to mitigate the barriers to access as families seek or receive interventions for their child with autism. Future directions are to employ community based participatory research methods to develop and test interventions that affect urban families seeking and receiving treatments for their African American child with autism.

218 **141.218** Increasing Awareness of Autism and Other Developmental Disorders Among Rural Ethiopian Community Health Workers: Impact of a Brief Training

R. A. Hoekstra[1], D. Tilahun[2], Y. Baheretibeb[2], B. Tekola Gebru[1], I. Roth[1], B. Davey[1], A. Fekadu[2] and C. Hanlon[2,3], (1)Department of Life, Health and Chemical Sciences, The Open University, Milton Keynes, United Kingdom, (2)Department of Psychiatry, School of Medicine, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia, (3)Centre for Global Mental Health, Institute of Psychiatry, King's College London, London, United Kingdom

Background:
In Ethiopia basic health services are provided by community health workers (CHWs). Most of the 39,000 currently practicing CHWs have received basic training not encompassing mental health. In 2012 the Ethiopian Ministry of Health started upgrading the training of existing CHWs using the Health Education And Training (HEAT) curriculum, which includes a brief overview of mental health. In 2013 additional training materials, including a DVD with 5 short videos and a Mental Health Pocket Guide, were added to the curriculum of a new cohort of CHWs. This enhanced mental health training (HEAT+) has a particular focus on developmental disorders, including autism.
Objectives:
To examine the impact of HEAT and HEAT+ training on raising awareness among CHWs about autism and other developmental disorders.
Methods:
Participants (all females, all working in Ethiopia's Southern Nations and Nationalities Peoples Region) comprised i) 107 CHWs who had completed the upgrading training using HEAT 16 months prior to the data collection and had since returned to their work place; ii) 101 CHWs who had studied the enhanced (HEAT+) training 4 months prior to the data collection and were still in full-time study; iii) 111 practicing CHWs untrained in mental health (controls). All participants completed a survey that included case vignettes describing intellectual disability and autism, followed by questions on autism characteristics (adapted from the Autism Survey; Stone, 1987). The survey also asked whether and how CHWs used the training in practice.
Results:
All groups were equally likely to recognise intellectual disability from its case vignette (p>.05). A greater proportion of HEAT+ trained CHWs (28.7%) than untrained CHWs (16.2%) were aware of children in their local community with intellectual disability (p=.03); the HEAT trained and control group did not differ significantly from each other (p>.05). CHWs trained using the HEAT+ curriculum (64.4%) more often identified autism from the case vignette than HEAT trained (8.4%) and untrained (0.0%) CHWs (both p<.001), while the HEAT cohort performed better than untrained CHWs (p=.002). Using the adapted Autism Survey, HEAT and HEAT+ trained CHWs could identify more symptoms of autism than controls, with the HEAT+ group outperforming the HEAT group (all p<.001). HEAT+ trained CHWs (13.9%) were more likely than controls (5.4%) to know local children with symptoms of autism (p=.04). Most (74.8%) HEAT trained CHWs indicated that they apply the training at least once

a month in their job; 97.2% of HEAT trained CHWs had organised one or more mental health awareness raising meetings in their community, compared to 10.8% of controls (p<.001).
Conclusions:
Brief mental health training for CHWs, particularly the enhanced (HEAT+) training, helped to increase awareness of developmental disorders, including autism. CHWs are the primary source of help for families living in rural Ethiopia and the referral gateway to more specialised services. In addition to case identification and referral, a key responsibility for CHWs is providing health education to their community. Most HEAT trained CHWs indicate they are disseminating their mental health knowledge locally, so the HEAT/HEAT+ training has a potentially wide reach.

219 **141.219** Physiological Monitoring during PEERS®: A "Culture-Free" Method of Understanding Intervention Response

N. Jain[1], S. Ahamed[1], S. Stevens[1], K. A. Schohl[2], B. Dolan[1], A. J. McVey[1], S. Potts[1], C. L. Casnar[3], C. Caiozzo[1], E. M. Vogt[2] and A. V. Van Hecke[4], (1)Marquette University, Milwaukee, WI, (2)Clinical Psychology, Marquette University, Milwaukee, WI, (3)University of Wisconsin Milwaukee, Milwaukee, WI, (4)Psychology, Marquette University, Milwaukee, WI

Background: Adolescents with ASD are at an increased risk of anxiety disorders (White et al., 2009) versus typically developing individuals. Arousal from the autonomic nervous system is the somatic component of anxiety (Vitasari et al., 2011) and is experienced by an increase in heart rate, increase in electrodermal activity (Critchley, 2009), and shortness of breath. In addition to physiological arousal, emotions are expressed behaviorally through facial expressions, body gestures, and speech. No study has examined electrodermal activity (EDA) as a base to understand anxiety and arousal over the course of intervention in ASD, even though objective, universal measures would be beneficial to understanding how and why certain interventions are conducive for positive outcomes.
Objectives: To examine the relationship between presence of physiological arousal, expression of this emotion through facial features, and self-awareness of anxiety among adolescents with ASD who participated in the PEERS® intervention. The current study aims to address whether physiological arousal can serve as a "culture-free" measure of intervention response.
Methods: For the present study, 13 adolescents (11 to 18 years-old) with ASD were drawn from a larger ongoing study over the span of 1.5 years. All participants had an IQ greater than 70 on KBIT and diagnoses were confirmed with the ADOS. Adolescents participated in the Program for the Education and Enrichment of Relational Skills (PEERS: Laugeson & Frankel, 2010). Measures that were taken during each of the 14 intervention sessions included (1) 30 minutes of electrodermal activity (Q-Sensor wristband: Affectiva, Inc.), (2) self-report of anxiety (STAI: State Trait Anxiety Inventory: Short Form: Marteau & Bekker, 1992), and (3) video coding of facial affect (The EigenFace method: Turk & Pentland, 1991).
Results: Regression analysis indicated a significant relationship between maximum EDA during each PEERS session and the average score for self-reported anxiety, $F(9,89) = 2.16$, $p< .05$. The EigenFace method (for identification of facial affect from facial images), followed by a machine learning algorithm (for image classification), was only able to predict the EDA arousal states at a slightly better than chance accuracy, 57%. The image clustering technique (k-means) did not provide a clear distinction between facial affect images that corresponded to highest and lowest EDA in the PEERS sessions for each participant.
Conclusions: EDA and self-report data shows the presence of physiological arousal and anxiety in adolescents with ASD during PEERS intervention sessions. However, adolescents' facial expressions were not predictive of their anxiety or arousal. A significant relationship between EDA and self-report of anxiety suggests that adolescents are self-aware of their arousal states, and that EDA shows promise as a "culture-free" method of monitoring arousal during intervention. Future objectives include examining trajectories of EDA response and relations to intervention outcome.

220 **141.220** Spirituality in Latino Families of Children with Autism Spectrum Disorder

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Background:
Research on families of children with developmental disabilities indicates that parents use spirituality to conceptualize and to cope with their child's diagnosis (Skinner, Rodriguez & Bailey, 1999). This is especially true in Latino families, whose cultural contexts often emphasize spiritual beliefs (Herrera et al., 2009). Latino families may use spiritual methods of conceptualizing more than non-Latino families due to societal oppression, the colonization process, immigration status, socioeconomic factors and educational factors (Zea, Quezada & Belgrave, 1994). However, little is known about how spirituality is conceptualized among Latino families of child with Autism Spectrum Disorders (ASD).
Objectives:
The current study explores how Latino parents of children with ASD use spirituality to make sense of their child's disability.
Methods:
For the current study, Latino parents (N=34; 59% Mexican, 15% Puerto Rican, 24% other) of children diagnosed with ASD (82% autism, 12% PDD-NOS, 3% Asperger's, 3% unsure) between the ages of 2-

22 were recruited from community organizations . In-person interviews with the parents were done in the participants' homes. Interviews asked parents about autism services, family characteristics, and cultural beliefs. Using content analysis, research assistants read and coded parents' responses to the question "Some people think that having a child with an illness is a message from God, what do you think?". They also considered excerpts which referred to "God", "blessing" or any reference to spirituality.

Results:
Overall, 53% of families reported attending religious services at least a few times per year. In the content analysis, four main themes emerged: Child is a positive sign from God; Child is not a sign from God; Child is a negative sign from God; and Unsure/Other. The majority of parents believed that their child was a positive sign from God including, beliefs that their child was a blessing from God, part of God's plan, a test from God, or a sign from God that the parent was special. Only five parents believed that their child was a punishment from God. Other parents believed that having a child with a disability was not an act of God, but an act of nature. Some parents said that the larger culture believed that having a child with a disability was a punishment but they markedly disagreed with that notion.

Conclusions:
Most parent responses were consistent with themes found in other literature. For example, Latino parents in other studies conceptualize their child with a disability as a gift from God, a blessing, part of God's plan, a test from God, or a punishment from God. Novel themes found in this study are ways in which parents conceptualize their child in non-spiritual ways, including conceptualizing their child with a disability as an act of nature instead of an act of God. Furthermore, the recognition and disagreement with what other Latino parents believe about culture is a novel theme that warrants further research.

221 **141.221** The Analysis of Korean Urban High School Students' Awareness on Autism Spectrum Disorder

C. J. Shin, *Korea International School, Seongnam-si, Gyeonggi-do, South Korea, South Korea*

Background:
The prevalence of autism has increased precipitously in the past 40 years. As it is not rare to encounter individuals with autism spectrum disorder (ASD) in schools and communities, more enlightenment regarding autism awareness and integration is needed amongst people.
Previous study suggests that individuals with ASD are at greater risk for both traditional and cyber bullying victimization and perpetration than their typically developing peers (Little, 2002).
The general consensus in school is that it is underprepared to work with students with disabilities, particularly those with ASD. Despite the fact that inclusive education is widely used in many schools these days, not all the non-disabled students have the correct understanding of ASD. Unfortunately, autistic students often experience social isolation even when physical inclusion is provided. It is essential for non-disabled students to understand the symptoms of ASD and to form a welcoming attitude towards autistic students so that they do not get discriminated or excluded in peer groups and community.

Objectives:
The purpose of this study is to find out how much knowledge Korean urban high school students have about ASD and to analyze the effect of how the experiences on inclusive education affect their awareness on ASD.

Methods:
In this study, 421 subjects (boys: 131, girls: 290) were selected from two high schools located in Seoul, Korea. The finalized survey is constructed in three parts: demographic data, general knowledge about ASD, and raising awareness on ASD through inclusive education. There are 27 questions in total and the answers are measured on 5-point Likert agreement scale.

Results:
The survey results clearly indicated the lack of knowledge of the students in general. The result showed that the awareness and acceptance level is meaningfully higher in the students who were in inclusive education and who had the experience of ASD related community services. However, the knowledge level on ASD does not show differences whether the respondents have the above experience or not.

Conclusions:
Conclusion: The students with ASD who are in inclusive education classroom need to have more meaningful interaction opportunities with their peers as participating in group activities including lunch and recess. For this, constant effort is needed to raise the awareness on ASD. Adding on to experiencing inclusive education, ASD awareness education will present much more positive progress. It is necessary for high school students to know more about ASD to reduce the bias against autistic students. Considering the prevalence of smart phones and social network systems among adolescents, dissemination of knowledge through SNS and smart phone applications would be very effective. Along with inclusive education, the diverse programs which enable autistic students and non-disabled students interact with each other are needed. Not only will these interactions help the disabled students, but also will help promote the non-disabled students' personal growth by understanding their peers' difficulties and ultimately accepting them into their circle of friends.

141.222 Understanding Parents' and Professionals' Knowledge and Awareness of Autism in Nepal

A. Alexander[1], E. Pellicano[1], E. Medeiros[2], K. Man Tumbahangphe[3], F. Gibbons[4], M. Wickenden[2], M. Shrestha[5], A. Costello[2] and M. Heys[2], (1)Centre for Research in Autism and Education (CRAE), Institute of Education, London, United Kingdom, (2)University College London Institute for Global Health, London, United Kingdom, (3)Mother and Infant Research Activities, Kathmandu, Nepal, (4)King's College London, London, United Kingdom, (5)Autism Care Nepal, Kathmandu, Nepal

Background:
Autism is a global phenomenon. While in Western countries such as the US and UK, prevalence estimates of autism spectrum disorders are around 1% of the population, much less is known about the prevalence of autism in countries outside of the US and Europe, or indeed of the way that autism is manifested in individuals from different countries. Indeed, cross-cultural differences (in eye gaze processing, for example) have caused some researchers to call for the need to determine culturally specific understandings of autism, especially in developing and underserved populations (Grinker et al., 2012), like Nepal.
Objectives:
The aim of this study was to examine parents and (health and education) professionals' perceptions and understanding of typical and atypical development in both rural (Makwanpur District) and urban (Kathmandu Valley) Nepal, focusing specifically on autism.
Methods:
In collaboration with our community partner, Autism Care Nepal, we carried out 9 focus groups with health workers, junior and senior paediatricians, primary school teachers and parents of autistic and non-autistic children in Makwanpur and Kathmandu and 9 semi-structured interviews with early childhood development (ECD) teachers, faith healers, paediatricians and other people working in the disability sector in Makwanpur. The focus group and interview schedules included questions about typical development and vignettes of typically and atypically developing children.
Results:
Overall, those parents and professionals who were not directly involved with atypically developing children had very little awareness of autism. Participants, particularly parents of non-autistic children, used terms such as "doggedly child", "lonely child", "introvert, "egoistic", "dumb", or "mental patient" to describe vignettes of children with autism. The majority of participants felt that environmental factors (e.g., parenting style, home or school environment) were key causes of atypical child development. Furthermore, junior doctors, who receive very limited training in childhood developmental disorders like autism, felt that doctors in general had some knowledge of developmental conditions like autism but no understanding of how to manage and support these children and their families in the long-term. In contrast, senior doctors felt they had had no training at all or theoretical training only in the recognition and management in disorders of child development. Many participants called for wider awareness of autism in the community through special schools or awareness campaigns in the media.
Conclusions:
This is the first study to examine parents and professionals' understanding of typical and atypical child behaviour and development in rural and urban Nepal. These findings clearly show the lack of awareness of developmental disorders, such as autism, from both parents and professionals alike. These results have important implications for future work aiming to increase awareness and enhance support available for autistic children and families in Nepal. The next step, prior to a prevalence study, is to explore the ethical considerations of disclosure of risk of or definite diagnosis of autism in Nepal.

141.223 What about the Adults?

C. Hoffner Barthold, Special Education, Graduate School of Education, George Masson University, Fairfax, VA

Background: It is clear that individuals with autism spectrum disorders (ASDs) benefit from the use of Applied Behavior Analysis-based interventions (ABA). In many American states, insurers are required to cover ABA services for children with ASDs. Requirements to fund ABA-based services, though, often end at age 21. Supports after age 21 are often eclectic, delivered by individuals with less training and skill, and difficult to access (Gerhardt, Cicero, & Mayville, 2014). Given that individuals on the autism spectrum have poorer outcomes than their peers without disabilities (Lawler, et al., 2008), there is a need to put effective supports in place for adults as well as children. Those providers who are looking to the research for guidance find that there is little research on interventions for adults with ASD, especially those with less significant developmental delays. While ABA is the evidence-based treatment of choice for children with autism, there is no empirical guidance on how supports and interventions can be adapted to increase good outcomes for adults with ASD.
Objectives: The purpose of this talk is to outline the need for ABA-based services for adults with ASD and describe how evidence-based practices for children and adolescents with ASD can be adapted for adults in the community. Included are suggestions on how to integrate ABA services within Person-Centered Planning, and how to make interventions age appropriate and socially valid.
Methods: Data will be presented from an onging pilot project with a University program for individuals with developmental and intellectual disabilities. Individuals with ASD selected for this project are all

able to communicate verbally and have at least a first-grade reading level. This project includes the validation of a process by which individuals select their own goals for support, as well as a process for assessing and supporting appropriate behavior in the community. Applied behavior analysis supports will be put into place in a white-collar (office) environment. Supports are individualized based upon each person's need and may include visual feedback, verbal reinforcement for appropriate behavior, video modeling, and social skill support. Emphasis will be placed upon how to meet each individuals' needs in a way that is both effective and appropriate for the setting. Case studies as well as aggregate data will be reported. Suggestions for implementation by providers as well as suggestions for future research will be presented.
Results: N/A.
Conclusions: N/A

Oral Session
142 - Preterm Birth and ASD Risk
1:45 PM - 2:35 PM - Grand Ballroom B

Session Chair: Lonnie Zwaigenbaum, *University of Alberta, Edmonton, AB, Canada*

1:45   **142.001**   Detection of Early ASD Risk in Preterm Infants

M. Yaari[1], N. Yirmiya[1], B. Bar-Oz[2], S. Eventov-Friedman[3], D. Mankuta[4], E. Friedlander[1], A. Harel[1] and N. Yitzhak[1], (1)Psychology Department, Hebrew University, Jerusalem, Israel, (2)Department of Neonatology, Hadassah Medical Center, Jerusalem, Israel, (3)Neonatology Unit, Hadassah Ein-Kerem University Hospital, Jerusalem, Israel, (4)Department of Obstetrics and Gynecology, Hadassah Ein Kerem University Hospital, Jerusalem, Israel

Background:
During the recent years, there has been significant advance in delineating the early markers of Autism Spectrum Disorders (ASD). The Autism Observation Scale for Infants (AOSI) is an observational measure designed to detect and monitor these early abnormalities in infants aged 6-18 months. Most of the research using the AOSI included high-risk siblings of children with ASD, therefore, it's generalization in other high-risk populations is still unclear.
Objectives:
The objectives of this this study were: a) to examine the prevalence of early social-communication abnormalities, as assessed with the AOSI, in a sample of preterm infants at 8 and 12 months corrected age (CA). b) to examine the association between the AOSI at ages 8 and 12 months and the ADOS at 18 months. c) To identify a cut-off criterion with optimal sensitivity and specificity in identifying preterm infants at risk for ASD, as assessed with the ADOS at 18 months.
Methods:
This study included 101 singleton infants (45% girls), born at 34 weeks gestation or earlier (M = 31.28; SD = 2.57; range = 24-34 weeks) at Hadassah Medical Centers in Jerusalem, Israel. Infants were assessed at 8 and 12 months CA with the AOSI and the Mullen; and at 18 months CA with the ADOS-T and the Mullen. A total score of ≥ 7 (counting the number of items coded one or above) and a total score of ≥ 9 are considered to be AOSI scores of concern.
Results:
Using the original cut-off criteria of the AOSI, eighteen infants scored above the cut-off at 8 months CA and six infants scored above the cut-off at 12 months CA (see Table 1). At 18 months CA, eight infants' ADOS-T algorithm scores were in the moderate to severe concern range. Using the original cut-off of ≥ 7 markers **and** total score ≥ 9 in the AOSI, sensitivity and specificity were 0.5 and 0.90 at 8 months, and 0.5 & 0.95 at 12 months, respectively (see table 2). Receiver operating characteristic analyses (ROC) analyses yielded lower cut-offs of 5 for number of items and 7 for total scores with more optimal prediction on ADOS classification at 18 months with 0.87 sensitivity and 0.73 specificity. Seven out of 8 children who scored positive on the ADOS have been identified at risk by the AOSI using these cut-offs. About half of the false positives were infants with other developmental difficulties.
Conclusions:
Although there were alarmingly high rates of social-communication abnormalities at 8 months, by 12 months most of those who scores at risk "grew out" of it and had much less abnormalities at 12 months. However, 8% of the children scored at risk for ASD by the ADOS-T at 18 months CA. Lower cut-off criteria on the AOSI yielded better predictive validity than those suggested for siblings. The trajectories and the phenotype of ASD in preterm population may be different from other high-risk populations and requires more research and follow-up.

1:57   **142.002**   Social Cognitive Atypicalities Associated with Preterm Birth: A Challenge to the Early Diagnosis of Autism

S. Fletcher-Watson[1], E. Moore[1] and J. Boardman[2], (1)University of Edinburgh, Edinburgh, Scotland, (2)Child Life and Health, University of Edinburgh, Edinburgh, United Kingdom

Background: Prospective research into the early signs of autism has focused largely on the infant siblings of children with a confirmed diagnosis. These infants have approximately 18 times higher likelihood of an autism diagnosis compared with the general population. This research has uncovered a number of early features which seem to be associated with later autism outcome. However many such features (e.g. reduced fixation on eyes) are contested and some are associated with autism-siblinghood but not with autism diagnosis specifically. This has led to a questioning of the previously-convincing hypothesis that early autism is characterised by reduced social interest. Exploring early social cognition in preterm infants gives insight into both an alternative route to autism (since preterm birth is associated with approximately 4 times higher likelihood of diagnosis) as well as the association of early cognitive traits with general developmental delay (which is present in about 50% of infants born preterm).

Objectives: We tested the hypothesis that the early social cognitive phenotype associated with preterm birth differs from that of term controls. Our goal is to consider whether instead of being autism-specific, some early social cognitive atypicalities are generic markers of delayed development or associated with intellectual disability rather than autism.

Methods: We have recruited a large sample (n=92) of infants born preterm (less than 32 weeks gestational age, and weighing less than 1500g at birth). Of these, 38 have been assessed at approximately 9 months corrected age along with 37 typically-developing infants matched on age and gender.

Tasks were eye-tracker based assessments of social cognition previously used in comparative studies of populations with and without autism. The tasks increased in the complexity of the stimulus presented, but were all free-viewing tasks. Stimuli in order of complexity were: neutral, static faces; faces presented alongside other objects in a grid-like array; people depicted in naturalistic photographs alongside another photograph without people.

Results: We calculated looking time scores to social and non-social areas of interest. The preterm group fixated the eyes of a neutral face significantly less than the control group (mean difference = 0.62s, p=.036). They also looked less at a face in a grid-like array (mean difference = 0.45s, p=.05) and looked less at naturalistic photos with social content (mean difference = 0.34s, p=.048). There were no differences in latency to fixate social areas of interest. In addition, preterm children showed a normal sized attentional disengagement effect in the gap-overlap task, indicating that generalised attention deficits were not contributing to differences in social attention. Final results will be presented from a predicted sample of approximately n=60 in each group.

Conclusions: In each task preterm infants showed atypical fixation on social content, a pattern previously thought to be specific to children who later receive an autism diagnosis, but perhaps instead associated with general cognitive delay. Final results will be considered in light of their impact on our understanding of early autism and specifically consequences for attempts to create early diagnostic assessments.

2:09 **142.003** Early Brainstem Dysfunction in Preterm Infants Increases Risk for ASD: Findings from Parent Report Measures

J. M. Gardner[1], *B. Z. Karmel*[1], *I. L. Cohen*[1], *H. T. T. Phan*[1], *P. M. Kittler*[1], *E. M. Lennon*[1], *S. Parab*[2] and *A. Barone*[2], (1)Infant Development, New York State Institute for Basic Research in Developmental Disabilities, Staten Island, NY, (2)Pediatrics, Richmond University Medical Center, Staten Island, NY

Background: Identifying early indicators for Autism Spectrum Disorders (ASDs) could enhance understanding of the underlying pathways to ASDs, thus contributing to earlier screening and intervention. We have reported abnormalities more prevalent in NICU graduates later diagnosed with ASD that reflect brainstem dysfunction including: (1) a pattern of arousal-modulated-attention (AMA) at 4 months post-term-age (PTA) more typical of newborns (Karmel et al, 2010); (2) abnormal auditory brainstem evoked responses (ABRs), and (3) abnormal AMA conjoined with abnormal ABRs, predicting increased ASD risk in preterm infants (Cohen et al, 2013). To further increase understanding of factors associated with early identification of ASD in preterm infants, we related these to parent report measures associated with autism diagnosis.

Objectives: To ascertain if these findings of very early neurofunctional associations to ASD are: (1) common to the atypical development associated with high-medical-risk NICU graduates; and (2) related to later parent report measures indicating ASD risk.

Methods: Two groups of medically at-risk NICU infants recruited as newborns were compared: 1. later-diagnosed ASD (n=50); and 2. non-ASD (n=1985). Various contrasts between ASD and non-ASD groups were performed where the effects of gestational age, birth weight, gender, CNS injury, and ASD were included along with information from: (1) ABRs obtained shortly after birth (after 32wks PCA); (2) AMA at 4 months PTA: Slope of preference function across pairs of stimuli >.1 = looking at higher rate (8Hz>3Hz>1Hz); (3) Parent report measures of ASD risk: Communication and Symbolic Behavior Scales (CSBS) Infant-Toddler Checklist (13 months); Modified Checklist for Autism in Toddlers, (M-CHAT) (18 mo); PDD Behavior Inventory Short Version (PDDBI-SV) (18 mo): Screening to assess PDD/ASD.

Results: There was a high incidence of abnormal ABRs in ASD compared to non-ASD (72% vs. ~28%). ASD looked more at higher stimulus rates than non-ASD (70% vs. 40 %). The combination of abnormal ABR with AMA slope >.1 predicted ASD, with 60% of ASD having both vs. 17% of non-ASD. Preterm infants showing high abnormality may represent developmental problems not necessarily within criteria for ASD. M-CHAT (> 60%) and CSBS (~26% across 3 composites and total) indicated positive

findings for ASD, but a high rate of failures for non-ASD preterms.

Conclusions: Dysfunction during early brainstem development, indicated by altered neuronal transmission speeds together with deficits in attention regulation observable as early as 4 months of age may represent a potentially important path leading to later ASD, an idea strengthened by their relationship to parent report measures associated with later diagnosis of ASD. Moreover, the high rate of failures found for preterms on parent report measures likely reflect developmental and regulatory issues common to ASD and high-medical-risk. Findings support the conclusion that increased incidence of ASD in preterms may be secondary to the conditions that increase risk for preterm birth, but the consequences of preterm birth are independent. Thus, preterm birth may be correlated, but not causal to ASD.

2:21 **142.004** Quality of Interaction Between Very Preterm Infants and Their Mother in the First Year of Life Predicts General Development and Autism Features at 18 Months

J. Vermeirsch[1], L. Verhaeghe[1], E. Demurie[1], L. De Schuymer[2] and H. Roeyers[1], (1)Department of Experimental Clinical and Health Psychology, Ghent University, Ghent, Belgium, (2)Kind&Gezin, Brussels, Belgium

Background: Previous research has indicated that preterm born children have an increased risk for impairments across different domains (e.g., cognition, language) and for neurodevelopmental disorders such as Autism Spectrum Disorder (ASD; e.g., Dudova et al., 2014). Apart from this biological vulnerability, environmental factors such as early parent-child interactions (PCI) also seem to be important to understand differences in developmental outcome associated with ASD (e.g., Wai Wan et al., 2012). It is surprising that, although these early PCI can have a profound impact on the development of preterm infants (PI), to date still little prospective research has been conducted on these interactions and their relationship to later outcome in infants at risk for ASD.

Objectives: This study examined whether 5- and 10-month PCI in PI differ from PCI in full-term infants (FI) and whether characteristics of such early interactions can predict general development and ASD features at 18 months.

Methods: As part of a longitudinal follow-up study, global aspects of PCI were assessed at 5 and at 10 months of age during unstructured play interactions in 68 PI (<30 gestational weeks) and 37 FI and coded with the Coding Interactive Behaviour rating scales (Feldman, 1998). At 18 months, measures of developmental level (BSID-II; Van der Meulen et al., 2004) and language (N-CDI; Zink & Lejaegere, 2003) were included and ASD features were observed with the ADOS-T (Lord et al., 2012).

Results : At 5 months of age, no significant differences were found in the quality of PCI between the PI and FI. In contrast, at the age of 10 months results showed that PI were less involved ($p<0.001$), and their parents exhibited lower sensitive responding ($p=0.01$). Moreover, the dyadic patterns between PI and their mothers were less reciprocal ($p<0.001$) and more negatively charged ($p<0.001$).

Preliminary analyses with a subset of the preterm sample, showed that parent sensitivity at 5 months is positively related to language comprehension at 18 months and that parent sensitivity at 10 months is positively related to the developmental level and both language comprehension and production at 18 months. We also found significant associations between infant involvement, dyadic reciprocity, dyadic negative state at 5 months and parent sensitivity at 10 months, with social affect scores as well as with the repetitive behaviour and interest scores on the ADOS-T at 18 months. More detailed analyses of the entire sample will be provided at the meeting.

Conclusions : Our findings indicate that PCI in high risk PI and FI are very similar at 5 months but once the infants grow older, the mother-preterm infant dyads experience more interactional difficulties compared to full-term dyads. This prospective study also provides information on the association between the quality of PCI and different aspects of development in preterm children, an area that has been analysed in only a few studies. In the PI-group, different characteristics of the quality of PCI were significantly associated with later general development and ASD features. This finding may stress the importance of supporting the early social-communicative skills during PCI in PI.

Oral Session
143 - Early ASD Surveillance and Screening
2:40 PM - 3:30 PM - Grand Ballroom B

Session Chair: Lonnie Zwaigenbaum, *University of Alberta, Edmonton, AB, Canada*

2:40 **143.001** Broadband and Autism-Specific Screening Using the Early Screening for Autism and Communication Disorders (ESAC): Moving from Paper to the Smart ESAC for Children 12 to 36 Months of Age

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Background: The American Academy of Pediatrics (AAP) recommends all children be screened for ASD at 18-24 months. However, there are no well-validated screening tools for ASD at this age and time needed to complete separate broadband and autism-specific tools has not been feasible in primary care settings. The need for validated screening tools is critical so families can access intensive, appropriate intervention services early.

Objectives: The primary objectives of this study were: 1) to replicate findings on the *Early Screening for Autism and Communication Disorders*(ESAC), a 30-item autism-specific parent-report screening tool that screens for ASD in children 12-36 months of age; and 2) to develop a streamlined "smart" ESAC for primary care consisting of 10 broadband questions for universal screening, which if positive, are followed seamlessly by 20 autism-specific questions.

Methods: Florida State University and University of Michigan conducted screening from two sources: 1) follow-up of over 12,000 children screened by the FIRST WORDS® Project with the Infant-Toddler Checklist for communication delays in primary care; and 2) children referred for possible ASD to each university. Follow-up diagnostic evaluations were conducted for 647 children in 3 age groups: Early 2nd year (12-17 months, m=15.38, n=203), Late 2nd year (18-23 months, m=20.26, n=346), and 3rd year (24-36 months, m=28.01, n=323). A best estimate diagnosis of ASD (n=283), developmental delay in which ASD was ruled out (DD; n=120), or typical development (TD; n=244) was made. Prometheus Research designed and built a web-based application—the Smart ESAC, using logic to dynamically tailor questions, automatically score responses based on algorithms, and providing a calculated risk assessment and report for review by healthcare providers.

Results: Receiver Operating Characteristic (ROC) curves indicated excellent discrimination, and good sensitivity and specificity of established cutoffs for the ESAC 30 as an autism-specific screener in this large community and referral sample for all age groups. Item-Response Theory was used to analyze Item Information Function and characterize performance of each item in discriminating ASD from non-ASD. ROC curves run for each item within the three age groups indicated slightly different item sets were needed to best discriminate children with atypical development (i.e., ASD or DD) from those with typical development. The best 10 individual items within age group demonstrated acceptable item-level sensitivity and specificity and when summed, the total ESAC 30 showed good sensitivity and specificity. A pilot of the Smart ESAC is being implemented with 8 healthcare provider practices. Late breaking results will be available.

Conclusions: These findings offer promise for a cost-effective screener as early as 12 months of age and add to the research documenting the accuracy of parent report to screen young children, which minimizes time required of primary care providers, maximizes the role of the family, and provides reasonably accurate information about whether to refer a child for a diagnostic evaluation for ASD or other developmental problems. The pilot of the Smart ESAC offers promise to make effective screening more accessible to both families and providers, key to early access to care.

2:52   **143.002**   Universal Developmental Surveillance for Autism Spectrum Disorders in Infants and Toddlers Using the Social Attention and Communication Study-Revised (SACS-R)

J. Barbaro[1] and C. Dissanayake[2], (1)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Victoria, Australia, (2)Olga Tennison Autism Research Centre, Melbourne, Australia

Background: Despite increasing knowledge of the early markers of ASD, no screening tools have demonstrated sufficient psychometric properties for universal ASD screening in infants and toddlers. Barbaro and Dissanayake (2010) utilised developmental surveillance for the early identification of ASD within the Social Attention and Communication Study (SACS). The SACS involved training Maternal and Child Health (MCH) nurses to monitor children for ASD at their 12, 18 and 24 month health check-ups. The SACS has been found to be the most accurate and sensitive method for the early identification of ASD to date, with 81% positive predictive value (PPV), and estimated sensitivity and specificity of 83.8% and 99.8%. However, not all children monitored (n = 20,770) were followed-up to identify any "missed" cases of ASD (false-negatives).

Objectives: The objectives of the current study were: 1) to improve the psychometric properties of the SACS by using the SACS-Revised (SACS-R) in a low-risk, community-based sample, at children's routine health consultations from 12-24 months; and 2) to follow-up all children monitored with the SACS-R at 3.5 years to identify any false-negatives and confirm diagnoses made at 24 months.

Methods: The SACS-R contains brief checklists of key social-communication markers of ASD at 12, 18, and 24 months. 200 MCH nurses in Victoria, Australia, were trained on the SACS-R for use at their 12-24 month routine consultations. All children identified "at risk" for ASD on the SACS-R were referred for developmental assessments every 6 months until 2 years of age, and followed-up at 3.5 years to confirm diagnoses. Children were assessed with the ADOS-Toddler and Mullen Scales of Early Learning at each assessment, with the ADI-R administered at 24 months. All children monitored between 12-24 months were also followed-up with a SACS-preschool checklist at their 3.5 year MCH consultation, with all children "at risk" referred for assessment. Furthermore, all children who have a confirmed diagnosis of ASD in the community, but are "not at risk" on the SACS-R, will be referred for assessment.

Results: To date, 11,379 children have been monitored, with 200 children identified "at risk" for ASD thus far (1.7% referral rate). Of these, 139 children have been assessed, with 113 children meeting criteria for ASD (81.3% PPV), with the remaining children having developmental and/or language delays. 78% of 12-month-olds, 85% of 18-month-olds, and 80% of 24-month-olds assessed currently meet criteria, or are showing the early signs, for a diagnosis of ASD. There were no "true" false

positives identified, as no child "at risk" on the SACS-R was typically developing.
Conclusions: Developmental surveillance using the SACS-R has been shown to be the most effective method for the early identification of ASD to date. It is on par with the PPV of the original SACS, and is showing promising results in increasing sensitivity given the ASD prevalence found in the current sample (1%). These preliminary results confirm that developmental surveillance, not screening, is the most useful way of identifying infants and toddlers with ASD. Updated results to May 2015 will be presented at the conference.

3:04   **143.003** Parents' Concerns Predict a Later Autism Spectrum Disorder Outcome: A Prospective Study of High-Risk Siblings from 6 to 36 Months

L. A. Sacrey[1], L. Zwaigenbaum[1], S. E. Bryson[2], J. A. Brian[3], I. M. Smith[4], W. Roberts[5], P. Szatmari[6], C. Roncadin[7], N. Garon[8], T. Vaillancourt[9] and C. Novak[1], (1)University of Alberta, Edmonton, AB, Canada, (2)Autism Research Centre, Dalhousie/IWK Health Centre, Halifax, NS, Canada, (3)Autism Research Centre, Holland Bloorview Kids Rehabilitation Hospital/ U of Toronto, Toronto, ON, Canada, (4)Dalhousie University / IWK Health Centre, Halifax, NS, Canada, (5)Pediatrics, University of Toronto, Toronto, ON, Canada, (6)University of Toronto, Toronto, ON, Canada, (7)Kinark Child and Family Services, Markham, ON, Canada, (8)Psychology, Mount Allison University, Sackville, NB, Canada, (9)University of Ottawa, Ottawa, ON, Canada

Background: Studies of 'high-risk' (HR) infants (infant siblings of children diagnosed with Autism Spectrum Disorder (ASD)) provide a unique opportunity to *prospectively* track parents' developmental concerns in relation to subsequent ASD diagnosis. Using this method, parents of children with ASD have reported concerns as early as 12 to 14 months of age, the most frequent concerns relate to delayed communication (Ozonoff et al., 2009; Hess & Landa, 2012). Although promising, the findings of these studies are limited in scope, in respect to range of developmental domains covered, number of time points, and lack of low-risk (LR) community controls. The present study addresses these limitations.
Objectives: To examine which parental concerns in the first 24 months distinguished HR infants who were diagnosed with ASD at 36 months from other HR and LR infants.
Methods: *Participants*: Three groups of children: (1) HR siblings who did not receive an ASD diagnosis at 36 months (HR-N), (2) HR siblings who did receive a diagnosis of ASD at 36 months (HR-ASD), and (3) infants without a family history of ASD (low-risk; LR). At 36 months, an independent, diagnostic assessment for ASD using the ADOS and ADI-R was conducted for all participants, blind to risk status and prior assessments, including parent concerns.
Parent Concerns: Parents of LR and HR infants were interviewed about current concerns regarding their infants' development at ages 6, 9, 12, 15, 18, and 24 months. The interview queried 10 domains: sleep, diet, sensory interests or unusual reactions, gross and fine motor development, repetitive movements and restrictive behaviors, communication development (both verbal and non-verbal), regression in communication skills, social skills, play behavior, and behavioral problems. A coder blind to group membership coded the concerns using a binary system, with "0" representing the absence and "1" the presence of a concern. A second coder, also blind, coded 30% of all forms to assess reliability using Cohen's kappa (overall 0.71).
Statistical Analyses: Total number of concerns and each individual domain were analyzed using mixed model analyses, with Group and Age as independent variables. To determine when group differences emerged, group x age interactions were explored using Benjamini & Hochberg (1995) corrections.
Results: Total number of concerns differentiated HR-ASD from the HR-N and LR groups by 12 months of age ($qs < .003$). Domain-specific concerns revealed that sensory ($qs < .032$) and motor ($qs < .028$) concerns at 6 months differentiated HR-ASD from the other two groups, whereas other domain-specific concerns did not differentiate HR-ASD until 12 months or later; social (12 months; $qs < .025$), communication (15 months; $qs < .028$), repetitive behaviors (18 months; $qs < .03$), and behavioral problems (24 months; $qs < .017$).
Conclusions: The results suggest that the presence or absence of parental concerns provides valuable predictive information to aid in differentiating between HR infants who will and will not receive an ASD diagnosis. The sequencing of parent concerns reflects the developmental course of ASD, with early concerns mirroring the 'prodrome' of ASD, and later concerns reflecting the 'core' domains of the disorder.

3:16   **143.004** Social but Not Repetitive Scores on the Quantitative Checklist for Autism in Toddlers (Q-CHAT) Predict Later Autism Spectrum Diagnosis in a Prospective High-Risk Sibling Study

G. Pasco[1], C. Allison[2], S. Baron-Cohen[3], M. H. Johnson[4] and T. Charman[1], (1)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (2)Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom, (3)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (4)Centre for Brain and Cognitive Development, Birkbeck, University of London, London, United Kingdom

Background: The British Autism Study of Infant Siblings (BASIS) is a prospective study of children with older siblings with ASD (High-Risk sibs: HR) and controls with older siblings who are developing typically (Low-Risk sibs: LR). Participants are assessed at various time points from approximately 5 months until 36 months of age. The Q-CHAT is a 25-item parent questionnaire, designed to be an

early screening instrument for autism. Each item has a 5-point Likert scale, with scores ranging from 0 to 4. Higher scores relate to higher levels of autism symptomatology.

Objectives: To investigate the factor structure of the Q-CHAT in a sample of 24-month-olds participating in a prospective study of children at risk for ASD, and to determine which factors, if any, are predictive of outcome, and at what ages.

Methods: The Q-CHAT was completed by parents when their children were 14-, 24- and 36-months of age. Following the 36-month visit a best estimate research diagnosis was applied to HR sibs. Outcome categories are: Typically developing (HR-TD); ASD (HR-ASD) and Atypical (HR-ATYP). The latter group consists of children not meeting criteria for ASD but meeting ASD criteria on the ADOS, ADI-R or being below 1.5 SD on the Mullen. Principal Component Analysis (PCA) was conducted on the 24-month Q-CHAT scores.

Results: Q-CHAT scores were available for 218 children. PCA suggested a two-factor solution. Factor A, Social Communication (SC), has 8 items, and Factor B, Stereotyped and Repetitive Behaviours (SRB), 9 items. Outcomes were known for 182 children: LR (N=69); HR-TD (N=67); HR-ATYP (N=22); HR-ASD (N=24). At 14 months SC scores predicted ASD outcome ($t=3.61$, $p<.001$) but the SRB factor did not ($t=-1.42$, $p=.17$). In fact, the LR scores for SRB were significantly *higher* than for the combined HR group scores ($t=-2.76$, $p=.007$). At 14 months the two factors were not significantly correlated ($r=.02$, $p=.79$). At 24 months SC was significantly higher in the HR-ASD group than the combined non-ASD groups ($t=4.23$, $p<.001$), but differences were not significant for SRB ($t=1.96$, $p=.06$). SRB scores for LR and HR groups did not differ significantly. At 36 months both factors were significantly higher in the ASD group than in the non-ASD groups (SC: $t=4.18$, $p<.001$; SRB: $t=3.27$, $p=.003$).

Conclusions: Findings suggest that differences in parent-reported social communication skills in children during their second and third years may be predictive of later autism diagnostic status. For stereotyped and repetitive behaviours, however, there seems to be a more dynamic situation, with differences in early ratings not predicting outcome but by 36 months scores differed in the expected pattern. This shift appears to be due to a combination of two issues: children who are on their way to developing autism may show more stereotyped and repetitive behaviours over time; and parents with no direct experience of autism may rate their young children as having more repetitive behaviours relative to parents of children with older siblings with autism.

Oral Session
144 - Conditioning and Anxiety
1:45 PM - 2:35 PM - Grand Ballroom A

Session Chair: Dermot M. Bowler, *Autism Research Group, City University London, London, United Kingdom*

1:45   **144.001**   Neural Networks for Anxiety? Decreased Integration in ASD of Sensorimotor and Emotional Pathways That Support Classical Fear Conditioning

M. South[1], C. Doxey[2], D. N. Top[3], K. Stephenson[2] and C. B. Kirwan[1], (1)Psychology and Neuroscience, Brigham Young University, Provo, UT, (2)Department of Psychology, Brigham Young University, Provo, UT, (3)Giant Steps Program, Wasatch Mental Health, Provo, UT

Background: Multimodal neuroimaging methods have the potential to elucidate specific networks underlying behavioral symptoms related to autism spectrum disorders. We recently performed a classical fear conditioning fMRI experiment that revealed abnormal right amygdala and left anterior insula activation in ASD during early fear acquisition. We collected diffusion tensor imaging (DTI) data from the same individuals and hypothesized that DTI based on our fMRI results could expand understanding of the neural basis for co-morbid anxiety that is commonly seen in ASD.

Objectives: We hypothesized that atypical function during acquisition and extinction of learned fear may be due to differences in white matter connectivity in neural networks related to integrating fear recognition and response. Low connectivity measures may be associated with a decreased ability to adapt to changing contexts and lead to subsequent symptoms of uncertainty and anxiety.

Methods: Participants included seventeen adults ages 18-29 diagnosed with ASD and age- and IQ-matched healthy controls. ROIs in right amygdala and left insula, defined from our fear conditioning fMRI data, were used as seeds for a tractography analysis using FSL's probtrackx software; this software estimates a "connectivity distribution" for each participant based on the initial seed. These participant-specific connectivity distributions were used to create a mask for each ROI such that voxels in the mask had connections with the ROI in at least half of the participants (collapsed across groups). We log-transformed the connectivity distribution maps to minimize skew, then performed group t-tests on the connectivity distribution measures for voxels within the masks using a voxel-wise threshold of $p<.02$ (two-tailed) and spatial extent threshold of >20 contiguous voxels.

Results: Analyses of the right amygdala revealed significantly lower connectivity within the uncinate fasciculus (see Figure 1), inferior fronto-occipital fasciculus, and inferior temporal gyrus white matter tracts for ASD. Our left anterior insula mask showed greater connectivity of the inferior frontal gyrus in ASD, but overall decreased connectivity in the thalamocortical tract, superior longitudinal fasciculus, corticospinal tract, and superior frontal gyrus white matter compared to controls (see Figure 2).

Conclusions: These DTI data expand on our fMRI BOLD data showing *decreased* amygdala and insula

activation during fear acquisition but *increased* activation during contexts (e.g., extinction trials) that should be safe. DTI highlights underconnected networks from amygdala to frontal lobe monitoring and decision making areas, and insula cortex to integration of sensorimotor information. These data support our hypothesis that chronic everyday anxiety in individuals with ASD may arise from uncertainty regarding environmental cues related to fear and safety. Improved understanding of the neural mechanisms that underlie unique manifestations of anxiety in ASD may provide targets for etiological research as well as for better treatment specificity.

1:57 **144.002** Right Place, Wrong Time: Delayed Amygdala and Insula Activation in ASD during Classical Fear Conditioning and Extinction

D. N. Top[1], K. Stephenson[2], M. South[3] and C. B. Kirwan[3], (1)Giant Steps Program, Wasatch Mental Health, Provo, UT, (2)Department of Psychology, Brigham Young University, Provo, UT, (3)Psychology and Neuroscience, Brigham Young University, Provo, UT

Background: Improved understanding of the neural mechanisms that underlie unique manifestations of anxiety in ASD may provide targets for etiological research as well as for better treatment specificity. Classical fear conditioning, which is well understood in both animal and human models, offers a useful starting point for research into brain-behavior relationships between anxiety and autism. Several recent studies have shown intact fear acquisition but disrupted extinction or reversal learning in ASD. To date, however, there have been no fMRI studies of brain mechanisms that contribute to fear learning and extinction in this population.
Objectives: We report findings from behavioral and functional neuroimaging studies of potentially atypical function involving medial temporal and frontal systems. We hypothesize that such atypical function during extinction of learned fear may contribute to difficulty adapting to changing contexts in ASD and lead to subsequent symptoms of uncertainty and anxiety.
Methods: Twenty-one adults ages 18-29 diagnosed with ASD were compared to age- and IQ- matched healthy controls on a classical conditioning task used by Phelps and colleagues (Hartley et al., 2011) during fMRI. We conducted whole brain analyses of activation during two functional runs of fear acquisition and two extinction runs. Resulting regions of interest (identified with a minimum 20-voxel cluster size and voxel-wise $p < .005$) were identified with a 2x2 repeated measures ANOVA comparing diagnostic group (ASD vs. controls) and task condition (threat vs. non-threat stimulus). Post-hoc t-tests were used to determine the direction of reported differences.
Results: Analyses of initial *early fear acquisition* yielded the greatest differences, with right amygdala and left insula activation greater in controls than ASD for threat compared with non-threat stimuli. ROI analysis across all 4 runs revealed that activation patterns for these ROIs show a consistent, statistically significant *descrease* for the CON group, in contrast to a steady *increase* across the experiment in the ASD group that persists into the extinction or safety period (see Figure 1). During the final extinction run, both left amygdala and right insula showed significantly greater activity in the ASD group compared to controls (see Figure 2).
Conclusions: Although previous psychophysiological studies of fear conditioning studies in ASD have had mixed findings, several such studies have suggested delayed acquisition of fear conditioning, fear learning, and subsequent updating of fear to safety conditions. These fMRI data support the idea that fear learning networks including amygdala and insula are less activated in ASD during fear acquisition, but show increased activation during contexts (e.g., extinction trials) that should be safe. In other words, the ASD group is delayed in activation of the fear networks and is subsequently delayed in their response to extinction cues, meaning they are afraid when they should be feeling safe. We hypothesize that chronic everyday anxiety in many individuals diagnosed with ASD may arise from uncertainty regarding contextual cues for fear versus safety.

2:09 **144.003** Association of Cognitive Factors and Anxiety with Math Achievement in Adolescents with ASD

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Background: Mathematics achievement in adolescents with ASD has been understudied, with most research focusing on young children and arithmetic calculation. The paucity of research on this topic may be partly explained by the widely-held belief that most individuals with ASD are mathematically gifted, despite evidence to the contrary (Dickerson, Mayes & Calhoun, 2008). Solving applied math problems helps develop quantitative reasoning skills which are associated with both academic and everyday problem-solving abilities. Thus, it is critical to examine the ability of students with ASD to solve applied math problems and to identify those factors that influence achievement on such problems.
Objectives: (1) Determine proportions of the sample demonstrating giftedness or disability on applied math problems. (2) Examine which aspects of cognition (i.e., fluid intelligence, verbal ability, working memory) and anxiety (i.e., test anxiety) best predict achievement on applied math problems in ASD relative to a typically-developing control group.
Methods: The sample consisted of 27 high-functioning (FSIQ > 80) adolescents with ASD and 27 age- and FSIQ-matched typically-developing controls (combined-group means: age 14.8 yr.; FSIQ 102.8).

Math achievement was evaluated by the untimed WIAT-III Math Problem Solving subtest. We utilized 1.5 *SD* above/below the mean cutoffs to classify children as having performance indicative of mathematical giftedness or a math disability. To explore factors that uniquely predict math achievement in ASD, we entered cognitive and anxiety variables as predictors in a linear regression model of grade-normed math achievement. The predictors were fluid intelligence and verbal ability, working memory, and test anxiety, as measured by the WASI-II, WRAML2, and BASC-2 respectively. Regression commonality analysis was used to illuminate how predictors shared variance.

Results: 22% of the ASD group was classified as evidencing a math disability, with only 4% showing giftedness. Compared to the typically-developing group, the ASD group contained a significantly greater proportion of participants whose math achievement indicated a math disability (χ^2 = 6.75, $p \leq$ .01). The final most parsimonious linear regression model (R^2_{adj} = .54) showed that the strongest predictor of math achievement was fluid intelligence (β = .39), followed by verbal ability (β = .30), test anxiety (β = -.29), and diagnosis of ASD (β= -.26). All interaction terms between diagnosis and significant predictors were non-significant. This model suggests that, even after accounting for other significant factors, a diagnosis of ASD was associated with an 8.3 point decrease in math achievement standard score.

Conclusions: While a majority of our sample of high-functioning adolescents with ASD demonstrated average math achievement on applied problems, a significant minority had achievement indicative of a math disability. This finding adds to the body of research suggesting that math is not an area of strength for the majority of students with ASD. In fact, an ASD diagnosis significantly predicted poorer math achievement; although, cognitive abilities and text anxiety were even stronger predictors of math achievement. These results inform our theories of math ability in ASD and highlight possible targets of intervention (i.e. test anxiety reduction) for students with ASD struggling with mathematics.

2:21 **144.004** Effectiveness of CBT in Changing Attention Biases in Children with ASD and Comorbid Anxiety

A. T. Meyer[1], P. S. Powell[1], M. R. Klinger[2], J. Reaven[3], A. Blakeley-Smith[3] and L. G. Klinger[4], (1)Psychology, University of North Carolina, Chapel Hill, NC, (2)Allied Health Sciences, University of North Carolina, Chapel Hill, NC, (3)Psychiatry, JFK Partners/University of Colorado School of Medicine, Aurora, CO, (4)TEACCH Autism Program; Department of Psychiatry, University of North Carolina, Chapel Hill, NC

Background: Due to high rates of co-morbid anxiety and ASD, interventions have been developed to specifically target anxiety reduction. Although these interventions have proven effective in reducing parent or child-reported levels of anxiety, few studies have documented changes in cognitive processes. Anxious children without ASD tend to have an attentional bias to threat-related stimuli such as angry faces; changes in attention bias have been found with CBT (Waters et al., 2012). Attention bias has not been studied in anxious children with ASD although an object bias is typically found in children with ASD (Moore et al., 2012).

Objectives: The purpose of this study was to (1) Replicate the attentional bias towards objects compared to faces in children with ASD compared to those with typical development and (2) Examine whether attentional bias in children with ASD was changed after receiving a CBT-based anxiety intervention.

Methods: Twenty-six high-functioning children with ASD (8-14 years) and 18 age-matched children with typical development (7-14 years) completed a dot-probe task to measure attentional bias. Each trial consisted of an emotional face (happy or angry), or an object paired with a neutral face. Participants were asked to respond to a target probe (e.g., an asterisk) that appeared immediately after the two stimuli. Faster reaction time (RT) to the target presented at the location of an emotional face or object compared to a neutral face was taken as evidence of an emotional bias (faster RT to happy or angry faces) or an object bias (faster RT to objects). Twelve children with ASD were diagnosed with comorbid anxiety and participated in a 14-week CBT anxiety-intervention program (Fighting Worries and Facing Your Fears; Reaven et al., 2009). The intervention focused on emotion identification, anxiety coping strategies, and graded exposure. Children completed the dot-probe task pre- and post-intervention to examine changes in attentional bias.

Results: Participants with typical development responded quicker to probes at the location of emotional faces over neutral faces (17ms) and neutral faces over objects (27ms), both results indicating a bias toward attending to faces, especially emotional faces. Participants with ASD (with and without comorbid anxiety) showed a preference for objects over neutral faces (17ms) but no preference for emotional faces over neutral faces (2ms). This interaction between diagnosis and stimulus type was a large effect, $F(1, 42)$ = 21.80, $p<.001$.
 After intervention, children with ASD showed attentional bias scores that were similar to those with typical development including a preference for emotional faces over neutral faces (10ms) and a preference for neutral faces over objects (15ms). A time x stimulus type interaction was observed, $F(1,11)=4.37$, $p=.06$.

Conclusions: Children with ASD showed more bias towards objects compared to emotional faces than children with typical development suggesting that children with ASD were not attending to potentially important social cues in their environment. However, children who received the anxiety intervention showed increased attention to faces, especially emotional faces. These findings suggest that CBT can alter underlying cognitive processes in children with ASD and comorbid anxiety.

Session Chair: **Dermot M. Bowler**, *Autism Research Group, City University London, London, United Kingdom*

2:40 **145.001** Repetitive and Restricted Behaviours in the General Population: Validation and Heritability of Two New Instruments for Parents and Children

D. W. Evans[1] and M. Uljarevic[2], (1)Bucknell University, Lewisberg, PA, (2)Olga Tennison Autism Research Centre, School of Psychological Science, La Trobe University, Bundoora, Australia

Background: In the autism literature repetitive and restricted behaviours (RRBs) are commonly classified into repetitive sensory-motor (RSM) and insistence on sameness (IS). These two dimensions of RRBs are believed to be relatively independent in terms of their function, as well as their neurobiological and genetic basis. As RRBs are not specific to ASD, the key for better understanding RRBs is to explore these behaviors across other neurodevelopmental and neuropsychiatric conditions, as well as their manifestation as dimensions of typical development. One of the main obstacles in conducting this type of research has been the lack of measures that allow for a detailed and systematic assessment of RRBs across the life span. Moreover, some of the most widely-used measures of RRB result in near floor-effects in unaffected siblings of ASD probands, thereby masking potentially critical information about prodromal symptoms that may portend later clinical risk.
Objectives:

- To validate and extend a measure of RRBs in a large, nationally representative United States sample of parents and their children
- To explore the heritability of these RRBs through parent-child intraclass correlations

Methods: Three thousand one-hundred eleven parents (31.1% male, 68.9% female; M age=38.15 years, SD= 9.95) completed the Adult Routines Inventory (ARI), a newly developed 55-item questionnaire about their own RRBs. Parents also completed the Childhood Routines Inventory-Revised (CRI-R), a 62-item questionnaire about their children's repetitive behaviours. Children ranged in age from 1 year to 17 years, 11 months (M=9.29 years, SD= 4.82).
Results: Exploratory factor analysis (Maximum Likelihood with oblique rotation) yielded the following two factors for both the ARI and CRI-R: Rigidity/Insistence on Sameness (RIS) and Motor Stereotypies/Compulsions (MSC). Indices of skewness and kurtosis revealed normal distributions of both measures. Internal consistency and test-retest reliability for both scales for both ARI and CRI-R was excellent (Cronbach $\alpha \geq$ .92). The association between repetitive behaviours in children and parents was examined with the intraclass correlation coefficient (ICC). ICC for Rigidity/Insistence on Sameness was 0.73 (p< 0.0001) and for Motor Behaviours/Compulsions was 0.83 (p< 0.0001). CRI-R data were available for 844 sibling pairs (mean age= 7.99 years; SD= 4.14; 51.5% male, 48.5% female). ICC for Rigidity/Insistence on Sameness was .75 (p< 0.0001) and for Motor Behaviours/Compulsions was .85 (p< 0.00001).
Conclusions: This study introduced two RRB instruments suitable for use in both neurodevelopmental disorders and in studies of normative development, across the lifespan. We report their validity and reliability based on a large nationally-representative sample. Parent-child ICCs suggest high heritability. These measures will be useful for family studies as well as for studying children who are at risk and/or who may exhibit sub-clinical or prodromal symptoms reflecting a wide range of neurodevelopmental disorders characterized by RBBs.

2:52 **145.002** Repetitive and Restricted Behaviors in Infants at Risk for ASD: Comparing Caregiver Report and Observational Measurement

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Background: Diagnostic criteria for autism spectrum disorder (ASD) necessitate significant impairment in social communication behaviors and the presence of restricted and repetitive behaviors (RRBs). Early identification research has dedicated most of it's attention to social communication impairments, leaving a gap understanding early manifestations of RRBs. Studies have found infants exhibiting the highest frequency and variety of RRBs were at highest risk (HR) for ASD (Wolff, et al., 2014) which indicates the ability of RRBs to augment early identification tools in detecting early manifestations of ASD (Elison, et al., 2014). Many of the studies examining RRBs have used caregiver report, yet researchers have yet to validate caregivers' ability to recognize these behaviors in infancy.
Objectives: The goal of this study is to examine if caregiver reports of RRBs relate to observational coding in an infant population exhibiting risk for ASD. Infant characteristics such as DQ and 12- month follow up ADOS scores were also explored to further characterize the potential developmental impact early RRB presentations have on infants at risk.
Methods: Thirty-two infants between 15 and 29 months old (*M*=22) completed a caregiver-child play

interaction (CCX) and caregiver questionnaires including the Parent PDD Behavior Inventory (PDDBI). The CCX was discretely coded for RRB frequencies across 6 domains: *object, visual, verbal, hand/body, sensory seeking and sensory aversion.* Subscales from the PDDBI corresponding to each RRB domain were analyzed to determine the correlation between caregiver report and observational coding of RRBs. Further, child characteristics such as their developmental quotient and 12-month follow up ADOS scores were analyzed to determine relationships between RRB presentation and these areas of development.

Results: Results indicate that the only RRB domain that showed a significant relationship between caregiver report and observational coding score was for *sensory-seeking behaviors (S/S)* (r_s = .417, p = .018). In fact, observed frequencies of S/S behaviors was the only domain to have a significant correlation to the follow-up ADOS (r_s =.507, p = .01). Interestingly, the observed RRB domains of object, visual, verbal and hand/body were significantly correlated with each other (all p < .05) and with the total observed RRBs (all p < .01); yet S/S and sensory aversion (S/A) did not follow this pattern.

Conclusions: These findings highlight several important factors in studying RRBs early in development. First, there is extreme heterogeneity in early RRB manifestation, yet with the utilization of observational measures, patterns have emerged across studies such as the domain of repetitive object use being most endorsed. Results indicate S/S behaviors may be an important domain, which did not correlate with more commonly rated RRBs; yet may provide insight into the emerging understanding of early RRB presentation and the implications for improving early detection practices.

3:04 **145.003** Measuring Commitment to Special Interests in Adults on the Autism Spectrum

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Background: Special or 'circumscribed' interests play a prominent role in the behavioural phenotype of autism in both children and adults. Yet how and why individuals with autism engage with their special interests and the impact of these interests on well-being are poorly understood. Parental reports tend to emphasise troublesome and functionally impairing features and few studies have directly explored special interests in adults. This study addressed these gaps using an online self-report questionnaire for a large sample of male and female adults with autism and neurotypical controls.

Objectives: i) To compare how adults on the autism spectrum and neurotypical controls engage with special interests in terms of intensity of commitment and reasons for attraction ii) to explore whether level of commitment to a special interest is related to well-being.

Methods: Participants were 175 adults with an Autism Spectrum Disorder (ASD) diagnosis (95 males; 80 females) and 330 adult neurotypical (NT) controls (237 males; 93 females). Participants completed the survey via the online questionnaire interface of The Open University's Biomedical Online Research Network (BORN). The questionnaire included item ratings on a specially developed Special Interest Commitment Scale (SICS), and on questions exploring participants' reasons for attraction to their chosen interest.   Participants also completed Cantril's Happiness Ladder (1965), the Satisfaction With Life Scale (Dieder et al., 1985) and the Rosenberg Self-Esteem Scale (Rosenberg, 1965).

Results: The Special Interest Commitment Scale (SICS) comprised 8 items with good internal consistency (Cronbach's Alpha=.84). On the SICS, ASD participants showed significantly more intense commitment to their interest than controls (p<.0001). For instance, 61.1% of ASD participants vs. 31.6% of controls indicated that their special interest is the most important thing in their life (p <.0001). Participants with ASD were significantly more likely than controls to report that their interest prevented interactions with other people (64.2% vs. 28.0% p<.0001), and that others said they talked too much about it (56.2% vs.23.6% p<.0001). On the 'reasons for attraction' measure, ASD participants placed significantly less value than controls on meeting others through their interest and on encountering the unexpected, and were significantly more likely to value scope within their interest for predictability and order, being in control, and spending time alone (all p <.0001). For ASD participants SICS scores were unrelated to happiness, life satisfaction and self-esteem measures, while for controls there were modest negative correlations (happiness: r= -.18, p=.004; life satisfaction: r= -.16, p=.01; self-esteem: r= -.13, p=.04).

Conclusions: Participants with ASD showed more intense commitment to their interests than controls. According to some previous research, intense special interests in autism are functionally impairing, as they impede meeting new people and engaging with new experiences. However, in this study ASD participants were positively attracted by the regularity and 'non-social' qualities of their interests such as predictability, order, control and spending time alone. Correspondingly, for the ASD group only, special interest commitment was not negatively related to happiness, life satisfaction and self-esteem, confirming that for this group, intense, somewhat solitary interests can be benign if not life-enhancing.

3:16 **145.004** Examining Patterns of Restricted and Repetitive Behaviors in Angelman Syndrome and Idiopathic Autism Using the Behavior and Sensory Interests Questionnaire

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Background:
Sensory interests and repetitive behaviors (RRBs) are a diagnostic feature of Idiopathic Autism Spectrum Disorders (I-ASD) and have been clinically reported in Angelman Syndrome (AS). Past research has shown that RRBs in I-ASD can have negative impacts on outcomes for individuals and their families (Gabriels et. al, 2004). Additionally, the literature evaluating RRBs in autism spectrum disorders has suggested that two subdomains of RRBs, repetitive sensorimotor (RSM) and insistence on sameness (IS), may be distinct in presentation and have shown to be correlated with ratio Intelligence Quotient (IQ). The literature also suggests that these subdomains should be evaluated separately, rather than lumped as RRBs (Richler et. al, 2010). There has been one previous study reporting on a limited selection of RRBs in the AS population (Walz, 2007), and none comparing the type and rate of these behaviors between I-ASD and AS populations.
Objectives:
This study examines the type of RRB's and the expression of IS and RSM subdomains with regard to ratio IQ in two cohorts of AS and I-ASD individuals, using the Behavior and Sensory Interest Questionnaire (BSIQ).
Methods:
The I-ASD cohort consisted of 87 children (65 male) between 36-213 months (M=106, SD=52) and IQ range between 4-69 IQ (M=41, SD=17) with I-ASD from the Boston cohort of the Simons Simplex Collection and the Boston Autism Consortium
The AS cohort consisted of 152 children with AS (77 male) between 36-209 months (M=84, SD=42) and 4-69 IQ (M=26, SD=15)from the Angelman Syndrome NIH RDCRN consortium.
Measures:
The Ever and Current codes on the BSIQ, a newly standardized, parent interview measure (Hanson et. al, submitted) were used to evaluate RRBs. The Bayley Scales of Infant Development II (AS), the Mullen Scales of Early Learning, or the Differential Ability Scales (I-ASD) depending on age and level of cognitive function were used to determine ratio IQ scores. Additionally, the Vineland Adaptive Behavior Scales II was used to evaluate co-occurrence of adaptive behaviors.
Analyses:
Kruskal-Wallis and Wilcoxon rank sum tests with Bonferroni correction, ANCOVA and Spearman's rank correlations were used to compare RRB patterns in the I-ASD and AS groups.
Results:
IQ was inversely correlated with RSM and RRBs in AS and was not correlated with IS in AS nor RSM, IS, or RRBs in I-ASD. Overall the I-ASD cohort exhibited a greater rate of RRBs than the AS cohort and the greatest discrepancy occurred in the IS subdomain. Ongoing analyses focus on evaluation of intensity and type of RRBs observed.
Conclusions:
While RRBs are a defining feature of both diagnostic groups, analyses showed that RSM, IS, and total RRBs are significantly more prevalent in I-ASD than in AS. The difference is significant in all but the <10 IQ bin. Our findings of significantly lower prevalence of IS behaviors in AS in comparison to I-ASD supports the suggestion of previous literature that IS and RSM behaviors should be evaluated as distinct domains. It also suggested that IS behaviors could be characteristic of I-ASD and that RSM behaviors are more broadly seen.

Oral Session
146 - Adult Outcome: Influence of Family and School Contexts and Psychopathology
1:45 PM - 2:35 PM - Grand Ballroom C

Session Chair: Laura Klinger, *TEACCH Autism Program; Department of Psychiatry, University of North Carolina, Chapel Hill, NC*

1:45 **146.001** Family and School Contexts Predict Patterns of Change in Functioning over 10 Years Among Adolescents and Adults with Autism Spectrum Disorders

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Background: Adults with autism spectrum disorders (ASD) constitute a population with growing significance, given increases in the rate of diagnosis and life expectancy. Yet little research has documented the life course of ASD. Prospective, longitudinal research is needed to identify antecedents of change. A supportive family environment is central to promoting optimal outcomes, since many day-to-day interactions occur within the family context. As children age, the school environment becomes an increasingly salient context for development.
Objectives: The present study jointly employs variable-centered and person-centered approaches to identify classes of individuals with ASD who have similar profiles of change over a 10-year period across three critical domains of functioning: maladaptive behavior, autism symptoms, and daily living skills. Above and beyond individual characteristics, aspects of the family (maternal positivity and criticism) and school (level of inclusion) contexts were examined as predictors of the likelihood of

following a positive pattern of change.

Methods: The sample included 364 individuals with ASD and their mothers. ASD diagnoses were confirmed by the Autism Diagnostic Interview-Revised (ADI-R). Most participants were male (74%) and most also had intellectual disability (ID; 70%). They ranged in age from 10 to 52 (M=21.85, SD=9.42) at the start of the study. Six waves of data were collected across approximately 10 years. Maladaptive behaviors were based on the Problem Behavior Subscale of the Scales of Independent Behavior-Revised (SIB-R). The ADI-R was used to measure autism symptoms. Independence in activities of daily living was measured using the Waisman Activities of Daily Living Scale (W-ADL). Individual characteristics measured at the start of the study included age, gender, comorbid ID, and childhood verbal language ability and autism symptom severity. The Five Minute Speech Sample was used to code the number of maternal positive and critical remarks. Parents reported on the extent of their child's inclusion with typically developing peers while in school. Change in each outcome variable was first examined through multilevel modeling. Next, latent profile analysis was conducted on the growth parameters across outcomes to cluster individuals with similar trajectories of change across domains of functioning. Lastly, individual and contextual factors measured at the start of the study were used to predict the likelihood of class membership.

Results: Two distinct profiles of change were identified. Participants in Class 1 displayed fewer maladaptive behaviors and autism symptoms and higher daily living skills at the start of the study compared to Class 2. Over the course of the study, participants in Class 1 showed greater improvements in autism symptoms and daily living skills. Above and beyond individual characteristics, partial or full inclusion in school as well as higher levels of maternal positivity increased the likelihood of following a positive pattern of change (Class 1).

Conclusions: Autism symptoms, maladaptive behaviors and daily living skills were observed to improve over time, although there was variability in the rate of improvement. Implementing evidence-based interventions that target the school and home environments during childhood may have lasting impacts on functioning into adulthood for individuals with ASD.

1:57 **146.002** Association Between Psychiatric Comorbidity and Employment in Adults with ASD

K. J. Cottle[1], *D. A. Bilder*[1], *J. Viskochil*[1], *A. V. Bakian*[1], *H. Coon*[1], *M. Farley*[2] and *W. M. McMahon*[1], (1)Psychiatry, University of Utah, Salt Lake City, UT, (2)Waisman Center, University of Wisconsin - Madison, Madison, WI

Background: In recent years, the amount of literature focused on outcomes in adults with autism spectrum disorder (ASD) has increased exponentially. However, we still have much to learn about why these adults have varying outcomes compared to adults without ASD, as well as adults with other disabilities. Employment is critical to independence, and employment rates among adults with ASD are low, even for adults with average and above average cognitive abilities. Prior studies report that about 50% of adults with ASD do not earn a wage. Psychiatric disorders may impact employment status and frequently occur in this population. Common psychiatric disorders identified in adults with ASD include anxiety, depression, and obsessive-compulsive disorder (OCD).

Objectives: To evaluate the association between psychiatric comorbidity and employment status in a population-based cohort of adults with ASD.

Methods: As part of a large adult outcomes study, individuals with ASD were originally ascertained during the 1980's for a state-wide autism epidemiological study in Utah. Participants with an intellectual quotient (IQ) ≥50 were included for this component of the adult follow up study. Employment status (i.e., unemployed, day program, sheltered workshop, supported employment, part-time employment, full-time employment), psychiatric comorbidity (i.e., history of anxiety, depression, and obsessive-compulsive disorder (OCD) and IQ were queried during an in-person assessment which included a semi-structured interview, Mini PAS-ADD Clinical Interview, and Wechsler Adult Intelligence Scale, 4th Edition or Stanford Binet, 5[th]Edition. Employment status was condensed into three categories: unemployed (unemployed and day program), employment with support (sheltered workshop and supported employment), and independent employment (part-time employment, full-time employment). Demographics were calculated through descriptive statistics. Ordinal regression models were fit to look at the association between employment status and the presence of psychiatric comorbidity. Effect sizes were measured by odds ratios (OR) and 95% confidence intervals (95% CI).

Results: The study sample consisted of 68 participants (78% male; mean age 35.4 years, SD=5.4). Fifty-six percent of participants had mild intellectual disability (ID), while 44% had an IQ ≥70. No statistically significant association was found between intellectual ability and employment status (Figure 1; OR=0.60; 95% CI=0.24-1.49). The odds of being independently employed were significantly heightened among individuals without comorbid OCD (OR=4.25; 95% CI=1.50-12.04) and anxiety (OR=3.15; 95% CI=1.22-9.08). No association was found between the presence of depression (OR=1.10; 95% CI=0.33-3.64) or experiencing one or more psychiatric comorbidities (OR=2.25; 95% CI=0.86-5.81) and employment status (Table 1).

Conclusions: Although no significant association was found between ID and employment status, many of the adults in the current sample were unemployed or participated in employment with supports (sheltered workshop or supported employment). Frequencies of OCD and anxiety were higher among adults with ASD who are unemployed or in employment with support settings compared to those who work in settings without accommodations. The absence of a statistically significant difference in employment status between those with mild ID and without ID suggests the importance of other

aspects of impairment that impact the ability to obtain and maintain gainful employment.

2:09 **146.003** Longitudinal Associations Between Social Experiences and Depression for Youth with Autism Spectrum Disorders

S. L. Bishop[1], *R. E. Adams*[2], *K. Gotham*[3] *and C. Lord*[4], (1)Department of Psychiatry, University of California, San Francisco, San Francisco, CA, (2)Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (3)Vanderbilt University, Nashville, TN, (4)Weill Cornell Medical College, White Plains, NY

Background: Adolescents and young adults with ASD are marked by limited social interactions and high rates of loneliness (Bauminger & Kasari, 2000; Bauminger, Shulman, & Agam, 2003). While these and other deficits in the social lives of young adults with ASD have been well documented, no studies have actually examined the longitudinal effects of loneliness and social experiences on psychological adjustment in this group.
Objectives: To test loneliness and social experiences as predictors of depressive symptoms in adolescents/young adults with ASD.
Methods: Participants were drawn from an ongoing longitudinal study of individuals with ASD first diagnosed at age 2 and followed so far through the age of 22 years (EDX study, C. Lord). Between the approximate ages of 17 and 21 years, participants capable of completing self-report measures (n=38) and their parents filled out questionnaires, either through mailed packets sent out every 6-12 months or as part of a face to face visit that occurred when the individuals were approximately 18 years old. Questionnaires of interest for the current study included a slightly modified version of the Asher Loneliness Scale and a measure of depressive symptoms (either the Child Depression Inventory or the Beck Depression Inventory), as well as a self-report measure of social experiences developed for the current study.
Results: Time 1 loneliness was correlated with depressive symptoms at all three time points ($r_s > .43$, $p_s < .001$), time 2 loneliness was correlated with depressive symptoms at times 1 and 2 ($r_s > .49$, $p_s < .001$), and time 3 loneliness was not correlated with depressive symptoms at any time point. Multiple regression analyses indicated that loneliness predicted increases in depressive symptoms from time 1 to time 3 ($\Delta R^2 = .19$, F = 12.58, p < .003), but depressive symptoms did not predict changes in loneliness over the same period ($\Delta R^2 = .01$, F = 0.20, p ns). Analyses were also conducted to examine the links between social experiences, loneliness, and depression, controlling for both age and verbal IQ. First, significant correlations were found between loneliness and time spent with family ($r = -.43$, $p < .01$) and at social events ($r = -.33$, $p < .05$) but not time spent with friends ($r = -.27$, $p = .13$). Higher rates of time spent with family and at social events were linked to lower rates of loneliness. Subsequent analyses will explore the mediating and moderating effects of social experiences on the relationship between loneliness and depressive symptoms.
Conclusions: Findings suggested a predictive link between loneliness and depressive symptoms in adolescents/young adults with ASD over the course of 4 years. This underscores the importance of addressing loneliness and other aspects of the peer world in interventions for internalizing problems in this group. Preliminary results also suggest that the interplay between loneliness and time spent with family and friends may be important for understanding depressive symptoms in high functioning young adults with ASD.

2:21 **146.004** Major Life Events and Their Role in Psychopathology Among Transitioning Youth with Autism Spectrum Disorder

J. L. Taylor[1] *and K. Gotham*[2], (1)Vanderbilt Kennedy Center, Nashville, TN, (2)Department of Psychiatry, Vanderbilt University, Nashville, TN

Background: Rates of comorbid psychiatric disorders are extraordinarily high among individuals with autism spectrum disorder (ASD). Extant studies have focused on the behavioral characteristics associated with psychopathology, but tend to ignore the contextual factors that influence the emergence of these disorders. The present analysis examines the role of a contextual factor strongly related to the emergence of psychopathology in typically developing populations: major and potentially traumatic (MPT) life events.
Objectives: 1) To describe the frequency of MPT life events among youth with ASD transitioning to adulthood, as well as their rates of co-occurring psychiatric disorders; 2) To examine whether MPT life events predict psychopathology.
Methods: Participants were 41 families of youth with ASD in their last year of high school. Autism spectrum diagnoses were confirmed using the Autism Diagnostic Interview-Revised and Autism Diagnostic Observation Schedule. Youth averaged 18.7 years of age (range=17-22). The majority were male (80.7%) and white non-Hispanic (90.2%). Just under one-third (29.3%) had an intellectual disability (with full-scale IQ ranging from 40-137; M=83.25, SD=25.89). Parent respondents included 37 mothers and 4 fathers. The sample was generally well-resourced, although 25% had annual incomes < $40,000.
Results: Just over 40% of youth had a current co-occurring psychiatric disorder. Nearly one-quarter (24.4%) had a mood disorder and over one-quarter (26.8%) had an anxiety disorder. Youth averaged 4.02 (SD=2.08) life events, with a range from 1 to 11. The most common events were death of someone close (56.1%), life-threatening illness/injury within the household (46.3%), parental job loss (36.6%), parental divorce/separation (34.1%), and severe bullying (29.3%). Approximately 60% of

youth experienced one or more events that "severely affected" them.

The number of MPT life events was related to the presence of a current anxiety disorder, with each additional event increasing the odds of an anxiety disorder by 63%, Wald $\chi2$=5.53, p<.05, OR=1.63. Youth who were severely affected by an MPT life event were 3 times more likely to have any comorbid disorder, $\chi2(1)$=5.58, p<.05, 5.7 times more likely to develop a mood disorder, $\chi2(1)$=4.68, p<.05, and 6.3 times more likely to develop an anxiety disorder, $\chi2(1)$=5.66, p<.05. Youth rarely developed a psychiatric disorder in the absence of severe life events.

Conclusions: Just as in typically developing individuals, MPT life events are related to the emergence of psychopathology among youth with ASD. Given high rates of co-occurring psychopathology in this population, which have been linked to diminished quality of life and significant public costs, further research should consider the role of trauma when focusing on behavioral health and development in ASD.

Key Reference: Turner, R.J., & Lloyd, D.A. (2004). Stress burden and the lifetime incidence of psychiatric disorder in young adults. Archives of General Psychiatry, 61, 481-488.

Oral Session
147 - Cognitive Aging in ASD
2:40 PM - 3:30 PM - Grand Ballroom C

Session Chair: Laura Klinger, *TEACCH Autism Program; Department of Psychiatry, University of North Carolina, Chapel Hill, NC*

2:40 **147.001** Do Cognitive Challenges of Adults with Autism Persist, Abate or Increase into Old Age?

A. G. Lever[1] and H. M. Geurts[1,2], (1)Dutch Autism & ADHD Research Center, Brain & Cognition, University of Amsterdam, Amsterdam, Netherlands, (2)Dr. Leo Kannerhuis (autism clinic), Amsterdam, Netherlands

Background: Although autism spectrum disorder (ASD) is a lifelong condition linked to various cognitive challenges occurring from childhood into young adulthood, hardly any study focused on cognition in late adulthood. This is surprising as healthy aging is associated with age-related decline in several cognitive domains, including memory, fluency, and theory of mind (ToM), and ASD is associated with difficulties in exactly some of these domains. In a small study on cognition in elderly with ASD (aged 51 to 83 years; Geurts & Vissers, 2012), a steeper decline with increasing age was observed for visual memory, while problems with phonemic fluency seemed to abate. However, before firm conclusions can be drawn, these findings need to be replicated in a larger ASD sample.

Objectives: To replicate findings on the role of age on visual and verbal memory and phonemic fluency and to investigate the role of age on semantic fluency and ToM from young to late adulthood in ASD.

Methods: One-hundred-eighteen individuals clinically diagnosed with ASD and 118 age, gender, and IQ matched individuals without ASD diagnosis (COM group) between 20 and 79 years (IQ>80) performed a series of neuropsychological tests assessing visual and verbal memory, phonemic and semantic fluency, and ToM.

Results: Group comparisons revealed that the ASD group had higher scores on visual memory immediate recall, similar scores on visual memory delayed recall, verbal memory immediate and delayed recall, and reduced scores on phonemic (trend) and semantic fluency and ToM. Regression analyses revealed similar age-related patterns on visual and verbal memory delayed recall and on phonemic and semantic fluency. However, a differential effect of age was found on visual memory immediate recall and a trend towards a differential effect was found on ToM and verbal memory immediate recall. Separate regressions per group showed that ToM declined with increasing age in the COM group, whereas it did not in the ASD group. Also visual memory immediate recall was affected by age in the COM group and there was only a trend in the ASD group. Even though both groups showed age-related decline on verbal memory immediate recall, the effect was larger in the COM group.

Conclusions: These preliminary findings suggest that, at least in the studied cognitive domains, age-related decline characteristic of typical aging is not observed, less pronounced, or parallel, but not increased, in individuals with ASD. Some cognitive problems occurring in adulthood are still present in old age (i.e, fluency) and others become less apparent (i.e, ToM) due to decline in those without ASD. Moreover, we see clear cognitive strengths in some domains (i.e, visual memory) that persist over the years. Hence, in this large cross-sectional study we found, unlike Geurts and Vissers (2012), no evidence for accelerated cognitive decline in intellectually able adults and elderly with ASD.

2:52 **147.002** Working Memory Across the Adult Lifespan: Do Individuals with and without Autism Show Differential Age-Related Decline?

A. G. Lever[1], M. Werkle-Bergner[2], A. M. Brandmaier[2], K. R. Ridderinkhof[3] and H. M. Geurts[1,4], (1)Dutch Autism & ADHD Research Center, Brain & Cognition, University of Amsterdam, Amsterdam, Netherlands, (2)Center for Lifespan Psychology, Max Planck Institute for Human Development, Berlin, Germany, (3)Amsterdam Brain and Cognition, University of Amsterdam, Amsterdam, Netherlands, (4)Dr. Leo Kannerhuis (autism clinic), Amsterdam, Netherlands

Background: Working memory (WM), the ability to maintain and manipulate information for guiding goal-directed behavior, is characterized by large individual and pronounced age-related differences. In typical development, WM performance increases across childhood, decreases constantly during adulthood, and shows accelerated decline in old age. In autism spectrum disorder (ASD), WM development in childhood seems to be delayed; there is inconsistent evidence whether it reaches comparable levels in adulthood, and it is largely unknown how it develops in old age. This study aims at bridging this gap by studying WM performance in individuals with ASD over the entire adult lifespan.
Objectives: To investigate age-related patterns in WM performance across adulthood in participants with and without ASD, as well as inter-individual differences therein.
Methods: WM performance was assessed with a N-back task (three load-level: 0, 1, 2-back) in 111 adults with a clinical diagnosis of ASD (IQ>80) and in a comparison group (COM) of 164 adults without an ASD diagnosis between 19 and 79 years old. Dependent measures were accuracy (the proportion of correct responses) and reaction times (RT). Using regression trees, we explored whether demographical variables, comorbidities, or executive functioning could predict inter-individual differences in change over age.
Results: There were no differences in accuracy between participants with and without ASD across all load levels. However, people with ASD exhibited longer RTs overall. Regression analyses revealed a linear decline of WM performance over age. Adding a quadratic age term, and its interaction with group, explained considerably more variance and revealed group-by-age interactions. Whereas performance change with age within both the ASD and COM group was well described by a linear trend, the decline was steeper in the COM group. Moreover, the quadratic fit was more suited for the COM group, suggesting an accelerated decline in older age. Exploratory regression trees revealed that IQ and interference control were predictors of inter-individual differences in age-related WM decline. Higher IQs (>109) were associated with better WM performance and stronger WM decline over age in comparison to lower IQs (<=109). Within participants with lower IQs, better interference control was associated with slightly better WM performance but not with differential age-related decline.
Conclusions: Although the current study does not provide evidence for a WM performance deficit across adulthood in ASD, the effect of age on WM is differentially expressed in adults with and without ASD. While increasing age is associated with marked, and finally accelerated, decline in individuals without ASD, increasing age had only a slightly detrimental effect on individuals with ASD. These findings provide initial insights into how ASD modulates cognitive aging, but also underlie the need for analyzing individual change trajectories.

3:04 **147.003** Older Adults with ASD: Executive Functioning Deficits, Functional and Structural Connectivity Differences, and Accelerated Cortical Thickness Atrophy

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Background: The adult population of autism spectrum disorder (ASD) is rapidly growing and continuing to get older, yet there are few studies of aging in ASD to inform appropriate care and biological targets for intervention. ASD and normal aging have similarities; executive functioning deficits are commonly associated with ASD and declines are also observed in normal aging. This decline is often attributed to greater rates of age-related atrophy in the frontal lobe, which largely subserves executive functions. There is also an anterior-to-posterior gradient in brain pathology related to ASD, which implicates the frontal lobe as the most affected region. Additionally, reduced integrity of white matter fibers supporting the frontal lobe are evident and functional connectivity disturbances are largely characterized as anterior-posterior hypoconnectivity in ASD and also observed in normal aging.
Objectives: Given the striking cognitive and neuroanatomic parallels in ASD and aging, it is hypothesized that ASD exacerbates age-related executive functioning deficits, frontal lobe integrity, and functional connectivity differences, compared with young-adult and aged typically developing (TD) controls. The study objective is to address the current gap in knowledge of the aging ASD cohort through available cross-sectional structural imaging data from the Autism Brain Imaging Data Exchange (ABIDE) and pilot cognitive and imaging analysis of middle-age ASD and TD cohorts.
Methods: From the open-access ABIDE data repository, 2.8% of the sample was middle-aged (39-58; 15 ASD, 15 TD). There were no significant group differences in IQ or age between ASD and TD and we matched middle-age participants with young-adults (18-25) based on gender, ASD diagnosis (autism vs. Asperger's vs. PDD-NOS), and IQ. We examined cortical thickness in FreeSurfer (http://surfer.nmr.mgh.harvard.edu/) for an interaction between age and diagnosis. We also examined differences in 9 middle-age ASD and 9 TD control males on executive functioning via the Wisconsin Card Sorting Task (WCST), frontal lobe structural connectivity via fractional anisotropy (FA), and anterior-posterior resting-state functional connectivity (rsFC).
Results: For cortical thickness using the ABIDE data, we observed an anterior-to-posterior gradient of interaction, such that effects were most pronounced in the frontal and temporal lobes (Figure 1a). Using automated segmentation we extracted regional averages and detected a pattern of thicker anterior cortices in young-adult ASD versus young-adult TD, but thinner cortices in middle-age ASD, as

compared with TD, suggesting an exacerbation of age-related cortical thickness loss in ASD (Figure 1b). Within our sample of middle-age men, the ASD group made more perseverative errors on the WCST (Figure 2a), had reduced FA in bilateral corona radiate (Figure 2b), and decreased rsFC between medial prefrontal cortex and posterior cingulate cortex, than the TD group (Figure 2c). Conclusions: Taken together, preliminary evidence from the ABIDE dataset suggests an anterior to posterior exacerbation of age-related cortical thickness loss in ASD; and preliminary evidence from our sample confirms the presence of robust executive function deficits, decreased integrity of anterior white matter tracts, and anterior to posterior resting-state hypoconnectivity in an aging ASD cohort, which warrants further cross-sectional and longitudinal investigation of age-related changes.

3:16   **147.004** Ageing and Psychological Functioning in Autism Spectrum Disorder

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Background: The patterning of cognitive function in individuals with Autism Spectrum Disorder (ASD) is selectively impaired, compared to typical individuals. For example, selective memory and executive function impairments are frequently observed in ASD (Hill, 2004; Howlin et al., 2004; Bowler, 2007; Boucher & Bowler, 2008). However, little is known about the way in which people with ASD age (Mukaetova-Ladinska et al., 2012; Perkins & Berkman, 2012). Relatively few studies have reported poorer outcomes and lifecourse trajectories for older individuals with ASD (Magiati et al., 2014). Declines in cognitive functioning such as dementia, memory decline and impaired executive function have been reliably identified in older typically developed adults (Schaie, 2005; Salthouse, 2009), however, it is unknown whether or not similar changes occur during the course of ageing with autism.
Objectives: To document the magnitude and patterning of age-related differences in memory and executive function between older and younger adults with ASD compared to matched typical adults.
Methods: Cross-sectional analyses explored age-related differences between younger (18-49 years) and older (50-79 years) adults with (N = 35) and without (N = 35) ASD. Executive function related to working memory, planning and visual learning were assessed on a subset of CANTAB tasks. Self-reported measures of autistic traits (Baron-Cohen et al., 2001) and frequently concomitant conditions such as alexithymia and anxiety (Berthoz & Hill, 2005) were assessed for their potential mediating effects on cognitive performance in later life. Given the patterning of age-related cognitive decline in typical individuals, at least two possible outcomes were expected for older autistic adults: (1) preserved cognitive functioning might be expected, suggesting a 'buffer' against further age-related cognitive impairment in older adults with ASD; (2) alternately, the patterning of cognitive functioning in older adults with ASD may parallel that of typically ageing adults, suggesting greater cognitive risks for ageing adults with ASD.
Results: The results supported the first hypothesis. No age-related differences in executive functioning were observed in older autistic adults compared to older typically ageing adults or younger adults with ASD. Alexithymia was highly comorbid with ASD, and self-reported anxiety was greater in younger adults with ASD. There were no differences in anxiety levels between older adults with and without ASD. The findings suggest that, despite observations of similar cognitive profiles in younger autistic and older typical adults (Bowler, 2007), ASD may provide a 'buffer' against further age-related cognitive decline (Geurts & Vissers, 2012). The results should be interpreted with caution as they are based on small sample sizes and cross-sectional analyses. Possible differential participant attrition in the ASD and typical samples may also have affected the results.
Conclusions: The absence of significant differences on these measures between younger and older adults with ASD suggests that severity of autism and certain concomitant conditions may remain unchanged across the adult lifespan in this population. These preliminary findings suggest potentially optimistic outcomes for ageing adults with ASD. However, the findings represent a small subset of older adults with autism, who might exhibit age-related declines when followed-up longitudinally. Future work will address these issues.

Oral Session
148 - From Mice to Monkeys: New Approaches to Dissecting the Neurobiology of ASD
1:45 PM - 2:35 PM - Grand Ballroom D

Session Chair: Jeremy Veenstra-Vander Weele, *Psychiatry, Columbia University / New York State Psychiatric Institute, New York, NY*

1:45   **148.001** Convergent Excitability Defects in Prefrontal Corticothalamic Pyramidal Neurons Link Genes to Behavior in Mouse Models of Autism

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Background:
Autism is a neuropsychiatric disorder that can be caused by diverse genetic changes that converge in deep projection layers of prefrontal cortex during mid-gestational development. How various genetic mutations cause a common behavioral phenotype of autism is poorly understood.
Objectives:
Our work aims to understand the neuronal circuit mechanisms in prefrontal cortex that link distinct genetic changes and environmental exposures to autism-associated behaviors.
Methods:
We study three mouse models of autism (CNTNAP2 knockout, FMR1 knockout, and prenatal valproate exposure) at the level of cells, circuits, and behavior using slice electrophysiology, optogenetics, and behavioral assays.
Results:
First, *in vivo* patch clamp electrophysiology of Layer 5 medial prefrontal pyramidal neurons shows that in the autism models, there are selective defects in the intrinsic excitability of neurons projecting to the thalamus, while the Layer 5 neurons that project to the contralateral cortex are normal. These intrinsic excitability deficits in corticothalamic cells are associated with altered responses to synaptic inputs. Finally, acute optogenetic manipulation of the corticothalamic circuit in awake, behaving mice modulates social interest in valproate-exposed mice.
Conclusions:
The medial prefrontal corticothalamic circuit is disrupted by diverse genetic and environmental causes of autism. Acute manipulation of this circuit modulates social interest, implying a causal relationship between the corticothalamic hypoexcitability and the behavioral abnormalities seen in autism.

1:57 **148.002** Cognitive Impairments in a Mouse Model of 16p11.2 Deletion Syndrome

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Background: 15% of patients with a ~600kb deletion in the human chromosomal region 16p11.2 have autism (Marshall et al., 2008; Weiss et al., 2008; Zufferey et al., 2012). 16p11.2 deletions and duplications are also associated with speech delay, intellectual impairment, and developmental delays (Hanson et al., 2010; Owen et al., 2014). Two mouse models of 16p11.2 deletion syndrome were independently generated (Horev *et al.* 2011; Portmann *et al.* 2014), in which the syntenic region on mouse chromosome 7F3 was heterozygously deleted. Both models exhibited low body weight, perinatal mortality, and sporadic motor stereotypies. We previously reported that juvenile and adult 16p11.2 +/- males and females exhibited normal general health, neurological reflexes, responses to social and non-social odors, motor learning, normal social approach, normal juvenile reciprocal social interaction, and a novel object recognition deficit (Portmann *et al.* 2014).
Objectives: The present study was designed to replicate the initial finding of novel object recognition deficits, and evaluate the generalization of cognitive deficits in 16p11.2 mice as compared to wildtype littermates across a range of assays: a) preference for social novelty as a corroborative measure of novel recognition, b) acquisition and reversal learning of a pairwise visual discrimination task using the Bussey–Saksida operant touchscreen equipment as a measure of cortical dependent recognition learning and memory, and c) contextual fear conditioning as a measure of hippocampal-depending emotional learning and memory.
Methods: Novel object recognition measured seconds spent sniffing two identical objects, then 1 hour later, time spent sniffing one now-familiar object and a new object (coral or treasure chest plastic toys). Standardized Med Associates automated equipment calculated time spent freezing during the fear conditioning session 1 day after the aversive association training session. Touchscreen pairwise visual discrimination and reversal were modified from Silverman et al., 2013. Mice were trained to discriminate two illumination-matched images on the touch-sensitive panel of an operant chamber. Touching the correct image triggered a 2-s flashing light that signaled the mouse to retrieve 50µl of strawberry flavored Ensure reinforcer. Days to reach criterion during the initial learning, and days to criterion on reversal learning, were compared between genotypes using Student t-test.
Results: Robust novel object recognition deficits were replicated in two new cohorts of 16p11.2 +/- mice. 16p11.2 +/- mice did not exhibit preference for social novelty when presented with a familiar versus an unfamiliar 129Sv/ImJ mouse, indicating deficits in social recognition. Contextual conditioning was normal in two cohorts of +/- mice. In the touchscreen test, 16p11.2 +/- required significantly more days than +/+ to reach criteria during both the acquisition and reversal phases, indicating learning deficits and cognitive inflexibility.
Conclusions: 16p11.2 deletion caused robust deficits in tasks that require discriminating differences between familiar versus novel objects or conspecifics, and on pairwise visual discrimination and reversal learning. These phenotypes support the use of 16p11.2 deletion mice as a model for aspects of intellectual disabilities in 16p11.2 deletion patients with autism.

2:09 **148.003** Oxytocin Reverses Social Deficits in the Shank3-Deficient Rat, a First Genetically Modified

Rat Model for Autism

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Background:
Shank3 is a scaffolding protein that forms a key structural part of the postsynaptic density (PSD) of excitatory synapses, where it recruits glutamate receptors and binds cytoskeletal elements regulating glutamate signaling. Haploinsufficiency of SHANK3 causes a monogenic form of autism spectrum disorder (ASD), known as Phelan McDermid Syndrome (PMS). The findings emerging form independent mouse models with *Shank3* mutations together with our recent findings in a novel rat model with a *Shank3* mutation, provided evidence for impaired glutamatergic synaptic function in ASD-associated brain regions and deficits in several behavioral measures related to ASD. Yet the neurobiology of *Shank3*-deficiency is not fully known and no treatments are available to target the core symptoms of PMS. Oxytocin is well known for its pro-social effect, however its efficacy in PMS has not been studied yet.

Objectives: The first aim of our study is to uncover the synaptic plasticity-related mechanisms affected in *Shank3* deficient rats, which may underlie the synaptic and behavioral deficits that are evidenced in *Shank3*-deficiency. Our second aim is to study the capability of candidate compounds to reverse the core symptoms observed in PMS. To achieve aim one, we are using unbiased transcriptomic and proteomic analysis to compare WT and *Shank3*-deficient rats. For aim two, we are studying the efficacy of different candidate compounds, including oxytocin, in reversing the synaptic plasticity and social behavioral deficits that we observed in the *Shank3*-deficient rat model.

Methods:
Proteomic and transcriptomic analysis: To compare the mRNA and protein expression profiles between the *Shank3*-deficient rats and their WT littermate, we used RNA sequencing (RNAseq) technology and 2-dimensional differential in-gel electrophoresis, respectively, then projected the transcpritional-perturbed signatures onto human brain co-expression network from different developmental periods and applied gene ontology (GO) analysis to reveal the affected molecular pathways. *Pharmacological treatment:* We treated the *Shank3*-deficient rats with intracerebroventricular injections of saline or the neuropeptide oxytocin and then tested their long-term social recognition memory (SRM).
Behavior: We have previously reported that the long-term SRM of the *Shank3*-deficient rats is impaired. To test the effect of oxytocin and other compound on social behavior we test the long-term SRM of the rats using the social discrimination test, following oxytocin or Saline injection.
Electrophysiological recording: We have previously reported the hippocampal long-term potentiation (LTP) in the *Shank3*-deficient rats is impaired. To study the effect of oxytocin on LTP, we use in vitro recording from acute hippocampal brain slices following perfusion in oxytocin bath.

Results:
Proteomic and transcriptomic approaches followed by bioinformatics analysis of brain co-expression networks demonstrated that decreased Shank3 levels influence molecular networks implicated in distinct developmental periods, mainly during fetal developmental periods, and indicated that Shank3 may play an important role in scaffolding the synaptic proteins involved in the actin remodeling machinery. Finally, the application of the neuropeptide oxytocin reversed the deficits in both social behavior and hippocampal synaptic function.

Conclusions:
The results suggest that, although clinical studies of oxytocin in autism remain quite equivocal, oxytocin has a therapeutic potential for PMS.

2:21 **148.004** Assessment of Social Behavior in Non-Human Primate Infants Following Administration of Thimerosal-Containing Vaccines

L. Hewitson[1], B. Curtis[2], N. Liberato[2], C. Kenney[2], V. Yutuc[2], C. Ferrier[2], C. N. Marti[3] and G. P. Sackett[2], (1)The Johnson Center for Child Health and Development, Austin, TX, (2)Washington National Primate Research Center, Seattle, WA, (3)Abacist Analytics, LLC, Austin, TX

Background: In the 1990s, thimerosal (sodium ethylmercurithiosalicylate) was used as a preservative in most pediatric vaccines. While there is currently only one pediatric vaccine formulated with thimerosal that is included in the US pediatric immunization schedule, parental perceptions that vaccines are associated with the onset of neurodevelopmental disorders still continue to impact vaccination rates.
Objectives: The objective of this study was to examine whether administration of multiple thimerosal-containing vaccines (TCVs) to non-human primate infants increased the incidence of negative

behaviors, such as fear-disturbance, rock-huddle-self-clasp, and stereotypies.

Methods: We administered vaccines to 6 groups of infant male rhesus macaques (n=12-16/group) using a standardized thimerosal dose. Study groups included the recommended 1990s pediatric vaccine schedule (which included multiple TCVs), an accelerated 1990s primate schedule with or without the measles-mumps-rubella (MMR) vaccine, the MMR vaccine only, and the expanded 2008 vaccine schedule. We also administered saline injections to age-matched control animals (n=16). Social behavior was evaluated in 40 minute daily playroom sessions for each peer group from 1-12 months of age. Scoring was conducted by a blinded observer in 5 minute focal periods using a coding system of mutually exclusive and exhaustive behaviors. Scored behaviors included passive, explore, withdraw, fear-disturbance, rock-huddle-self-clasp, stereotypy, play, sex and aggression, and could be scored as either a social interaction or a non-social behavior. Data were analyzed using multi-level modeling.

Results: Overall means and standard deviations for duration and frequency of social and non-social behaviors scored for all infants is shown in Table 1. The duration and frequency of negative behaviors by animals in all groups was very low. In fact, there were no instances of stereotypies recorded across all sessions. Analyses of social interaction data identified a significant Group X Quadratic interaction for negative behaviors ($F[5, 752]=2.92$, $p=0.030$). Follow-up contrasts indicated that at 2 months of age, relative to the controls, animals in the 1990s Primate and 2008 groups exhibited significantly fewer negative behaviors ($t[752]=-2.47$, $p=0.034$ and $t[752]=-2.85$, $p=0.023$), respectively. However, by 12 months of age, there were no significant differences in social behaviors in the experimental groups relative to the control group. Analyses of non-social interaction data also revealed a significant Group X Quadratic interaction for negative behaviors ($F[5, 751]=3.68$, $p=0.021$). Follow-up contrasts indicated that at 2 months of age, relative to the control group, the 1990s Primate and MMR groups exhibited significantly fewer overall negative behaviors ($t[751]=-4.12$, $p<0.001$) and ($t[751]=2.35$, $p=0.048$), respectively. By 12 months of age there were no significant differences in non-social behaviors in the experimental groups relative to the control group.

Conclusions: TCVs did not appear to affect the development of social behaviors characteristic of infant macaques of this age. Social and nonsocial behaviors in all study groups, including the MMR only and the expanded 2008 pediatric groups, developed as expected for normal laboratory-reared macaque infants. Of particular relevance under the hypothesis that TCVs may impact behavior, there were very few instances of negative behaviors, such as rocking, self-clasping, and stereotypy, reported across the entire infancy period for all groups.

Oral Session
149 - Metabolomic and Genetic Factors in ASD
2:40 PM - 3:30 PM - Grand Ballroom D

Session Chair: Jeremy Veenstra-Vander Weele, *Psychiatry, Columbia University / New York State Psychiatric Institute, New York, NY*

2:40 **149.001** Effects of Metabolism Changes during Development on the Plasma Profile of ASD in Children

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Background: Current methods of autism diagnosis rely largely on behavioral testing that is time consuming, expensive, and usually performed around the age of 4 years. Prior work at Stemina showed that plasma metabolic profiles can be used to distinguish children with autism spectrum disorder (ASD) from typically developing (TD) children. With the aim of developing a diagnostic test, we studied metabolites in plasma from children ranging in age from 1-10 years, to identify potential age-related metabolic biomarkers of ASD. The outcome of these studies will define metabolic signatures capable of diagnosing autism at different stages of child development.

Objectives: To identify metabolite profiles that can discriminate ASD from TD as children develop up to 10 years of age. Additionally, age dependent metabolic signatures will be used to further understand the impact of childhood development on the metabolic nature of ASD.

Methods: Plasma samples from 211 children (1-10 yrs; 97 ASD, 114 TD) were analyzed using 4 orthogonal Liquid Chromatography-High Resolution Mass Spectrometry (LC-HRMS) methods, in an untargeted metabolomic approach. Patient samples were further divided into defined age ranges to examine metabolic changes associated with ASD over-time. For either the entire cohort, or age limited sample subsets, diagnostic-stratified random sampling was used to create a training set (75%) and an independent test set (25%). Univariate statistical tests were performed to select features differentially abundant (DA) between ASD and TD children. Classification models were built using the DA features and several multivariate supervised learning methods. Finally, chemical structure identification of metabolites was performed using reference standards and MS/MS spectral matching.

Results: Using the entire cohort, a set of 76 statistically significant metabolic features (p-value < 0.05) differentiating ASD from TD were identified and ranked by their influence on class discrimination.

Classification results were iteratively evaluated by varying the number of ranked features to identify the most predictive feature subsets. Models were evaluated on the test set and classification accuracy for the best models was found to be 60-65%. By contrast, when a subset of 77 samples (54 ASD, 23 TD) representing children with ages 2-4 years were evaluated using similar methods, the number of significant features comparing ASD to TD was 104, suggesting more pronounced differences in the metabolism of ASD and TD in the younger age group. Classification of these samples also yielded models exhibiting better classification accuracy, greater than 80%. Confirmation of features of specific metabolism is ongoing but preliminary annotations include known biomarkers of autism as well as changes related to childhood development.

Conclusions: This study demonstrates that metabolic variation in patients from a wide age range adds metabolic complexity; however a 2-3 year age range can provide a more predictive signature capable of classifying ASD from TD. In addition, the study further suggests that specific metabolites as biomarkers of autism can be measured and used over the course of childhood development allowing early diagnosis and subsequent therapy on a personalized basis.

2:52 **149.002** Epigenetic Dysregulation of microRNA-142 and Upregulation of Multiple microRNAs That Target Oxytocin Receptor in the Frontal Cortex of Individuals with Autism

E. Elliott, M. Easton and S. Nardone, Faculty of Medicine, Bar Ilan University, Safed, Israel

Background: MicroRNAs are small RNA molecules that can bind messenger RNA (mRNA) and inhibit the translation of proteins. While mounting evidence has shown that levels of specific genes and mRNAs are dysregulated in the brains of individuals with autism, there is little information about the dysregulation of microRNAs in the brain. Since any one microRNA can possibly target many mRNAs, the dysregulation of a single microRNA can have a very high impact on cellular and neuronal function.

Objectives: Our first objective was to identify microRNAs that are dysregulated in the brain of individuals with autism. The second objective is to determine the probably targets of these microRNAs, and to determine the biological implications of the dysregulation of these specific microRNAs.

Methods: In order to identify differentially expressed microRNAs in the autistic brain, we performed high throughput small RNA sequencing on RNA samples from 12 autistic and 12 control prefrontal cortex samples. Results were validated with real time PCR and interesting microRNAs were further studied for changes in epigenetic regulation. Bioinformatic analysis (DIANALAB and microrna.org) were used to reveal potential target genes for the dysregulated microRNAs, and to identify their biological patways (gene ontology). Luciferase assays in cells were performed to validate possible mRNA targets, and real time PCR was performed on the target mRNAs to understand the relationship between microRNA expression and mRNA expression.

Results: High throughput sequencing revealed a list of 23 microRNAs that were differentially expressed between control and autistic brains. Using real time PCR, we validated three of the top seven of these microRNAs, mir-142, mir-21, and mir-451. We further discovered that the promoter of mir-142 is hypomethylated in these same brain samples, therefore suggesting an interaction between epigenetic dysregulation and microRNA expression. Gene ontology analysis revealed that the main mRNA targets of the three microRNAs are involved in axon guidance. Additional bioinformatic analysis revealed that both mir-21and mir-451 can target the oxytocin receptor gene. Using luciferase assays, we provide evidence that mir-21 and mir-451 can inhibit translation of the OXTR transcript in cells. Of interest, we found that oxytocin receptor gene expression levels are increased in our autism brain samples, and that there is a direct positive correlation between oxytocin gene expression levels and the levels of microRNA-21.

Conclusions: We have identified three microRNAs that are overexpressed in our autistic brain cohort. We provide significant evidence that these microRNAs are involved in molecular mechanisms that are highly related to brain function and social behavior. Specifically, the finding that mir-21 and mir-451 target OXTR provides a direct link between microRNA dysregulation and molecular mechanisms that regulate social behavior. Therefore, we provide evidence that microRNAs may play an integral role in the etiology of autism spectrum disorders.

3:04 **149.003** Upregulation of Phospho-S6 and Dendritic Overgrowth of Developing Layer V Neurons Are Phenotypes in Common Between Pten+/- and Fmr1-/y Mice

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Background: *PTEN* and *FMR1* are two examples of susceptibility genes for autism spectrum disorder (ASD) that encode regulators of the PI3K-mTOR pathway. Phosphorylation of ribosomal protein S6 (p-S6) is a downstream readout of activity in the mTOR pathway. Altered levels of p-S6 has been reported in the postmortem cerebral cortex of individuals with autism and in mouse models of autism risk factors. However, it is not known when during development and in which cell types dysregulation of p-S6 signaling may contribute to the symptoms of ASD.

Objectives: Our goal is to identify common cell type(s) and time window(s) in which p-S6 is dysregulated across two different mouse models of autism risk factors, *Pten* and *Fmr1*, and to study the cellular phenotypes associated with dysregulated p-S6 in these two models.

Methods: We have used immunohistochemistry and Western blot to analyze the spatiotemporal

distribution and levels of p-S6 in the developing cerebral cortex of $Pten^{+/-}$ and $Fmr1^{-/y}$ mice. Furthermore, we have also used genetic labeling along with cellular imaging and reconstruction techniques to analyze neuronal growth, a process that is tightly correlated with p-S6 activity, in these models.

Results: In the developing brain of wild type mice, p-S6 immunoreactivity is differentially enriched across cell types during the first two postnatal weeks. One particularly interesting cell type that shows enrichment for p-S6 during this time window is layer V neurons of the cerebral cortex. We find that p-S6 levels are elevated during development in the cerebral cortex of both $Pten^{+/-}$ and $Fmr1^{-/y}$ mice. Consistent with this, these models exhibit dendritic overgrowth of layer V neurons during development. Moreover, the neuronal overgrowth is not uniformly across cortical cell types since we observed increased cell soma size in layer V neurons (which are enriched for p-S6), but not in layer VI neurons (which are not enriched for p-S6).

Conclusions: Upregulation of p-S6 in layer V neurons during development is a point of convergence for two distinct autism risk factors, *Pten* and *Fmr1*. Layer V neurons are the primary cortical output neurons and project to subcortical areas essential for social behavior. Dendritic overgrowth in developing layer V neurons could disrupt the cortical circuit assembly or desynchronized cortical output. Consistent with reports of abnormal layer V dendritic morphology in individuals with ASD, this phenotype may contribute to the pathophysiology of autism risk factors associated with mTOR/p-S6 signaling.

3:16   **149.004** Engrailed Expression in Hippocampus and Its Effects on Dendritic Complexity: Implication for Autism Spectrum Disorders

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Background: Engrailed (En) is a transcription factor that plays essential roles in the establishment of embryo anterior-posterior axis during early embryogenesis. It also contributes to midbrain and hindbrain patterning, to development and maintenance of monoaminergic pathways, and to retinotectal wiring. En2 is an autism susceptibility gene but the mechanisms remain unclear. As several homeoproteins, En can also act as an extracellular signaling molecule being secreted and internalized in target cells. As a signaling molecule En acts through transcriptional and/or translational dependent mechanisms.

Objectives: Cognitive disorders are encountered in En1+/- mice and En2-/- mice. The present work was aimed at addressing the effect of En on synaptogenesis in the forebrain.

Methods: To address a putative role for En1 and En2 in the forebrain we measured their expression in hippocampus in wild-type mice using RT-qPCR, and performed immunochemistry on hippocampal primary culture cells to characterize cell type expression and localization. Dendritic spine density was measured in hippocampal neurons in En2-/- and En1+/- mice as well as in cultured hippocampal neurons treated with bath application of recombinant En protein.

Results: Both mRNAs were readily detected in late mouse embryos. Levels of En1 declined after postnatal day 14 down to 50% of initial values while En2 mRNAs abruptly dropped during the first postnatal week before rising back to initial values, suggesting a temporal coupling between En2 expression and synaptogenesis. Engrailed was detected by immunocytochemistry in most of the neurons from hippocampal cultures and was markedly enriched in GABAergic cells. Adding recombinant Engrailed to cultured neurons increased dendritic branching and dendritic spine density. Stubby, thin and branched spines were particularly affected, suggesting increased spine plasticity. In contrast, the number of presynaptic terminals and synapses remained unchanged. However, an En mutant defective in eIF4E binding reduced presynaptic terminal density and synaptic matching, suggesting that Engrailed impacts on synaptogenesis. The latter results indicate that eIF4E interaction with Engrailed is, at least in part, responsible for its effects on spinogenesis and suggest a role of En in presynaptic button formation/stabilization. Because eIF4E has a key function in translation, it is possible to speculate that some of En effects reported here could be translation dependent. Consistently, our results show that Engrailed is capable to increase protein synthesis in hippocampal neurons. In vivo, spine density was increased in the hippocampus of young En1+/- mice but reduced in adults, whereas the opposite was found in En2-/- mice, confirming that Engrailed controls spinogenesis either directly or indirectly.

Conclusions: Taken together, our results identify Engrailed as a novel actor in dendritic plasticity. They reveal that an excess of En during synaptogenesis may alter the characteristics of dendritic plasticity that could ultimately lead to synaptic network dysfunction. Our observations open new perspectives on the relationship between Engrailed and ASD.

Oral Session

Session Chair: Christine Ecker, *The Sackler Institute for Translational Neurodevelopment, Institute of Psychiatry, King's College London, London, United Kingdom*

1:45 **150.001** Cortical Surface Anatomy in Adult Females with Autism

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Background: It is well established that Autism Spectrum Disorder (ASD) is accompanied by neurodevelopmental differences in brain anatomy and connectivity. The neurocognitive networks underlying ASD may involve the cerebellum, amygdala-hippocampal complex, frontotemporal regions and caudate nucleus (Amaral, Schumann, & Nordahl, 2008). However, most of the previous structural neuroimaging studies only examined measures of cortical volume (CV), which is a product of cortical thickness (CT) and surface area (SA). Thus, examining independent variations of these distinct anatomical features may provide additional important insights into the cortical neuropathology of ASD (Ecker et al., 2013). Further, most previous studies examined males and not females with ASD, and the neuroanatomy of ASD in females therefore remains currently underexplored (Lai et al., 2013).
Objectives: The present study aimed to establish the neuroanatomical correlates of ASD in adult females with the condition relative to typically developing adult female controls, using a spatially-unbiased surface-based approach.
Methods: Structural T1-weighted MRI scans were collected on 49 females adults with ASD (mean age=28yrs (sd=7), mean FSIQ=119 (sd=16)) diagnosed with gold-standard diagnostic tools (i.e. ADOS, ADI-R), and 49 matched typically developing female controls. Participants were recruited with the support of the MRC AIMS (Autism Imaging Multi-Centre Study) Consortium, and scanned at two sites (London and Cambridge, UK). Surface reconstructions for all structural MRI scans were performed using FreeSurfer software (http://surfer.nmr.mgh.harvard.edu). A set of three volumetric features (CV, CT, SA) was obtained at each spatial location on the cortical surface. Between-group differences in these features were examined using a general linear model including group and site as categorical fixed effects factors, and age and IQ as continuous covariates. A random-field-based cluster-threshold (p<0.05) was used to correct for multiple comparisons.
Results: Females with ASD differed from controls in all three surface-based features. Females with ASD had a significant increase in CV in right occipital lobe relative to controls. We also found a significant increase in CT in the right superior frontal gyrus in ASD, and a decrease in CT in the left fusiform gyrus and right parahippocampal gyrus. Finally, females with ASD showed a decreased SA of the right superior frontal gyrus relative to controls. However, neither CT nor SA contributed uniquely to the observed differences in CV.
Conclusions: Adult females with ASD have significant neuroanatomical differences in a variety of surface-based cortical features relative to controls. It remains to be established, however, to what extent these differences overlap with the neuroanatomical differences observed in males with the conditions, and to what degree neuroanatomical differences between the sexes mediate differences in the respective symptom profiles that are typical for males and females with ASD.

1:57 **150.002** On the Question of Brain Overgrowth in ASD: An in Depth Methodological Analysis Using the Large Abide Dataset

A. Michael[1] and G. J. Katuwal[1,2], (1)Autism and Developmental Medicine Institute, Geisinger Health System, Lewisburg, PA, (2)Center for Imaging Science, Rochester Institute of Technology, Rochester, NY*

Background: Neuroimaging findings of autism spectrum disorder (ASD) have produced inconsistent results even on global measures such as total intracranial volume (TIV). In comparison to age matched typically developing controls (TDC), studies suggest lower TIV in ASD at birth and overgrowth at early childhood; but there is disagreement at what age of onset this overgrowth occurs.
Objectives: We test the influence of site and preprocessing and analysis toolboxes (PAST) on ASD versus TDC TIV, gray matter volume (GMV) and white matter volume (WMV) differences. We also investigate if TIV growth curve is sensitive to PAST and provide evidence for methodological

discrepancies.

Methods: Structural MRIs were obtained from the Autism and Brain Imaging Data Exchange˙ (ABIDE). We preprocessed 417 ASDs (average age ± std: 17.7 ± 8.2 years) and 459 TDCs (17.7 ± 7.9 years) using SPM, FSL and FreeSurfer (FS). After accounting for age, IQ, sex and site for each and all 15 ABIDE sites we performed two sample t-tests on residual brain volumes. Growth curves were computed for all ABIDE subjects within the age window of 6 to 40 years using local polynomial regression fitting.

Results: In Figure 1A, B and C we present boxplots for TIV, GMV and WMV computed with SPM (in red), FSL (in green) and FS (in blue) along with ASD vs. TDC t-test p-values for all 15 sites. When TIVs from all sites were compared, only SPM showed significantly higher TIV in ASD, FSL showed **lower** TIV in ASD and FS higher TIV in ASD (insignificant). Site wise comparisons were inconsistent. Only one site (Caltech) showed significantly higher TIV volume in ASD with all three methods. Out of the other fourteen sites, SPM showed higher ASD TIV volume in 10 sites and FSL and FS only in 6 sites (not same). For GMV and WMV, SPM showed higher values in ASD for most sites, but FS and FSL results were inconsistent. Growth curves (Figure 1D) indicate lower ASD TIV at birth and later overgrowth across all three methods but with differing onset of overgrowth (SPM: 7, FSL: 15 and FS: 10 years with possible degeneration around 30 years). In Figure 2A we present the standard deviations of TIV indicating generally higher TIV variance in ASD and FS. In Figure 2B SPM vs. FS and SPM vs. FSL TIV scatter plots for all ABIDE subjects indicate that compared to SPM, FS can either under or overestimate TIV and FSL under estimates TIV in most subjects. In Figure 2C and 2D we overlay GM and CSF maps of SPM and FSL. Although most GM regions overlap, CSF estimates have many non-overlapping regions.

Conclusions: By applying three different volume computation methods to a very large dataset we show that in addition to inter-site heterogeneity of ASD brain volume, poor inter-method reliability may also contribute toward inconsistent results. Note: subjects used in this study were older than 6 years and hence we could not test the popular early brain growth hypothesis.

2:09   **150.003** Older Adults with Autism: So Much for the Gray Matter?

P. C. M. Koolschijn[1] and H. M. Geurts[2], (1)Brain & Cognition, Dutch Autism & ADHD Research Center, University of Amsterdam, Amsterdam, Netherlands, (2)Dutch Autism & ADHD Research Center, Brain & Cognition, University of Amsterdam, Amsterdam, Netherlands

Background: The anatomical signature of autism spectrum disorder (ASD) is marked by age-specific changes in children and adolescents, showing different rates in different brain regions during different life phases. However, there's a paucity of studies examining brain anatomy in middle and late adulthood in ASD, making it unknown whether ASD in adults is characterized by differences in brain anatomy.

Objectives: To use structural neuroimaging to characterize disorder-related and age-related changes of gray matter morphology in adults and elderly with ASD and controls.

Methods: We performed a cross-sectional structural 3T MRI study of 51 individuals with clinical ASD (35 Males) and 49 age- and sex-matched controls (32 Males) between the ages 30-74 years (Mean age ASD=51.5 (12.6); Mean age Controls=50.1 (11.9)). Inclusion criteria for ASD participants: 1) a formal clinical diagnosis of ASD prior to inclusion; 2) confirmation of the clinical diagnosis: 33 individuals had a score above the cutoff of the ADOS (>7; Autism Diagnostic Observation Schedule module 4) and those not scoring above this cutoff did score above the AQ cutoff (>26; Autism-Spectrum Quotient, 50-item list). All participants had an estimated IQ above 80, lack of history of neurological disorders or chronic illness, learning disabilities and schizophrenia. For the control group, an additional exclusion criterion was a first or second-degree family member with ASD. Our main outcome measures included: Surface-based and lobar measures of cortical volume, cortical thickness, surface area and local gyrification index, and volumes of subcortical structures. In addition, we examined laterality indices reflecting the magnitude of left > right asymmetry of these morphological properties. Exploratory analyses were performed to examine group-by-age interactions for the various morphometric measures.

Results: Surface-based and lobar measures, and subcortical volumes did not differ significantly between ASD and controls. Irrespective of group, significant age-related volume loss and cortical thinning was found, but no age-related differences in surface area or local gyrification indices were found. No group differences were found in lateralization indices after correction for multiple comparisons. Taking a conservative approach, all between-group analyses were also performed with the ADOS-only group (i.e. those individuals with ADOS-scores above cutoff (>7), but this did not result in any significant findings.

Conclusions: The lack of significant anatomical differences between individuals with ASD and controls suggests that clinical ASD in middle and late adulthood is not related to or explained by gray matter morphology. These results extent prior findings of suggestive gray matter normalization in late adolescence and early adulthood, and may suggest that ASD is not characterized by continuous distinct developmental gray matter trajectories.

2:21   **150.004** Persistence of Megalencephaly in Early Childhood in a Subset of Children with Autism Spectrum Disorder

L. Libero[1], C. W. Nordahl[2], D. D. Li[2], S. J. Rogers[3] and D. G. Amaral[2], (1)UC Davis MIND Institute,

Sacramento, AL, (2)MIND Institute and Department of Psychiatry and Behavioral Sciences, University of California Davis Medical Center, Sacramento, CA, (3)Psychiatry and Behavioral Sciences, UC Davis MIND Institute, Sacramento, CA

Background: Accelerated brain growth in early childhood in autism spectrum disorder (ASD) has been widely reported. This pattern of excessive growth leads to enlarged brain size and head circumference (HC) in young children with ASD and is purported to plateau in growth (normalization) by adolescence. Although enlarged brain size and HC appear to be a common finding, longitudinal studies specifically examining brain growth in early childhood in individuals with ASD are needed to confirm these conclusions. The current study utilizes a longitudinal dataset of young children with ASD to examine the developmental trajectory of overall brain volume and HC in children with and without ASD.

Objectives: We evaluated total cerebral volume (TCV) and HC longitudinally in a large cohort of preschool-aged children with ASD and age-matched typically developing (TD) controls.

Methods: Participants were enrolled in the Autism Phenome Project. We acquired structural T1-weighted MRIs in 150 children with ASD (122 male/28 female) and 62 TD controls (40 male/22 female) at Time 1 (mean age: 3.1 years). The same participants returned at two time points, resulting in the collection of 99 ASD (80 male/19 female) and 47 TD (31 male/16 female) MRI scans at Time 2 (mean age: 4.2 years), and 79 ASD (64 male/15 female) and 38 TD (25 male/13 female) MRIs at Time 3 (mean age: 5.3 years). Height measurements were collected at each time point. Head circumference at birth was acquired from retrospective examination of medical records, and HC was measured at the Time 1 and Time 3 MRI scans. TCV was measured using a template-based automated method. Individuals with a standardized ratio of TCV to height that was 1.5 standard deviations above the mean for the TD group were classified as having disproportionate megalencephaly (ASD-DM).

Results: At Time 1, 21 ASD children were classified as ASD-DM (19 male/2 female), while 129 ASD children (103 male/26 female) remained in the normal range of TCV (ASD-norm). Head circumference did not significantly differ at birth between any of the groups, but was significantly higher for ASD-DM children, compared to the ASD-norm and TD groups, at Time 1 and Time 3. No significant differences in height were found between ASD-DM, ASD-norm, and TD children at any of the time points. By Time 3, two ASD-DM children were no longer in the DM range while two ASD-norm from Time 1 could newly be classified as DM.

Conclusions: These data suggest there is a subgroup of children with ASD who have brain enlargement, which cannot be accounted for by body size, while most children with ASD remain within the normal range of TCV from ages 3 to 5 years. Contrary to prevailing views, we find that the vast majority of ASD-DM children continue having enlarged brains and greater HC at 5 years of age, with no plateau in growth. In sum, the developmental pattern of brain growth is accelerated only for a subset of ASD children with DM, who persist in having disproportionate megalencephaly across early childhood.

Oral Session
151 - Brain Connectivity in ASD
2:40 PM - 3:30 PM - Grand Salon

Session Chair: Christine Ecker, *The Sackler Institute for Translational Neurodevelopment, Institute of Psychiatry, King's College London, London, United Kingdom*

2:40   **151.001** Connectivity Differences in a Heterogeneous Sample of Mice from Multiple Mouse Models of Autism

Y. Yee[1], J. Ellegood[2] and J. P. Lerch[2], (1)Medical Biophysics, University of Toronto, Toronto, ON, Canada, (2)Hospital for Sick Children, Toronto, ON, Canada

Background: Autism is often described as a disorder of aberrant connectivity. Belmonte, 2004[1], suggests that global long range connections are weakened, an idea supported by DTI findings of altered white matter. Just, 2012[2], contends that the diminished long range connections are localized to fronto-posterior connections rather than global ones, measured by fMRI.

Objectives: We sought to describe connectivity differences in autism-related mice. While mouse models of autism reduce phenotypic variance by controlling the underlying genetics, comparisons between mouse and human research require samples that adequately reflect this heterogeneity. We therefore asked, if a connectivity study modeled after human research was carried out in mice in which individual mice from a variety of mouse models were grouped together, do the connectivity changes reflect human patterns?

Methods: We used anatomical covariance (AC) as a measure of connectivity. In AC, correlating regional volumes between a seed region and target regions or voxels across a sample of mice provide a network of correlation coefficients across the brain for each seed. Data (currently unpublished) suggest that networks of AC correlation coefficients significantly correlate with the underlying fiber networks in mice and predict expected functional connections. Unlike DTI, AC can capture connections mediated by small fiber tracts, and unlike fMRI, AC can be done ex-vivo. High-resolution MR images of mice from multiple autism-related mouse models were obtained and

registered together in a single group, and AC networks were computed between a set of seed regions and target voxels throughout the entire brain. Ellegood, 2014[3], found that in a study of brain region volumes across mouse models, certain structures appear to be consistently affected; we used structures from this study as seeds. We looked at which voxels consistently showed increased or diminished connectivity across all seeds. Connectivity differences were determined by taking the difference in AC correlation coefficients at every voxel between the autism group and an appropriate set of wildtype mice for every seed, and computing the t-statistic at every voxel across all seeds.

Results: We found that overall, diminished connectivity was localized to the cerebral cortex, and increased connectivity was seen in subcortical structures. Specifically, regions consistently implicated in overconnectivity (Figure 1) included parts of: striatum, nucleus accumbens, corpus callosum, thalamus, hypothalamus, hippocampus, periaqueductal grey, midbrain, superior and inferior colliculus, medulla, and cerebellar paraflocculus and vermis. Regions consistently implicated in underconnectivity (Figure 1) included parts of: frontal association cortex, somatosensory and motor cortex, lateral orbital cortex, cingulate cortex, olfactory bulbs, corticospinal tracts and the arbor vita. Preliminary results further indicate that overconnectivity is seen in regions closer to the seed, and that this decreases as a function of distance to seed.

Conclusions: Connectivity differences in mice from the autism-mouse models used are spatially ordered, with structures within the cerebral cortex showing decreased connectivity and certain subcortical structures showing increased connectivity. While these findings fit the idea that higher order cognitive and behavioural deficits arise from aberrant cortical connectivity, more needs to be done to test the two connectivity theories proposed by Belmonte and Just.

2:52   **151.002**   Abnormalities in Large-Scale Brain Network Architecture in Autism

B. A. Zielinski[1], M. D. Prigge[2], J. E. Lainhart[3], A. Alexander[4], E. D. Bigler[5], N. Lange[6] and G. Gerig[7], (1)Division of Pediatric Neurology, University of Utah, Salt Lake City, UT, (2)Pediatrics, University of Utah, Salt Lake City, UT, (3)Psychiatry, Waisman Center, University of Wisconsin-Madison, Madison, WI, (4)Waisman Center, University of Wisconsin-Madison, Madison, WI, (5)Psychology, Neuroscience Center, Brigham Young University, Provo, UT, (6)McLean Hospital, Belmont, MA, (7)School of Computing & Scientific Computing and Imaging Institute SCI, University of Utah, Salt Lake City, UT

Background: Autism is a complex neurological condition characterized by childhood onset of dysfunction in multiple cognitive domains including socio-emotional function, speech and language, and processing of internally- versus externally-directed stimuli. 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. However, large-scale brain network structure has yet to be fully characterized in autism.

Objectives: Using an emerging technique known as structural covariance MRI (scMRI), this study sought to determine whether specific abnormalities in large-scale brain network organization are associated with autism, and whether network-level abnormalities in brain architecture can be detected with standard clinical MRI.

Methods: We used scMRI to interrogate network-level differences in gray matter structure within eight canonical large-scale 'intrinsic connectivity networks' (ICNs) strongly implicated in autism, in 49 high-functioning autistic subjects and age-, gender-, and IQ-matched controls (mean age 13.4 yrs, range 3.5-22.5 yrs, all male). T1-weighted 3.0 Tesla anatomical MRI scans were realigned, segmented, normalized to a customized template, modulated, and smoothed. To study network structural covariance, we derived 4-mm radius spherical seed regions-of-interest (ROIs) within core hubs of canonical ICNs. Extracted mean ROI gray matter intensities provided covariates-of-interest for whole brain condition (diagnosis)-by-covariate analyses based on the General Linear Model. Resulting seed covariance maps for each age group were thresholded at p <0.001, corrected for family-wise error. Direct between-group comparisons were performed using ROI, diagnosis group, and neuropsychiatric test scores as covariates of interest.

Results: Seed-based scMRI revealed specific perturbations in brain network architecture within distinct ICNs, consistent with phenotypic manifestations of autism. Structural covariance maps in controls were consistent with canonical ICN topologies. Extent and topology of the salience network, involved in social-emotional regulation of environmental stimuli, is markedly underdeveloped in autism. In contrast, the default mode network (DMN) is larger in autism, but demonstrates 'posteriorization'. Moreover, discrete nodes outside of canonical DMN boundaries are present in the autism group, including many regions commonly associated with autism. Other networks demonstrate concurrent over- and under-development, regional decoupling, or remain unaffected.

Conclusions: Specific abnormalities in large-scale brain network structure underlie autism. Our findings are consistent with a network-based 'selective vulnerability' model of autism, provide a plausible substrate for phenotypic features of the disorder, and suggest a unifying interpretation of previous work. Structural brain network abnormalities in autism are quantifiable using standard clinical MRI.

3:04   **151.003**   Distinctive Developmental Pattern of Functional and Structural Connectivities within Default Mode Network in ASD

H. Y. Chien[1], S. S. F. Gau[2], Y. J. Chen[1], Y. C. Lo[1], H. Y. Lin[2], Y. C. Hsu[1] and W. Y. I. Tseng[1], (1)Center for Optoelectronic Medicine, National Taiwan University College of Medicine, Taipei, Taiwan, Taipei,

Taiwan, (2)Department of Psychiatry, National Taiwan University Hospital and College of Medicine, Taipei, Taiwan

Background: Literature documents aberrant brain connectivity in individuals with autism spectrum disorder (ASD). Among the brain networks, the default mode network (DMN) has been widely reported to be atypical in ASD based on both the functional connectivity (FC) and structural connectivity (SC) neuroimaging studies. However, the developmental differences in the FC and SC of the DMN between individuals with ASD and typically developing individuals (TD) remain underinvestigated.

Objectives: We used the resting-state fMRI (rs-fMRI) and diffusion spectrum imaging (DSI) to clarify, respectively, the atypical FC and SC in boys and adolescents with ASD and their TD counterparts. We also examined the age effect on the FC-SC correlations in the two groups.

Methods: The final sample recruited 80 individuals with ASD and 75 TD with age and PIQ matched after the rs-fMRI and DSI imaging preprocessing (Table1). Rs-fMRI data (3-Tesla Siemens Tim Trio system, 6-minute scan with eyes closed, TR=2sec) were preprocessed using the DPARSF toolbox (http://rfmri.org/DPARSF) with SPM8. Motion artifact was corrected by nuisance regression against 24-autoregressive motion parameters at an individual level. The DMN FCmap with significant activation of posterior cingulate cortex (PCC) and medial prefrontal cortex (mPFC) was constructed with the seed-based approach.

DSI data were acquired by a twice-refocused balanced echo diffusion echo planar imaging sequence, TR/TE = 9600/130 ms, imaging matrix size = 80 x 80, spatial resolution = 2.5 x 2.5 mm^2, and slice thickness = 2.5 mm. 102 diffusion encoding gradients with the maximum diffusion sensitivity bmax = 4000 s/mm^2 sampled on the grid points in a half sphere of the 3D q-space with $|q| \leq 3.6$ units. The bilateral cingulum tracts were reconstructed on the DSI standard template by an expert using cingulate cortex as ROIs defined in the Automatic Anatomical Labeling system and the individual generalized fractional anisotropy values were sampled as SC indices. (Figure 1)

The effects of age (younger/elder) and group (ASD/TD) on the FC between PCC and mPFC and the SC of the cingulum were analyzed with two-way ANOVA analysis. The FC-SC correlations were investigated using multiple regression analysis with age as an independent factor in the two groups.

Results: The results showed that all the SC and FC indices were significantly higher in the elder group than the younger group (left cingulum: F (1,153)=10.833, p=0.001; right cingulum: F (1,153)=5.156, p=0.025; left_FC: F(1,153)=6.150, p=0.014; right_FC: F(1,153)=5.088, p=0.026), and the SC of right cingulum was significantly higher in the TD than ASD (F (1,153)=7.113, p=0.008). No group-by-age interaction was found. Multiple regression results showed a significant positive FC-SC correlation regarding age as an independent variable in ASD group (Right: beta=0.325, p=.004, Left:beta=0.270, p=.016), while there was no such correlation in the TD group.

Conclusions: Despite the same age effect on the SC and FC in both ASD and TD, significant age-dependent SC-FC correlation was noted only in ASD. This implies that the developmental patterns of FC-SC interaction differ between the ASD and TD groups and such finding warrants further investigation across different ages.

3:16   **151.004** Ultrastructural Analysis of Axons in Temporal Lobe White Matter in Autism

T. A. Avino[1], X. B. Liu[2] and C. M. Schumann[1], (1)Psychiatry and Behavioral Sciences, UC Davis MIND Institute, Sacramento, CA, (2)Cell Biology and Human Anatomy, UC Davis, Davis, CA

Background: From a physiological perspective, autism is often characterized as a disorder of aberrant cortical connectivity, which has been demonstrated through a number of gross functional and structural imaging methods. For example, functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) studies demonstrate desynchronized and disrupted cortical communication in autism. Additionally, diffusion tensor imaging (DTI) and structural MRI scans show abnormal growth trajectory and loss of white matter fiber integrity in autism particularly within the temporal lobes. While these studies demonstrate aberrant cortical connectivity in autism, the microanatomical mechanisms that underlie this large-scale deficit are relatively unknown and limited. Because white matter tracts serve as the conduits for which short and long distance cortical communication occurs, the ultrastructural characteristics of these axons may provide such a microanatomical basis in autism.

Objectives: The goal of the present study was to assess the ultrastructural characteristics of axons within the superficial and deep white matter in subregions of the temporal lobe in autism relative to their age-matched neurotypical counterparts.

Methods: White matter from the superior temporal gyrus and fusiform gyrus was dissected from autistic and age-matched neurotypical subjects from 50μm frozen sections. Using a novel method for tissue processing (Schumann & Liu, 2014), these samples were prepared for ultrathin sectioning and electron microscopic analysis. Myelinated axons were randomly selected for g-ratio analysis and imaged at high magnification (8,400x) whereby the myelin sheath thickness is calculated relative to the axon diameter. Data regarding the overall density and size distribution of axons are acquired at low (1,600x) and medium (4,800x) magnification, respectively, and analyzed in age-matched autistic and neurotypical subjects across a wide age range.

Results: Consistent with previous reports, preliminary data from the g-ratio analysis indicate decreasing proportional myelin thickness with increasing axon diameter in both autistic and neurotypical subjects. However, these data show thinner myelination patterns across all axon sizes in the autistic subjects relative to their neurotypical counterparts. Data regarding axon density and size

distribution in autistic and neurotypical subjects will also be presented.

Conclusions: While preliminary, our data show a trend of reduced myelination across all axon sizes in the temporal lobe white matter of autistic subjects. These data are consistent with similar reports of alterations to axon ultrastructure in areas of the frontal lobe in autism (Zikopoulos & Barbas, 2010) and may provide a basis for the observed altered neuronal communication in the disorder. The results may also provide a substrate for increased diffusivity of white matter tracts in autism.

Panel Session
152 - Tackling Teenage Troubles: Interventions Aimed at Guiding Adolescents with ASD through the Challenges in the Domains of School, Peers and Psychosexual Development
3:30 PM - 5:30 PM - Grand Ballroom B

Panel Chair: David Skuse, *Institute of Child Health, London, United Kingdom*

Discussant: Kirstin Greaves-Lord, *Erasmus MC-Sophia Children's Hospital, Rotterdam, Netherlands*

Adolescence can be a challenging period for individuals with autism spectrum disorder (ASD), because of the physical, emotional and social changes that occur simultaneously. The change from primary to secondary education entails a large environmental change in location, daily schedule, and social context. Therefore, guidance in this transition is important. It is also crucial to foster a save relation with the teachers, to enhance the learning environment and facilitate optimal academic achievement. In order to have positive peer interactions and develop and maintain friendships, social skills become increasingly important. Training social skills, while involving the parents who can additionally coach these skills in the home and community environment, is therefore also important. Finally, due to hormonal changes, psychical changes occur that usually concur with increased sexual awareness and interest. Since sexuality and intimate relations require regulation of emotions, behaviours and social-communication, guidance in the area of psychosexual development can also be of importance. Given these challenges, the current panel will discuss research on interventions that are aimed at guidance for adolescents with ASD regarding 1) the transition from primary to secondary school, 2) a positive teacher-pupil relation, 3) social skills for interaction with peers, and 4) a healthy psychosexual development.

3:30   **152.001** The Transition to Secondary Education for Young People with Autism Spectrum Disorder (ASD): A Controlled Trial of the Systemic Transition in Education Programme for ASD (STEP-ASD)

W. Mandy[1], M. Murin[2], O. Baykaner[2], J. Hellriegel[3], S. Staunton[4], S. Anderson[5] and D. H. Skuse[6], (1)Behavioural and Brain Sciences Unit, UCL Institute of Child Health, London, United Kingdom, (2)Great Ormond Street Hospital, London, United Kingdom, (3)UCL, london, United Kingdom, (4)Institute of Child Health, Dublin, Ireland, (5)Behavioural and Brain Sciences Unit, Institute of Child Health, UCL, London, United Kingdom, (6)Institute of Child Health, London, United Kingdom

Background:

In most western cultures, the early stages of the transition from childhood to adolescence include a move from primary to secondary education. This is a major ecological shift, characterised by an escalation of the social, emotional, academic and organisational demands made upon an individual. It represents a critical period at the start of adolescence: a successful move to secondary school provides a foundation for meeting future developmental challenges; whereas a failed school transition can trigger difficulties that cascade throughout the teenage years and beyond. No empirical studies have described the school transition for people with autism spectrum disorder (ASD); and no validated interventions exist to manage this crucial moment in the development of people on the autistic spectrum.

Objectives:

To study the transition from mainstream primary to secondary school of young people with ASD; to develop an intervention that promotes good outcomes during school transition; and to estimate the feasibility and efficacy of this intervention.

Methods:

Over a period of three years, 42 children with ASD (80% male, mean IQ = 85.92, mean age = 11.14 years), were assessed before and after they had made the transition from mainstream primary to secondary school. In the first two years, the young people (n=26) received management as usual (MAU); and focus groups were conducted with children, parents and teachers. On the basis of this information, the Systemic Transition in Education Package for ASD (STEP-ASD) was designed. This is a manualised, ecological intervention: it effects modifications of the school environment, to reduce maladaptation by improving the fit between the individual with ASD and their environment. In the final year of the study, STEP-ASD was implemented with 16 children with ASD. The primary outcome was Total Problems score of the Strengths and Difficulties Questionnaire (SDQ), by teacher report. Transition trajectories were compared for young people who received STEP-ASD and those who had MAU.

Results:

During transition, in the control (MAU) group SDQ scores increased by 0.6 SD, but in the Intervention

group they had *decreased* **-**5.20 SD (p< 0.01). All results were adjusted for gender, social deprivation score, OFSTED primary and secondary ratings and IQ. No child in STEP-ASD received additional psychiatric or other treatment as a consequence of the intervention. Teachers, children and parents reported high levels of satisfaction with STEP-ASD.
Conclusions:
This non-randomised controlled trial suggests that the STEP-ASD approach may reduce difficulties at school for children with ASD as they embark upon adolescence. This shows the value of interventions that seek to reduce maladaptation by taking a manualised approach to modifying the environments in which people with ASD function.

3:55 **152.002** Impact of a Preventive Intervention on the Relationship Between Teachers and Adolescent Students with Autism Spectrum Disorder

J. Hopman[1,2], N. Tick[1,2], J. van der Ende[2], P. van Lier[3], T. Wubbels[4], F. C. Verhulst[2], L. Breeman[1,2] and A. Maras[1], (1)Yulius Academy, Yulius Mental Health Care, Barendrecht, Netherlands, (2)Department of Child & Adolescent Psychiatry/psychology, Erasmus MC - Sophia Children's Hospital, Rotterdam, Netherlands, (3)Department of Developmental Psychology, VU University Amsterdam, Amsterdan, Netherlands, (4)Utrecht University, Faculty of Social and Behavioral Sciences, Utrecht, Netherlands

Background: In order to obtain optimal functioning in the school setting, a positive relation with the teacher is imperative for adolescents with ASD.
Objectives: The goal of this study was to explore the impact of the Good Behavior Game (GBG), a universal classroom-based behavioral management program, on the relationship between teachers and adolescents who are placed in special education schools due to psychiatric problems. Subsequently, we examined whether similar findings were obtained when including only students with autism spectrum disorder (ASD), because of their particular social difficulties.

Methods: Data were collected among 412 adolescent students with psychiatric problems from fourteen special secondary schools in the Netherlands (*M* age = 14.3 years, *SD* = 1.6). Based on students' school files, 107 students had an ASD diagnosis. After random assignment to conditions, students in classes that implemented the GBG were compared to students who received education-as-usual. Characteristics of the teacher-student relationship were examined from both the teacher's and student's point of view.
Results: Results of multilevel modeling showed that the GBG positively impacted the teacher-reports of teacher-student closeness, and student-reports of teacher-student strict interaction. These findings remained significant, also when including only the students with an ASD-diagnosis.

Conclusions: The GBG may be regarded as an possible element of an approach to facilitate special secondary education teachers, who educate adolescent students with a wider range of psychiatric disorders, including ASD, in creating a more positive classroom climate.

4:20 **152.003** Using Parent-Assistance and Teacher-Facilitation to Teach Social Skills in the Classroom: Treatment Outcome for the PEERS® School-Based Curriculum

E. A. Laugeson[1], R. Ellingsen[2], L. C. Tucci[3], Y. Bolourian[4] and S. Bates[5], (1)Psychiatry, UCLA Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA, (2)University of California Los Angeles, Los Angeles, CA, (3)The Help Group/UCLA Autism Research Alliance, Redondo Beach , CA, CA, (4)The Help Group - UCLA Autism Research Alliance, Moorpark, CA, (5)Psychiatry, UCLA PEERS Program, Los Angeles, CA

Background:
While social skills training is a common treatment method, few evidence-based interventions exist to improve the social functioning of adolescents on the spectrum. Parent-mediated interventions in clinic settings have shown promise in teaching social skills to adolescents with ASD, and school-based interventions have also shown some promise; yet, the effectiveness of including both parents and teachers in school-based social skills training has heretofore been unexplored.
Objectives:
The purpose of this study is to examine: (1) changes in social functioning and peer engagement following a school-wide, teacher-facilitated social skills program for adolescents with ASD; (2) examine differences in treatment outcome with and without parent-assistance; and (3) identify behavioral correlates of parent participation.
Methods:
Participants included 146 adolescents with ASD ranging in age from 11-18 (*M*=15.08; *SD*=1.82). Adolescents received daily social skills instruction in the classroom for 20-30 minutes for 14-weeks using the PEERS® Curriculum for School-Based Professionals. Instruction was provided by 24 classroom teachers and 36 teacher aides trained and supervised by the program developer. Skills focusing on friendship development and maintenance were targeted. Approximately 34% of parents (*n*=49) participated in 90-minute weekly social coaching groups led by a licensed clinical psychologist certified in PEERS®. Parents were given didactic instruction on targeted social skills and strategies

for providing social coaching in the home and community. Treatment outcome was measured across the two groups (parent-mediated v. no-parent participation) using a battery of standardized and criterion based measures.

Results:
Results from an ANOVA (SPSS 22.0) reveal significant treatment effects across groups regardless of parent participation. Parent-reports of social functioning for all participants indicate improvement in overall social skills (SSIS; $p<.01$), social responsiveness (SRS; $p<.05$), and peer engagement (QSQ; $p<.05$), and decreased social anxiety (SAS; $p<.01$). Teacher-reports reveal a significant decrease in internalizing behavior (SSIS; $p<.01$), while adolescent-reports show significant improvements in self-esteem (PHS; $p<.01$) and social skills knowledge (TASSK; $p<.01$) for all participants. However, participants receiving teacher-facilitation with parent-assistance benefited to a greater extent than those without parent-assistance through improved social responsiveness (SRS; $p<.05$) in the areas of social awareness ($p<.05$), social cognition ($p<.05$), and social communication ($p<.05$), with teens also reporting improved friendship quality (FQS; $p<.05$). Furthermore, number of sessions attended by parents was correlated with greater peer engagement (QSQ) through initiated ($p<.05$) and invited get-togethers ($p<.01$), and decreased problem behaviors (SSIS; $p<.05$) in internalizing ($p<.01$) and hyperactivity ($p<.01$).

Conclusions:
This research is one of the largest social skills studies conducted in the educational setting for adolescents with ASD, and is the only known study using parent-assistance and teacher-facilitation. Findings suggest the use of PEERS® as a school-based intervention is more efficacious when parents are included—highlighting the need for more family-supported treatments, even in the classroom.

4:45 **152.004** A Randomized Controlled Trial to Investigate the Effects of a Psychosexual Training Program for Adolescents with Autism Spectrum Disorder: Results of the Tackling Teenage Training Program

K. Visser[1], K. Greaves-Lord[2], F. C. Verhulst[3], N. Tick[3], A. Maras[4] and E. van der Vegt[1], (1)Erasmus MC-Sophia, Rotterdam, Netherlands, (2)Yulius Autisme Expertisecentrum, Rotterdam/Dordrecht, Netherlands, (3)Department of Child & Adolescent Psychiatry/psychology, Erasmus MC - Sophia Children's Hospital, Rotterdam, Netherlands, (4)Yulius Academy, Yulius Mental Health Care, Barendrecht, Netherlands

Background:
In adolescence social-communication skills become increasingly important. Friendships play a bigger role in the life of adolescents and most adolescents have their first romantic and intimate relationships. Adolescents with ASD usually lack the required knowledge, insight and skills required for sexual socialisation and therefore they need specific guidance in adolescence. Such guidance is provided in the Tackling Teenage Training (TTT) program. In 18 one-on-one sessions, adolescents with ASD receive psycho-education and practise communicative skills regarding several topics related to puberty, sexuality and intimate relationships.

Objectives:
To investigate whether the TTT program (1) increases psychosexual knowledge; (2) increases friendship and romantic relational skills (3) increases insight in acceptable versus inappropriate sexual behaviours; (4) reduces inappropriate sexual behaviours; (5) increases general self-esteem, and friendship and romantic relational confidence (6) reduces concerns about current and future friendship and romantic relations.

Methods:
We conducted a randomised controlled trial in the Netherlands with an intervention group and a waiting-list control group. We assessed both self- and parent-report questionnaires on two time points: at baseline (T1) and directly after the TTT program, or after six months on the waiting-list (T2). In addition, the adolescents filled out a psychosexual knowledge test at both time points and performed a test on insight in acceptable and inappropriate sexual behaviours.

Results:
160 adolescents, age 12-18 years old (M=14.67, SD=1.72) with ASD and an average IQ (M=106.24, SD=12.88) completed the T1 en T2 assessments. By means of 2x2 Analyses of variance (ANOVAs) we found that psychosexual knowledge significantly increased more in the intervention group than in the control group ($F(2, 159) = 14.97$, $p < .01$, $\eta^2=0.09$). In addition, after following the TTT program, adolescents with ASD reported to have better friendship skills ($F(2, 159) = 8.82$, $p < .01$, $\eta^2=0.05$) and reported to portray fewer inappropriate behaviours, such as inappropriate touching of other people ($F(2, 159) = 3.50$, $p < .05$, $\eta^2=0.02$). In the parent-report questionnaires, no differences were found between the groups over time.

Conclusions:
These results show that the TTT program improved psychosexual knowledge and particular behaviours and skills in adolescents with ASD. However, findings are confined to self-report and do not reflect progress in all domains of psychosexual functioning. A follow-up measurement is needed to investigate whether the positive effects of the TTT program sustain, accumulate or diminish over a longer period of time.

Panel Chair: Matthew State, *Psychiatry, UCSF, San Francisco, CA*

Gene discovery via next generation sequencing is paramount to understanding the underlying biology of autism spectrum disorder (ASD). However, interpretation of genetic variation is confounded by the heterogeneity of ASD, as well as the difficulty understanding the functional role of non-coding regions. This panel outlines a paradigm for translating findings from whole-exome and whole-genome sequencing to testable hypotheses of ASD neurobiology. In the first talk, recent findings from whole-exome and whole-genome sequencing studies are presented with an emphasis on using maps of regulatory regions to interpret non-coding variation. Next, specific chromatin modifiers, associated with ASD risk via these DNA sequencing studies, are investigated with ChIP-seq in order to build regulatory networks that may be perturbed in ASD. The third talk in this panel uses a novel framework to integrate the data from the first two talks with gene expression data from the developing human brain in order to increase our power to detect genes associated with ASD. Finally, in the fourth talk, we highlight recent efforts to translate genetic findings to functional biology and pharmacological screening using zebrafish as a model system.

3:30 **153.001** Whole-Genome Sequencing in ASD Quartets and Integration with Regulatory Elements Active during Human Brain Development

A. J. Willsey[1], S. Reilly[2], M. Walker[1], R. A. Muhle[3], J. Cotney[2], S. J. Sanders[1], B. Devlin[4], K. Roeder[5], N. Sestan[6], J. Noonan[2] and M. W. State[1], (1)Psychiatry, UCSF, San Francisco, CA, (2)Genetics, Yale University School of Medicine, New Haven, CT, (3)Yale Child Study Center, New Haven, CT, (4)Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, (5)Statistics, Carnegie Mellon University, Pittsburgh, PA, (6)Neurobiology, Yale University School of Medicine, New Haven, CT

Background: Large-scale genotyping and whole-exome sequencing studies have strongly established the contribution of *de novo* copy number variants (CNVs) and rare *de novo* coding mutations, respectively, to autism spectrum disorder (ASD) risk. However, the contribution of rare *de novo* non-coding mutations, such as those identified by whole-genome sequencing (WGS) has not been well characterized. This is partly due to the difficulty in interpreting the biological effects of non-coding variation, especially since the complement of regulatory regions is temporally and spatially specific. Several recent studies have identified strong convergence of ASD-associated mutations during midfetal development, indicating that regulatory elements active during this critical point of brain development may be particularly relevant to ASD. Thus, we report preliminary results from WGS of 40 quartets with simplex ASD, and interpret them in the context of regulatory elements active during midfetal human brain development.
Objectives: (1) To utilize WGS to identify *de novo* non-coding mutations in probands and matched sibling controls from 40 quartets in the Simons Simplex Collection (SSC); (2) to annotate these mutations based on non-coding regulatory elements active in developing cortex; and (3) to associate regulatory elements and their genic regulatory targets, with ASD based on recurrence of mutations within these regions.
Methods: WGS was conducted on the Illumina HiSeq X Ten to a minimum mean coverage of 30x. Data were aligned using BWA-mem and duplicate reads were removed with Picard. Variants were called with the Genome Analysis Toolkit. Published and in-house maps of regulatory elements active during human brain development were integrated with identified variants in order to determine the burden of these mutations within active regulatory elements in probands versus matched sibling controls. Based on the rate in unaffected siblings, statistical models were developed to identify particular regulatory elements with a statistically significant overrepresentation of mutations. These regulatory regions were then associated with nearby genes using computational methods and existing databases of genome topology domains.
Results: Non-coding *de novo* variants identified by WGS are present within regulatory elements active during midfetal brain development, as identified by ChIP-seq for active chromatin marks in human cortical tissue. Additionally, regulatory targets of specific chromatin modifiers and transcription factors associated with ASD are also impacted by *de novo* variation.
Conclusions: WGS in 40 quartet families with simplex ASD has identified a large number of non-coding *de novo* mutations. Integration of this data with chromatin state and targeted ChIP-seq data from the developing human brain helps prioritize which of these variants are functional, and indicates which regulatory elements and their corresponding genes may be relevant to ASD risk.

4:00 **153.002** Chromatin Remodelers in Autism: Deciphering Regulatory Networks That Contribute to Autism Risk

J. Cotney[1], R. A. Muhle[2], S. J. Sanders[3], L. Liu[4], A. J. Willsey[3], W. Niu[1], W. Liu[1], L. Klei[5], J. Lei[4], J. Yin[1], S. Reilly[1], A. Tebbenkamp[6], C. Bichsel[6], M. Pletikos[6], N. Sestan[6], K. Roeder[4], M. W. State[3], B. Devlin[5] and **J. Noonan**[1], (1)Genetics, Yale University School of Medicine, New Haven, CT, (2)Yale Child Study Center, New Haven, CT, (3)Psychiatry, UCSF, San Francisco, CA, (4)Statistics, Carnegie Mellon

University, Pittsburgh, PA, (5)Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, (6)Neurobiology, Yale University School of Medicine, New Haven, CT

Background: Recent gene discovery efforts in autism spectrum disorder (ASD) have identified chromatin modifiers, such as the chromodomain helicase *CHD8*, as important new contributors to ASD pathogenesis. These and additional ASD risk-associated genes are co-expressed in human midfetal cortex, suggesting that ASD risk genes may converge in regulatory networks that are perturbed in ASD. To investigate the factors shaping this regulatory network, we have undertaken studies to globally map regulatory targets of ASD risk-associated chromatin modifiers during human neurodevelopment. Additionally, these regulatory networks may aid in the identification and classification of non-coding regulatory regions, which is critical for interpreting whole genome sequencing (WGS) data.
Objectives: We have found that CHD8 regulates other ASD risk genes during human neurodevelopment. These studies provide an initial view of ASD-associated regulatory networks in the human brain. We will build on these results by identifying regulatory targets of other chromatin modifiers conferring risk for ASD.
Methods: We have mapped the binding sites of CHD8 in the developing human and mouse brain using ChIP-seq, and have characterized global dysregulation of CHD8 targets following CHD8 knockdown utilizing shRNAs followed by RNAseq. We will extend these analyses to the targets of ASD risk genes bound by CHD8. Integration of these ASD risk gene target maps with each other, and with maps of specific active and/or repressive histone modifications, will identify genes and regulatory elements targeted by other ASD risk genes within the CHD8 regulatory network. These studies will be further informed by cell model systems in which ASD risk gene expression will be decreased by shRNA and/or CRISPRi. Finally, we will integrate WGS data obtained from ASD cohorts in order to assess the impact of coding and regulatory variation on ASD-associated regulatory networks.
Results: We find that CHD8 gene targets in human and mouse developing brain are significantly enriched in ASD risk genes bearing one or more de novo loss of function mutations, and that genes found in ASD risk-associated spatiotemporal co-expression networks during human brain development are more likely to be targeted by CHD8. Knockdown of CHD8 expression levels by shRNA leads to significant dysregulation of ASD risk genes. CHD8 binds the ASD risk genes *CHD2*, *SUV420H1*, *ARID1B*, *POGZ*, *MLL5*, *ASH1L*, and *SETD2*, among others, and preliminary results suggest that CHD2 and CHD8 targets substantially overlap. In further studies, we will characterize the gene targets of CHD2 and other ASD-associated chromatin modifiers to elucidate the regulatory networks dependent on each gene.
Conclusions: Advances in next generation sequencing technologies have greatly advanced the field of autism genetics. However, obtaining biological insights from the ever-increasing numbers of variants from exome and genomic sequencing requires unbiased, functional genomic analysis of ASD-associated genes. Mapping regulatory targets of CHD8, CHD2 and other ASD-associated chromatin modifiers in the developing human brain will identify biological pathways underlying ASD etiology. This will provide the means to interpret ASD-associated noncoding variation, and offer potential avenues for drug discovery by revealing specific mechanisms contributing to ASD.

4:30 **153.003** Gene Expression, Regulatory Elements and Rare Sequence Variation Identify Genes and Subnetworks Underlying Autism Risk

A. E. Cicek[1], L. Liu[2], S. J. Sanders[3], A. J. Willsey[3], J. Cotney[4], R. A. Muhle[5], N. Sestan[6], J. Noonan[4], M. W. State[3], B. Devlin[7] and **K. Roeder**[2], (1)Ray and Stephanie Lane Center for Computational Biology, Carnegie Mellon University, Pittsburgh, PA, (2)Statistics, Carnegie Mellon University, Pittsburgh, PA, (3)Psychiatry, UCSF, San Francisco, CA, (4)Genetics, Yale University School of Medicine, New Haven, CT, (5)Yale Child Study Center, New Haven, CT, (6)Neurobiology, Yale University School of Medicine, New Haven, CT, (7)Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA

Background: Whole-exome sequencing (WES) studies have uncovered risk-conferring variation by enumerating de novo variation, which is sufficiently rare that recurrent mutations in a gene provide strong causal evidence. Analysis of rare coding variation in more than 20,000 people has lead to the discovery of dozens of risk genes. Yet, the genetic architecture suggests that autism spectrum disorder (ASD) involves nearly 1000 genes. Using BrainSpan gene expression data, ChIP-seq data from chromatin modifiers, and exome- and genome-wide sequencing data, we aim to accelerate the search for ASD risk genes. DAWN provides a statistical framework for attaining this goal.
De novo loss of function (dnLoF) mutations occur substantially more often in ASD probands than their unaffected siblings. Multiple, independent dnLoF mutations in the same gene implicate the gene in risk and hence provide a systematic, albeit arduous path forward for ASD genetics. Willsey et al. (2013) identified brain gene coexpression networks as meaningful for organization and inter-relationships of ASD genes; and identified the mid-fetal prefrontal and motor-somatosensory cortex as the developmental periods and regions in which these genes tend to coalesce to confer risk to ASD.
Objectives: Co-expression networks will be estimated from spatially and temporally rich mRNA expression data from developing human brain. Using these co-expression networks along with targets of chromatin modifiers determined by ChIP seq, we aim to identify genes and subnetworks of genes that affect risk for autism.
Methods: We build on the DAWN algorithm, to model three kinds of data: rare variants from whole-

exome and whole-genome sequencing; gene co-expression; and regulatory elements and their impact on gene expression. The algorithm casts the ensemble data as a Hidden Markov Random Field in which the graph structure is determined by gene co-expression and co-regulation. The algorithm combines these interrelationships with node-specific observations, namely gene identity, expression, genetic data, and its estimated effect on risk to identify risk genes.

Results: DAWN identifies novel genes and gene networks that plausibly affect ASD risk. Using recent sequencing data, a significant fraction of these genes are validated. In the validation experiment, DAWN was able to distinguish genes that will accumulate new dnLoF mutations better than any existing method. Moreover, incorporating binding events of ASD-associated chromatin modifiers, identified by ChIP-seq, significantly increased the detection of ASD risk genes.

Conclusions: Focusing on human mid-fetal prefrontal and motor-somatosensory cortex, we obtain a predicted list of risk genes that is enriched for genes under evolutionary constraint. A subnetwork obtained by seeding these genes within a high-confidence protein-protein interactome confirms that the putative genes are enriched for neuronal functions. Enrichment analysis reveals genes involved in synaptic transmission and cell-cell communication, histone modifying enzymes and DNA binding proteins and neurodegenerative disorders. Finally, the power of the DAWN prediction model is enhanced by incorporating the targets of histone modifier genes such as CHD8 into the model.

5:00 **153.004** Zebrafish Mutants of the Autism Risk Gene Cntnap2 Identify Gabaergic Defects and Estrogens As Phenotypic Suppressors

E. J. Hoffman[1], *K. J. Turner*[2], *J. M. Fernandez*[1], *S. W. Wilson*[2], *J. Rihel*[2], *M. W. State*[3] and *A. J. Giraldez*[4], *(1)Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Department of Cell and Developmental Biology, University College London, London, United Kingdom, (3)Psychiatry, UCSF, San Francisco, CA, (4)Genetics, Yale University, New Haven, CT*

Background: Gene discovery in autism has accelerated dramatically, yet the underlying mechanisms remain unknown, limiting the development of targeted treatments. The resulting rapidly accumulating pool of reliable autism genes is providing a launching point for the illumination of biological pathways and rational drug discovery. Homozygous loss-of-function mutations in *Contactin Associated Protein-2* (*CNTNAP2*), which encodes a member of the neurexin family of cell adhesion molecules, are strongly linked to autism and epilepsy. Loss of Cntnap2 in mice revealed abnormal migration of projection neurons to upper cortical layers, reduced GABAergic neurons, spontaneous seizures, and behavioral abnormalities. CNTNAP2 localizes voltage-gated potassium channels at the juxtaparanodal region of myelinated axons, yet its role in the human central nervous system and the consequences of its loss for autism pathophysiology are less well understood. Currently, mammalian model systems offer limited opportunities for large-scale *in vivo* drug screening. In contrast, zebrafish is a model vertebrate system well-suited for small molecule screens.

Objectives: Our goals are: 1) to investigate the function of Cntnap2 in nervous system development; 2) establish a model for conducting pharmacological screens; and 3) identify phenotypic suppressors and novel pathways with relevance to autism.

Methods: Because an imbalance in excitatory and inhibitory signaling in the CNS has been proposed as a mechanism underlying autism, we investigated excitatory and inhibitory neuronal populations in the brains of zebrafish *cntnap2* mutants using transgenic lines labeling GABAergic and glutamatergic cells. Next, to determine the effect of loss of Cntnap2 on seizure susceptibility, we treated wild-type and mutant larvae with pentylenetetrazol, a GABA-A antagonist that is used to induce seizures. Further, we adapted an automated, high-throughput assay to quantify a series of behavioral parameters, including rest-wake cycle behaviors, in *cntnap2* mutants over multiple days. By comparing the behavioral profiles of *cntnap2* mutants and wild-type fish exposed to >500 psychoactive agents, we conducted correlation analyses to identify drugs that induce responses that strongly correlate or anti-correlate with the mutant behavioral phenotype. Further, we tested a select group of psychoactive agents to identify drugs that specifically reverse the mutant behavioral phenotype.

Results: Zebrafish *cntnap2* mutants display GABAergic deficits, particularly in the telencephalon and hypothalamus at 4 days post fertilization. In addition, *cntnap2* mutants display hypersensitivity to drug-induced seizures, consistent with decreased inhibitory tone. Further, high-throughput behavioral profiling reveals a prominent phenotype of nighttime hyperactivity in *cntnap2* mutants, while pharmacological screening reveals dysregulation of both GABAergic and glutamatergic systems. Specifically, we identify significant enrichment of NMDA antagonists among compounds that correlate with the mutant behavioral phenotype and 4 estrogenic agents among the top 10 anti-correlating drugs. Moreover, we find that *cntnap2* mutants display differential behavioral responses to GABA agonists and increased sensitivity to behavioral activation by NMDA antagonists. Interestingly, biochanin A, a phytoestrogen identified in our unbiased screen, specifically reverses the mutant behavioral phenotype.

Conclusions: Zebrafish *cntnap2* mutants identify GABAergic deficits and estrogenic compounds as phenotypic suppressors. These results highlight the utility of the zebrafish model as a genetic tool for illuminating novel phenotypic and pharmacological pathways relevant to autism.

Panel Session

154 - Meaningful Social Outcomes in Real World Settings: Targets, Interventions, and Change

3:30 PM - 5:30 PM - Grand Ballroom C

Panel Chair: Jill Locke, *University of Pennsylvania, Philadelphia, PA*

Discussant: David Mandell, *Psychiatry, University of Pennsylvania School of Medicine, Philadelphia, PA*

Children with autism spectrum disorder (ASD) usually face complex social challenges in schools. Although placing children with ASD with their typically developing peers is a common practice in public school settings, inclusion alone may not be sufficient to increase social ability. Studies of included children with ASD demonstrate that they have poorer social outcomes than their typically developing peers, and these differences worsen with age. Interventions to address social challenges typically occur outside of school settings and rarely generalize. This symposium will address these challenges by: a) presenting data from measures of social connectedness and peer engagement of elementary aged children with ASD and their typical classmates in public schools; b) exploring the role of age and gender in these connections; and c) comparing changes in peer engagement in response to different interventions. These data represent the large multi-site efforts of researchers engaged in community-based research designed to introduce effective social skills interventions and testing meaningful social outcome measures in community settings.

3:30 **154.001** Social Network Analysis of Children with ASD: Predictors of Fragmentation and Connectivity in Elementary School Classrooms

A. Anderson[1] and C. Kasari[2], (1)UCLA, Los Angeles, CA, (2)UCLA Center for Autism Research & Treatment, Westwood, CA

Background: Children with ASD consistently experience more peer rejection, fewer reciprocal friendships, and less acceptance from their classroom peers than their typically developing classmates. Little is known, however, about which children with ASD are at greatest risk for these poor outcomes, and therefore should receive more intensive social skills interventions.
Objectives: This study characterized risk factors for friendship fragmentation and low connectivity in the social networks of children with ASD and their typical classroom peers over an 8-12 week period.
Methods: Participants included 185 children with ASD in 155 mainstream general education classrooms in 59 schools (AIR-B Network). Associations were examined between social network at baseline (i.e., closeness, degree), age, IQ, classroom size, sex and the number of children with ASD within each classroom, and changes in social networks over time. The average "closeness" measure of the student(s) with ASD was used to measure the connectivity with the rest of the classroom. Using a general linear model, we predicted (1) baseline closeness using all demographic covariates, (2) change in closeness using baseline connectivity, baseline degree, and demographic covariates, and (3) final connectivity using only demographic covariates. All models included second-order interactions, and a step-wise model selection automatically determined the final covariates with the maximal explanatory power.
Results: IQ and class size were the most important predictors of social connectivity at baseline. Children's sex and classroom size predicted social fragmentation and social network connectivity 8-12 weeks later. Classroom size had a differential impact based on sex; girls remained more connected to peers when they were in classrooms of 21 students or more, while boys retained more connections with peers when they were in classrooms of 20 students or fewer. In earlier grade levels, boys with ASD were more connected to their peers than were girls with ASD, but this difference decreased with age and increased classroom size. Peer connections among children who were more connected at baseline diminished over time.
Conclusions: The social difficulties experienced by children with ASD may be mitigated by assigning females to larger classrooms and males to smaller classrooms. These results have implications regarding placement, intervention objectives, and ongoing school support aimed to increase the social success of children with ASD in public schools.

3:55 **154.002** What Are They Doing at Recess? Examining Playground Behavior Between Elementary School Children with and without Autism Spectrum Disorder

J. J. Locke[1], W. Shih[2] and C. Kasari[3], (1)University of Pennsylvania, Philadelphia, PA, (2)UCLA, Los Angeles, CA, (3)UCLA Center for Autism Research & Treatment, Westwood, CA

Background: The social communication and interaction deficits associated with ASD can dramatically impair peer engagement and social relationships at school. The majority of children with ASD experience poorer social outcomes in schools than those of children without ASD (Kasari et al., 2011; Locke et al., 2013). Studies have reported that children with ASD spend approximately a third of the recess period solitary or unengaged with peers (Frankel et al., 2011; Kasari et al., 2011); less is known about the playground engagement and peer interaction behaviors of children *without* ASD during recess. This comparison is necessary to determine an appropriate benchmark of peer engagement during recess and reasonable expectations for improvement for children with ASD who undergo interventions designed to improve social ability in schools.
Objectives: The purpose of this study was to document the recess engagement and peer interaction

behaviors of children with and without ASD in inclusive school settings to provide a benchmark of the range of engagement and peer interaction during recess of typical classmates.

Methods: Participants included 51 children with ASD (9 females and 42 males; M_{age} = 8.1, SD = 1.6 years old; M_{IQ} = 86.9, SD = 12.6) and 51 typically developing children (20 females and 31 males; M_{age} = 8.1, SD =1.5 years old) matched on gender, classroom, grade, age, and ethnicity (wherever possible) from 42 classrooms in seven public schools in a large urban school district (AIR-B Network). The Playground Observation of Peer Engagement (POPE), a timed interval behavior coding system, was collected twice for both children with ASD and the matched sample during two separate recess periods within one week.

Results: Classification and Regression Tree and Receiver Operating Characteristic curve analysis indicated that the optimal cut-point for discriminating between children with ASD and typically developing peers was .58 on the POPE (sensitivity, 0.72; specificity, 0.79). There was a statistically significant difference in the percentage of time spent in solitary (M_{diff} = 19.6 after adjusting for age) and joint engagement (M_{diff} = -28.0 after adjusting for age) between children with ASD and their matched peers (p<0.001 for both). Children with ASD also had significantly fewer successful initiations (p<0.001), total initiations (p=0.02), lower initiation rate (p<0.001), positive responses (p=0.01), total opportunities to respond (p=0.03), and lower response rate (p=0.01) than did the matched sample.

Conclusions: Comparing the engagement of children with ASD with that of typically developing classmates in the same context may determine whether children with ASD need intervention and what the expectation for improvement should be. A goal of 58% (the cut point that differentiates children with ASD from their typically developing peers) engagement may be a reasonable intervention objective.

4:20 **154.003** Gender Differences in the Social Behaviors of Children with ASD

M. Dean[1] and R. Harwood[2], (1)University of California Los Angeles, Los Angeles, CA, (2)HRSA, Rockville, MD

Background: Elementary school boys and girls socialize differently from each other. When girls socialize, they engage in less structured activities and talking is the primary focus. Boys, on the other hand, are associated with playing structured games with rules (Maccoby, 2002). While children with ASD prefer same-sex friendships (Dean et al, 2014), it is unclear whether they prefer social activities that are similar to their same-sex peers.

Objectives: The purpose of this study was to examine the social behaviors of girls and boys with and without ASD during recess, and to identify the extent to which the social behaviors of children with ASD are similar to the typically developing (TD) same-sex peers. Second, we also examined gender differences within the ASD sample.

Methods: This is a secondary analysis of data collected during a large randomized controlled trial (AIR-B Network). We analyzed observation data from 185 children with and without ASD. Children with ASD had a diagnosis confirmed by the ADOS (Lord et al., 2002), an average IQ of 93.6, SD=13.4, and were included in a general education classroom. Data from girls with ASD were selected (n=24). Boys with ASD (n=24) were matched to girls with ASD on age, grade, IQ, and city. TD children (girls=69; boys=68) were classmates of a child with ASD. Participants were observed during recess using the Playground Observation of Peer Engagement, which measured the proportion of time that children spent in games (formal games with rules), joint engagement (unstructured activities with peers) or were solitary (playing alone).

Results: Two (group (ASD or TD) by two (gender) ANOVA tests identified significant between-group differences on games, joint engagement, and solitary engagement. In games, the main effect of gender was significant ($F(3,181)$=2.94, p=.09); boys played more games than girls. The main effect of group on games also was significant ($F(3,181)$=10.50, $p < .001$) where TD children played more games than children with ASD. In joint engagement, there were significant main effects of gender and group with girls being more likely to be in joint engagement than boys ($F(3,181)$=6.874, $p < .01$) and TD children spent more time in joint engagement than children with ASD ($F(3,181)$=6.874, p=.03). The main effects of gender, group, and the interaction (gender x group) were significant in solitary. Boys with and without ASD spent more time solitary than girls with and without ASD ($F(3,181)$=5.085, $p < .01$), and children with ASD spent more time solitary than TD children ($F(3,181)$=6.874, $p < .01$). The significant interaction effect indicated that boys with ASD spent more time solitary than any other group ($F(3,181)$=6.572, $p < .01$).

Conclusions: Generally, while children with ASD have more solitary, less engaged interactions than TD children, their activities during school recess are similar to TD children. Gender differences are evident and in most ways similar between children with and without ASD, with girls preferring less structured activities and boys preferring more formal games. These data are important in structuring social interactions at school according to gender preferred activities.

4:45 **154.004** Does Peer Composition and Intervention Approach Matter for Improving Peer Engagement during Recess for Children with ASD?

M. Kretzmann[1], F. Orlich[2], B. H. King[3], R. J. Landa[4], C. Lord[5] and C. Kasari[6], (1)University of California Los Angeles, Los Angeles, CA, (2)Seattle Children's Research Institute, Seattle, WA, (3)Psychiatry and

behavioral sciences, University of Washington, Seattle, WA, (4)Department of Psychiatry and Behavioral Sciences, Johns Hopkins School of Medicine, Baltimore, MD, (5)Weill Cornell Medical College, White Plains, NY, (6)UCLA Center for Autism Research & Treatment, Westwood, CA

Background: Social impairment may be the most complex and intractable challenge facing children with autism spectrum disorder (ASD). Clinic-based social skills groups can improve social impairment but often improvements do not generalize to community settings, such as school. To examine whether including typically developing children in social skills interventions would improve generalization, we compared two social skills group models, both conducted at school. One group mirrored a clinic-based didactic teaching group and was composed of children with disabilities including ASD, with each child from a different class (SKILLS). The other group included typical children and children with ASD from the same classroom in a 2 or 3 to 1 ratio (typical to ASD) using an activity-based model of naturalistic, behavioral intervention (ENGAGE). Each group was composed of 6 to 8 children.

Objectives: The goal was to compare SKILLS vs ENGAGE on joint engagement of the target children with ASD during recess at school.

Methods: Study participants included school-aged children with ASD recruited across four sites (Los Angeles, Baltimore, Seattle, Ann Arbor) over the course of two years (AIR-B Network). One hundred and fifty children with ASD (IQ >70) from 99 general education classrooms were randomized to the ENGAGE or SKILLS group. Children met ADOS research criteria for ASD. Interventions were carried out weekly for 3 months with a 3 month follow up. Children were observed twice within one week on their recess playground by blinded observers at entry, exit and follow up using the Peer Observation of Playground Engagement. Joint engagement and solitary behavior were coded.

Results: The percentage of time spent in joint engagement with peers was evaluated using a linear mixed model. On average, all children significantly increased time spent engaged with their peers from the start of the treatment to the end of the treatment (p=0.002). Children in the SKILLS group improved significantly more than the children in the ENGAGE group (p=0.031). The treatment effect was maintained within the SKILLS group at follow-up since their follow-up engagement was significantly higher than their entry engagement (p=0.013).

Conclusions: Children who received a structured, didactic intervention with similarly impaired peers at school were observed as more engaged during recess. These results differ from previous studies that find peer-mediated interventions involving typical peers are more successful for peer engagement (Bauminger et al., 2008; Kasari et al., 2012). However, mixed (typical and ASD) groups have not been directly compared to more homogeneous groups (all disability) of children at school as in this study. These data suggest there can be benefits to children's social interaction skills regardless of group composition and that direct instruction of social skills also is beneficial.

Panel Session
155 - Neuronal Migrational Abnormalities in Autism
3:30 PM - 5:30 PM - Grand Ballroom D

Panel Chair: Manuel Casanova, *Psychiatry and Behavioral Science, University of Louisville, Louisville, KY*

Discussant: Manuel Casanova, *Psychiatry and Behavioral Science, University of Louisville, Louisville, KY*

There are many neuropathological findings in autism spectrum disorder (ASD). Some of the reported findings can be accounted by either methodological flaws, the effects of preagonal/agonal conditions, artifacts of postmortem tissue, or as being secondary to comorbidities. A few findings remain that by themselves are abnormal and symptomatic, e.g., heterotopias, cortical malformations (dysplasias). The presence of heterotopias and cortical dysplasias in ASD suggests abnormalities of germinal cell division and their subsequent migration to the cortical plate. In this panel we will discuss and illustrate the available evidence for a neuronal migratory disturbance in ASD. The lectures will summarize the following findings in the brains of ASD individuals: 1) Computerized image analysis studies will provide quantitative evidence of increased neuronal cellularity within the white matter of the brain, especially the subplate region, 2) Serial sections of whole brain specimens will detail the presence of heterotopic clusters of cells and cortical dysplasias, 3) Immunocytochemical staining of the cerebral cortex will illustrate abnormalities of specific interneurons in regards to their location within the laminae of the cerebral cortex, and 4) We will summarize genetic evidence for the roles of disturbed neurogenesis and network desynchronization in autism.

3:30   **155.001** Neuronal Profiles within the Subplate and Their Potential Contributions to Cortical Organization in Autism

J. J. Hutsler[1] and T. A. Avino[2], (1)Cognitive and Brain Sciences, University of Nevada Reno, Reno, NV, (2)MIND Institute, University of California, Davis, Sacramento, CA

Background: As a neurodevelopmental disorder, autism spectrum disorders are associated with multiple cortical alterations. Many of these alterations implicate neurodevelopmental events during the prenatal and perinatal periods, and these early changes have the potential to profoundly

influence subsequent cortical activation and the establishment of cortical connectivity. One early and important cell population is found within the cortical subplate. Neurons within the subplate play a role in neuronal patterning within the cortex, and are responsible for guiding thalamo-cortical and cortico-thalamic connections. In addition, they provide early coordinated activation of the overlying cortical layers and, in the adult, may serve an additional role as modulators of cortical afferents. Although many subplate neurons undergo apoptosis during development, in primates a substantial proportion of these cells are retained into adulthood. Adults with autism show a diffuse organization within the subplate region and excess neuronal profiles. These excess profiles could be neurons that did not migrate into the overlying cortex or they could be vestiges of the subplate population that have not undergone apoptosis.

Objectives: The goal of the present study was to quantitatively assess the density of neurons in the cortical subplate of individuals with autism relative to their neurotypical counterparts.

Methods: Postmortem tissue samples from the superior parietal lobe (BA 7) were acquired from twelve subjects (6 autistic, 6 neurotypical; age-matched). Cryostat sections were processed for neuronal nuclei (NeuN) immunohistochemistry and were subsequently digitized and subjected to an automated identification procedure of the cortical layer VI-white matter boundary to ensure reliable definition of the superficial white matter and placement of the sampling boxes. In addition, Golgi-staining was utilized to provide a morphological evaluation of this cell population in ASD subjects.

Results: Our results show a large systematic increase in the density of NeuN+ cells in the cortical subplate in autism relative to age-matched neurotypicals ($F(1,119.42) = 93.1$, $p < .001$; Cohen's $d = 1.56$). Furthermore, four of the six autistic subjects showed an average subplate neuron density >1.5 standard deviations from the mean of the neurotypical subjects. Golgi staining demonstrates the presence of both multipolar and fusiform cell types that are morphologically similar to subplate neurons.

Conclusions:

Neurons of the subplate play a critical role during development in guiding afferent and efferent connectivity to the cerebral cortex. Although many of these cells are lost during development they continue to play a critical role in gating cortical activity in the adult. Like ASD, the presence of excessive neurons subjacent to the cerebral cortex has been shown in other neurological disorders such as schizophrenia (Eastwood & Harrison, 2003) and epilepsy (Emery et al., 1997). In these conditions it has been hypothesized that these neurons contribute to disconnectivity in the mature brain (Kostovic et al., 2011). As such, excessive neuronal profiles in the subplate may be a contributor to both abnormal cortical development and disconnectivity in the ASD brain, and could potentially play a future role in prenatal diagnosis through imaging methods.

3:55 **155.002** Patterns of Neuronal Migration Abnormalities in Autism of Unknown Etiology and Autism Caused By Chromosome 15q11.2-q13 Duplications, and Their Contribution to Clinical Phenotype

J. Wegiel[1], I. Kuchna[1], J. Wegiel[1], K. Nowicki[1], S. Y. Ma[2], H. Imaki[1], E. B. London[3], T. Wisniewski[3] and W. T. Brown[3], (1)Developmental Neurobiology, New York State Institute for Basic Research in Developmental Disabilities, Staten Island, NY, (2)Developmental Neurobilogy, 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

Background: Our concepts of autism neuropathology have evolved over the past several decades from no abnormalities to a global encephalopathy with type, brain-region and age specific alterations. Abnormal neuronal migration resulting in ectopias, heterotopias and dysplasia appears to be evidence of abnormal germinal cell divisions and migration in autism. Depending on the type, size and topography, they are clinically silent or contribute to diverse clinical manifestations that can include epileptogenic activity, epilepsy and sudden unexpected death of subjects with known epilepsy (SUDEP). Interstitial duplications of maternal origin on chromosome 15q11.2-q13 (dup15) are one of the most prevalent cytogenetic aberrations associated with autism (Rineer et al 1998), epilepsy and SUDEP.

Objectives: The first aim of this study was to identify patterns of neuronal migration in idiopathic autism, including heterotopias and dysplastic changes. The second aim was to study subjects with dup(15)/autism to establish how genetic duplications alter the type and topography of neuronal migration abnormalities and increase the prevalence of the early onset of seizures and SUDEP.

Methods: One formalin-fixed brain hemisphere was examined from each of 23 individuals diagnosed with idiopathic autism (including 13 hemispheres embedded in celloidin and 10 in polyethylene glycol (PEG), nine subjects diagnosed with dup(15) (PEG) and 21-age-matched control brains (including 14 in celloidin and seven in PEG). The examination of cresyl violet stained hemispheric sections was designed to detect the global pattern of neuronal migration defects in cortical and subcortical structures including white matter. The aim of the study of 200-µm-thick (celloidin) and 50-µm-thick (PEG) serial sections was to maximize the detection of small alterations.

Results: Different patterns of developmental changes distinguished idiopathic autism and the dup(15) cohorts. In the dup(15) cohort, the leading pathology was microcephaly with mean brain weights 300 g less than in idiopathic autism. Dysplasia in the dentate gyrus was observed in 89% of the dup(15) cases but in only 10% of idiopathic autism. However, cortical dysplastic changes that were absent in dup15 were present in 50% of the idiopathic autism cases. A comparable prevalence of neuronal heterotopias in the cerebellar white matter in idiopathic autism (60%) and dup(15) (56%) suggests that the mechanisms which control the abnormal migration of neurons in the cerebellum

are similar in idiopathic autism and autism associated with dup(15). Infiltration of the cerebral and cerebellar subcortical white matter with a unique phenotype of FMRP-positive astrocytes suggested a response of glial cells to the defective migration of neurons in both idiopathic autism and dup(15). Neuronal deficits and severe dysplastic changes in the flocculus, which is known to be involved in eye movement control, coexisted with a disruption of the oculomotor system in 88% of individuals diagnosed with autism and atypical gaze.

Conclusions: This study demonstrates abnormal neuronal migration in autism of unknown and known etiology but the prevalence of developmental alterations was higher in the dup(15)/autism cohort than in idiopathic autism and was associated with an increased risk of an early onset of intractable epilepsy and SUDEP.

4:20 **155.003** Parvalbumin Stained Cells Are Reduced in the Cerebral Cortex of Individuals with Autism Spectrum Disorders

V. Martinez-Cerdeno, *Pathology, UC Davis, Sacramento, CA*

Background: Postmortem studies in autism spectrum disorders (ASD) indicate alterations in the number and/or distribution of neurons within the cerebral cortex. The presence of heterotopias and dysplasias create a suitable scenario for an excitatory/inhibitory imbalance capable of explaining some of the core features of the condition.

Objectives: Here we examine the number and location of interneuronal subpopulations within the prefrontal cortex in autism. We propose that an alteration in the number and/or type of interneurons could help explain alterations in cognition, sensory problems, and seizures commonly observed in ASD.

Methods: To test this hypothesis we collected cortical tissue from 10 male subjects with autism and 10 age (7 to 56 years old) and gender matched neurotypicals. Formalin fixed blocks (2 cm^3) containing each area (BA 46, 47 and 9) were collected based on anatomical landmarks. We sectioned blocks into 14 μm sections and performed Nissl staining in three of the sections. We took pictures of each Nissl section and determine the boundaries of each the areas of interest based on the cytoarchitecture of the cortical layers. The localization in the Nissl stained tissue allowed us to select the region of tissue where immunochemistry was performed. We performed triple immunostaining for markers of the three main cortical interneuron subpopulations: parvalbumin+ (PV); calbindin+ (CB); and calretinin+ (CR). We quantified the number of interneurons that express each marker within each cortical layer, and statistically compared results between groups.

Results: We found that the number of PV+ interneurons is decreased in upper layers of areas B46 and 47 in autism. Based on the morphology, size and layer distribution of PV+ cells in each group, we propose that the PV+ cells we found to be decreased in upper layers in the prefrontal cortex in autism are most likely Chandellier cells.

Conclusions: Chandellier cells are crucial for proper cortical function. Chandellier cells are the only cortical interneurons that synapse on the initial axon segment of pyramidal neurons, thereby controlling the output signal from pyramidal cells. The variability in the number of lost PV+ cells in the cortex with autism might explain the presence of seizures in some patients with autism. Using the same tissue, we are currently investigating PV+ chandelier cell terminals within each cortical layer. Exploring whether and how Chandellier interneurons are altered in autism will open new lines of research that focus on the modulation of signaling factors and genes that control interneuronal genesis, migration, and survival, as well as on transmission of electrical signals between cortical neurons in autism.

4:45 **155.004** Genetics Studies Indicate That Disturbances in Premigratory Neuroblast Maturation Are a Core Feature in the Pathology of Autism Spectrum Disorders

E. L. Casanova, *Psychiatry, University of Louisville, Louisville, KY*

Background: Neuropathological studies of autism report cortical and subcortical malformations in the vast majority of cases, indicating early disturbances to neurogenesis and neuronal fate determination. Genetics research, however, has largely focused their efforts on understanding synaptopathology in the condition. This places the two fields at odds with one another, making it a challenge to integrate the research coming from these disparate disciplines.

Objectives: To address whether high-risk autism gene products affect multiple stages of neuronal development, from neurogenesis and induction, to neurite extension and synaptogenesis, in the hopes of reconciling the range of findings reported in autism.

Methods: Because many studies have relied on simplified Gene Ontology (GO) terms to investigate overlapping biological functions in autism-risk genes, we instead took a more direct approach to understand the various functions that these gene products maintain and what stages of neuronal development are ultimately affected. We did so by scouring the original literature upon which GO terminology has been founded, searching for indications of involvement in neurogenesis and pre-migratory neuronal fate determination. We investigated 197 high-risk syndromic and nonsyndromic autism genes, derived from the *SFARI* and *AutismKB* databases, hereto referred as the "core set". A 0-3 rating scale was used to summarize findings for each gene: "0" indicated that there was no known relationship between the gene product and early neuroblast development, "1" suggested minor evidence, "2" indicated moderate, highly-suggestive evidence for involvement, and "3" indicated a confirmed direct relationship. We also looked for evidence as to whether these same

gene products influenced later stages of neuronal development, specifically in neurite elongation, branching, synaptogenesis, and plasticity.

Results: Our review revealed that 88% of the core set attained a rating of 2-3, with 52% of the core gene set directly influencing induction and/or pre-migratory neuroblast differentiation. This was most frequently manifest as premature or delayed neurogenesis in loss-of-function and overexpression studies. Meanwhile, 80% of the core set gene products also influenced later stages of neuronal development, e.g., neuritogenesis and synaptogenesis.

Conclusions: Most high-risk autism gene products influence multiple stages of neuronal development, encompassing induction and neurogenesis, pre-migratory differentiation, migration, axonal and dendritic elongation and branching, synapse formation, and dendritic and synaptic plasticity. This may be due to a combination of cascading effects from earlier foundational stages leading to a reverberation throughout the life of the neuron, as well as functional redundancy of gene products that are reused at multiple stages of neuronal development. This work offers a theoretical construct in which to view the neuropathological and genetics research produced on autism to date under a single umbrella, one which helps to integrate apparently disparate findings into a single pathological concept.

Panel Session
156 - Understanding Early Dyadic Interaction in ASD
3:30 PM - 5:30 PM - Grand Salon

Panel Chair: Kristelle Hudry, *Olga Tennison Autism Research Centre, Melbourne, Australia*

Discussant: Michael Siller, *Psychology, Hunter College of the City University of New York, New York, NY*

The early emergence of ASD is characterized by progressive difficulties in social communication. These early emerging symptoms are likely to perturb the dyadic interactions between caregivers and their children. However, very little is known about how this process unfolds, and what implications it may have for a child's ongoing trajectory of development. For example, many caregivers may adapt to their child's communicative style to maximize a child's learning opportunities. Identifying the caregiver adaptions that can promote optimal socio-communicative development in children can thus help us design more effective parent-mediated interventions for young children with ASD. In this symposium, we present data that illuminates the effects of child symptomatology on caregiver-child interactions in the first years of life. We identify caregiver adaptations and behaviors that may be optimal for promoting positive socio-communicative trajectories. Finally, we present the results of a large survey of parents, service providers and individuals with ASD that illuminates the thoughts of the wider community on research in early ASD. We will discuss the implications of this work for harnessing the dynamic interactions that shape the developmental course for individuals with ASD.

3:30   **156.001** A Longitudinal Examination of Parent-Child Interaction in the Context of Toddlers at High-Risk of Autism

K. Hudry[1], M. Grant[2], R. Bedford[3], G. Pasco[4], V. Slonims[5], J. Green[6], M. Elsabbagh[7], M. H. Johnson[8] and T. Charman[4], (1)Olga Tennison Autism Research Centre, Melbourne, Australia, (2)La Trobe University, Olga Tennison Autism Research Centre, Melbourne, Australia, (3)King's College London, London, United Kingdom, (4)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (5)Guy's and St Thomas' NHS Foundation Trust, London, England, United Kingdom, (6)Institute of Brain, Behaviour and Mental Health, University of Manchester, Manchester, United Kingdom, (7)Department of Psychiatry, McGill University, Montreal, QC, Canada, (8)Centre for Brain and Cognitive Development, Birkbeck College, University of London, London, United Kingdom

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Background: Dyadic interaction can be challenging in the context of Autism Spectrum Disorder (ASD), for children and their social partners alike. Children with ASD initiate little and their parents often adopt more directive/asynchronous rather than responsive/synchronous interaction styles. Individual variability in parental contributions seem to be important, as increased parental responsiveness/synchrony has been shown to facilitate the development of child social-communication skills (e.g., Green et al., 2010; Siller & Sigman, 2002). Little is yet known, however, about the mechanisms and trajectories underlying the development of dyadic interaction styles for parents and their toddlers who are developing ASD.

Objectives: Within a familial ASD-risk design, the current study evaluated parent-child dyadic communication around the 1st, 2nd and 3rd birthdays of 100 toddlers. The aim was to determine at what developmental point and in what order/sequence parent and child contributions might become differentiated for groups including toddlers developing ASD vs. toddlers following more typical trajectories.

Methods: Among the 100 parent-child dyads, 52 toddlers were considered to be at familial high-risk (HR) of ASD (due to having an older sibling with the diagnosis) while 48 were at low-risk (LR). Among HR toddlers, 17 were confirmed to have ASD by 3-years of age (HR-ASD), while 12 presented other developmental atypicalities (HR-Atypical) and 23 were typically developing (HR-Typical). At each of

three visits, around toddler ages of 14, 24, and 38 months, parent-child interaction footage and standardised child developmental assessments were collected. Eight-minute interaction clips were later coded by blinded research assistants, for the following key measures; a) frequencies of parent synchronous and asynchronous communication acts, and b) frequencies of child initiation and response acts, based on the Dyadic Communication Measure for Autism (DCMA; Hudry et al., 2013). As per the DCMA procedure, proportionate scales were then computed from these raw codes, representing the relative balance of *Parent Synchronous* contributions and of *Child Initiations*.
Results:
Child Initiations increased significantly across toddlerhood for all groups. HR-ASD toddlers, however, contributed significantly fewer initiations than LR toddlers at around the 2nd and 3rd birthdays, with the initiated contributions of HR-Typical toddlers also significantly reduced around the 2nd birthday, but HR-Typical and HR-Atypical toddlers falling intermediate to HR-ASD and LR toddlers around the 3rd birthday. *Parent Synchrony* also showed changes across the toddlerhood period, increasing between toddlers' 2nd and 3rd birthdays. At a group level, however, this increase in *Synchrony* was not apparent for parents of HR-ASD toddlers, who remained relatively more asynchronous.
Conclusions: While children with ASD increased their initiated contributions across toddlerhood, increases were less pronounced than for other children, with differences apparent from the second birthday. Furthermore, parents of children with ASD failed to show a normative increase in relative synchrony between their toddlers' second and third birthdays. These findings provide downward extension from past research on children with established diagnoses, and suggest that early differentiation of child interaction behaviours precedes any differentiation of parent contributions. This provides an important step toward delineating how parent-child interaction is shaped in the context of toddlers developing ASD.

3:55 **156.002** Mother-Child Interaction in 5- and 10-Month Old Infants at Risk for Autism Spectrum Disorder

E. Demurie[1], P. Warreyn[1], L. Verhaeghe[1], J. Vermeirsch[1], L. De Schuymer[2] and H. Roeyers[1], (1)Department of Experimental Clinical and Health Psychology, Ghent University, Ghent, Belgium, (2)Kind&Gezin, Brussels, Belgium

Background: Parent-child interaction (PCI) is the first and most important context in which infants learn, influencing different domains of later development. In the context of autism spectrum disorder (ASD), characterized by social-communicative deficits, parents' interaction with their child can be challenging. Parental behavior towards a child with or at risk for ASD is often more directive and less sensitive and infants at risk for ASD are less lively during PCI (Doussard-Roosevelt et al., 2003; Wan et al., 2012). Given the positive association of sensitive responsiveness and following the child's focus with later language and cognitive development (Gros-Louis et al., 2014; Penela et al., 2012), it is important to investigate the generalization and possible impact of this ASD-specific interaction style on younger siblings of children with ASD.
Objectives: The current study investigated mother-child interaction in siblings of children with ASD (high-risk sibling group, HR) and a comparison group of children with a typically developing older sibling (low-risk group, LR). Maternal, infant and dyadic interaction characteristics were compared between the two groups and the link with later cognitive and social-communicative functioning was explored.
Methods: Participants were 55 parent-infant dyads taking part in a longitudinal study of early social-communicative skills: 21 HR infants (11 boys, 10 girls) and 34 LR infants (19 boys, 15 girls). Unstructured play interactions between mother and child were observed at 5 and 10 months and coded with the Coding Interactive Behavior coding scheme (Feldman, 1998). Cognitive development was measured at 10 and 14 months with the Mullen Scales of Early Learning (MSEL; Mullen, 1995) and social-communicative functioning at 14 months was observed with the ADOS-toddler (Lord et al., 2012).
Results: At the age of 5 months, no differences between LR and HR interactions could be observed, while at 10 months, mothers of HR children scored lower for maternal sensitivity and maternal limit setting. HR infants had lower infant involvement and higher negative emotionality scores. The HR dyadic interaction was rated lower for dyadic reciprocity and higher with regard to dyadic negative state.
Correlations within the whole sample between PCI at 10 months and MSEL and ADOS scores at 14 months showed a positive association between maternal sensitivity, infant involvement and dyadic reciprocity on the one hand and MSEL subscale scores and developmental index on the other hand. Dyadic negative state was negatively associated with MSEL scores. Furthermore, maternal sensitivity and dyadic reciprocity were negatively correlated with ADOS scores, while dyadic negative state was positively associated with ADOS scores.
Conclusions: At the age of 10, but not 5 months, PCI of HR siblings is characterized by less maternal sensitivity, infant involvement and dyadic reciprocity and more infant negative emotionality and dyadic negative state. Furthermore, these PCI characteristics are associated with lower cognitive and social-communicative functioning at 14 months. Given the positive effects of early parent-mediated interventions for young children with ASD on PCI (Oono et al., 2013), it is promising to further investigate the impact of these interventions on the developmental pathways of siblings at risk for ASD.

4:20 **156.003** Understanding the Parental Interactive Behaviours of at-Risk Infants: What We Have Learned from Basis and Ibasis

M. W. Wan[1], J. Green[1], A. Brooks[1] and T. B. Team[2], (1)Institute of Brain, Behaviour and Mental Health, University of Manchester, Manchester, United Kingdom, (2)BASIS, UK, United Kingdom

Background: How parents interact with infants who are at risk of developing autism spectrum disorder (ASD) is thought to be important because perturbations in the early social environment, combined with existing neurological vulnerabilities, may have a cascading effect on the infant's social development. The logical deduction therefore is to introduce early interventions that focus on optimising parenting behaviours in at-risk infants to promote more positive social and communicative development. However, there has been little discussion about what precise parental behaviours may be affected and how, and which others tend to remain intact and contribute positively to developmental outcomes.

Objectives: Synthesising our parent-infant interaction data from the British Autism Study of Infant Siblings (BASIS) and our early parenting intervention trial (iBASIS), we attempt to address: (1) What aspects of parental interaction are positive in parents of at-risk infants? (2) How might parents adapt to their high risk child and can this have positive and/or negative consequences for development?

Methods: The validated global Manchester Assessment of Caregiver-Infant Interaction (MACI) was used to evaluate seven areas of interaction at 7 and 13 months in infants at familial risk of ASD compared with typically developing controls, as well as our parent-mediated intervention, iBASIS. We also explored a subsample of videotaped interactions taken during home intervention sessions at 5 time points using the MACI.

Results: Overall parental sensitivity remained relatively intact; in particular, those parents of at-risk infants who did not go on to develop ASD showed similar degrees of sensitivity at 13 months. However, low-sensitive parents who participated in a parent-mediated (modified VIPP) intervention, on average, showed a time course of steady improvement in their sensitive responding through the programme, which was partially reflected in the post-intervention lab assessment. Parental directiveness, however, was higher in at-risk infants than in typically developing infants from 7 months, but the lack of mutuality effect at 7 months which is then apparent at 13 months, may suggest that this directiveness is an adaptive strategy that may 'work' in the short-term, but may be unhelpful to the infant in the longer term. The parent-mediated intervention reduced parent directiveness and slightly improved infant affect, which were highly correlated in the intervention arm and not among controls.

Conclusions: Combining our published results with new analysis as well as recent data from iBASIS lab and home visit observations, a complex picture is emerging of the interactive behavioural tendencies of parents with at-risk infants, how they may impact both positively and negatively to infant development, and how they may respond to a modified parenting intervention. The findings provide a number of discussion points, such as the possible impact of parental behaviours on infant affective tendencies and language development.

4:45 **156.004** What Does the Autism Community Think of Research with Infants with Higher Likelihood of Later Autism Diagnosis? Results of a Large International Survey

S. Fletcher-Watson[1] and M. COST ESSEA Action Group[2], (1)University of Edinburgh, Edinburgh, Scotland, (2)Institute of Psychiatry, London, United Kingdom

Background: Research in early autism, especially recruitment of infants having higher likelihood of ASD by virtue of having a diagnosed older sibling, carries specific ethical concerns. These are even more pointed when studies consider involving an intervention component. There is to date no research explicitly addressing the attitudes of the stakeholder community to this important but challenging work.

Objectives: Our goal was to elicit the opinions of the autism community on the practical and ethical issues surrounding early autism research with infant groups. In addition, we were interested to explore differences between stakeholder groups (parents, healthcare and education practitioners, and adults with autism).

Methods: Five focus groups were convened in the UK, Italy and Portugal involving autistic adults, parents of children with autism and professionals. Data from these focus groups informed the design of an online survey which was translated and circulated to the autism community in the Czech Republic, France, Finland, Italy, Israel, Macedonia, Norway, Poland, Portugal, Spain and the UK. The survey collected demographic data and information about local services, but the majority of questions explored attitudes to early autism research under five topic headings: reasons for doing research; involvement in research; acceptability of measures; intervention; at-risk language.

Results: Respondents (n=2318) were supportive of the need for early autism research (97% agree) and their top priority targets were the genetic basis of autism and the early signs of autism in infants. Autistic Adults differed significantly from other groups in their attitudes and priorities for research, for example ranking the search for early signs of autism in babies as a lower priority than did other groups (χ^2 (24, n=2251) = 55.05, p<.001).

Participants, especially autistic adults, did not favour the use of the phrase "infants at-risk of autism", with a significant minority across all groups (31%) agreeing that this phrase makes parents feel blamed. Preferred language included "higher chance" and "higher likelihood" of autism.

Results also reveal how parents decide whether to take part in research (see Figure 1), what practical information stakeholders want from research, how research findings should be disclosed to participants and whether intervention is considered an essential component for research (see Figure 2). Parents show a strong preference for home-based and parent-training intervention types. Regression analyses will be presented to reveal the impact of aspects such as nationality, quantity and quality of local services, and (for parents) age of diagnosis of the child with autism, on attitudes to early autism research.

Conclusions: These data reveal the priorities of stakeholders, and are thus important to the future success and ethical grounding of early autism research worldwide. They will be discussed in terms of: 1) guidance for early autism researchers; 2) what they reveal about differences in attitudes among the autism community more generally; and 3) consideration of a wider need for researchers to engage directly with the autism community.

Poster Session
157 - Interventions - Non-pharmacologic - School Age, Adolescent, Adult
5:30 PM - 7:00 PM - Imperial Ballroom

1   **157.001** A Brief Behavioral Sleep Intervention Improves Sleep and Irritability in Adolescents with Autism Spectrum Disorders

W. A. Loring[1], R. L. Johnston[1], L. Gray[2] and B. A. Malow[1], (1)Vanderbilt Kennedy Center, Vanderbilt University Medical Center, Nashville, TN, (2)Vanderbilt University Medical Center, Nashville, TN

Background: Sleep problems affect many individuals with autism spectrum disorders (ASD). The majority of 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 a brief individual 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: The program consists of 2 individual education sessions with a psychologist, the adolescent, and the adolescent's parent, followed by 2 follow-up phone calls. These sessions focus on components of successful sleep that we documented to improve sleep in children with ASD ages 2-10. This includes daytime habits, bedtime routines, sleep timing, and sleep environment. This program also includes the addition of strategies related to relaxation, distraction, and mindfulness-based breathing for the adolescent to utilize at sleep onset and during night wakings. The adolescent participant wears an actigraphy device to provide objective data concerning their pre- and post-program sleep. The parent and adolescent also complete pre- and post-program self-report measures to assess various aspects of sleep and daytime behavior.

Preliminary results from 11 completers of this program ages 13-18 years are presented here with a focus on 2 measures. One is the Adolescent Sleep Wake Scale (ASWS) used as a parent report measure of sleep along 5 behavioral dimensions: going to bed, falling asleep, maintaining sleep, reinitiating sleep, and returning to wakefulness (morning awakening). The other is the Aberrant Behavior Checklist (ABC), focusing specifically on its Irritability subscale, as this has been a frequently used outcome measure of daytime behavior in previous ASD research.

Results: The average age of the completers was 15.18 years old (SD=1.99). In our parent report of the ASWS, a statistically significant improvement in total score was seen with treatment (p=.003; Wilcoxon Signed Rank Test). Improvement on the ASWS was correlated with improvement on the ABC (r = 0.81; p < 0.0001; Spearman correlation coefficient).

Conclusions: Through this brief format of behavioral sleep education, statistically significant improvements were detected in reported overall sleep behaviors. Overall parent-reported improvements in sleep also strongly correlated with improvements of parent-reported irritability. Our work offers promising initial results in improving sleep and subsequent daytime behavior for adolescents with ASD.

2   **157.002** A Randomized Clinical Trial on Promoting Face Recognition Skills in Children with ASD Using the Facestation Video Game Curriculum

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Background: While individuals with autism spectrum disorders (ASD) have many complex social skill impairments, this randomized controlled trial (RCT) focused on face perception skills, a central ability for successful social interactions. The impairments of a majority of children with ASD in their ability to

recognize a person's identity and facial expressions are well-documented. However, there is a dearth of intervention studies targeting face perception skills in children and adolescents with ASD. Computerized video games are an especially promising intervention tool, because they capitalize on powerful "reward" circuits in the brain that co-opt the natural tendency to play in the pursuit of learning. For this RCT, we developed a novel therapeutic video game platform, *FaceStation*, to improve face recognition skills among children and adolescents with ASD.

Objectives: The purpose of the RCT was to determine whether systematic gaming with *FaceStation* can improve basic face perceptual skills in children and adolescents with ASD compared to age and IQ matched individuals with ASD not playing these games (waitlist controls). We also explored the extent to which individual differences in responsivity of reward circuitry measured with fMRI at baseline predicted treatment effort (i.e., amount of game play) in the game-playing ASD participants.

Methods: Sixty participants were included in the final data analyses (24 TDC, 19 ASD active treatment, and 17 waitlist control). TDC served as normative comparison group for basic face perception skills. Only participants with ASD, who were significantly impaired in their face recognition abilities, were assigned to either a treatment or a waitlist group. Children in the active treatment group were asked to play at least 20 hours – and up to 50 hours – of *FaceStation* video games over 3 months. The *FaceStation* platform is a systematic curriculum for enhancing face recognition skills. It consists of seven different, stand-alone computer games, modeled after perceptual expertise training. Pre- and post-intervention performance for the two ASD treatment groups was assessed with the Benton Test of Facial Recognition. In addition, at baseline participants were asked to take part in a 3T functional imaging experiment to study reward circuitry activation with an incentive delay task from the normative literature (Kohls et al. 2013, *Neuropsychologia*).

Results: The main finding was that, relative to the waitlist control group, the active treatment group demonstrated improvements in face recognition skills through ~29 hours of game play on the *FaceStation* platform (Benton Test: group by time interaction effect p=0.026). While both ASD groups had diminished face recognition skills at baseline relative to TDC, the active treatment group did not differ from healthy controls after the intervention (whereas the waitlist group still did). In addition, basic reward circuitry activation in the ventral striatum predicted gaming effort in the active treatment group (r=0.47, p=0.05).

Conclusions: These results suggest that a relatively short-term video game curriculum can produce measurable ameliorations in face recognition skills of children with ASD. Moreover, basic reward circuit responsivity may serve as a potential „biomarker" for therapy engagement (and success?) in ASD.

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3   **157.003** A Randomized Controlled Study into the Efficacy of Social Skills Training in Autism (ESTIA) for Preadolescent Children

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Background:
Social skills training (SST) is a common intervention for children with Autism Spectrum Disorders (ASD) to improve their social and communication skills. Such training is clinically appreciated as relevant, and is often applied. However, the evidence for the effectiveness of SST for children with ASD is inconclusive, due to limitations in design, lack of adequate measures of social skills and deficits associated with ASD, limited sample size and lack of information from multiple informants. Moreover, long term outcome and generalization of learned skills have been little evaluated. Additionally, there is no research on the influence of involvement of parents and teachers on the effectiveness of SST and on the generalization of learned social skills.

Objectives:
The main objective of the ESTIA study (Efficacy of Social skills Training In Autism; Dekker et al., 2014) is to investigate the efficacy of an SST compared to care-as-usual in 10-12 year old children with ASD. The second aim is to investigate the efficacy of an enhanced SST (involving parents and teachers) as compared to non-enhanced SST, specifically on the generalization of the learned skills. Additionally, we aim to investigate factors that possibly influence the effectiveness of the SST, examining whether and which specific groups of children improve more or less with SST.

Methods:
In a randomized controlled trail (RCT) with three conditions, 128 participants with ASD at the end of primary school (10-12 years of age) were randomized to SST (n=52), SST-with Parent & Teacher Involvement (SST-PTI, n=51), or care-as-usual (n=25). The SST consisted of 18 group sessions of 1.5 hours for the children (Van Warners et al., 2010a). In the SST-PTI condition, parents additionally participated in 8 parent sessions and parents and teachers were actively involved in homework assignments (Van Warners, 2010b). Assessment took place before and immediately after the intervention period and at 6 months follow-up. The effectiveness will be investigated with hierarchical linear modeling. All data will be analyzed using the intent-to-treat principle.

Results:
Data collection has finished and we will perform the analyses late 2014-early 2015. The current presentation will focus on the socialization domain of the Vineland Adaptive Behavior Scales-Survey Version and parent report about training-specific social skills and more general social skills pertaining to home and community settings.

Conclusions:
The effectiveness of SST and SST-PTI will be discussed in relation to the existing literature. Specific attention will be given to long term outcome.

References:

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Van Warners, S., & Vet, L. (2010b). SSTG-PT-ASD. Groningen: Accare University Center, internal publication.

4   **157.004** Adapted Cognitive Behavior Therapy to Treat the Anxiety of Children with Autism and Low Verbal Ability

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Background: Research investigating Cognitive Behavioral Therapy (CBT) programs for youth with autism has been limited to participants with average IQ scores. The present study describes results of a second multiple-baseline investigation of an adapted CBT program to treat the anxiety of three youth with autism (ages 10-12) and verbal IQ scores < 70. The first study revealed statistically significant decreases in anxiety across all symptoms for three participants. The program was adapted from the *Building Confidence* manual, which addresses anxiety in highly verbal youth with autism. Adaptations included using play-based stories with preferred characters, using simplified rating techniques, and equipping participants with mantras as coping strategies. The manual was further refined based on feedback of participating families in the first study and prepared for the current study.

Objectives: The current study aims to further support the effectiveness of the adapted manual in treating the anxiety of youth with autism.

Methods: A multiple-baseline design was employed across three participants with baseline sessions of 5, 7, and 9 respectively. Three anxiety symptoms for each participant were treated and rated throughout the 16-session program. Following treatment, participants' parents completed anxiety ratings during a 5-week follow up period. Also, an anxiety interview was conducted before and after the treatment program. Effect sizes will be calculated using multiple recommended approaches for single-case data: standard mean difference, visual inspection, and simulation modeling analysis. Simulation modeling analysis is a computer-based statistical procedure that allows researchers to evaluate the statistical significance of between phase changes (i.e. between baseline and intervention) by generating thousands of data streams to determine the probability of the observed effect size being due to chance (Borckardt et al, 2008).

Results: treatment at the end of January. For the first participant, standard mean difference, visual inspection and simulation modeling analysis all revealed decreases in severity for all three of the participant's anxiety symptoms. Standard mean difference effect sizes ranged from 1.72 to 3.24. Simulation modeling analysis calculations revealed effect sizes of r=.407, p=.0001), (r=.465, p =.08), and (r=.551, p=.0001). Lastly, visual inspection also suggested decreases for all three anxiety symptoms which were maintained during the 5-week follow-up period. The previous study of the manual revealed similar results with standard mean difference effect sizes ranging from 5.2 to 18.0 and simulation modeling analysis coefficents ranging from .522 to .961 at statistically significant levels. The two participants currently enrolled in the program are displaying similar progressions to previous participants who demonstrated decreases in anxiety by the end of their respective programs.

Conclusions:
Results of the participant currently finished with treatment and results from the previous study both indicate potential for CBT programs to be effectively adapted to treat anxiety in children with less verbal capabilities. This can be a valuable avenue of treatment to a population who currently has few options for anxiety-focused behavioral interventions.

5   **157.005** An Exploratory Analysis of Intolerance of Uncertainty in the Response to CBT Intervention for Anxiety in Children and Adolescents with Autism Spectrum Disorder

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Background: Anxiety is a common co-occurring disorder in children and adolescent with autism spectrum disorder (ASD; White et al., 2009). Although there is growing evidence that cognitive-behavioral therapy (CBT) may be efficacious in reducing anxiety in some children with ASD (Wood et al., 2014; Storch et al., 2013; Reaven et al., 2012), little is known regarding the mechanisms underlying treatment response. Intolerance of uncertainty (IU) is a dispositional factor in which individuals experience distress in response to uncertain situations (Buhr and Dugas, 2009). IU has

been identified as a correlate of worry and anxiety in neurotypical youth (Laugesen et al., 2003; Fialko et al., 2012; Comer et al., 2009), and CBT treatments targeting IU have reduced anxiety symptoms in adults and children (Ladouceur et al., 2000; Wilkinson et al. 2011; Leger et al. 2003; Payne et al. 2011). There is emerging evidence that children with ASD experience increased physiological response to uncertainty (Chamberlain et al., 2013) and that IU mediates the relationship between ASD and anxiety (Boulter et al., 2014). However, no studies have examined the role of IU in response to CBT interventions in the ASD population.

Objectives: This study has two objectives: 1) To examine if pre-intervention IU level predicts response to an established CBT intervention targeting anxiety. We hypothesize that higher levels of IU will predict lower response to the intervention. 2) To examine if change in IU predicts change in worry and anxiety severity following intervention. We hypothesize that greater change in IU will result in greater change in worry and anxiety severity.

Methods: Participants were youth aged 8 to 14 years with ASD, recruited from multiple sites, who completed the Facing Your Fears CBT group therapy program for children and their parents (Reaven et al., 2011) targeting DSM-IV anxiety disorders (GAD, Social Anxiety, SAD). Diagnosis of ASD was confirmed using the ADOS (Lord et al., 1999). Anxiety disorder was established using the ADIS-P (Silverman & Albano, 1996). Approximately 36 children and their parents completed the Intolerance of Uncertainty Scale - Children (Comer et al., 2009) and the Penn State Worry Questionnaire (Pestle et al., 2008), both modified for ASD youth, and the SCARED (Birmaher et al., 1999) preceding and following intervention.

Results: Data collection will be completed by December 2014. Exploratory analysis will include descriptive statistics using t-tests and chi-square tests. Paired t-tests will be used to examine the distribution and change in IU and anxiety across the two time points. We will use robust linear regression models to examine the relationship between change in IU and treatment response, controlling for pre-intervention anxiety levels and to investigate change in anxiety and worry following intervention. Analyses will also investigate the role of age and ASD severity by controlling for them in the linear regression model.

Conclusions: This novel study examines the role of IU in treatment response to CBT in youth with ASD. Results will provide critical direction to enhance the efficacy of psychosocial assessment and treatment of anxiety in individuals with ASD.

6   **157.006** Assessment of Social Skills Training Needs in a Disability Community

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Background: Deficits in social skills represent a core feature of autism spectrum disorder (ASD) in children; however, difficulties with social interaction are commonly seen across development disabilities. Social skills deficits represent a significant area of overlap in terms of intervention needs. Despite the recognition that children across diagnoses may require social skills support, little research has examined how social skills training needs may differ across diagnostic groups.

Objectives: The purpose of this study was to gain information, through a parent-report questionnaire, regarding specific social skills deficits of children with disabilities (ASD and ADHD).

Methods: A social skills needs assessment was mailed to 1,000 families who are current patients at our large health-care facility. Families were selected for inclusion if they had a son between the ages of 8 and 12 with a diagnosis of ASD or ADHD without a comorbid intellectual disability. The needs assessment collected information about the age and primary diagnosis of the child. Participants were asked to rank the top five social skills they would most like their child to learn from a list of skills. There was space on the form for parents to add concerns that were not listed. The needs assessment then optionally asked participants to provide their contact information if they were interested in participating in a summer social skills group.

Results: We received responses from 126 families (12.6% response rate). The most commonly reported social skills needs were: maintaining a conversation ($n = 59$), understanding others' intentions ($n = 54$), using appropriate tone of voice ($n = 53$), withholding rude comments ($n = 52$), identifying feelings in self/others ($n = 52$), being a good loser ($n = 50$), and minimizing repetitive behaviors ($n = 50$). Among these, only using appropriate tone of voice varied significantly among diagnostic groups, with a greater proportion of children with ADHD reporting this as a concern ($p = .03$). Other significant differences were found in three other skills: handling criticism (greater concern in ADHD; $p = .04$), initiating conversation (greater concern in ASD; $p = .02$), and being polite (greater concern in ADHD; $p = .01$). All other skills showed no significant difference (p values ranged from .07 - .866).

Conclusions: The results of the study provide us with an understanding of which social skills are the most challenging for boys with disabilities, guiding future interventions for this population. Importantly, because parents of children with ASD and ADHD reported similar social skills needs for their children, we find support for mixed-diagnosis social skills groups. This research is in line with the National Institute of Mental Health's Research Domain Criteria, which moves away from traditional diagnostic labels towards a more dimensional approach that examines skill strengths and weaknesses in a quantitative way. These results provide evidence for the potential effectiveness of offering interventions based on need rather than segregating children by DSM diagnosis. Children with ASD and ADHD may equally benefit from concurrent participation in social skills groups.

7 **157.007** Assessment-Based Peer-Mediated Social Competence Interventions for Children with Autism Spectrum Disorder

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Background: Social competence deficits are considered the most foundational characteristic used in diagnosing individuals with Autism Spectrum Disorders (ASD; American Psychological Association, 2013). Most children form social relationships with their peers as they progress through school; however, for children with ASD peer-related social competence does not develop without explicit instruction and exposure to relevant social agents (Brown, Odom, & Conroy, 2001). As a result, many children with ASD form few friendships with peers and may be at a distinct disadvantage in accessing critical learning opportunities that normally follow social interactions (Carter, Davis, Klin, & Volkmar, 2005) and in accessing critical learning opportunities required for success later in their lives.
Objectives: This poster will present findings from a single-case design research study investigating the effectiveness of an assessment-based peer-mediated intervention aimed at increasing peer-related social competence skills of children with ASD within their school settings.
Methods: Four children (ages 4 – 11 years) diagnosed with ASD and five socially competent peers participated in the study. The children with ASD were paired with same-aged peers in order to form 3 dyads (i.e., 1 child with ASD and 1 same-age peer) and one triad (i.e., 1 child with ASD-two peers). Using a systematic assessment-based approach, individualized interventions were developed for each focal child dyad and triad with the goal of promoting their peer-related social interactions during three school activities. Using a multiple-baseline across activity design, the effectiveness of a multi-component intervention package, that included behavioral prompting strategies, preferred materials/activities and reinforcement strategies, was employed and participants were taught to initiate to peers, respond to social bids and increase the frequency and duration of their social interactions. A direct observation measurement system was used to code the frequency of occurrence of the target social behavior during the intervention observation sessions. All of the interventions were implemented using authentic school activities.
Results: As illustrated in the two graphs attached below, the results indicated that the children with ASD increased their peer-related social competence. This is evident by increases in their responses to peers' social bids and increases in the social interactions between them and their peers following the implementation of the intervention. Additionally, peers were more likely to initiate, engage and sustain social interactions with the children with ASD. Interobserver agreement checks on the target social behaviors were calculated for 25% of the total observation sessions for each dyad and triad. The overall mean percentage interobserver agreement on the target behaviors was 96.4%. Moreover, procedural fidelity was assessed for 20% of the total observation sessions and calculated to be 100% for each dyad and triad.
Conclusions: Peer-related social competence is a critical skill for school success. The data from this study demonstrate the effectiveness of a systematic assessment-based approach for designing individualized school-based peer-mediated social competence interventions for children with ASD. Data from this study will be presented and discussed in terms of implications for school-based interventions.

8 **157.008** Associations of Health Related Quality of Life and Adaptive Skills Functioning in Children Diagnosed with ASD:Implications for Treatment Planning

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Background: Although it is a relatively new area of investigation, research has shown that children diagnosed with Autism Spectrum Disorder (ASD) evidence poorer Heath Related Quality of Life (HRQoL) when compared to children without ASD. Research has also preliminarily indicated that children with ASD experience a multitude of psychosocial effects (e.g., family stress, internalizing and externalizing emotional/behavioral distress, etc.) and physical health effects (e.g., higher rates of sleep problems, gastrointestinal problems, etc.). However, the association between adaptive skill functioning and HRQoL among children diagnosed with ASD has not been directly examined within this pediatric population.
Objectives: The objective of this study was to statistically explore the associations of HRQoL and adaptive skill functioning in a population of children diagnosed with ASD.
Methods: This study examined HRQoL associations of children with ASD using the Pediatric Quality of Life Inventory 4.0 (PedsQL) with adaptive skill functioning using the Vineland Adaptive Behavior Scales, Second Edition (VABS-II). This study examined whether adaptive functioning (overall and in specific domains of behavior) is positively associated with HRQoL. Data were collected at an autism specialty clinic located at a regional academic medical center (the Oregon Health and Science University [OHSU] site of the Autism Treatment Network [ATN]). Data on 155 diagnosed children (87% male; mean age: 7 years; range: 5-12 years) were available. Study participants had confirmed ASD diagnoses according to DSM-IV-TR criteria and supported by administration of the ADOS-G.
Results: Mean PedsQL scores were 34.11 (SD=15.30) for the total, 9.11 (SD=7.00) for the physical functioning domain, and 24.93 (SD=10.93) for the psychosocial domain. Mean VABS-II standard

scores were 68.12 (SD=14.59) for the overall composite, 67.70 (SD=11.20) for the socialization domain, 74.37 (SD=16.16) for the daily living skills domain, and 71.53 (SD=17.22) for the communication domain. When total PedsQL scores were predicted it was found that VABS-II overall scores were not a significant predictor when age was not included; however, the VABS-II overall scores did predict total PedsQL scores when age was included (Beta = -0.23, p < .01). Outcomes on the ADOS were never a significant predictor for HRQoL or adaptive skills functioning.

Conclusions: Adjusted regression models showed an association between adaptive skill functioning and HRQoL, with poorer adaptive skill functioning problems being associated with poorer HRQoL. These findings suggest that treatments focused on developing adaptive skills in children diagnosed with ASD may improve overall HRQoL. Follow-up analyses will examine how the variables are distributed and whether a linear relationship best characterizes the associations. Implications for clinical practice in the context of outcomes driven healthcare will be discussed.

9   **157.009** CPRT Fidelity of Implementation: An Examination of Antecedent and Consequence Strategies in Relation to Student Active Engagement

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Background: Active student engagement has been identified as a necessary component of learning for students in general and special education classrooms. Specific environmental arrangements, instructional strategies, and classroom contexts improve engagement in students with autism spectrum disorder (ASD). Classroom Pivotal Response Teaching (CPRT) is a naturalistic, behavioral intervention for children with ASD. The effectiveness of CPRT is under examination in a randomized control trial across 102 participating teachers. CPRT aims to increase active student engagement through antecedent strategies such as incorporating choices, following student interest, use of preferred materials, and turn-taking and consequence components such as providing contingent consequences and use of direct reinforcement to maintain student motivation. Because CPRT is a newly adapted intervention, there is a need to examine the relationship between teacher fidelity of individual components and student engagement.

Objectives: The purpose of this study is to examine the relationship between teacher fidelity on specific antecedent and consequent components of CPRT and active student engagement.

Methods: Teachers were randomized to intervention or one of two waitlist control groups. Each teacher identified one to two target students with autism. Video observations of teachers and their students were collected four times annually. Observations were behaviorally coded to assess teacher fidelity of implementation (FI) of CPRT during classroom activities and to measure student engagement. Videos were categorized based on activity type: one-on-one, group, and circle. CPRT FI was coded on a 1-5 Likert scale for each individual component with a score of a 4 or 5 considered passing. Active engagement was coded when the student was engaged appropriately with the teacher. We defined high active engagement as 50% or more of the coded segment. Trained student research assistants who reached reliability coded a total of 244 videos. A regression analysis was used to examine the relationship between teacher FI of individual components and student engagement.

Results: In one-on-one settings, teachers offering choices and/or using turn taking at passing levels was associated with students having higher active engagement. In one-on-one settings, across engagement levels, teachers tended to pass FI for contingent consequences, but most teachers had difficulty providing tangible reinforcement. In group and circle videos, across engagement levels, teachers consistently implemented antecedent strategies (following student interest and turn-taking) at passing levels, but also consistently had difficulty providing tangible reinforcement.

Conclusions: Active engagement in one-on-one settings is associated with teachers passing FI on antecedent strategies such as turn-taking and incorporating choices. There does not appear to be a link between active student engagement and teachers passing FI on antecedent strategies for group videos, meaning perhaps student control strategies are more important in individual activities or that they need to be more explicit in group activities. Findings imply that training could focus more on implementing reinforcement strategies more consistently in all activity types. Further analyses need to be done to explore the relationship between turn-taking and choices in individual activities. Additional analyses will be conducted to examine how child characteristics may moderate engagement during teacher use of CPRT strategies.

10   **157.010** Can Robotic Interaction Improve Nonverbal Communication and Social Anxiety of Children with Autism Spectrum Disorders?

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Background: Robot-mediated interventions for children with autism spectrum disorder (ASD) have recently received more attention. The use of robots has several advantages; robots are engaging and motivate children with ASD to interact. In addition, their behavior is consistent and highly predictable. Robot-mediated interventions may encourage children with ASD to exhibit social behaviors, such as imitation, eye contact, and joint attention. An android is a robot that looks human, but remain predictable and repeatable. The benefit of using androids in ASD therapy is that they may have the greatest potential for generalization.

Objectives: This study aimed to investigate the changes in non-verbal communication and social anxiety seen in ASD with a structured communication protocol using an android. We hypothesized that children with ASD would show improved nonverbal communication and decreased social anxiety after they communicated with an android.

Methods: The inclusion criteria were a chronological age of 6 to 16 years and previous diagnosis of high-functioning ASD (IQ ≥ 70). Twenty participants were randomly assigned to two experimental groups. Participants in one group received therapy with an android in the first session and with a human in the second. The other group received therapy with a human in both sessions. The investigator monitored the sessions from a neighboring room using a laptop. Remote controlled cameras were set on standby mode, ready to record and children were brought to the room by a clinical psychologist. We used the android Geminoid F, which is a female type, tele-operated android that looks like a person. Its artificial body has the same proportions, facial features, hair color, and hairstyle as its model such that, at the first instance and from a distance, it is difficult to distinguish the android from the model. The android is capable of a range of movements (moving limbs up & down and turning the head to the sides). We used hidden, Wizard of Oz-style, real-time, human remote control of the robot, a popular design paradigm in human-robot interaction research, in order to elicit each participant's belief that the robot was behaving and responding autonomously.

Results: Based on video recordings of the interactions, a quantitative and qualitative analysis was conducted. Some elementary behavioral criteria, such as eye contact, touching, pointing, smiling, attending to sounds, and following instructions were evaluated throughout the trials. In one group, eight out of 10 children showed improvements in their social interactions after they received therapy with the android. In the other group, only two out of 10 showed improvements in their social interactions (after therapy with a human.).

Conclusions: These results suggested that androids might help improve the nonverbal communication and social anxiety of children with ASD. Therapeutic approaches using androids are promising and warrant further study.

11 **157.011** Change in Expressed Emotion As a Marker for Intervention Effectiveness in the Parents of Individuals with High Functioning Autism

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Background: Expressed emotion (EE) refers to the emotional climate between family members in their home environment. High levels of EE have a detrimental impact on the functioning of family members with neurodevelopmental disorders including schizophrenia, ADHD, and autism (Hooley & Gotlib 2000, Dossetor et al 1994; Hastings et al 2006; Hastings & Lloyd 2007).

Objectives: The aim of this pilot study was to examine whether the Five Minute Speech Sample (FMSS) measure of EE (Magana et al 1986) would be sensitive to changes in EE after parent participation in a psycho-educational support group conducted as part of an evidence-based child social skills group training program (Solomon, Goodlin-Jones, & Anders, 2004). We hypothesized that participation in the parent group would be associated with a shift from high EE to low EE as measured by the FMSS.

Methods: Parents of 39 verbal children ages 6-19 years (mean age 11.3 years) with a community diagnosis of autism spectrum disorder (ASD) completed the FMSS, which is a 5 minute semi-structured interview. Scoring reliability was established between coders by Magana, using her scoring system. The interviews were audiotaped, transcribed and coded for the content and tone of the parent-child relationship. The transcripts were rated 0 "Low", 1 "Borderline" or 2 "High" on levels of criticism (CRIT) and emotional over-involvement (EOI) displayed in the parents' narratives about their children at the beginning and again at the end of the 25 week social skills intervention program and linked psycho-educational parent support group.

Results: EOI levels declined significantly over-time (mean difference = -0.15, 95% CI -0.84 to -0.19). Mean levels of CRIT and of high EE also changed in a clinically favorable direction, but were not statistically significant (mean difference in CRIT = -0.18, 95% CI: -0.51 to 0.15; difference in proportion EE = -0.18, 95% CI: -0.40, 0.04).

Conclusions: Parent participation in a psychoeducational group linked to their children's social skills group resulted in improvement in one type of EE (i.e. EOI). The parents were able to complete the FMSS and many enjoyed doing so. Parental EE can be used as a means to better understand family functioning and provide a focus of intervention. Lower EE has the potential to improve family functioning and child outcomes. Based on these initial results, it appears that the FMSS is sensitive to functioning in families of children with ASD and, can be used longitudinally as a measure of intervention outcome for this population.

12 **157.012** Characterizing Change in Social Skills and Executive Functioning after Social Competence Intervention in Youth with ASD

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Background:
Deficits in executive functioning (i.e., EF, the ability to flexibly allocate mental resources to guide thoughts and actions in light of internal goals) are implicated in the development of the core symptomology of ASD (i.e., deficits in social communication and restricted, repetitive behaviors), and more broadly, have been shown to have a positive correlation with deficits in social skills across clinical populations. Targeted interventions to improve socials skills or EF are often associated with improvements in both domains. Conducted in structured settings, performance-based measures of EF are appropriate to assess a participant's ability to internally engage and disengage from a higher-order cognitive task. In contrast, ratings-based measures of EF provide information on an individual's ability to maintain and manipulate higher-order processes in unstructured, everyday settings, capturing the ability to not only internally engage and disengage, but also to suppress the effect of external stimuli (i.e., distractions and disruptions). Specifically, a comparison between performance-based and ratings-based measures of EF may provide additional information on the ability of individuals with ASD to suppress external stimuli. Targeted social skills interventions such as the Social Competence Intervention for Adolescents (SCI-A) provide opportunity to measure the relationship between social skills improvements and low-suppression (e.g., D-KEFS) versus high-suppression EF measures (e.g., BRIEF).
Objectives: The goal of the current proposal is to characterize changes in improvements in social skills on low-suppression versus high-suppression measures of EF in youth with ASD after social competence intervention.
Methods: The SCI-A curriculum, a school-based group social skills intervention, was administered to 24 students with social skills deficits (mean age = 13.2, *SD*= 1.24). SCI-A utilizes evidence-based cognitive-behavioral techniques and applied behavior analysis with the aim to increase social competence through 20+ hours of classroom intervention. Past studies illustrate that students undergoing SCI-A demonstrate gains in social behavior, problem solving, and EF. Assessment batteries were conducted two weeks prior to implementation and two weeks following the completion of the curriculum and included measures of social skills (i.e., NEPSY, SRS-2, GSOM), performance-based EF measures (i.e., D-KEFS), and ratings-based EF measures (i.e., BRIEF).
Results:
Repeated measures ANOVA models were used to analyze differences on each outcome assessment from pre- to post-intervention. Consistent with past research on SCI-A, social skills improvements were evidenced in measures of affect recognition on the GSOM, theory of mind on the NEPSY, and in social cognition and autistic mannerisms on the SRS. On EF measures, students revealed significant improvement on D-KEFS Design Fluency (F(1,15)=18.04, p=.001, η_P^2 =.55) and overall improvement on the BRIEF (t(16)=2.02, *p*=.03, *d*=.35).
Conclusions:
Without intervention, youth with ASD demonstrate distinct deficits in EF, namely a typical but delayed developmental trajectory in performance-based EF and expanding deficits in ratings-based EF across childhood. Improvements on the D-KEFS and BRIEF are indicative of increases in EF regardless of suppression level. Notably, the downward trajectory of high-suppression EF measures may be reversed after social competence intervention. Characterizing the changes in low-suppression and high-suppression EF after participation in a social skills intervention will elucidate the mechanisms involved in deficits associated ASD.

13 **157.013** Clinical Trials of Deep Repetitive Transcranial Magnetic Stimulation (rTMS) to Bilateral Dorsomedial Prefrontal Cortex in Autism Spectrum Disorder

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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). Despite a high prevalence (currently 1 in 68 children), at present there are no validated biomedical treatments for ASD that target core symptoms.
Objectives: Across two studies, 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 12 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. Preliminary findings from Study Two indicate a number of clinical and cognitive improvements, and associated changes in neural activity.
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.

14   **157.014** Component Analysis of Pivotal Response Training: Child Preferred-Materials and Reinforcement Strategies

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Background: Pivotal response training (PRT), an evidence-based behavioral intervention for children with autism, incorporates child-preferred materials and contingent, direct reinforcement and can significantly improve children's language when administered with high fidelity of implementation. However, community providers often struggle with implementing these components and modify PRT depending on their preferences or the characteristics of the children they work with (Stahmer, Collings, & Palinkas, 2005). Whether these modifications still yield maximum treatment benefits is unknown because most studies to date have focused on PRT as a package and little is known about its essential components. A systematic manipulation of PRT components is needed in order to identify the active ingredients and to make modifications to PRT that would facilitate ease of use in community settings.
Objectives: The effects of teaching materials (child-preferred or standard academic) and reinforcement strategies (direct, indirect, or non-contingent) on children's receptive language gains were evaluated by making component-specific modifications to PRT.
Methods: An alternating treatments design was used to assess differential effects of preferred materials and direct reinforcement on skill acquisition. Five children with ASD, ages 4 to 10, are enrolled and three have completed the study. Each child's preferred materials were determined by a preference assessment and a parent report prior to the PRT sessions. While holding other PRT components constant, therapists systematically varied teaching materials and reinforcement strategies in four conditions: (1) preferred materials and direct reinforcement, (2) preferred materials and indirect reinforcement, (3) standard academic materials and indirect reinforcement, and (4) preferred materials and non-contingent reinforcement. Conditions were alternated randomly until each condition has been presented five times. Child response was coded on a trial-by-trial basis. The mastery criterion for each target skill was defined as at least 80% correct responding in a single session.
Results: All participants mastered the fewest skills in Condition 4, which utilized preferred materials and non-contingent reinforcement. Even though child-preferred materials were incorporated, PRT was less effective when the contingent reinforcement component was excluded. Individual differences were observed in children's responsivity to teaching materials and direct and indirect reinforcement. Participant 1 learned the greatest number of skills in Conditions 2 and 3, both of which involved indirect reinforcement, whereas Participant 2 responded most favorably in Condition 1. Participant 3, who showed the greatest skill gains among the participants, learned more than twice as many skills in Condition 3 as in any other conditions. Additional data from remaining participants and maintenance and generalization results will be presented.
Conclusions: Motivational use of preferred materials alone is not adequate for teaching new skills. Contingent reinforcement is necessary to maximize PRT treatment benefits, and a strict adherence to fidelity of this component by community providers may be required. Future studies should consider the use of indirect reinforcement in PRT as it may be more practical in the community settings and still produce optimal treatment outcomes.

15   **157.015** Determining Appropriateness of a Mobile Technology Application to Treat Prosodic Deficits in ASD

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Background: For those individuals with ASD who acquire spoken language, approximately 50–80% exhibit prosodic deficits including monotone or sing-song speech quality (Baltaxe & Simmons, 1985). Despite the limiting nature of these deficits, there are few available interventions (Diehl & Paul, 2009). The emergence of mobile technology provides speech-language pathologists (SLPs) with another medium to deliver intervention. While most SLPs use iPads for treatment (Fernandes, 2011),

little is known regarding who is best suitable for technology-based interventions.

Objectives: The purpose of this study is to 1) characterize the speech and language skills of those with ASD for whom *SpeechPrompts,* an application for iPad to treat prosodic disorders, might be suitable and 2) evaluate the application features that are most useful for clinicians.

Methods: Students, 5-15 years of age ($M = 8.80$, $SD = 3.16)$ with a diagnosis of ASD and prosody deficits, were enrolled (N = 11). Students were recruited from school-based speech-language pathologists (SLP; N = 5). Students' prosody was assigned a global prosody rating pre-treatment. *SpeechPrompts* includes four main components with each targeting a different prosodic construct (*Intensity*, *Stress*, *Rate*, and *Pitch*). SLPs used the software for 16 weeks, with each of their recruited students, based on clinical judgment. A student engagement rating was assigned at the conclusion of each session.

Results: Students received an average of 14 software sessions ($SD = 9.79$). Number of sessions was highly positively correlated with students' social dysfunction as measured by the *Social Responsiveness Scale-2* (Constantino, 2012) $r = 0.69$, $p = 0.02$. SLPs used the software with students whose verbal IQ standard scores ranged from 72-99 ($M = 86.8$; $SD = 11.2$). The software was used equally with students whose prosody was rated as monotone (n = 5; 45%) or sing-song (n = 6; 54%). Student engagement ratings did not differ between the monotone (M = 1.90, SD = 0.21) or sing-song (M = 1.97; SD = 0.40) groups. No significant correlation was found between prosody ratings and engagement ($r = .12$; $p = 0.72$). The majority of SLPs (80%) rated the main application components as useful to extremely useful with the exception of the *Rate* component. The components that addressed pitch (36.7%) and stress (35.3%) were used most frequently while intensity (24.3%) and rate (3.7%) were used less frequently.

Conclusions: Results of this pilot study suggest that SLPs used the software primarily with high-functioning students of low average verbal IQ. The application appears to be appropriate for students who present with flat prosody as well as those who present with exaggerated speech prosody. Students with monotone prosody and students with sing-song prosody were highly engaged while using the software. SLPs rated the application from useful to extremely useful for the majority of features and used visualization of pitch curves and waveforms most frequently with their students. Although further efficacy testing is necessary, this preliminary study suggests that *SpeechPrompts* might be an engaging application for high-functioning students with ASD who present with either flat or exaggerated speech prosody.

16 **157.016** Does Compass Improve Common Elements of Instructional Quality?

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Background:
Implementation science is concerned with the factors that hinder or facilitate the use of evidence-based practices (EBP) in real world settings. Teachers who work in inclusive early childhood settings and serve children with a wide variety of needs are challenged to design, implement, and evaluate EBPs necessary for teaching each child, including children with autism spectrum disorder (ASD; Grisham-Brown, Hemmeter, & Pretti-Frontczak, 2005). As a result, research is needed on key elements of instruction that a) teachers can implement with fidelity and b) that support young children to achieve important learning outcomes. An instructional quality measure was developed that captures *common elements of teaching sequences* (Grisham-Brown & Ruble, 2013) for designing intervention plans, and measuring implementation fidelity in inclusive early childhood settings. This measure assumes that regardless of the EBP employed, the following must occur in order for the child to have an opportunity to demonstrate the targeted skill: 1) the environment must be arranged so that there is an opportunity for the child to demonstrate the response; 2) the child must be engaged in meaningful activities with high-interest materials; 3) the teacher, peer, or environment must provoke the child to initiate or respond; and 4) the child must be given an opportunity to respond. Once the child responds, the teacher must make a decision about how to close the teaching sequence if the child 1) demonstrates the expected response, *or* 2) needs further support to demonstrate the expected response. This preliminary work is guided by the premise that teachers are more likely to implement consistent instruction with fidelity if they can focus on common elements.
Objectives:
 This poster will examine whether teaching quality increases during COMPASS consultation using a common elements approach to measurement.
Methods:
Data are from a secondary analysis of 29 special education teachers of students with ASD between 3 and 8 years participating in an RCT of COMPASS consultation (Ruble, et al., 2013). COMPASS is a consultation approach designed to identify ecologically valid goals and teaching strategies to improve child educational outcomes and consists of an initial 3-hour parent-teacher consultation that produces a social, communication, and learning skill goal (e.g., start and complete a task independently), followed by four, 1-hr, teacher coaching sessions spaced equally throughout the remaining school year. For each coaching session, teachers prepare a videorecording of their implementation of the three intervention plans. For this project, the first and fourth coaching sessions were analyzed using the Sequence of Common Elements measure. Paired t-tests were used

to determine mean score differences between the two coaching sessions for each learning domain (social, communication, and learning skills).
Results:
Results showed that coaching 4 mean scores for all three learning domains was significantly higher compared to coaching 1 mean scores (p < .000; Figure 1).
Conclusions:
Instructional quality based on a common elements of teaching sequences approach is sensitive to change during COMPASS consultation. Future research on the utility of the measure for improving educational outcomes is warranted.

17   **157.017** Does Pivotal Response Training Moderate the Effect of Social Anxiety Symptoms on Student Outcomes?

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Background: Variability in response to intervention is commonly reported in outcome studies for children with autism. Differential responses to intervention may be associated with both the type of intervention delivered and differences in children's clinical characteristics. Recent investigations have found differences in outcome associated with intervention type and children's characteristics. However, the moderating effects of treatment variables and children's clinical characteristics on student outcomes have yet to be convincingly identified.
Objectives: to identify the moderating effects of treatment type and child characteristics on student outcomes for children with autism. Specifically, the study evaluated differences in outcome following one year of the Strategies for Teaching Based on Autism research (STAR) program, a behaviorally-based intervention package with three distinct components: discrete trial training (DT), Pivotal Response Training (PRT), and teaching in functional routines (FR). A variety of child variables were examined, including age and baseline levels of cognition, language, and behavior.
Methods: Participants included 191 students with autism in 53 kindergarten-through-second-grade autism support classrooms in a large urban public school district that participated in an intervention study. As part of this study, students received instruction using the STAR program. Fidelity to each intervention component (DT, PRT, and FR) was measured monthly via direct observations, and was analyzed as a product of intervention intensity and intervention accuracy. Child measures were completed by teachers, parents and direct observation at the beginning and end of the school year, and included the Differential Abilities Scales, 2nd Edition (DAS-II, the primary outcome measure); Aberrant Behavior Checklist; Adaptive Behavior Assessment System, 2nd edition; Autism Diagnostic Observation Schedule; Child Symptom Inventory; PDD Behavior Inventory; and Social Responsiveness Scale. Linear regressions with random effects for classroom and student were used to evaluate the association between change in DAS-II GCA scores and 1) fidelity to each intervention component and 2) child characteristics (age, language ability, autism severity, social skills, adaptive behavior, co-occurring psychological symptoms, and restrictive and repetitive behavior. To estimate the potential moderating effect of different intervention components on the association between child characteristics and outcome, we introduced interaction terms (intervention fidelity x child characteristic) into the regression model.
Results: In main effects analyses pivotal response training was associated with improved student outcomes. Higher levels of social anxiety symptoms, as measured by the CSI, were associated with poorer outcomes. Analyses testing the interaction of whether fidelity to pivotal response training moderates the association between social anxiety symptoms and outcome are ongoing.
Conclusions: The findings that PRT was associated with improved gains for children with autism, even when implemented at lower levels of fidelity, suggests PRT may be an effective intervention choice in under-resourced autism support settings. The finding that children with greater social anxiety were more likely to have poorer outcomes suggests the importance of identifying and treating social anxiety symptoms early. These results suggest that addressing social impairment, through interventions like PRT that focus on increasing engagement and social motivation, may be a necessary precursor or adjunct to improving response to intervention.

18   **157.018** Driving Simulator Performance in Adolescents with Autism Spectrum Disorder: The Role of Executive Functions and Basic Motor Skills

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Background: The recent increase in research on motor vehicle driving for individuals with autism spectrum disorder (ASD) reflects an improved understanding of the disorder's lifetime course and changing functional impairments across development. Previous studies have shown that individuals with ASD demonstrate poorer driving performance than their peers and are less likely to obtain a driver's license.
Objectives: The purpose of this study is to examine the association between driving performance, basic skills, and executive functioning among adolescents and young adults with and without ASD

using a sophisticated virtual reality driving simulator (VRDS).

Methods: Forty-four males (ages 15-23), 17 with ASD and 27 healthy controls, completed paradigms assessing driving skills and executive functioning. The VRDS protocol involved two types of tests: Tactical and Operational. The *Tactical test* employed a standardized route, during which participants negotiate realistic road and traffic demands (both expected and unexpected). *Operational tests* assess driving-relevant basic skills and executive function abilities (dual processing, response inhibition, working memory) using driving-specific stimuli, requiring driving-specific responses in a driving-relevant context.

Results: Consistent with previous investigations, results from the tactical drive revealed that adolescents with ASD demonstrated poorer overall driving ability relative to novice drivers without ASD. Additionally, drivers with ASD had significantly slower reaction times during steering (d = 1.45) but not braking. Results also revealed that there was a significant interaction effect attributable to the differential effects of adding working memory demands (road sign recall task) for ASD relative to non-ASD adolescents. That is, between-group differences in steering/braking did not reach significance for either the response inhibition (p = .146) or working memory (p = .174) conditions. However, the increase in working memory demands was associated with a significant one-tailed decrease in steering/braking performance for the ASD group (p = .10, d = -0.45) relative to a significant increase in steering/braking performance for the comparison group (p = .016, d = 0.54). In contrast, adolescent drivers with ASD performed similarly to healthy control adolescents on driving tests assessing their ability to flexibly shift between steering and braking as well as successfully inhibiting responses at similarly high levels relative to healthy control adolescents.

Conclusions: Deficits in executive functioning have been well-documented in the ASD literature; this study's findings highlight the influential role these higher order abilities play in driving performance for this population. Interestingly, the ASD group did not demonstrate impaired performance during response inhibition or dual processing tasks, whereas the addition of a working memory task differentially impacted drivers with ASD. For these drivers, working memory abilities, but not motor speed, served as a significant covariate of driving ability, suggesting that working memory may reflect an important mechanism underlying some of these drivers' on-road difficulties. Clinically, these findings suggest that driver training programs for adolescents with ASD may provide maximum benefit through repeated practice of scenarios that place relatively high demands on working memory (e.g., multitasking) in addition, or in place of more basic driving skills.

19   **157.019** Efficacy of the Multi-Media Social Skills Project for Adolescents with ASD

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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 social fluency, flexibility and responsiveness for optimal social outcomes.

Objectives: The authors sought to examine the effectiveness of a social skills intervention for adolescents with ASD. It was hypothesized that individuals who participated in the intervention would display significant decreases in social difficulties and increases in conversational skills. Additional differential treatment effects by internalizing and externalizing symptoms were explored in *post hoc* analyses.

Methods: Thirty-six adolescents diagnosed with ASD ages 13- to 18-years-old (M = 14.61, SD = 1.36; 81% male; 97% Caucasian) enrolled in the Multi-media Social Skills Project which utilized manualized group instruction, video modeling, and peer generalization. ASD diagnosis was confirmed via the Checklist for Autism Spectrum Disorders (CASD; M = 21.83, SD = 4.59) and verbal IQ was estimated using the Kaufman Brief Intelligence Scale, Second Edition (KBIT 2; M = 104.33, SD = 18.85). Exclusionary criteria included verbal IQ below 70. Samples of five minute conversations between participants and a same-age confederate were coded for social behaviors and fluencies pre- and post-intervention, as well as at a three-month follow-up. The Social Responsiveness Scale, Second Edition (SRS 2) and the Strengths and Difficulties Questionnaire (SDQ) were obtained at each time point.

Results: Repeated measures ANCOVAs were conducted to assess effectiveness of the intervention. Cohort, age, and verbal IQ were entered as covariates. Caregivers and participant's report of peer difficulties significantly decreased [F = 7.22, p < .01 (caregiver); F = 4.15, p < .05 (self)]. Additionally, changes in seconds of silence (F = 4.73, p < .05), number of questions asked (F = 6.32, p < .01), validation statements (F = 5.64, p < .01), topic changes (F = 2.82, p < .08), and run-on statements (F = 3.53, p < .05) were found at post-intervention and three-month follow-up. *Post hoc* analyses found that participants who were younger (≤ 14-years-old), had lower verbal IQs (< 102), and were less impaired in ASD symptoms asked more questions following the intervention. Similarly, participants who were younger were found to display significant decreases in run-on statements while those with more peer difficulties and more restricted and repetitive behaviors displayed significant decreases in topic changes. Finally, participants who were more anxious made improvements in conversational skills (e.g., total words spoke, number of commenting statements); however, this was not maintained at three-month follow-up.

Conclusions: The Multi-media Social Skills Project for adolescents with ASD was found to demonstrate significant improvements in peer difficulties, as well as several observable conversational skills. The

majority of these improvements were maintained at a three-month follow-up. *Post hoc* analyses found that social fluency improved for individuals who were more anxious, social flexibility improved for adolescents who had more peer difficulties and restricted and repetitive behaviors, and social responsiveness improved for adolescents who were younger, had lower IQs, and were less impaired in ASD symptoms.

20   **157.020** Enhancing Cognitive Processing of Complex Emotional Cues in Young Adults on the Autism Spectrum through an Online Intervention

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Background: Individuals with autism spectrum disorder (ASD) exhibit differences in executive functioning compared to individuals without ASD, particularly with regard to selective visual attention and emotional identification. Little research has developed interventions aimed at young adult individuals with ASD, although this is a developmental period of critical transitions and important educational milestones.
Objectives: This study aimed to develop and evaluate a novel, short-term, online intervention to improve selective visual attention in young adults with ASD.
Methods: A total of 23 participants (13 males; age range: 18-24 years) completed the intervention. Seventeen individuals who were clinically diagnosed with ASD were recruited from the autism clinic at a local medical school. The remaining six were recruited from the undergraduate population at a small liberal arts university and reported autistic traits in the clinical range as assessed by the Autism Quotient (Baron-Cohen et al., 2001). The intervention included eight online sessions, to be completed over the course of three weeks. The first and last sessions constituted a pre- and post-test of performance on tasks designed to assess visual attention and emotion identification. The training sessions included six tasks designed to train participants in selective attention (e.g., Stroop task) and emotion identification (e.g., emotion identification of morphed faces). The pre- and post-training tasks consisted of 1) an emotional flanker task, in which participants identified whether a center face flanked by four other faces displayed a congruent or incongruent emotion, 2) a classic flanker task, in which participants identified whether a center arrow pointed in a congruent or incongruent direction as its flanking arrows, 3) a basic face emotion identification task, in which participants identified basic emotional expressions (i.e., happy, angry), 4) a complex face emotion identification task, in which participants identified complex emotions (i.e., shame, pride), 5) a basic eyes emotion identification task, in which face stimuli were cropped to only display the eyes, and participants identified basic emotional expressions, and 6) a complex eyes emotion identification task, in which participants identified complex emotions from the cropped face stimuli.
Results: ASD individuals showed a significant improvement in the complex eyes emotion identification task after completion of the training modules (M_1 = 5.69, M_2 = 6.77), t = -2.59, p= .024. For the basic eyes emotion identification task, participants averaged a similar number of correct responses during both the pre-training and post-training tests. There were no other significant differences in pre- and post-task performance.
Conclusions: These data indicate that this training module might be useful for improving emotional identification skills in individuals with ASD, at least with those emotions that are less easily identifiable than basic emotions. These findings suggest that these online training modules, that could be accessible to a large number of affected individuals, might be effective in helping individuals with ASD to distinguish between subtly different emotional expressions. Larger scale studies are needed to further investigate the efficacy and ecological validity of this intervention.

21   **157.021** Establishing Predictors of Outcomes of the Social Competence Intervention for Adolescents (SCI-A)

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Background:
Education research emphasizes the importance of teaching both academic content as well as social and emotional competence (Collaborative for Academic, Social and Emotional Learning, 2005). Social emotional competence can be particularly important for children with social learning deficits, such as individuals with Autism Spectrum Disorders (ASD). However, this population usually requires more in-depth or targeted instruction, as they lack necessary foundational skills (Arick et al., 2005; Rao et al., 2008). Interventions targeting social competence for individuals with High Functioning Autism may be especially important. While their level of cognitive functioning suggests an ability to live independently and maintain employment, deficits in social competence for adults with HFA have been associated with low quality of life (Howlin, 2000; Howlin, Goode, Hutton, & Rutter, 2004) and job failure (Barnard, Harvey, Potter, & Prior, 2001).
While initial investigations of social competence interventions for children with HFA are promising (Bauminger, 2002, 2007; Lopata, Thomeer, Volker, Nida, & Lee, 2008; Schmidt, Laffey, & Stichter, 2011; Solomon, Goodlin-Jones, & Anders, 2004; Stichter et al., 2010; Stichter, O'Connor, Herzog,

Lierheimer, & McGhee, 2012), response rates vary within and across interventions. Individual characteristics that predict varying levels of response remain unexplored. Understanding the characteristics of those who respond best may improve the practical applications of these interventions.

Objectives:
The goal of the current study is to explore individual factors that predict responsivity to the Social Competence Intervention for Adolescents (SCI-A) curriculum as developed by Stichter et al. (2010; 2014). Two areas identified as possible predictors of social-competence gains include cognitive abilities and executive function. Because SCI-A takes a cognitive behavioral approach, IQ should be explored as a predictor of outcomes, as children's cognitive abilities may play a role in the success of cognitive behavioral interventions (Solomon et al., 2004; Taylor, Lindsay, & Willner, 2008). Additionally executive function has been linked to core deficits of HFA that impact social competence (Buitelaar et al., 1999; Fisher & Happé, 2005; Hughes, 2011).

Methods:
Data for the proposed research was pulled from a larger study. 52 adolescent students with HFA (and related social difficulties) who received SCI-A were included in the study.

SCI-A includes scaffolded content covering: recognizing and reading facial expressions, sharing ideas, turn-taking in conversation, recognizing feelings and emotions in self and others, and problem solving.

IQ was measured using either the WISC-IV or the WASI prior to the intervention. Outcomes were measured using the: Social Responsiveness Scale, Social Problem Solving Inventory—Revised, Delis-Kaplan Executive Function System, Behavior Rating Inventory of Executive Function, and Developmental Neuropsychological Assessment—Second Edition.

Proposed analyses will include simple regressions as well as multiple regressions to build prediction models.

Results:
Initial results identified several potential predictors when exploring a sub-sample of the data. The proposed research will serve to replicate and extend those results.

Conclusions:
The results from the proposed research will help further develop SCI-A, and serve as a model for the development and modification of other interventions.

22 **157.022** Everything They Wanted to Know about Sex but Were Afraid to Ask: Assessing Knowledge of Sexuality and Relationships with Parents and Children with ASD

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Background: Individuals with ASD have less information about sexuality, rely on their parents more for information, and experience fewer opportunities for social contact and learning than their non-ASD peers. In addition, individuals with ASD have less sexuality education in school and display more inappropriate sexual behaviors.

Objectives: To investigate the knowledge that individuals with ASD and their parents have about sexuality and relationships, as well as assess parents' levels of confidence in teaching their children with ASD about sexuality.

Methods: 103 individuals with ASD (83 males) aged 9-18 years (M=13.0, SD=2.1) without Intellectual Disability (mean IQ=102.3, SD=17.0, range 80-149) and their parents participated in this study. All individuals possessed a clinical diagnosis of ASD. Parents completed the Parenting Self Efficacy Scale (PSES) as well as a knowledge questionnaire assessing knowledge of sexuality and relationships as well as differences in the social development of their child with ASD. Individuals with ASD completed the Social Self Efficacy Scale (SSES) and two measures created for this study: a knowledge questionnaire, which had similar questions to the parent questionnaire regarding sexuality and relationships, as well as questions pertaining to video vignettes they watched, which also assessed knowledge of sexuality and relationships.

Results: Youth with ASD demonstrated gaps in their knowledge about sexuality: their mean percentage correct on the knowledge questionnaire was 70.5 (SD=14.1) with more than half of the participants scoring lower than 70%. Questions about the video vignettes were more difficult for the youth and the mean percentage correct was 57.9 (SD=14.9). There were no significant correlations with age, and teen IQ was weakly correlated with the knowledge questionnaire (r=.25;p>.05), but not performance on the video vignettes (r=.18;p=ns). Parents also demonstrated limited knowledge of sexuality and relationships, their mean percentage correct on the knowledge questionnaire was 68.6% (SD = 8.7). On the SSES, youth with ASD felt most confident in their ability to wear the kind of clothes they like even if they are different from what others wear (65.1% said that was "Very Easy") and least confident in their ability to ask someone to go to a school dance or movie (49.0% said that was "Impossible"). On the PSES parents reported they felt most confident in their ability to explain to their child how someone can get AIDS if they don't use a condom (69.8% said they were "Completely Sure") but least confident in explaining to their child how to put on a condom (52.8% said they were "Not Sure at All to Moderately Sure").

Conclusions: Both individuals with ASD and their parents had limited knowledge of healthy sexuality and relationships. It was especially difficult for individuals with ASD to interpret and respond to

questions about real scenarios they observed in video vignettes. Parents of individuals with ASD were not confident on all their abilities to teach sexuality education to their children. There is a need for a specialized sexuality education program for individuals with ASD and their parents that targets social interactions and relationships.

23 **157.023** Examining Therapeutic Alliance in an Emotion Regulation Intervention for Children with Autism Spectrum Disorder

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Background: Therapeutic alliance (TA) is an important component of treatment success. Much of what we know about this process is rooted in adult psychotherapy research and for typically developing individuals. Less is understood about TA in child psychotherapy, and even fewer studies examine alliance with children with ASD. An understanding of TA in this population and how it relates to other treatment processes and outcomes is needed.
Objectives: The goal of the current study was to examine relations between TA and other process and outcome measures in a trial of cognitive behavior therapy (CBT) for children with ASD. Our objectives were to examine: (1) child- and parent-therapist alliances using a behavioral coding scheme, and (2) relations between behavioral measures of TA and therapist-reported TA, client satisfaction ratings, treatment adherence, and changes in emotion regulation.
Methods: As part of an ongoing trial, 13 males ages 8.3 to 12.8 years ($M = 10.3$; $SD = 1.2$) with ASD and their parents completed 10 CBT sessions to improve emotion regulation. Parents and children reported on children's emotion regulation before and after the intervention, using the *Emotion Regulation Checklist* (Shields & Cicchetti, 1997) and the *Children's Emotion Management Scale* (Zeman et al., 2010; Zeman et al., 2001). At each session, parents and children completed treatment satisfaction measures, and therapists reported on treatment adherence and on their degree of TA with children and parents. Two trained coders rated video recorded therapy sessions using the *Therapy Process Observational Coding System–Alliance Scale* (McLeod & Weisz, 2005). Coders established excellent reliability (ICC = .95).
Results: To date, 36 unique sessions have been coded across 13 participants for child-therapist and parent-therapist alliance. Overall behavioral ratings of these alliances were correlated ($r = .61$, $p = .037$). Ratings of child-therapist alliance were high across early ($M = 35.7$, $SD = 7.62$), middle ($M = 36.2$, $SD = 6.31$), and late sessions ($M = 34.5$, $SD = 8.86$). Similar patterns were found for parent-therapist alliances ($M = 39.0$; $SD = 6.28$; $M = 39.7$; $SD = 6.06$; $M = 39.2$; $SD = 5.59$, respectively). Mean behavioral ratings of child-therapist alliance across the three sessions were correlated with overall homework completion ($r = .59$, $p = .03$) and therapist-reported TA across all sessions ($r = .76$, $p = .002$). Mean behavioral ratings of parent-therapist alliance were correlated with mean therapist-reported TA ($r = .77$, $p = .004$) across all sessions. High overall child satisfaction was correlated with decreases in child-reported emotion dysregulation ($r = -.58$, $p = .046$). High mid-therapy behavioral ratings of child-therapist alliance were correlated with improvements in child emotional lability and negativity (mood swings, dysregulated negative affect) ($r = .79$, $p = .002$).
Conclusions: Preliminary findings suggest a concordance between behavioral and therapist-reported ratings of relational processes in a treatment study for children with ASD, and relations between TA ratings and treatment adherence and parent-reported improvements in emotion regulation. These findings have implications for future investigations of therapy processes that may mediate treatment outcomes in this population.

24 **157.024** Examining Treatment Implementation in Secondary Education Settings

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Background: Program implementation is a key feature of experimental research. In the early stages of any research project, it is necessary to develop and evaluate measures of implementation fidelity. The Center for Secondary Education for Students with ASD (CSESA) has developed a complex treatment model consisting of four features (Academic, Social, Independence, and Transition). In the current study, researchers examined the construct validity of the individual implementation fidelity measures for each of the CSESA components as well as students' progress on goals related to that component.
Objectives: (Research Question) Do CSESA fidelity measures discriminate between sites implementing and not implementing program features?

Methods: As part of model development, investigators created implementation fidelity measures. Using a variation of the classic multi-method/multi-trait matrix process that Campbell and Fiske (1959) designed for building construct validity of assessments, the authors created an evaluation design to assess construct validity of fidelity measures. In this design, staff in high schools implemented two features of the CSESA program (see Table 1) and served as controls for the other two components. In most cases a feature had more than one measure (e.g., social had peer support, peer network and Social Competence Intervention components). Research staff collected implementation fidelity on all features/components in all settings. The rationale for the design is that the implementation measures should reflect high ratings of fidelity in schools where a specific feature is being implemented and low levels of fidelity will occur in schools where a specific feature is not being implemented. All combinations of the four components are being implemented in six schools[1](e.g., transition and academics, social competence and independence, academics and independence). The fidelity measures were comparable in format, consisting of a four point Likert rating scales (0-3) that documented the degree to which individual practices were implemented with fidelity. Six high schools across the country (CA, NC1&2, TN, TX, WI) were enrolled in the study, involving 6-8 students with ASD at each school (N=43). Research staff monitored fidelity of all components through observations of students during instruction. The students were randomly selected from the pool of students in the study receiving a given intervention. [1]One school was scheduled to implement the academic feature but did not.

Results: The small number of schools precludes statistical analysis, and descriptive comparisons of mean fidelity ratings appear in Table 2. As hypothesized, the fidelity measures were sensitive to implementation fidelity occurring in schools and appeared to discriminate schools in the control condition.

Conclusions: This poster presentation provides a case example of a program development process that focuses on measurement of implementation fidelity. Implications for iterative design of program development, measurement of fidelity, and use of implementation science will be discussed at the poster.

25 **157.025** Exploring the Role of Child Ethnicity on Community Therapist Delivery of a Mental Health Intervention for ASD

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Background: Racial/ethnic disparities have been documented in access to and quality of community services for children with ASD. It is not known, however, whether disparities exist when community providers are trained to deliver evidence-based intervention strategies. Examining the role of child race/ethnicity is critical when measuring the impact of community implementation efforts.

Objectives: To examine the impact of child ethnicity on community therapist fidelity of a mental health intervention for ASD within the context of publicly-funded mental health services.

Methods: Preliminary data on child ethnicity and therapist fidelity were drawn from an ongoing randomized community effectiveness trial of AIM HI ("An Individualized Mental Health Intervention for ASD") conducted in publicly-funded community and school-based MH services. AIM HI is package of evidence-based behavioral intervention strategies designed to reduce challenging behaviors in children with ASD ages 5 to 13. It was designed specifically for use in routine mental health care settings by providers who do not specialize in ASD. MH programs were enrolled and randomized to immediate AIM HI implementation (i.e. 6 months of ongoing therapists AIM HI training and consultation) or to a wait-list control/routine care observation condition. Participants included the first 44 therapists and 52 children participating in the AIM HI implementation condition and for whom video data were available. Children were ages 5-14 (M = 8.62 years; SD= 2.54), 81% male, and 52% Hispanic. Six therapist adherence summary scores were calculated based on three reports: Observer (average over 6 months based on video recorded sessions) and Therapist and Parent (obtained by survey at 6 months post baseline).

Results: Preliminary analyses reveal no significant differences between Hispanic and Non-Hispanic children in Observer, Therapist or Parent report of the adherence scales reflecting strategies directed to children (*Session Structure Strategies, Motivational Strategies, Active Teaching Strategies) or Session Structure Strategies* directed to parents. Differences in Therapist and Parent Rated adherence scores were found in strategies directed to parents. Specifically, therapists and parents reported significantly higher ratings of *Involvement Strategies* directed to parents for Hispanic (M=4.86; SD=0.47 and M=4.57; SD=0.81, respectively) compared to Non-Hispanic children (M=3.75; SD=1.48 and M=3.74; SD=1.63; $t(40)$=-3.22 p=0.004 and $t(42)$=-2.17 p=0.04). Additionally, Therapists reported significantly higher *Active Teaching Strategies* directed to parents for Hispanic children (M=4.38; SD=0.71) compared to Non-Hispanic children (M=3.75; SD=0.95); $t(40)$=-2.46 p=0.019).

Conclusions: The high and representative proportion of Hispanic children in this large community sample provides a unique opportunity to examine ethnic disparities in therapist fidelity. Although no differences were found in therapist adherence to strategies directed to children, therapist and parent ratings of adherence to strategies directed to parents differed by child ethnicity. Interestingly, adherence scores were higher for Hispanic children. Future analyses will examine differences in therapist adherence based on additional diversity factors including parent ethnicity and parent and child primary language for children whose therapists receive AIM HI training. Similar analyses of usual care mental health services will also be conducted. Future research focused on understanding ethnic

differences will be critical to informing the increasing effectiveness and implementation research conducted for ASD.

26 **157.026** GREAT Expectations: The Influence of Parent Outcome Expectancies on Social Skills Gains in Children with Autism Spectrum Disorder

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Background: Extensive research has been conducted on the influence of client expectancies on the therapeutic process in adult therapy. However, when examining the influence of expectancies in *child* therapy, the expectations of the parent are critical because of the influential role of the parent. Specifically, it is the parent who generally initiates, continues, and terminates treatment for the child. To date, the literature on child therapy has primarily focused on parent expectancies on treatment protocol (*treatment expectancies*) rather than treatment outcomes (*outcome expectancies*; e.g., Burck, 1978; Nock & Kazdin, 2001). Furthermore, the effect of parent expectancies on treatment outcomes has yet to be studied in interventions for children with autism spectrum disorder (ASD).
Objectives: This study investigated the relationship between parent outcome expectancies on in-session and parent-perceived therapeutic gains for children with ASD participating in a novel applied behavioral analysis (ABA) type intervention. We predicted that higher parent outcome expectancies in the earlier stages of the intervention would lead to greater in-session and parent-perceived social skills gains.
Methods: Participants were 15 children with ASD and their parents. Participants were involved in a larger study examining the influence of an interactive humanoid robot as a co-therapist in a novel ABA type intervention. Parents completed an adapted version of the Credibility/Expectancy Questionnaire (Devilly & Borkovec, 2000) to assess outcome expectations. Parents also completed the Autism Social Skills Profile (Bellini, 2006) to measure parent-perceived social skills gains. In-session social skills gains were the frequency of appropriate responses, comments, and questions independently made by the child during the initial and final probes of the therapy session.
Results: Parent outcome expectancies at pretest were positively correlated with parent-perceived social skills gains ($r = .52$, $p < .05$). Parent outcome expectancies at midpoint were positively correlated with in-session ($r = .64$, $p < .05$) and parent-perceived ($r = .74$, $p < .01$) social skills gains. When controlling for child's IQ, ASD symptom severity, adaptive behavior functioning, and order of robot presentation in therapy, parent outcome expectancies at midpoint accounted for a significant proportion of variance of in-session [$R^2 = .69$, $F(5, 9) = 4.05$, $p < .05$] and parent-perceived [$R^2 = .81$, $F(5, 9) = 7.56$, $p < .05$] social skills gains. Furthermore, parent outcome expectancies at midpoint predicted in-session ($\beta = .64$, $p < .05$) and parent-perceived ($\beta = .59$, $p < .01$) social skills gains at the end of the intervention.
Conclusions: These data suggest that parent expectations of treatment outcomes are predictive of in-session and parent-perceived social skills gain over and above their child's IQ, ASD symptom severity, adaptive behavior functioning, and order of robot presentation in therapy.   The influence of parent expectancies on in-session social skills gains may be attributed to an increased level of parent involvement, such as practicing skills outside the sessions. These findings highlight the importance for professionals to monitor parents' perceptions and beliefs of therapy, even after treatment has begun. This study further supports the existing literature emphasizing the significance of parents in treatment for children with ASD.

27 **157.027** Hyperthermia and the Improvement of Autism Spectrum Disorder (ASD) Symptoms

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Background: The observation that some ASD patients manifest clinical improvement in response to fever suggests that symptoms may be modulated by immune-inflammatory factors. The febrile hypothesis of ASD stems from this observation, and could be due to (1) the direct effect of temperature; (2) a resulting change in the immune inflammatory system function associated with the infection of fever; and/or (3) an increase in the functionality of a previously dysfunctional locus coeruleus-noradrenergic (LC-NA) system.
Objectives: To assess the effect of hyperthermia on ASD symptoms.
Methods: We completed a double blind crossover study of 15 children with ASD (5 to 17 years) using two treatment conditions, hyperthermia condition (102°F) and control condition (98°F) in a HydroWorx aquatic therapy pool. Five children with ASD without fever response acted as controls, completing only the hyperthermia condition, to ensure safety and feasibility. Safety measures and Social Responsiveness Scale (SRS) were collected. Ten patients with ASD and history of fever response were enrolled and received both treatment conditions. Vital signs, temperature monitoring and

clinical observations were completed throughout their time in the pool. Parents completed the SRS and RBS-R. Pupillometry biomarker and buccal swabs for DNA and RNA extraction were collected pre and post pool entry.

Results: Ten subjects with ASD and a history of fever response were enrolled and completed the hyperthermia condition (102°F) and control condition (98°F) at the aquatic therapy pool. Improvement during the hyperthermia condition (102°F) was observed in social cognition, using the Social Responsiveness Scale (SRS) total raw score (p = 0.0430) and the SRS Social Behavior subscale raw scores (p = 0.0750); repetitive behaviors, using the Repetitive Behavior Scale-Revised (RBS; p =0.0603) and the SRS Restricted and Repetitive Behavior subscale (p = 0.0146); and on global improvement, using the Clinical Global Impression Scale-Improvement (CGI-I; p=0.0070).

Conclusions: This study demonstrates the feasibility of observing the direct effect of temperature in children with ASD, both with and without a history of febrile response, and provides preliminary data on the relationship between body temperature and changes in social and behavioral measures. It explores the direct effects of temperature on ASD symptoms, and offers a window into understanding mechanisms involved in improvement in ASD symptoms during fever episodes. Behavior changes observed for each child were similar to those observed by parents during febrile episodes, including increased cooperation, communication and social reciprocity and decreased hyperactivity and inappropriate vocalizations. This study is important for the development of translational models on the mechanism of symptom improvement and the identification of novel targets for therapeutic development.

Funding provided by the Simons Foundation.

28 **157.028** Implementation of a Computer-Assisted Intervention with Preschool and School-Aged Children Who Have Autism in Public Schools

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Background:
During the 2011—2012 and 2012—2013 school years, 264 districts in 40 states and 3 provinces across the United States and Canada, respectively, used *TeachTown: Basics* with 2,842 students who had autism spectrum disorder in preschool through grade 8. *TeachTown: Basics* combines lessons delivered through a computer with teacher-delivered instructional activities.

Objectives:
This evaluation addressed the following questions: (1) how much do teachers implement the computer-assisted portion of the curriculum in their classrooms and does usage change over time?; (2) how much progress do students make over eight months of program use? ; and (3) how many discrete trial exercises do students complete before mastering a lesson?

Methods:
Student usage and progress data as well as chronological age and gender were examined for students enrolled in the program. Data were downloaded from the Teachtown online reporting system. Results are reported for students who had used the program for at least eight months, which included 382 students (program use range: 8 to 21 months). The mean age was 6.9 years old (range: 2.9 to 17.8 years old; SD: 2.5). Eighty-one percent of the sample was male.

The computer-based lessons are delivered in a discrete trial format. The student is provided with a specific instruction, and selects the correct response from a field of 3 to 8 choices. Correct responses are immediately reinforced using verbal praise and graphics. The lessons use specific prompting procedures, such as fading the incorrect answers. Teaching strategies include repeated trials, teaching multiple exemplars of concepts, and interspersing easy tasks while teaching new concepts. The curriculum progresses through five levels of difficulty and addresses six domains: 1) adaptive skills, 2) cognitive skills, 3) language arts, 4) language development, 5) mathematics, and 6) social emotional skills. Continuous progress monitoring and automatic data collection are part of the program. Students complete pretests and must pass posttests before moving on to the next lesson. Each lesson targets an average of three concepts or skills. Teachers are asked to have the child spend 20 minutes a day on the software.

Results:
Total hours spent on the program was less than the amount of time recommended by the publisher and varied significantly with student age and month of use (see Figure 1). Approximately 97 percent of students mastered at least one lesson. The mean number of lessons mastered was 18.8 (range 0 to 96; SD: 15.6). The number of lessons mastered was positively related to the amount of time spent on the software (see Figure 2). The average number of exercises taken to master a lesson varied across learning domains. Students completed significantly more exercises to master lessons in adaptive and social emotional domains than cognitive skills and language arts domains (see Figure 3).

Conclusions:
The results indicated that although average program usage was lower than the minimum amount of usage recommended by the publisher, usage was consistent over time. Further, students who spent more time on the program mastered substantially more lessons and material than students who spent less time on the program.

29 **157.029** Improvements in Block Design Task Following Flexibility Intervention Related to Increased Time Spent on Items

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Background: Children with ASD have cognitive flexibility deficits that interfere with their ability to utilize a variety of problem-solving strategies. Participants who received *Unstuck and On Target!*, an executive function curriculum, in Kenworthy et al.'s 2013 comparative effectiveness trial demonstrated significant improvements on a block design task between pre and post intervention when compared to those who received a social skills intervention (and made no improvement on the task). Even though these results were striking, it was not clear if the improvements related to quicker processing, less impulsivity (i.e., slower processing), or fewer incorrect answers.

Objectives: This study investigates differences in pre-intervention and post-intervention performances on the Block Design task in order to understand the mechanisms underlying the observed changes.

Methods: 67 children (age M=9.52, SD=1.02) with ASD and IQ>70 (M=108.45, SD=18.01) were evaluated at pre and post intervention using the Block Design subtest of the Wechsler Abbreviated Scale of Intelligence (WASI). WASIs were administered by trained research assistants. The Block Design subtest is a measure of speeded problem solving, and has been used as an executive functioning measure is other studies.

Results: A paired-samples t-test demonstrated significant improvements in pre to post-intervention t-scores on the block design (BD) task. Pearson chi square identified item-level improvements between pre- and post- on items 7 & 8 of BD, X^2 (1, N = 118) = 4.735, p <.05 and X^2 (1, N = 105) = 3.464, p <.05, respectively. Paired samples t-tests indicated that relative to pre-testing, participants spent significantly more time on four BD items (items 3, 4, 5 & 10) at post-testing (t's(55)=2.109-3.187, p's<.05).

Conclusions: Improvements in BD scores at post-intervention related to improvements in task accuracy and increased time spent on items. Increased time spent on BD items may be an indicator of decreased impulsivity and/or increased use of varying strategies for problem solving, an indicator of cognitive flexibility.

30 **157.030** Improvements to Subjective Social Impression Ratings Associated with Participation in the START Social Skills Program for Adolescents with ASD

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Background: Social competence in adolescents with ASD has been implicated in a variety of favorable outcomes (Carter et al, 2014). Current social skill group interventions have primarily relied upon parent-report surveys to gauge improvement (Miller, Vernon, Wu, Russo, 2014). These instruments, while useful, appear to have several noteworthy limitations (including inherent reporting bias). A multimodal assessment of social competence may be warranted to more fully capture all of the interrelated factors of interpersonal success (Reichow, Steiner, Volkmar, 2012). One promising method, subjective ratings by naïve observers, may help us to better understand the components contributing to the formation of positive social impressions. Such data, when combined with video-coded social skill behaviors, parent and adolescent survey measures, and real-world interaction data, may yield a more robust social competence profile for adolescents participating in ongoing social skill intervention efforts.

Objectives: The current study reports on the utility of using subjective social impression ratings within a repeated-measure/randomized controlled trial (RCT) social intervention project for adolescents with ASD.

Methods: Participants were 17 adolescents with ASD (ages 12-17) enrolled in an ongoing RCT using the Social Tools And Rules for Teens (START) 20-week social skills curriculum. The adolescents completed a weekly 2-hour session consisting of individual therapeutic check-in sessions, an unstructured socialization period with typically developing (TD) high school and undergraduate facilitators, a structured social activity, discussion and practice of a social skills topic, and an individual check-out session with their parents. At a pre-intervention time point and after every 5 sessions of the program, adolescents participated in two 5-minute videotaped conversations with unfamiliar undergraduates who were unaffiliated with the project and unaware of its hypotheses. These video clips were subsequently shown to a group of naïve observers, who were asked to rate both of the on-screen conversational partners along a number of social dimensions (social skills, comfort, awkwardness, perceived relationships). Additionally, these video clips were coded by trained raters for the total frequency of (a) interpersonal questions asked and (b) overall verbal output. Finally, parent and self-report surveys (i.e. SSIS, SRS-2, and an unpublished social competencies and motivation scale) were collected at each time point for comparative analyses.

Results: As expected, all participants with ASD received significantly lower overall subjective social

ratings than their TD conversational partners at the pre-intervention time-point. While participants varied in their total change scores over the course of their START program enrollment, many experienced a significant improvement in overall subjective rating from pre-intervention to their post-intervention (20 session) time point. Subjective rating scores were found to be positively correlated to both objectively coded social skill behaviors and survey measure scores.

Conclusions: Subjective ratings of social skill improvement may add a valuable new dimension to existing social competence measures already being implemented in the research literature. Such a strategy directly taps into the immediate subjective impressions of potential social partners, which may be informed by a multitude of subtle verbal and nonverbal factors that are not adequately captured through traditional behavioral coding paradigms.

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31   **157.031** Improving Fidelity Measurement of Pivotal Response Training to Increase Systematic Use

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Background:
As demand for broader use of empirically supported behavioral treatments increases, accurate measures of fidelity of implementation (FI) of these practices has become a critical issue. In autism intervention research, only about 20% of autism intervention studies included FI measures (Dane & Schneider, 1998; Durlak & DuPre, 2008). The lack of reporting limits the conclusions that can be drawn regarding the relationship between patient outcomes and specific treatment provided. FI measurement is often time-consuming and costly due to the detailed review of video recordings of intervention. This may limit measurement in many research and community programs. In autism research, most validated measures of FI were developed in a research setting and have received minimal adaptation for use by community providers.

Objectives:
Assess the feasibility of adapting a simpler, five-point Likert scale FI measure of a naturalistic behavioral intervention, Pivotal Response Training (PRT), from a research-validated trial-by-trial (TBT) FI measure.

Methods:
36 video samples of research and community providers using PRT were rated by trained, reliable coders for FI in ten components using a TBT measure. A five-point Likert scale was adapted from the TBT measure. The same 36 video samples were rated for FI in the same PRT components using the adapted FI tool by trained, reliable coders. 30% of the video samples were second-coded and assessed for inter-rater reliability. Frequency percentages from the TBT measure were scaled to a corresponding Likert scale rating to compare the two FI measures: 1(0-29%), 2(30-49%), 3(50-79%), 4(80-99%), and 5(100%). Percent agreement across measures for the 10 components in PRT were examined.

Results:
Three components showed same-point agreement between the two FI measures in >80% of the videos: student attention, developmentally appropriate cues, and shared control. Four components showed same-point agreement between the two FI measures in 60-79% of the videos: clear cue, maintenance/acquisition tasks interspersed, direct reinforcement, and turn-taking. Three components showed same-point agreement between the two FI measures in 40-59% of the videos: contingency, reinforcement, and reinforcement of attempts. For nine components, both FI measures showed agreement in pass/fail criteria and agreement within 1 point for over 80% of the videos coded; the remaining component, reinforcement of attempts, showed agreement in pass/fail criteria and agreement within 1 point for 63% of the videos.

Conclusions:
The adaptation of a five-point Likert scale FI measure appears most feasible with antecedent components of PRT, in which same-point agreement occurred for over 80% of the videos. Agreement between the two FI measures appears lowest for consequence strategies (i.e., contingency, reinforcement for appropriate behaviors, and reinforcement of attempts). Operational definitions of child behavior may need to be refined to improve agreement between the two FI measures. Overall, these data suggest that a simpler, Likert scale FI measure can be adapted from a trial-by-trial FI measure, with 9 out of the 10 components showing agreement in pass/fail and agreement within 1 point on the Likert scale for over 80% of the videos coded.

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32   **157.032** Improving Oral Hygiene in Children with ASD Using Video Modeled Social Stories: A Pilot Study

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Background: Many children with ASD have habits placing them at risk for dental decay, and it can be difficult to treat these problems in the clinic. Consequently, providers often must complete treatment under general anesthesia in the operating room, straining families and the healthcare system. Improving oral hygiene is the most effective way to reduce decay in this population. Given the powerful impact of social stories and technology on individuals with ASD, the use of video-modeled

stories for addressing dental decay risk in children with ASD is a promising, yet unexplored, area of research.

Objectives: To investigate the effectiveness of video-format social stories for educating children about dental hygiene techniques.

Methods:

Thirteen children with a diagnosis of ASD were recruited from a pediatric dental clinic (Mean age = 9.4 years; 5 females). ASD diagnoses were confirmed with medical records and the Social Responsiveness Scale-2, Parent Report. Participants were randomly assigned to one of two groups: experimental (n=6) and control (n=7).

Parents received a link twice daily for three weeks prompting them to watch an assigned video with their child and confirm their child's brushing. The experimental video showed a girl using proper brushing technique with spoken instructions; the control video showed bright moving shapes and music. Post intervention, participants were given a link to their intervention video and allowed to watch it freely for the next three weeks. Following this final period, participants were given links to both videos and completed an outcome survey.

Children visited the clinic at intake (T1) and twice more at 1.5-week intervals (T2-3) over the course of the intervention. At each visit they received a four-tooth plaque index exam by a clinical examiner blinded to experimental condition. Parents completed a survey about their child's functioning and oral hygiene at each clinical visit.

Results: Two children from each condition dropped out of the study and were excluded from analysis. Groups did not differ in age, SRS-2 scores, or number of times they viewed their video. A repeated-measures ANOVA assessing improvements in dental hygiene (measured by plaque index results) between groups over time showed that children's oral hygiene improved in both groups (p<.05). While no group main effect or group x time interaction was detected, possibly due to small sample sizes, effect sizes suggested greater improvements in oral hygiene in the treatment group. At T1: Control group M=1.60, SD=.95 and Experimental group M=1.63, SD=.55 (Cohen's d = -0.04). At T2: Control group M=1.45, SD=.74 and the Experimental group M=.75, SD=.74 (d = .95). Finally, at T3: Control group M=1.2, SD=1.05 and Experimental group M=.38, SD=.90 (d = .84).

Conclusions: Both groups improved their oral hygiene, suggesting that email reminders to brush or the routine of watching a video may promote dental health independent of the video's content. This ongoing study shows that technological aids delivered to patients may be a helpful, low-cost strategy for improving oral hygiene in a large number of patients.

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33   **157.033** Improving Reaction Time, Static Balance Control, and Gait in Adults with Autism Spectrum Disorder and an Intellectual Disability: An Exercise Intervention Study

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Background: Recent research has documented differences in motor skill abilities in individuals with autism spectrum disorder (ASD), in comparison to typically developing individuals. In particular, differences in gait, static balance control, and manual motor reaction time (RT) have all been identified. Given the importance of these motor skills for independence, safety, and quality of life, investigation of activities that promote the development of these skills in this population is warranted. Participation in exercise and sports/games may have implications for individuals with ASD beyond general health and fitness benefits, such as promoting improvements in coordination and motor skills. To date, little research exists regarding the benefits of exercise for motor skills development in adults with ASD.

Objectives: To assess the impact of a 12-week adapted physical exercise (APEX) program on gait, static balance control, and simple manual RT in adults with ASD and an intellectual disability (ID).

Methods: Fourteen adults diagnosed with ASD and an ID participated in a 12-week APEX program (age range = 18-62 years; 2 females; IQ scores from previous clinical assessment = 20-70). Each participant was paired with a trainer to complete two 90-minute exercise sessions per week. The sessions included a warm-up, 20 minutes of cardiovascular exercise (cycling on a stationary bike), 20 minutes of strength training (machines and free weights), sports and games, and a cool-down. Fitness and motor skills testing was conducted pre-, mid-, and post-program so that any observed changes could be compared to the participants' own pre-program measurements. Each motor skills test session included three trials of walking across an instrumented walkway at a natural walking speed (gait); four, 20-second trials (two with eyes open, two with eyes closed) of quiet standing on a force platform (static balance); and fifteen trials per hand of a computerized test of simple manual RT.

Results: Mean RT (right and left hands collapsed) significantly decreased from pre-program (570 ± 78 ms) to mid-program (432 ± 78 ms, p = 0.04) and to post-program (385 ± 79 ms, p= 0.008). There were no significant changes in any of the static balance variables [anterior-posterior and medial-lateral RMS displacements and sway areas (RMS and range) of the center of pressure (COP): $p >$ 0.05]; nor in any of the gait variables (velocity, step length, heel-to-heel base of support, swing and stance phases as percent of gait cycle, toe in/out angles: $p>$ 0.05).

Conclusions: The APEX program provided a combination of cardiovascular and strength training, along with a sports/games component. The improvement in RT, but not in gait or static balance control, may be related to the APEX program format. Many activities within the sports/games component would have challenged participants' RT (e.g. catch, badminton), and likely elicited the participants'

improvement in this domain. However, none of the exercises included in the APEX program specifically focused on improving gait or balance. Future exercise programming should include components that specifically target these skills in order to elicit improvement.

34   **157.034** Inclusive Education of Children with ASD in Argentina. Support Teachers and Support Devices

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Background:
The Convention on the Rights of Persons with Disabilities (UN) marks a great change in relation to state policies regarding the rights to education, health, participation and full social inclusion of people with disabilities in the community. In Argentina's education policies must adapt inclusive practices in mainstream schools and promoting reasonable accommodation support systems such as support teachers. There is no research available on the subject and we need to promote this kind of experience in the education system.(Booth & Ainscow, 2011; Valdez, 2009)
Objectives:
Explore, describe and analyze the functions of support teacher in the process of inclusion of children with ASD in mainstream schools.
Analyze strengths and weaknesses of its function, which strategies and resources used.
Methods:
Surveys were conducted in 230 support teachers (ST) from Buenos Aires City, Province of Buenos Aires and Patagonia.
Results:
 94% of ST teachers believe that teachers in classrooms do not have adequate training to respond to diversity; 73% believe that schools do not have adequate resources for inclusion and 48% expressed a feeling of discomfort in his work in educational institutions.
98% of respondents are women.
In terms of academic education: educational psychologists (41%), Special Education Teachers (30%) Psychologists (20%).
Support teachers selected a wide variety of roles, including:
Develop strategies and activities, 99%,
Fostering relationships with their peers, 94%
Interfering with specific support 90%
To promote the relationship with the teacher in charge, 82%
Provide assistance and guidance to managers and parents, 76%
Develop tailored assessments, 64%
Promote participation in games with rules, 57%
Organize meetings between school and family, 54%
Promote participation in sports games, 38%
As for the factors considered that can affect the process of educational inclusion, 83% believe that the school staff is not qualified, 72% think designs inclusive education projects are not consistent. 48% say they feel uncomfortable not have the means or resources to deal with the inclusion of some students.
Conclusions:
Beyond the various interpretations that can be made from these data, we believe that constitute a first step in exploring the practices of support teachers, providing an overall picture showing the complexity of the task, the problems that own experience of support teachers to be "included" in schools, the poor training they perceive Held by classroom teachers to participate in inclusion projects and difficulty working cooperatively with school teams, managers and teachers.
These results can undoubtedly help to understand the scope and limitations of the work of support teachers and the real needs of intervention to improve the support devices for the inclusion of students with ASD in mainstream schools.

35   **157.035** It's Not Just a Guy Thing: Identifying Socially Valid Interventions to Address the Complex Needs of Adolescent Girls with ASD

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Background: Females with Autism Spectrum Disorders (ASD) are a vulnerable population at risk for internalizing symptoms (Solomon, et al., 2012) and increased social impairment during adolescence (McLennan et al., 1993), yet this population remains understudied,*with females representing less than 15% of participants in ASD samples across published intervention studies* (Watkins et al., 2014). Despite growing evidence for social skills programs targeting adolescents and young adults (Tse et al., 2007; Laugeson et al., 2009 & 2011), there are *no published intervention studies specifically targeting females with ASD* and interventions rarely address co-occurring internalizing symptoms. A 4:1 prevalence in males (Fombonne, 2003) and later diagnosis in females (Begeer et al, 2013) results in a predominantly male pool for research and a gap in understanding girls with ASD (IACC, 2010). Limited research in this population, changes in social demands across development, and the

importance of positive social and emotional health, suggest a critical need for interventions that address the complex needs of adolescent females with ASD. Research is needed to determine whether current interventions are appropriate for females (Kirkovski et al, 2013; Koenig & Tsatsanis, 2005; Rivet & Matson, 2011) and if results should be generalized across individuals with ASD. Objectives: Our *long term goal* is to understand key factors that contribute to social competence across development, resulting in innovative interventions and preventive measures to improve the social-emotional health of females with ASD and related disabilities. Our current objective is to establish preliminary evidence for an intervention package that targets social competence and co-occurring internalizing symptoms in adolescent girls with ASD.
Methods: We utilized a repeated measure, within subjects design including participants from multiple intervention groups to examine the preliminary efficacy of our intervention and obtain effect size estimates to power a future multi-site RCT. We hypothesized that targeting age and gender specific social and self-care skills through strategies based in cognitive-behavioral and social learning theories will result in: 1) improved social competence and self-perception and 2) fewer autism and internalizing symptoms, from pre-to post intervention in adolescent girls with ASD (ages 14-19).
Results: Participant data (n = 18) across intervention groups (n = 5) from the past four years suggests significant, medium to large effect size estimates for improvements in social competence (d = .529) and self-perception (d = .53) and significant decreases in internalizing symptoms (d = .47) following intervention. Consumer satisfaction (n = 30-35) from parents, participants, and peers is high (s*atisfaction with program activities = 4.5/5.0; positive changes in specific skills = 3.5/5.0*). These data, including treatment fidelity data, suggest preliminary support for the efficacy and social validity of our intervention.
Conclusions: Outcomes include significant improvements in a core area impacted by ASD (social competence) and co-occurring symptoms prevalent in our population, providing evidence for novel approaches that target females with ASD. Continuing to study primarily male samples will perpetuate current disparities in ASD research and limit the development of appropriate interventions to improve the lives of females with ASD.

36   **157.036**   Meta-Analysis of Parent Skills Training for Parents of Children with Autism Spectrum Disorder

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Background: Parent skills training programs are a popular treatment for families of children with autism spectrum disorders. Given the lower resource output of parent skills training programs compared to comprehensive treatment models, such programs have the potential to be a widely used intervention especially in low-resource settings, were a majority of individuals with autism spectrum disorders reside.
Objectives: The primary objective of our review was to systematically review and meta-analyze evidence to determine if parent skills training programs for parents of an individual with an autism spectrum disorder produce greater benefits than comparator on child and parental outcomes
Methods: We searched 11 databases through September 2014 with no language or publication restrictions and used snowball methods to locate relevant articles. We included studies that were conducted using randomized control trial design that had a sample size of at least 10 participants per pairwise comparison that conducted an experimental comparison of parent skills training programs to a no-treatment control group, including waitlist control, or a treatment as usual comparison group for parents or caregivers who had a child with an autism spectrum disorder. We extracted data on study characteristics, study level risk of bias using Cochrane methodology, sample characteristics, intervention content and delivery methods, outcome measures, and study results and effects. Two researchers independently extracted data, with discrepancies resolved through consensus. We combined the effects of parent skills training programs using a random effects meta-analysis with an inverse-variance weighted mean effect size for six outcomes (adaptive behavior, child development, problem behavior, parent skills, parent psychological health, and interpersonal family relations).
Results: We screened 606 full-text records and identified 21 studies with 22 independent pairwise comparisons. Random effects meta-analyses showed better outcomes in reduction in problem behaviors (k = 8, g = 0.38; 95% CI 0.19 to 0.57), but not for child development (k = 11, g = 0.14; 95% CI -0.07 to 0.35). Parents show improvements in parenting skills (k = 11, g = 0.84; 95% CI 0.64 to 1.03), psychological health (k = 13, g = 0.34; 95% CI 0.19 to 0.50), and interpersonal family relations (k = 7, g = 0.43; 95% CI 0.23 to 0.64). We also examined adaptive behavior but only located two studies examining this outcome thus did not statistically synthesize the data due to the small sample.
Conclusions: This review and meta-analysis of parent skills training programs for children with autism spectrum disorders shows the strongest evidence to date that this intervention leads to positive child and family outcomes. Specifically, our findings show children have reduced frequency and/or intensity of problem behaviors and parents have improved parenting skills, psychological well-being, and interpersonal relations with other members of their family.

37   **157.037**   Mindfulness in Intellectual and Developmental Disabilities

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Background: Though mindfulness based interventions, which teach individuals to focus their attention in a nonjudgmental way, have been successfully used in a variety of medical and psychiatric conditions to reduce stress and anxiety and improve quality of life, they have only recently been studied in the context of intellectual and developmental disabilities (IDDs). Before mindfulness programs become more widely accepted and applied in the IDD field, it is important to demonstrate their feasibility. As not all individuals with IDD are able to provide verbal report of their experiences during mindfulness sessions, physiological measures such as cortisol, a neuroendocrine hormone, can provide objective accounts of stress and arousal.
Objectives: Examine the effects of daily mindfulness practice on cortisol levels in individuals with developmental disabilities, including Autism Spectrum Disorders (ASD).
Methods: Participants included 68 individuals (22.8±7.9 years; 24% female) with an intellectual or developmental disability, including ASD, Down syndrome, and Williams syndrome. As part of their attendance in camp programs, individuals participated in a daily 20-minute mindfulness session for five consecutive days. Activities in the sessions included Qigong yoga, deep breathing, seated meditations, body scans, and lessons on incorporating mindfulness into everyday life. Prior to and 20-minutes after each session, participants provided saliva samples for cortisol. Hierarchical linear models were used to assess cortisol responses to the mindfulness sessions.
Results: Cortisol values >3 standard deviations were considered outliers and removed, resulting in a total of 623 cortisol data points available for analysis. Cortisol values were natural log transformed for normality. The random effects model revealed that while there was significant individual variability in cortisol values (i.e., model intercept variability; p<.001), there was not significant variability in the cortisol response to each session (i.e., model slope variability; p>.5). Indeed, there was a significant decline in cortisol levels in response to each day's mindfulness session (p<.001). Though individuals with ASD did not differ in overall cortisol levels from individuals with other IDDs, there was a trend for them to have a greater decline in cortisol levels in responses to mindfulness sessions (p=0.075).
Conclusions: To our knowledge, this is the first study to assess levels of a biomarker in response to a mindfulness intervention across individuals with a variety of IDDs including ASD. These results extend our previous work and demonstrate the feasibility of mindfulness training for a wider population. We will discuss how individual and disorder specific characteristics relate to participation in the mindfulness training. Findings have implications for the ability of people with IDD to engage in mindfulness and the usefulness of mindfulness as an intervention tool for people with IDD.

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38   **157.038** Movement and Synchrony in Interactions By Adolescents and Adults in Dance/Movement Therapy

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Background: Even higher functioning individuals with ASD struggle with nonverbal aspects of interactions. Limited interactional synchrony, which is associated with rapport, may contribute to this difficulty. One potential intervention is dance/ movement therapy (DMT) as it uses movement to address nonverbal relational skills including coordination with another person.
Objectives: To 1) assess the relationship between *synchrony* and *interaction quality*, 2) explore other movement qualities related to success in the interactions, and 3) observe change over 10 weeks of DMT.
Methods: This mixed methods secondary analysis used a multiple single subject design with embedded qualitative descriptions to investigate the movement and interactions of six participants in DMT. Participants were 4 males and 2 females, 14-42 years-old, with an ASD diagnosis, and an IQ of at least 70. The partners were other participants with ASD or research assistants of the parent study. For the current study, raters blind to session number rated either interaction or synchrony scales for four 30-second clips of partnered mirroring and open-ended partnered dances per session. Quantitative scales measured five types of movement synchrony and interaction quality (Affective Engagement and Flow of the Interaction; Garcia-Perez, Lee, & Hobson, 2007). All raters wrote descriptions of the video, with raters trained in movement observation listing specific movement qualities used by the participants. This was analyzed by participant and across participants using visual inspection of SSD graphs, correlations, and qualitative analyses.
Results: All participants received the highest or second highest score on the 5-point Affective Engagement scale at least once.   Visual inspection of graphs of each participant showed high variability across sessions with different partners. Change over time was only noted in one participant who had the same partner for five sessions. Together with the qualitative descriptions, this suggests that the partner plays a role in interpersonal synchrony and the participant's engagement. Initial qualitative analyses suggest that the partner can support more successful engagement by introducing movements at the right level of challenge for that participant. The two interaction scales were positively correlated across participants, $r_s(69)=.760$, $p<.001$. Synchrony scales were significantly correlated with interaction quality scales for some participants. Repeated paired t-tests of correlation values across participants, raters, and synchrony types showed that synchrony was

correlated positively and significantly more with scores on Flow of Interaction than with scores on Affective Engagement. This demonstrates a specific relationship between movement synchrony and Flow of Interaction.

Conclusions: Given the right conditions, these participants could demonstrate affective engagement with their partner. The partner's role suggests that therapists and others should be purposefully matched to the individual. As DMT can specifically address movement synchrony, it may be an appropriate treatment to improve the flow of interactions by individuals with ASD.   Further studies with a larger sample size and consistent partner pairings are needed to assess change over time and test for generalization.

Reference:

Garcia-Perez, R.M., Lee, A., & Hobson, R.P. (2007). On intersubjective engagement in autism: A controlled study of nonverbal aspects of conversation. *Journal of Autism and Developmental Disorders, 37*(7), 1310-1322. doi: 10.1007/s10803-006-0276-x

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39   **157.039** Neural Predictors of Treatment Response to Social Skills Training in Children with Autism —Findings from a Randomized, Comparative Study

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Background: Social skills training using a cognitive-behavioral (CBT) approach has been shown to be effective in improving social behavior deficits in children with ASD. A critical area for autism research is gaining a better understanding of variability in response to treatment. Several neuroimaging studies have shown that ASD is associated with hypoactivation of key "social brain" regions, including the fusiform gyrus (FG), the superior temporal sulcus, and the medial prefrontal cortex. However, little is known about patterns of brain activity that predict response to treatment. More work is needed to examine the potential of baseline functional neuroimaging to identify moderators and predictors of treatment outcomes.

Objectives: This study examined whether baseline brain activity was associated with response to social skills group treatment in the context of a randomized, comparative trial. A CBT approach was compared with a child-directed play group.

Methods: Verbally fluent children with ASD, 8-11 years of age, were randomized to the CBT or comparison group. Both treatments consisted of 12 weekly 90-minute sessions (4-6 children in each group) with a parent component. The CBT treatment addressed 3 skill areas: **N**onverbal communication, **E**motion recognition, and **T**heory of mind **T**raining (Seaver NETT). Behavioral assessments and fMRI were conducted at baseline, end of treatment, and at a 3-month follow up. While undergoing fMRI, children viewed images of emotionally expressive faces depicting anger, fear, disgust or a neutral expression. Faces displayed either a direct or averted gaze. Regression analyses were conducted to evaluate the relationship between baseline brain activity and changes in social cognition and behavior.

Results: Across both groups, baseline activity in the left FG was significantly correlated with improvement in social awareness, as measured by the social awareness subscale of the Social Responsiveness Scale. In addition, activity in the right FG moderated changes in social awareness; specifically, children with greater baseline FG activity showed greater improvement in social awareness for the CBT group only. Across both groups, baseline activity in the right FG predicted improvement on a social cognition composite measure following treatment.

Conclusions: Overall, these results show that baseline activity in the FG was associated with children who demonstrated the greatest improvement in measures of social awareness and social cognition following treatment. The FG is a key "social brain" region associated with face processing, particularly in the right hemisphere. Previous studies have found that right FG activity is associated with less severe social impairment in individuals with ASD. These findings could suggest that children who exhibit a more typical neural response to faces at baseline may be more likely to show improvement following social skills groups, both CBT-based and more child-directed approaches. However, the clinical significance of these findings is limited given that neither group showed significant increases in social awareness or social cognition following treatment; findings should be taken with caution. This study is a first step toward identifying potential predictors of treatment response—an essential goal of ASD research, as elucidating biomarkers may facilitate the development of tailored interventions and promote positive treatment outcomes.

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40   **157.040** Novel Music Intervention Model and Its Effects on Transition from Minimally Verbal to Verbal in Autism Spectrum Disorders

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Background: According to the Centers of Disease Control estimates of 2014, every 42nd boy and 189th girl in the United States has an Autism Spectrum Disorder. Every third child affected fails to develop functional language despite early intensive interventions, and will require life-long care. Tager-Flusberg and Kasari (2013) have suggested that particularly around the age of 4-5 years, there may be specific developmental changes that place a child on a path to becoming verbal, or remaining

minimally verbal, and that development of novel interventions that target this transitional stage may be important. Despite general lack of knowledge about minimally verbal autism, affinity to music activities and exceptional pitch perception have been described. Taking advantage of preserved musical abilities in these children coupled with the knowledge from neuroscience research of shared neural systems of music and language, may offer a novel, music-based way to target the transition from minimally verbal to verbal in these children.

Objectives: To identify the mechanism by which, and evaluate effectiveness of, the role of musical stimuli, based on shared characteristics between music and speech, in development of meaningful spoken language in a 5 1/2 year old girl with minimally verbal autism with severe behavioral disturbances, and high nonverbal intelligence quotient (IQ) score, who failed to respond to any known intensive intervention modes; to characterize developmental trajectories and timeline of language acquisition in minimally verbal autism.

Methods: A single subject design with short and long-term follow up. The novel intensive intervention model consisted of hierarchically designed active musical multicomponent system as primary intervention, 60 hours per week for two years, supported by operant conditioning to: (1) target the development of cognitive skills necessary for language acquisition and auditory scene analysis; (2) build access to spoken language development via shared features of music and speech (e.g., pitch, infra-pitch, timbre, prosody, patterns, accents, sequences); (3) enhance perception of basic meaningful vocabulary and construction of word combinations, sentences, and overcoming echolalia. Musical/speech stimuli incorporated the full range of sound frequencies of the human auditory system. Traditional and novel behavioral, cognitive, and linguistic assessments and observations at multiple time points, and adult outcome served as primary outcome measures.

Results: Substantial decrease in frequency and intensity of undesired behaviors, and improvement in attention to auditory scene information was noted within the first month. Subsequent gradual development of cognitive skills necessary for language acquisition, sound/meaning equation, auditory memory, meaningful verbalization, and mathematical/musical cognition enabled to incorporate the least restrictive educational environments after 2-year long intensive intervention, and ultimately led to an optimal adult outcome. The developmental trajectories and timeline of language development displayed unique characteristics.

Conclusions: The novel music intervention model proved to be an effective method for transition from minimally verbal to verbal, and may have potential to serve as a modifier to current early intensive interventions to benefit a subgroup of children with minimally verbal autism who would otherwise remain minimally verbal.

41 **157.041** Novel Neuromodulation Therapy Integrating rTMS and Neurofeedback for the Treatment of Autism Spectrum Disorders

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Background: Autism spectrum disorder (ASD) is a pervasive developmental disorder characterized by deficits in social interaction, language, stereotyped behaviors, and restricted range of interests. Based on neuropathological findings from our laboratory we proposed that repetitive transcranial magnetic stimulation (rTMS) could offer a therapeutic intervention targeting some of the described pathology. Our initial studies used 6, 12, and 18 sessions of slow frequency (0.5-1.0 Hz) rTMS over the dorso-lateral prefrontal cortex (DLPFC) with positive behavioral and electrophysiological results in children with ASD. Specifically we reported improvements in behavioral and executive functioning using electrocortical measures. In this study we probe the synergistic effects of neurofeedback in combination with rTMS.

Objectives: To study the combined effects of 18 sessions of low frequency rTMS over DLPFC with the prefrontal EEG biofeedback (neurofeedback -NFB) to prolong and/or reinforce TMS-induced EEG changes using a post-TMS EEG operant conditioning paradigm. The underlying hypotheses were that: (1) the combination of rTMS with neurofeedback would result in a synergistic outcome as compared to TMS-alone, and that (2) bothTMS-only and TMS+NFB would improve executive functions in autistic patients as compared to the waitlist control group.

Methods: The pilot trial recruited 54 children with ASD (mean age 14.2 yrs). Outcome measures included behavioral evaluations (Aberrant Behavior Checklist, repetitive Behavior Scale, Social Responsiveness Scale, etc.) and psychophysiological tests (e.g., visual oddball test with EEG recording). For the main goal of the study, we used 18 sessions of rTMS-only (TMS, N=17), 18 sessions of rTMS followed by prefrontal biofeedback combination (TMS+NFB, N=18) and waitlist (WL, N=19, 3-6 moths between tests) groups to examine effects on EEG, event-related potentials (ERP), and other functional and behavioral clinical outcomes.

Results: Behavioral, EEG and ERP outcomes were collected in pre- and post-treatment tests in all 3 groups. Results of the study support our hypotheses by demonstrating the positive effects of combined TMS+BFB neurotherapy as compared to TMS-only. Both TMS groups showed significant improvements in behavioral and functional outcomes as compared to the children in the wait-list group. Follow-up assessments in both treatment groups (6-9 months post-treatment) are underway to assess the longitudinal stability of the findings and the need for booster sessions.

Conclusions: Our preliminary results are supportive of the hypothesis that combined rTMS and neurofeedback neuromodulation has longer lasting effects than rTMS alone. There have been no

major side effects of the reported therapy and it has proven safe to apply in young children. Transcranial magnetic stimulation is the only treatment alternative, as of present, that targets some of the pathology observed in ASD.

42   **157.042** PEERS® in New York City: An Initial Feasibility Effort

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Background: Clinicians and researchers alike have increasingly placed emphasis on providing interventions to individuals with autism spectrum disorder (ASD) to facilitate the acquisition of social skills and foster positive peer relationships. These interventions are particularly important in adolescence, when social isolation has been linked to poor psychological health and academic achievement (Hall-Lande, Eisenberg, Christenson, & Neumark-Sztainer, 2007). During this developmental window, close friendships have been shown to increase self-esteem and protect against symptoms of anxiety and depression (Buhrmester, 1990).
Emerging evidence has shown that the Program for the Education & Enrichment of Relational Skills (PEERS®; Laugeson & Frankel, 2010) – a 14-week parent-assisted social skills intervention – may improve social competence and increase friendships among adolescents with ASD. While these initial efforts are promising, numerous areas of investigation remain, including and beyond independent replication. For example, given the heterogeneity of ASD, the following questions warrant investigation: which teens best benefit from PEERS®? Can we identify behavioral or other objective markers that predict response to treatment in participating teens and parents?
Objectives: Our long-term plan is to address the aforementioned questions in a randomized-controlled design and identify predictors of response to treatment at neuronal, cognitive, and or clinical domains. As a first step towards this long-term goal, we aim to establish a PEERS® intervention program in our northeastern urban clinic and assess its feasibility.
Methods: A group of licensed clinicians and postdoctoral fellows completed PEERS® training and certification led by the program developers in Summer 2014. Shortly after, they began recruitment and treatment for interested families. Treatment is currently ongoing in an open-label fashion and we are in the process of obtaining IRB approval to examine data collected pre- and post-treatment. Adolescents enrolled in the treatment have social impairments consistent with a diagnosis of ASD, average IQ, and at least one parent available for group meetings and treatment-related activities. Scores on the Test of Adolescent Social Skills Knowledge (TASSK; Laugeson and Frankel, 2006) were selected as the primary outcome. The Social Responsiveness Scale, Second Edition (SRS-2; Constantino, 2012) and a range of other clinical measures were selected as secondary outcome measures. Recruitment challenges and treatment attrition are also tracked.
Results: We will report data on the recruitment rates, barriers at enrollment (e.g., scheduling conflicts, inclusion criteria), and rates of response on our primary and secondary outcome measures. Based on previous studies, we anticipate participants will demonstrate gains in their knowledge and performance of social skills, engage in more get-togethers, and show decreases in core autistic symptoms and problem behaviors from pre- to post-intervention.
Conclusions: This represents our initial step toward replicating and extending previous findings. This effort will allow us to refine our objectives for future research.

43   **157.043** Parent Perspectives on the Impact of a Sexuality and Relationships Group Education Program for Adolescents with ASD and Their Parents

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Background: As individuals with ASD enter adolescence, they face new challenges, including the exploration of sexuality and romantic relationships. Individuals with ASD show interest in and desire for relationships, but deficits in social and communication skills characteristic of ASD can impair their abilities to seek and maintain relationships (Gabriels & Van Bourgondein, 2007). Despite this, individuals with ASD receive less education on sexuality than their typically-developing peers and are more likely to acquire knowledge about sexuality and relationships from their parents (Stokes & Kaur, 2005; Stokes, Newton, & Kaur, 2007). Parents of adolescents with ASD report concerns related to sexuality and relationships and express the need for support in teaching their children about these topics (Ballan, 2012).
Objectives: The first objective of the present study was to examine parent satisfaction with a group education program for adolescents with ASD and their parents. The second objective was to assess the impact of the program on parent-child discussion of sexuality and relationships, parent comfort discussing these topics, and parent concern regarding sexuality and relationships.
Methods: Eight adolescents with ASD (ages 12-16) and their parents participated in a six-session program designed to provide education on sexuality and relationships. Adolescent sessions covered topics including: puberty, privacy and personal boundaries, types of relationships, dating, sexual

activity, and legal and safety issues. Separate parent sessions included review of the adolescent material and discussion of strategies to support adolescents in understanding the topics. To examine the impact of the program, parents completed questionnaires assessing satisfaction with the group, experience and comfort discussing sexuality and relationships with their children (adapted from Schuster et al., 2008), and concerns related to sexuality and relationships (Stokes & Kaur, 2005).

Results: Parents reported that the group was beneficial for themselves and their adolescents, and that the group met the needs of their families. Parents reported having discussed more topics with their adolescents following the program ($M = 14.13$, $SD = 6.11$) than prior to participation ($M = 8.25$, $SD = 3.62$), t (7) = -3.18, $p = .015$. Parent ratings of comfort discussing sexuality and relationships were not significantly different prior to ($M = 33.75$, $SD = 12.51$) and following ($M = 38.50$, $SD = 10.80$) participation, though the means were in the correct direction. Parents reported less concern related to sexuality and relationships following the program ($M = 19.29$, $SD = 7.02$) than prior to participation ($M = 16.00$, $SD = 6.30$), t (6) = 2.97, $p = .025$. Further examination revealed that while group participation alleviated some parent concerns, worry about other topics appeared to increase (See Figure 1).

Conclusions: Providing education on sexuality and relationships in a group format appears to be beneficial for adolescents with ASD and their parents. Participation in a group education program was related to more discussion of sexuality and relationships between parents and adolescents, as well as decreased parent concern related to these topics. Further examination of these findings is justified, particularly given the need for sexuality and relationships education for adolescents with ASD.

44   **157.044** Parent Variables in Responder Status in a CBT for Children with ASD

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Background: Many studies highlight the crucial role that parents play in interventions for children with Autism Spectrum Disorder (ASD) (Hassenfeldt, Lorenzi, & Scarpa, 2014). Further, parental confidence, or self-efficacy, has been indicated as an important factor related to child problem behaviors and stress (Rezendes & Scarpa, 2011). Lecavalier (2006) estimated that more than 60% of children with ASD present with emotion regulation difficulties. The Stress and Anger Management Program (STAMP), a cognitive behavioral therapy (CBT) with an active parent training component, provides strategies for emotion regulation for children ages 5-7 with ASD (Scarpa, Wells, & Attwood, 2013). A small RCT showed group level differences (STAMP vs. wait-list control) in emotion regulation and coping skills. STAMP views parents as co-facilitators who are critical to their child generalizing self-regulatory skills to contexts beyond therapy groups (Hassenfeldt, Lorenzi, & Scarpa, 2014). While this program is designed to reduce emotional outbursts, it is important to study differences between responders and nonresponders.

Objectives: The primary objective is to examine the role of parental confidence in both themselves and their child in domains related to STAMP (anger and anxiety), as well as their perception of the material, in relation to responder status.

Methods: Thirteen children (86.4% male), ranging from 58-90 months (M =78.62, SD = 2.73), participated in STAMP. Originally, eligibility criteria included an ASD diagnosis; however, one transdiagnostic group included two children with other clinical diagnoses that involved emotion regulation issues. The intervention involved nine one-hour weekly child and parent group sessions. Parents completed measures pre- and post-treatment. Responder status was determined by meeting two of four criteria, which included a statistically significant decrease (RCI) in the Lability/Negativity subscale on the Emotion Regulation Checklist (Shields & Cicchetti, 1997), or a 20% decrease in meltdown intensity, frequency, or duration, as measured by a behavioral monitoring form.

Results: Based on the responder status criteria, 8 children were identified as responders and 5 as non-responders. Significant differences in parental confidence were found within groups. Specifically, parental confidence in the responder group increased from pre to post treatment in all domains, which included confidence in themselves in dealing with anger ($z = -2.375$, $p = .018$) and anxiety ($z = -2.032$, $p = .042$), as well as in their child dealing with anger ($z = -2.388$, $p = .017$) and anxiety ($z = -2.388$, $p = .017$). There were no significant changes in non-responders. Further, on Parent Satisfaction Surveys, there were significant differences in the difficulties parents expressed in learning cognitive skills ($U = 5.5$, $p = .030$), in addition to the degree to which they found these cognitive tools to be useful ($U = 4.0$, $p =.019$), such that non-responder parents found them to be more difficult and less useful.

Conclusions: This illustrates the importance of parental confidence and their perspective on the material in treatment outcomes. Increasing parental confidence and understanding of material may be key to treatment success, and further supports the value of parent involvement in intervention.

45   **157.045** Participation in a Social Competence Intervention in a Private Clinical Setting and the Impact of Anxiety and Emotion Dysregulation in ASD

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Background: Research has indicated high rates of anxiety symptomatology in ASD (White, Oswald,

Ollendick, & Scahill, 2009). A model proposed by White et al. (2014) indicated that in ASD, anxiety may manifest as a result of a disrupted underlying emotion regulation system. Furthermore, there continues to be a gap between research in such areas in controlled laboratory settings and corresponding clinical applications (Habayeb, Rich, & Alvord, 2014). There is therefore a need to understand the relationship between emotion regulation and anxiety in ASD and to develop targeted, community viable, interventions.

Objectives: To understand the clinical profile of children with ASD receiving services in community settings in regard to anxiety and emotion regulation presentation and to assess the effectiveness of the Resilience Builder Program® (RBP) in alleviating such symptoms.

Methods: 34 children with ASD (mean age, 9.74 years) were treated in a large private practice with the RBP, a manualized group therapy that targets social competence and resilience-based skills. Pre- and post- treatment questionnaires included the Behavior Assessment System for Children, 2nd Edition (BASC-2; Reynolds and Kamphaus 2006), which measured social, emotional and behavioral functioning, the How I Feel questionnaire (HIF; Walden, Harris, & Catron, 2003), which assessed positive and negative emotionality as well as emotion control, and the Self-Report for Childhood Anxiety Related Emotional Disorders (SCARED; Birmaher et al., 1997) which assessed anxiety.

Results: Based on BASC-2 measures, 36.3% (n=12) of the participants displayed at-risk levels of emotional dysregulation while another 18.2% (n=6) presented with clinically significant levels. Additionally, 25.8%(n=8) of the sample presented with at-risk levels of anxiety, while an additional 6.1% (n=2) showed clinically significant levels. Results from the SCARED indicated that 31.2% and 18.8% of the sample (n=5;n=3) presented with clinically elevated levels of general and social anxiety, respectively. Levels of emotional control as measured by the HIF improved significantly pre- to post-treatment (t(12)= -2.21, p = .047). Based on a median split, in the high emotional control group, improvements in emotional control predicted a decrease in anxiety across treatment (F(1,5)=17.83, R^2 = .82, p=0.01). This was not found in the low emotion regulation group (F(1,5)=0.23, R^2 = .06, p=0.66).

Conclusions: Compounded upon the inherent challenges of ASD, our findings indicate that a number of children with ASD receiving services in a clinical service setting present with additional challenges in regard to emotion dysregulation and anxiety. Approximately 50% of these ASD youth had at-risk or clinically significant elevations in anxiety and emotional dysregulation symptoms. Therapy effectiveness data found that children with ASD showed improved emotion regulation following the RBP. In the youth with high levels of emotion regulation at therapy onset (but not in those with low levels of emotion regulation), gains in emotion regulation were related to decreases in anxiety. Our findings begin to support White et al.'s (2014) model and allow us to better understand underlying mechanisms of co-occurring and often heterogeneous challenges experienced by individuals with ASD. Such research also provides insight on the importance of conducting intervention research in real-life clinical service settings.

46 **157.046** Peer-Mediated Pivotal Response Treatment for Young Children with Autism Spectrum Disorder at School

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Background: The gap in effective intervention models for children with autism spectrum disorder (ASD) at school is striking. School-based interventions must not only be evidence-based but also feasible and acceptable to school stakeholders. While researchers tend to focus on the fidelity of intervention implementation in lab settings, educators often feel that researchers do not consider the complexity of implementing interventions in the real-world school environment (Kasari & Parsons, 2013; Stahmer, Collings, & Palinka, 2005). Approaches in which typically developing (TD) peers are trained to implement an intervention directed toward children with a disability offer a face-valid and cost-effective means of promoting social skill development for children with ASD. A peer-training approach based on Pivotal Response Treatment (PRT; Koegel & Koegel, 2006) holds high heuristic value for implementation in schools given its emphasis on embedding learning opportunities into everyday contexts and routines (Koegel et al., 2011; Stahmer et al., 2011). Peer-implemented PRT has been shown to enhance the communication skills of children with autism in five published studies to date. This intervention is typically provided among 7- to 10-year-olds, although peer-implemented PRT may also be effective in the first year of school.

Objectives: The main objective of the present single-subject design case series was to evaluate the efficacy of peer training in PRT for improving social skills of children with ASD in the first year of school.

Methods: Four children with ASD, eight TD kindergarten peers (social skill coaches), and their parents and teachers participated. A non-concurrent multiple-probe (across participants) baseline design was used, in which TD peers were individually trained in PRT with a classmate with ASD using the Kids Helping Kids Manual (Pierce & Schriebman, 1997). Outcomes for children with ASD and peer coaches were assessed before, immediately after, and 6 to 9 weeks following training using behaviour coded from video recordings as well as questionnaires. Data were analyzed using visual inspection and percentage of non-overlapping data (PND).

Results: Overall, for children with ASD, social-communication skills (rate of social initiations and peer engagement) increased following training and were maintained at 6-9 week follow-up (*M* = 81.25 % PND). Peer coaches' fidelity in implementing PRT varied more, but generally increased following

training. Enhanced social-communication skills of children with ASD were demonstrated in non-training locations for all children, and generalized to non-trained same-aged peers for two of the four children.

Conclusions: Few effective interventions targeting social-communication skills for students with ASD have been implemented at school. In the present study, relatively brief training of TD peers in PRT produced gains in the social-communication skills of children with ASD in the first year of school. Our findings add to the body of literature on peer-mediated PRT and suggest that this may be an effective, feasible and cost-effective approach for children with ASD at school.

47 **157.047** Perceptions of Friendships in School-Aged Children with Autism Spectrum Disorder

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Background:
Developing meaningful friendships is challenging for many children with autism spectrum disorder (ASD). Children with ASD want friendships, but their friendships are often of poor quality compared to their neurotypical peers (Bauminger, Shulman, & Agam, 2004). Elementary-age children with ASD have reported fewer reciprocated friendships and are less engaged with their peers (Kasari et al., 2011). Little is known about these children's perceptions of friendships and how that affects their social engagement with their peers in schools.
Objectives:
The current study examined the association between perceptions of friendships and social engagement in elementary school-aged children with ASD.
Methods:
Participants included 141 children with ASD from the Greater Los Angeles area, ages 6 to 12 (M = 8.31, SD = 1.62), 89.4% were male, and from diverse ethnic backgrounds (28.5 % Caucasian, 10.9% African American, 21.2% Hispanic, 30.7% Asian, and 8.8% Other). Children were fully included in general education classrooms with IQs above 65.
The *Autism Diagnostic Observation Schedule (ADOS)* was used as a diagnostic tool for ASD and to measure perceptions of friendships. Three categories of friendships were created based on children's response during the assessment: Play, Emotion, and None. Play was defined as friendships that were activity-based (e.g., "We play Star Wars and tag."). Emotion was defined as friendships with an emotional or affective component (e.g., "You're always there for one another."). None was defined as children who didn't report any friends or didn't know the meaning of friendships.
The *Playground Observation of Peer Engagement* was used to measure engagement with peers on the playgrounds at school and was coded as percent time spent in solitary (e.g. play alone) or engaged (e.g. in games) during recess.
Results:
Descriptive analyses revealed only a small percentage (14.73%) of children described their friendships with an affective/ emotional aspect. The majority of the children describe their friendships as playing together, 82.97%. 4.21% of the children did not report any friends or understanding of friendship.
Independent samples *t* tests were used to examine the social engagement of children who perceived friendships as playing together. These children spent significantly less time in solitary at recess (M =16.79, SD = 19.50) than those who did not describe friendship as playing together (M= 36.27, SD =27.40), t (85) = 3.193, p = 0.002. Independent samples t-tests were also used to examine social engagement of children who perceived friendships with an emotional aspect and who did not. No significant differences were found between the two groups (p > .05).
Conclusions:
Similar to previous studies, children's definition of friendships was more activity-based and was limited in the emotional aspect of friendships. Interestingly, children who defined friendships as playing together were less isolated at school. This finding suggests that friendships for this population at this age may be more activity-based. Future intervention studies may want to consider using more activity- and play-based activities to foster meaningful relationships in schools.

48 **157.048** Performance Feedback Procedures for Sleep Protocol

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Background: Asking adults in community settings to implement evidence-based intervention (EBI), is an intervention in itself. That is, in order for interventions to be disseminated in community settings, the behavior of the adults implementing the EBI requires change too. The standard approach to adult training includes didactic presentation which rarely results in the desired behavior change. More than 60 years of consultation studies and scientific publications illustrate that didactic training without ongoing consultation and feedback *does not* result in implementation fidelity at clinical levels. Performance feedback (PFB) consultation (Noell et al., 2005; Connell, 2010) is a set of procedures that provides the important transfer of knowledge, *and*emphasizes implementation adherence through the use of modeling, practice and feedback. This project is novel in that

performance feedback procedures will be implemented in the home, where the primary intervention agent is the parent and the intervention procedures are designed to reduce night-time awakenings and insomnia using either a Tailored Behavioral Intervention or the Standard Care protocol.

Objectives:
(1) Describe positive routines and PFB procedures
(2) Discuss the challenges of training a multidisciplinary team to provide PFB to caregivers of children with ASD and insomnia implementing a TAB.
(3) Describe the strengths and limitations of a multidisciplinary team implementing PFB with the caregivers

Methods:
Performance feedback is a set of procedures that includes frequent consultative support about plan implementation using detailed and frequent consultative visits. Fidelity will be measured by the percentage of total number of steps completed by caregivers (s), divided by the steps in the TAB at each visit.

The 3 components of the TAB: positive routines, faded bedtime protocol and 12 activities in a Calming Module, all have specific sequenced steps to follow. Caregivers and consultant will develop a tailored plan and goals will be agreed upon. During each subsequent visit, the steps completed for each agreed upon activity will be reviewed and visually graphed and discussed with the caregiver. Feedback will be clear, focus on missed steps and overcoming barriers to implementation and have a graph to show the percent of completed steps for review and discussion. New goals may need to be negotiated depending on the barriers uncovered during the consultation, and the caregiver's ability to overcome those barriers.

Results: PFB consultation provides important transfer of knowledge, *and*emphasizes implementation adherence and fidelity through the use of modeling and implementation feedback to the consultee and caregiver.

Conclusions: We will present TAB implementation adherence for three participants before (baseline), and after (intervention) performance feedback is delivered using a within-subject, multiple baseline. The data will illustrate the effects of focused and tailored consultative procedures used in the home with the primary caregiver on the implementation of the TAB protocol.

49   **157.049** Physical Activity Among Children with Intellectual and Developmental Disabilities
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Background: In Canada, nearly 1 in 3 children and youth between the ages of 5 and 17 years are overweight or obese. Children and youth with intellectual and developmental disabilities (IDD) are at an even greater risk for obesity and have an increased prevalence of obesity-related health conditions than their typically developing peers. Physical inactivity is a significant lifestyle factor that is contributing to the increased prevalence of obesity. Approximately 7% of Canadian children and youth participate in the recommended 60 minutes of moderate- to vigorous- intensity physical activity (MVPA) on at least 6 days a week. It is suggested that children with ASD (Bandini et al., 2013; Rosser Sandt & Frey, 2005) and Down syndrome (Esposito et al., 2012) spend significantly less time engaged in MVPA than their typically developing peers.

Objectives: To understand physical activity participation among 17 children (10 boys, 7 girls) with IDD, ages 7 to 12 years. Children included in this research had formal diagnoses of ASD (n = 12), Down syndrome (n = 2), fetal alcohol spectrum disorder (n = 1), and global developmental delay (n = 1); all had some degree of intellectual impairment. Time spent engaged in MVPA and the number and type of activities were examined.

Methods: Physical activity was measured over a 7-day period using Actigraph GT3X accelerometers. Time spent in MVPA (minutes) was measured. To be considered in the analyses, the accelerometer was worn for a minimum of 10 hours for a minimum of 4 days (3 weekday and 1 weekend) during the week. All monitoring periods were during the school year. The Children's Assessment of Participation and Enjoyment (CAPE) was used to examine participation outside of school activities.

Results: A total of 85 days met the minimum wear time to be included in the analyses. On average, children with IDD spent 27.8 minutes per day engaged in MVPA (6 to 86 minutes) and only 1 child consistently achieved the recommended 60 minutes of MVPA. Two other boys achieved 60 minutes of MVPA on a single day during the monitoring period. Although not significantly different, boys (31.8 ± 22.7 minutes) participated in more MVPA than girls (22.1 ± 13.2 minutes). Looking specifically at the physical activity category of the CAPE, children with IDD participated in an average of 3 out of 13 different activities, with participation ranging from 0 to 7 activities. Although not statistically significant, younger children aged 7 to 9 years (4 ± 2 activities) participated in a greater number of activities than older children aged 10 to 12 years (2 ± 1.7 activities). In the physical activity category, boys and girls performed a similar number of activities.

Conclusions: In order to improve PA participation among children with IDD, it is important to understand their current levels of PA within the narrow range of activities they currently participate in. This understanding will facilitate the provision of services, programs, and supports to improve participation among children with IDD.

50   **157.050** Pilot Randomized Clinical Trial of a Wireless Moisture Pager for Toileting Training Children with Autism Spectrum Disorder
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Background:
For many children with ASD, toileting acquisition is delayed, resulting in decreased independence; therefore, a training method that is user-friendly and effective is needed. We developed a a novel enuresis alarm (the wireless moisture pager [WMP]) and a corresponding manualized intervention The WMP consists of an Ipod-based app that interfaces with a transmitter/disposable sensor positioned in the child's underwear. The WMP emits an auditory page upon contact with urine and provides Bluetooth data transmission for timely clinician monitoring and feedback.
Objectives:
The *primary objective* of this study was to evaluate the feasibility of the study protocol (i.e., ≥80% of recruitment and retention targets; ≥80% fidelity of parent training by interventionists and ≥80% fidelity of parent implementation). The *secondary objective* was to examine trends in outcome data by conducting a small RCT (N =30) of WMP and a standard behavioral intervention (SBT). Specific outcome measures included: (1) rate of urine accidents and toilet usage following 3 months intervention and at 3 month follow-up, (2) rate of toileting skill acquisition, and (3) parent satisfaction with intervention.
Methods:
Thirty-three participants, ages 3-6 with an ASD diagnosis and inability to use the toilet, were randomized 1:1 to either the WMP or SBT group. For both groups, parents received training at baseline and were expected to carry out their assigned interventions for 12 weeks with "booster sessions" at weeks 2, 4, 6, 9, and 12. Initial training sessions were recorded and scored using a fidelity checklist by an independent rater. Parents recorded data regarding accidents and toileting for 3 consecutive days prior to each booster session and 3 months after intervention. Interventionists rated parent fidelity to intervention at each visit. Parent satisfaction questionnaires were collected at final study visit.
Results:
Participant recruitment targets were successfully met and retention rates were not significantly below target (69% for WMP; 88% for SBT). Initial trainings were administered with a high degree of fidelity (95% for WMP; 97% for SBT). Parents implemented interventions with a high degree of fidelity (mean fidelity scores of 88-90% at each visit for WMP; 92-97% for SBT). At the conclusion of 12 weeks of intervention, no statistically significant differences were found for: (1) rate of at least 2+ daily urine accidents (WMP = 67%; SBT = 85%; p=0.38) and (2) median 3-day count of urination successes (WMP = 3.5; SBT = 2.0; p=0.72). No statistically significant differences on these measures were found at 3 months post-intervention. Using Kaplan-Meier curves indicates no significant group differences in time to toileting acquisition. Parent satisfaction with intervention was similar between the two groups.
Conclusions:
This study provides evidence that well-controlled research comparing parent implemented toilet training methods in the home setting can be conducted. Though outcomes were not statistically significant, differences in the trend of urination accidents over time between the WMP and SBT groups provide some indication that the wireless moisture pager intervention is promising. Future comparative studies with a greater number of participants are warranted.

51 **157.051** Pilot Study of a Tailored Behavioral Intervention for Insomnia in Children with Autism Spectrum Disorder

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Background: Children with Autism Spectrum Disorder (ASD) have demonstrated elevated rates of chronic insomnia, possibly stemming from an arousal dysregulation that produces a constellation of behavioral symptoms that include anxiety, sensory differences, and difficulties sleeping. Based on the theory that a subset of children with ASD are in a hyper-aroused state, we developed a **Tailored Behavioral Intervention (TAB)** for insomnia to supplement the **Standard Care (SC)** established by the Autism Speaks Autism Treatment Network Sleep Tool Kit. The **TAB** developed for this study includes: (1) positive routines, (2) the **Calming Module**, a novel component designed to decrease arousal levels with 12 soothing, relaxing activities, (3) faded bedtime protocol, and (4) **Performance feedback procedures (PFP)**, an effective consultative strategy used to support parents and foster study fidelity. Based on the child's arousal profile selected activities from the CM are incorporated

into the evening routine to relax the child and promote sleep.

Objectives:

(1) Determine the feasibility of implementing randomized control trial of a **TAB and SC** (n = 20) or **SC only** (n = 20) protocol for children with ASD and insomnia, evaluating recruitment, randomization, retention, and implementation of interventions by a multi-disciplinary team with parents of a child with ASD. (2) Complete a comparative cost analysis of the interventions, in terms of training and parent resources needed to teach the interventions, measure fidelity, and collect data on the primary outcome, sleep, as measured by actigraphy. (3) Compare the effects of the interventions on sleep parameters.

Methods: Children ages 6-10 years with ASD and insomnia, stable medical conditions and daytime behaviors and their families are eligible. Measures for all participants include sleep history, 10 days of Actigraphy, sleep diary, and Sensory Profile, Children's Sleep Habits Questionnaire, and Pediatric Anxiety Rating Scale taken at baseline, 4 and 8 weeks post-intervention, and a Parent Acceptability Survey following completion. The multi-disciplinary team develops arousal profiles for each child. **SC** is lead by the nurse or Occupational Therapist. Families are randomized to either **TAB and SC** or **SC only**. The **TAB** group receives eight one-hour home-based sessions.

Results:

To date, 27 families have been enrolled, with completed data sets for N = 8 **TAB** and N = 6 **SC**. Protocol is very acceptable to families (Mean (M) = 6.5, Scale: 0-7) and all subjects have tolerated wearing the actigraph. Actigraphy shows **TAB** participants significantly increased their sleep minutes from baseline to 8 weeks (M = 43.15, standard deviation (SD) = 37.80, p = 0.016), while **SC** participants did not (M = -2.80, SD = 37.78, p = 1.00). Further, **TAB** participants decreased their sleep latency from baseline to 8 weeks (M = -13.94, SD = 14.93, p = 0.055), while **SC** participants did not (M = 1.05, SD = 17.93, p = 0.438)

Conclusions: Preliminary results suggest that the **TAB** intervention is feasible to implement, acceptable to families, and is associated with significantly greater reductions in sleep latency and increases in sleep minutes than **SC only** for children with ASD and insomnia.

52   **157.052** Postural Control Outcomes Following Taekwondo and Videogame Activities in Youth with Autism Spectrum Disorder

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Background: Individuals with autism spectrum disorder (ASD) demonstrate underdevelopment of postural control. Taekwondo (structured group exercise) and Nintendo Wii (game-based individual activities) are two different methods that have been shown to improve postural control for both people with and without disabilities. In addition, these activities have shown positive outcomes on postural control in children with neurological disorders who display similar postural control impairments as children with ASD. However, there is a lack of studies on the effects of TKD and Wii activities on postural control in individuals with ASD.

Objectives: To compare postural control changes following participation in TKD or Wii activities in youth with ASD.

Methods: Eight (□: 10.25 years old, 8 males) and five (□: 11.2 years old, 4 males and 1 female) youth with ASD participated in an 8-week TKD training or Wii activities program, respectively. Each group participated in 40-minute sessions twice a week. TKD sessions were composed of punching, kicking, and forms. Wii activities program participants played games of their choice (Wii-Fit, Just Dance, & Just Dance for Kids). Postural control was measured using a forceplate (NeuroCom Balance Manager) during static (double-leg stance & unilateral stance) and dynamic (step-n-turn & sit-to-stand) activities. Center of gravity (COG) sway velocity and time were measured to examine postural control ability. Double-leg stance was measured on a firm and a compliant surface during eyes open and closed conditions. Unilateral stance was measured on both the right and left during eyes open and closed conditions. Step-n-turn was assessed to the right and left. All assessments were taken immediately before and after TKD training and Wii activities program.

Results: A mixed model analysis of variance was used to assess the overall group interaction (TKD vs. Wii activities) and across time (pre- vs. post- results). A number of assessments revealed significant improvements across time; however, there was no significant difference between the two activities in all postural control measurements. There were significant improvements in three conditions of double-leg stance ($ps<0.05$) and all conditions of unilateral stance ($ps<0.05$). No significant difference was found in double leg stance on a firm surface during eyes closed condition ($p=0.055$). Dynamic measurements show significant results in right-step turn time (F=6.31, $p<0.05$); however, no significance were found in time during sit-to-stand and left-step turn.

Conclusions: The findings indicate that both TKD and Wii activities improved postural control in youth with ASD. TKD training and Wii activities may be effective methods to improve postural control in youth with ASD. Participants with greater deficits in postural control showed more improvements with visible reduction of postural sway following the interventions. This suggests that future study is needed to examine the effects of TKD training and Wii activities in relation to severity of individual's postural control deficit. Also, a further study should investigate the effects of TKD training and Wii activities on postural control in a larger sample size and an extended intervention length.

157.053 Predicting Treatment Outcome of the PEERS® School-Based Curriculum for Adolescents with ASD

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Background: Previous research on the UCLA Program for the Education and Enrichment of Relational Skills (PEERS®), an evidence-based social skills curriculum, has revealed significant improvements in social functioning for adolescents with Autism Spectrum Disorder (ASD) in outpatient mental health settings (Laugeson et al. 2009; 2012; Schohl et al., 2013; Van Hecke et al., 2013; Yoo et al., 2013) and educational settings (Laugeson et al. 2014). Predictors of treatment outcome for outpatient settings have revealed Predictors of treatment outcome for outpatient settings have shown the importance of social control, responsibility and an adolescent's perceived popularity on outcomes in a parent-assisted, therapist facilitated curriculum (Chang et al., 2013). However, predictors of treatment success in school-based samples require further exploration.
Objectives: This study examines pretreatment variables that predict success in developing positive social skills outcomes following the implementation the PEERS School-Based Curriculum, a teacher-facilitated, school-based social skills program.
Methods: This research was conducted under the auspices of The Help Group/UCLA Autism Research Alliance. Participants included 80 adolescents with ASD (58 males, 22 females) attending a nonpublic middle/high school in Los Angeles County. The students, their parents and teachers each completed pre and post-test measures, including the Piers-Harris 2 (PH2; Piers, Harris, Herzberg, 2002), the Social Skills Improvement System (SSIS; Gresham & Elliot, 2008) and the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005). Following the completion of baseline measures, the students participated in a 14-week manualized teacher-facilitated intervention at school, then completed post-test measures. Predictors associated with increases in social skills outcomes as measured by the SSIS were examined using multiple regression analysis of the data.
Results: Preliminary data analysis shows that social responsiveness (SRS) as indicated by parents and child self-report of self-esteem (PH2) at baseline are significant in explaining the variance in social skill acquisition (SSIS) following intervention. Parent report of the child's social communication and the adolescent's perceived abilities in school were significant in explaining the variance in social skills following intervention $F(2,77) = 29.01$, p<001. These two pretreatment variables can account for approximately 43% of the variance in social skills scores after treatment.
Conclusions: Data analysis revealed that social communication and perceived school status/intellectual competence are significant predictors for social skills outcomes following a teacher-facilitated social skills intervention in the school setting. Although consistent with previous research conducted in a clinic setting that parent and adolescent report of social skills and self-perceptions are key in identifying treatment success, this study highlights different subscales that should be further investigated. Specifically, a child's perceived competence and ability in school as measured by the Piers-Harris-2 Intellectual and School Status subscale could predict success of a school-based intervention based on positive regard for the teacher or a motivation to do well in school. This in combination with the strength of the adolescent's social communication skills may help facilitate success.

157.054 Predictors of Companionship for Adolescents with ASD Following the School-Based PEERS® Curriculum

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Background:
Adolescents with Autism Spectrum Disorder (ASD) often suffer from impairment in social interactions which may lead to greater feelings of loneliness, less companionship, and poor friendship quality (Locke 2010; Bauminger & Kasari, 2000). The Program for the Education and Enrichment of Relational Skills (PEERS®) is an evidence-based, teacher-facilitated social skills intervention for adolescents with ASD, which targets the development and maintenance of friendships (Laugeson, 2014) and has been shown to improve friendship quality and companionship in adolescents with ASD (Laugeson et al., 2014). However, predictors of treatment outcome related to improved friendship quality and companionship have yet to be examined.
Objectives:
The present study examines the extent to which parent-reported social skills prior to treatment predict improvement in friendship quality in adolescents with ASD following the implementation of the School-Based PEERS® Curriculum.
Methods:
Under the auspices of The Help Group – UCLA Autism Research Alliance, 146 middle and high school students with ASD ranging from 12-18 years of age (*M*=15.15, *SD*=1.81) participated in a larger treatment outcome study investigating the effectiveness of the PEERS® curriculum, a teacher-facilitated program at The Help Group's Village Glen School. Adolescents received daily social skills

instructions in the classroom for 30 minutes, five days per week, for 14 weeks. Instruction was provided by classroom teachers trained and supervised on the intervention.

In order to understand the relationship between baseline social skills and improved friendship quality following treatment, adolescents and parents completed pre and post-treatment measures. Social skills at baseline were measured using baseline subscale scores on the parent-reported Social Skills Improvement System (SSIS-P; Gresham & Elliot, 2008). Friendship quality was assessed at pre- and post-intervention through adolescent self-reports on the Friendship Qualities Scale (FQS; Bukowski, Hoza, & Boivin, 1994). Pearson correlation coefficients were calculated to understand the relationship between baseline social functioning on the SSIS-P and changes in friendship quality on the FQS subscales following treatment.

Results:

Results indicate that baseline parent-reported Communication ($p<.05$), Assertion ($p<.05$), and Empathy ($p<.05$) on the SSIS-P predicts greater improvement on the Companionship subscale of the FQS following treatment. No statistically significant correlations were observed between the Total SSIS-P and Total FQS score or others subscales.

Conclusions:

This finding suggests that middle school and high school students with ASD with better parent-reported communication skills, assertion, and empathy are more likely to increase the amount of time spent together with other adolescents in social situations following the implementation of the School-Based PEERS® Curriculum. These findings are important because they provide useful information about who may be more likely to benefit from targeted treatment to increase companionship in adolescents with ASD.

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55   **157.055** Preliminary Outcomes of an Emotion Regulation Intervention for Children with Autism Spectrum Disorder

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Background: Children with Autism Spectrum Disorder (ASD) often present with associated psychopathology, including problems with emotion regulation (ER), ''the extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one's goals'' (Thompson, 1994, pp. 27–28). Evidence suggests that cognitive behavior therapy (CBT) can address symptoms of anxiety in many children with ASD without intellectual disability, however we know little about how CBT can address broader underlying features of ER, and thereby, impact not only anxiety, but problems managing anger and depression.

Objectives: To investigate the acceptability and preliminary effectiveness of a manualized CBT program (*Secret Agent Society: Operation Regulation*), for improving ER. This 10-week intervention was developed based on a group-based social skills program (Beaumont & Sofronoff, 2008).

Methods: Participants included 13 males, aged 8 to 12 ($M = 10.3$, $SD = 1.2$), who had IQ scores > 80 ($M = 108.54$, $SD = 10.4$) and had been diagnosed by regulated health professionals with ASD, confirmed via scores on the *Social Communication Questionnaire* (SCQ; Berument, Rutter, Lord, Pickles, & Bailey, 2003) and *Social Responsiveness Scale, 2nd Edition* (SRS-2; Constantino & Gruber, 2012). Children and parents completed pre and post measures of intervention acceptability and ER via parent report on the *Emotion Regulation Checklist* (ERC; Shields & Cicchetti, 1997) and child report on the *Children's Emotion Management Scale: Anger, Sadness, Worry* (CEM; Zeman, Cassano, Suveg, & Shipman, 2010); parent reports of child psychopathology and adaptive behavior via the *Behavior Assessment System for Children, 2nd Edition* (BASC-2; Reynolds & Kamphaus, 2006) and the *Anxiety Disorders Interview Schedule* (ADIS-P-IV; Silverman & Albano, 1996). A blind clinician rater assessed treatment response using the *Clinical Global Impressions scale* (CGI; Guy, 1976), severity (CGI-S) and improvement (CGI-I).

Results: Children and their parents completed all sessions (100%) and reported high satisfaction with the weekly session activities and the program overall. Therapist ratings of session activities and therapeutic alliance with children and parents were also high. Overall treatment integrity was 89.6% across 26 sessions (SD = 9.94, range = 65.4 – 100%). Parents reported significant improvements in children's emotional lability ($t = 3.13$, $p = .005$), a reduction in total psychiatric diagnoses ($t = 2.80$, $p = .016$) and diagnosis severity ($t = 3.39$, $p = .005$) on the ADIS-P-IV, and in internalizing difficulties on the BASC-2 ($t = 3.18$, $p = .008$). Blind clinician ratings on the CGI-I indicated that 69% ($n = 9$) children showed some level of improvement and a significant decrease in mean severity on the CGI-S ($t = 3.95$, $p = .002$). Children reported an overall decrease in dysregulation on the CEM ($t = 2.14$, $p = .056$) and increase in the ability to inhibit emotional responding ($t = -2.32$, $p = .04$.). Data collection is ongoing.

Conclusions: Preliminary outcomes demonstrate acceptability of the intervention and potential effectiveness in improving ER and decreasing psychopathology in children with ASD, an important area of further investigation due to the lack of evaluations of ER interventions for youth with ASD.

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56   **157.056** Psycho-Education for High-Functioning Adults with Autism Spectrum Disorder: Summary and Outcomes from a Novel Intervention

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Background: There is a lack of evidence-based interventions available for adults with autism spectrum disorder (ASD). Psycho-education offers a group setting in which to develop knowledge and strategies to manage core and associated difficulties, and has been noted as an effective intervention in a range of mental and physical conditions (McLoone et al., 2013). Psycho-education is becoming increasingly popular as a form of intervention and support for individuals with ASD (Bishop-Fitzpatrick et al., 2013); however, previous studies have not measured effectiveness or described satisfaction from participants.

Objectives: We sought to develop a novel psycho-education course for male adults with ASD. In addition, we aimed to acquire preliminary data on the association, if any, between adapted psycho-education, self-esteem/well-being, and other psychological variables.

Methods: The course was developed and facilitated by a multidisciplinary team of clinical researchers from the Autism Assessment Clinic at the Maudsley Hospital. Three courses were run; each was completed over three half-day sessions with one session / week. There were 5-7 participants in each group with approximately 1 facilitator / 2 participants. Sessions included: talks with visual aids and discussion, small group exercises, role-play, handouts and worksheets to take away, and several opportunities to recap and take breaks.

18 recently diagnosed male adults engaged in a course. Participants also completed cognitive tasks to measures verbal, performance and full-scale IQ, verbal fluency, and working memory. All participants were average or above average intelligence. Additionally, they completed the Broader Autism Phenotype Questionnaire (BAP) to assess autism phenotype traits, which confirmed the presence of a high level of ASD traits.

Self-report outcome measures were administered at baseline and post- intervention, as follows: knowledge about autism, anxiety, wellbeing, social anxiety, depression, self-esteem, and understanding emotions.

Results: Preliminary analyses indicated that participants scored significantly higher on the Autism Knowledge Questionnaire after completing the course (t (14) = 3.25, $p<0.01$). There were no other significant differences between pre- and post-course trait measures.

The difference between pre- and post-course trait measures was correlated with autism trait scores and IQ measures. Participants with higher scores on the Broader Autism Phenotype (BAP) questionnaire had lower self-esteem (assessed by the Rosenburg Questionnaire; r (18) = -.63, $p<0.01$, and moreover, those with higher BAP scores showed a greater increase in self-esteem, r (15) = 0.71, $p<0.01$. Working memory performance was also positively associated with improvement on self-esteem questionnaire (r (15) = 0.76, $p<0.01$) and well-being (assessed by the Warwick-Edinburgh Wellbeing Scale; r = 0.74, $p<0.01$). No other correlations were significant.

Conclusions: This is the first study to report a) a summary of a psycho-education course that can be used in adults with ASD, and b) outcome measures for participants who have completed the course. Preliminary outcome measures indicate significant improvements in knowledge about ASD and sense of well-being. The lack of improvement with respect to anxiety might indicate that a different intervention may be needed to address this issue. An important next step will be to test the effectiveness of the group with a comparator group.

57 **157.057** Reaching the Unreachable: Providing an Intentional Staff Training on Naturalistic Behavioral Assessment for Challenging Behaviors

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Background: Despite the great efforts that have been taken to solve the global issues in field of autism spectrum disorders (ASD), access to service remains an issue that deserves attention. One way to mitigate the influence of such an issue in developing countries is to utilize freely available technologies to ensure the accessibility to autism services is possible by enhancing the competencies of the front-line specialists that deal with individuals with ASD on a daily-basis.

Objectives: Evaluating the efficacy of videoconferencing and video-recorded training as a service-delivery model to train teachers in Saudi Arabia (i.e., who do not have access to experts in a regular basis) on the fidelity of implementation of naturalistic-behavioral assessment for challenging behaviors for students with ASD.

Methods: The host site (UCLA) and the remote site (i.e., a private center in Jeddah city, Saudi Arabia, that provides special education services to student with ASD) were connected to the Internet via a videoconferencing software (*Skype*) and a file-hosting website (*Dropbox*). We used a single-subject-

experimental design (multiple baseline) to evaluate the effect of video-recorded training on the fidelity of implementation of the trial-based functional analysis (TBA; Bloom et al., 2011) across four special education teachers. This naturalistic but systematic and experimental assessment consists of 4 different trials/opportunities that are designed to allow teachers to embed multiple opportunities during the day to investigate the effect of different environmental arrangements, activities and stimuli on challenging behavior prior to developing behavioral interventions that meet the individualized needs of their students with ASD.

During baseline, teachers were provided with a detailed and well-enhanced written instruction and were instructed to conduct the assessment and an actor (an experienced teacher) who played the rule of child engaging in aggression. In the second phase, training was provided which involved watching a 100 min. video-recoded training that comprised of written instruction, step-by-step and explicit explanation and video modeling of the correct implementation. All training materials were shared with the school though the file-hosting website.Poste-training evaluation was conducted in similar manner to that of the baseline (implementation of TBFA with the actor). Additional individualized feedback was provided for two teachers. Two teachers entered the generalization phase in which they implemented the assessment with an actual child who engaged problem behavior.

Results: Though teachers' performances were high following reading enhanced-written instruction during baseline (M=77%), their performances improved following watching the video-recording training to reach 100% fidelity for at least two conditions. However, all teachers needed additional specific feedback for at least one condition. During the generalization phase, two teacher maintained the high degree of fidelity when implementation the assessment with two students with ASD.

Conclusions*: These findings suggest that video-recorded training can be a promising service-delivery model when access to experts on a regular basis is not feasible.

Bloom, S. E., Iwata, B. A., Fritz, J. N., Roscoe, E. M., & Carreau, A. (2011). Classroom application of a trial-based functional analysis. *Journal of Applied Behavior Analysis*, 44, 19–31. doi: 10.1901/jaba.2011.44-1

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58   **157.058** Repetitive Transcranial Magnetic Stimulation for Executive Function Deficits in Autism Spectrum Disorder and Effects on Brain Structure and Function

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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, 16-25 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 started recruitment for our clinical trial and have four subjects who have entered into our study protocol within a short period of time. Thus far, there is considerable interest among individuals with HF-ASD to enter into our study and initial participants are tolerating our protocol well. Over the next six months, we anticipate that twelve participants with ASD will have completed our study protocol.

Conclusions: At IMFAR 2015, 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.

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59   **157.059** Self-Esteem Predicting Changes in Friendship Quality for Adolescents with Autism Spectrum Disorder: The UCLA PEERS® for Adolescents Program

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Background: The Program for the Education and Enrichment of Relationship Skills (PEERS®) is a 14-week evidence-based social skills intervention for adolescents with ASD that targets friendship development and maintenance (Laugeson & Frankel, 2010). Previous research has revealed a relationship between higher self-esteem and fewer autism spectrum behaviors in adolescents with ASD following participation in PEERS®(Bagrodia et al., 2013). However, the link between self-esteem at baseline as it relates to friendship quality post-treatment has yet to be studied.

Objectives: This study examines how adolescent-reported self-esteem at baseline predicts changes in friendship quality in adolescents with ASD following a 14-week evidence-based social skills intervention.

Methods: Participants included 125 adolescents (male=105; female=20) ranging from 11-18 years of age (M=14.00; SD=1.80), with an ASD diagnosis. Participants and their parents attended weekly 90-minute group treatment sessions over the course of 14 weeks focusing on skills related to making and keeping friends and handling peer rejection and conflict. In order to examine the relationship between self-esteem and the change in friendship quality over the course of treatment, each adolescent participant completed the Piers Harris Self-Concept Scale Second Edition (PH2; Piers, Harris, and Herzberg, 2002) at baseline, and the Friendship Qualities Scale (FQS; Bukowski, Hoza, & Boivin, 1994) prior to and following treatment. Pearson correlations were calculated to examine the relationship between PH2 subscales at baseline and change in FQS subscale scores from pre- to post-treatment.

Results: Results indicate that lower baseline self-esteem in the areas of behavioral adjustment (p<.05) and happiness (p<.05) significantly predict greater increase in overall friendship quality, with freedom from anxiety (p<.10) at a trend level, following the PEERS® intervention. In particular, less happiness at baseline predicts greater increases in companionship (p<.05) and helpfulness in friendships (p<.05) following treatment. Moreover, lower self-esteem with regard to physical appearance at baseline predicts greater improvements in security (p<.05) and helpfulness in friendships (p<.01) after treatment.

Conclusions: These findings suggest adolescents with ASD who report lower self-esteem related to behavioral adjustment and happiness prior to treatment may exhibit significantly greater improvement in overall friendship quality than teens that initially report higher self-esteem in these areas. Specifically, less happiness prior to intervention may be more likely to result in increased self-perceived companionship and helpfulness from friends following PEERS®. Additionally, adolescents who perceive themselves as less physically attractive prior to treatment may feel more secure and perceive greater helpfulness from their friendships after intervention. These findings suggest that teens with lower self-esteem in certain areas are more likely to experience greater improvement in friendship quality following a 14-week evidence-based social skills intervention.

60   **157.060** Sensorimotor Enrichment As an Autism Treatment

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Background: The symptoms of many human neurological disorders, including autism, are greatly ameliorated in animal models when the animals are housed in an enriched sensorimotor environment. We therefore attempted to use that approach to treat children with autism. In our initial randomized clinical trial, we used sensorimotor enrichment that consisted of daily at-home pairings of a wide range of sensory and motor activities that were changed at two-week intervals over 6 months (Woo and Leon, 2013). We found that the enriched group had a clinically significant improvement in their autism severity, as well as a clear improvement in cognition, compared to the standard care group.

Objectives: We attempted to extend the initial findings to further study the effectiveness of sensorimotor enrichment as a treatment for autism.

Methods: Fifty children, aged 3 to 6 years old, with classic autism were included in a randomized controlled trial. Children in the enriched group received daily sensorimotor enrichment, conducted by their parents, using a changing set of sensorimotor exercises that invariably involved paired sensory modalities. We communicated with the parents bi-weekly to inform them of the new exercises for their child. To determine compliance, parents were requested to keep diaries of the sensorimotor treatment. Children in the standard care group had no change to their daily schedule. Both groups of children continued with their ongoing standard care treatments and there were no differences between the groups regarding their participation in those treatments. Experienced, objective assessors, who were unaware of group assignment, administered the tests at baseline and after six months.

Results: We found that the average IQ score for the sensorimotor enrichment group increased by 8.4 points in six months, as assessed by the Leiter-R, compared to a 1.5-point gain by the standard care group. The sensorimotor enrichment group also had an improvement in their atypical sensory responsiveness, gaining an average of 11.4 points on the Short Sensory Profile, while the standard care group improved by 2.8 points. In addition, a statistically significant improvement in receptive language skills was observed for the sensorimotor enrichment group compared to the standard care group, as assessed by the Reynell Developmental Language Scales. Furthermore, we found that 21% of children in the sensorimotor enrichment group who initially had been classified with classic autism using the Autism Diagnostic Observation Schedule (ADOS) improved to the point that they fell below that mark after six months of therapy, while none of the children who received only standard care

reached that level of improvement.

Conclusions: The results of the initial randomized clinical trial using enriched sensorimotor stimulation were replicated and extended in this study. We continued to observe cognitive gains, but importantly, we also found improvements in both autism classification (ADOS) and sensory responsiveness. Given the pervasive and distracting nature of sensory sensitivities often experienced by individuals on the autism spectrum, improvements in this realm are particularly relevant. Sensorimotor enrichment therapy therefore may be a cost-effective means of successfully treating a range of symptoms for children with autism.

61   **157.061** Sensory Adapted Dental Environments: Reducing Distress during Dental Cleanings in Children with Autism Spectrum Disorders

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Background: Many children with autism spectrum disorder (ASD) have poorer oral health and greater oral care challenges compared to typically developing (TD) children. Prior research suggests these challenges are associated with sensory over-responsivity which may lead to distressing oral care experiences and discourage parents from bringing their child with ASD to the dentist for regular check-ups.

Objectives: It is important to identify innovative solutions that enable dentists to perform standard clinic-based procedures for children with ASD. This study examined the feasibility and pilot tested the efficacy of a sensory adapted dental environment to reduce physiological stress and anxiety, behavioral distress, sensory discomfort, and perception of pain during dental cleanings for children with ASD.

Methods: Participants were 44 children (n=22 ASD, 22 typical) ages 6-12 years. In an experimental crossover design, children underwent two dental cleanings, one in a regular dental environment (RDE) and one in a sensory adapted dental environment (SADE), administered in a randomized and counterbalanced order three to four months apart. Visual, auditory, and tactile stimuli were modified in the SADE. Outcomes included: (1) physiological stress and anxiety measured using *electrodermal activity*, a non-invasive way to measure sympathetic nervous system activation (2) behavioral distress measured by two *dentist-report surveys* (Frankl Scale and Anxiety and Cooperation Scale) and objective *coding of video-recordings* of children's behavior (Children's Dental Behavior Rating Scale) by researchers, (3) child-report of *sensory discomfort* (Dental Sensory Sensitivity Scale), (4) child-report of *pain perception* (Faces Pain Scale-Revised), and (5) cost savings as measured by the *number of hands*required to restrain children during cleaning.

Results: Implementation of the SADE was feasible and accepted by children, parents, and dentists. Intent to treat analyses used repeated measures analysis of covariance to test the effect of two factors: dental environment (within) and autism diagnosis (between). The ASD group exhibited greater challenges than the typical group across all measures. SADE:RDE comparisons were all in the hypothesized direction in both groups. Moderate effect sizes were found in the ASD group for physiological distress, perception of pain, sensory discomfort, and number of people required to restrain the child throughout cleaning (d's=.4-.7). Moderate effect sizes were also found in the typical group for physiological distress and perception of pain (d's=.3-.5). Behavioral distress measures exhibited small effect sizes in the hypothesized direction in both groups.

Conclusions: Enhancing oral care is critical for children with special needs. Using a SADE during routine oral care is feasible and indicates preliminary efficacy for children. The use of sensory adapted environments has potential for use in diminishing distress in children with ASD in a variety of settings.

62   **157.062** Sensory Processing and Insomnia

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Background: Chronic Insomnia is one of the most common co-occurring conditions in children with ASD. Multiple etiologies have been attributed to insomnia in ASD including sensory over-reactivity and resultant arousal regulation difficulties. Thus, assessment of sensory reactivity and the development of individually-tailored protocols that address the potential sensory factors that may impact sleep behavior is critical. We have evidence from our recent RCT (Schaaf, et al, in press, J A D D) to show that an individually-tailored, sensory intervention significantly improved functional behaviors (p = .003, d = 1.2) and decreased problem behaviors including sleep problems (Schaaf, et al, 2013). We apply these principles to the current study to refine the interdisciplinary, home-based intervention protocol for chronic insomnia in ASD.

Objectives: 1) Understand the role of the sensory-sleep environment as a potential contributor to insomnia; 2) Refine strategies to assess sensory processing and its impact on sleep; 3) Hone the process utilized to develop individually-tailored intervention strategies targeting the identified sensory contributors to insomnia; 4) Assess the outcome of sensory interventions on sensory domains

measured by the sensory profile; and 6) identify the unique role of occupational therapy(OT) on the interdisciplinary team.

Methods: Forty dyads (child with ASD, ages 6-10 + caregiver) will be randomized to standard care (SC; 1 hour ATN sleep tool kit session) or SC plus Tailored Behavioral Intervention (TAB). To develop the TAB, the team synthesizes all baseline data and identifies each child's arousal profile based on insomnia, anxiety and sensory sensitivity severity. When sensory processing difficulties are determined to be a factor impacting sleep, the family, guided by a team member, will choose intervention strategies from the "Calming Module". These include 1) The Five Senses Awareness Exercise, 2) Gentle Rocking protocol, 3) Taking a Warm Bath; 4) Qigong Massage and/or 5) Yoga Poses. The intervention is tailored to the child and sensitive to the families goals, cultural, beliefs, and capabilities. The interventionist (Nurse or Occupational Therapist) delivers the TAB over four weeks with eight (1-2 hr. sessions). An additional four weeks of phone support or visits are conducted by the team as necessary. All measures are repeated for both groups at four and eight weeks post intervention.

Results: 27 dyads have been enrolled thus far. Our data show that the interdisciplinary team process through case conferencing is effective in identifying specific, home based intervention strategies that match the unique needs of each child and family. We expect to have outcome data on the 40 dyads and details of the feasibility of implementing a RCT and refining a TAB and SC protocol.

Conclusions: The use of an interdisciplinary team and case conferencing is a valuable strategy to address the multi-factorial factors that may impact sleep in children with ASD and their families. We will present two exemplar cases (single with in case design) to describe the use of sensory interventions to improve sleep.

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63 **157.063** Social Skills Group Training for Children and Adolescents with Autism Spectrum Disorder, Kontakt: A Qualitative Responder Analysis

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Background: Systematic reviews of autism spectrum disorder (ASD) treatments demonstrate that the evidence-base of most interventions is still limited. Social skills group training (SSGT) is a widely applied form of treatment for higher functioning ASD, which has shown low to moderate evidence in a number of smaller scale randomized controlled trials (RCT) on children and adolescents. Qualitative studies investigating SSGT participants' experience of this form of intervention are scare. KONTAKT is a manualized SSGT for children and adolescents with ASD, which that has shown feasibility in several pilot studies, and now is evaluated in large scale, RCT multicenter study (NCT01854346).

Objectives: In a mixed qualitative/quantitative design, the objective of this study was to explore the thoughts and opinions of children, adolescents and parents participating in SSGT KONTAKT treatment. The aim was to investigate lived experiences especially in individuals responding and non-responding to the intervention.

Methods: Out of 129 RCT-participants included at that point (endpoint N=288) 6 responders and 5 non-responders, as well as their parents, were interviewed. Interviews were transcribed and analyzed using manifest thematic analysis. Responders and non-responders were defined according to their observed change in social skills as operationalized by the Social Responsiveness Scale (SRS), parent report, primary outcome measure in the RCT, pre-post 12 weeks of KONTAKT intervention. Participants were classified as responders if they had shown a relative increase in SRS total score of at least 30%, non-responders as those who had shown a decrease or a maximum of 10% increase.

Results: Both responders and non-responders (and their parents) reported improvements in social skills, awareness of own impairments, self-confidence, and independence in everyday life. Given examples were emotion expression, conflict management, social assertiveness, and social understanding. These experiences were richer and more frequent in the responders compared to the non-responder group. Participants were overall positive about the contents and structure of the training, but also provided useful ideas for improvement (e.g. more information on SSGT, choice of adequate SSGT age range and social embedding of the SSGT).

Conclusions: This study adds qualitative evidence to existing quantitative data on the usefulness of SSGT in children and adolescents. Interestingly, even participants not showing improvements on a primary quantitative outcome measure ("non-responders") reported treatment satisfaction and positive intervention effects, although to a lesser extent than "responders". This suggests that non-responders may have benefits from the treatment than are not captured by the SRS. Overall, findings endorse SSGT in pediatric ASD. Feedback from participants and relatives provide valuable insights for further improvements of manualized SSGT.

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64 **157.064** Social Skills Groups for Children with Developmental Disabilities: Issues of Providing Care in Rural Communities

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Background: Deficits in social skills comprise a common impairment seen in children with developmental disabilities (DD), including spectrum disorders (ASD). Despite a clear need for social skills intervention for children with DD, many school systems do not routinely provide formal social skills interventions; as a result, families often seek these services from community providers. Many community providers use social skills groups to improve social skills in children with DD; however, there is currently very limited well-designed, high quality research to determine the efficacy of these interventions (Kasari & Patterson, 2012).

Objectives: The objective of the current study was to evaluate the feasibility and effectiveness of a social skills group intervention for middle school aged boys with DD diagnoses in a rural community.

Methods: Families ($n = 83$) who expressed interest in the group and met inclusion criteria were contacted for participation. Families who agreed to participate were scheduled for an initial visit. Reasons for declining participation were recorded for families who did not participate. At the initial visit, participants ($n= 4$) were evaluated with the Comprehensive Assessment of Spoken Language (CASL) Pragmatic Judgment subtest, and the Social Responsiveness Scale (SRS). Parents also completed the Parent Stress Index (PSI) and identified specific social skills deficits in their child. Children engaged in a video-taped play session for coding of prosocial behaviors. Seven group interventions sessions were conducted, and included direct instruction, video modeling, live modeling, and practice. The CASL-PJ and PSI were readministered again after the last group session, and the children participated in an additional 30 minutes of video-taped play for coding. Parents also completed a satisfaction survey. The SRS was administered at a 6-month follow-up.

Results: We examined trends in families' reasons for declining participation in the groups. Common reasons included transportation and scheduling difficulties, despite great interest in participation. In addition, we used a within-subjects design to examine improvements across measures pre- and post-intervention. Comparisons of the CASL-PJ raw scores at pre-intervention and post-intervention demonstrated improvements that approached significance. All video data from pre- and post-intervention will be analyzed by blinded coders for prosocial behaviors. Parental feedback was overwhelmingly positive; all parents agreed that their child benefitted from participation and a majority expressed interest in continued participation.

Conclusions: While our intervention indicates potential effectiveness of social skills groups, our study brought to light challenges associated with providing clinical services in rural areas. These challenges prompt the consideration of alternative methods of providing clinical services, such as telemedicine, in order to reach a greater population. Such techniques have been utilized for cognitive-behavioral therapy (Griffiths, Blignault, & Yellowlees, 2006) and speech therapy (Mashima & Doarn, 2008), but have not yet been systematically employed for social skills interventions within pediatric populations. Opportunities and feasibility of providing social skills groups via telemedicine for families in underserved, rural areas will be discussed.

65   **157.065** Social-Emotional Development for Adolescents with Autism through Video Modeling

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Background:
Little research exists for a rapidly growing population of adolescents with autism spectrum disorders (ASD), especially in areas related to successful development and navigation of social-emotional aptitude, however, this is a critical component to adolescent success. Impairment in social-emotional development, skill acquisition and generalization put teenagers and young adults at risk for exclusion from their community as they age out of schools and other programs.

Objectives:
By conducting a systematic review of individual's behavior, tone of voice, and social interactions, video modeling can provide an effective intervention to increasing social-emotional development. Additional strategies such as 5-point scales, choice charts, Mindful breathing, and family collaboration supplement the success of video modeling.
    The purpose of this study is to:

1. Identify practical strategies for teaching adolescents with ASD to self-monitor their own social-emotional success through 5-point scales, choice charts, Mindful breathing, and family collaboration.

2. Assess the effectiveness of video modeling and video feedback when teaching an adolescent with moderate-severe ASD to self-monitor.

The presentation will describe the implementation of strategies for teaching self-monitoring, additional support strategies utilized, as well as assess the effectiveness of video modeling and video feedback through parent, staff and adolescent surveys.
Participants will leave the session with an overview of the study, practical knowledge of implementation in multiple settings, data on the effectiveness, and tools to implement video modeling effectively.

Methods:
Sample Size:

- 6 students (5 male, 1 female)

- Ages 13-16
- Moderate to severe diagnosis of ASD

Exposure:

- 10 months

Assessment:

- Pre and post Vineland parent surveys
- Survey of teachers/therapists
- Student satisfaction survey
- Video comparisons

Results:
The study indicates successful growth and acquisition in social-emotional self-monitoring based on self-review and teaching strategies through video modeling. Data also indicates decreased self-stimulatory behavior and aggressive behaviors after strategies were implemented. Results showed higher rates of success when family participation was occurred in the home setting. The data from the study also indicates satisfaction as reported by teachers/therapists, families and participants.
Conclusions:
Teaching practical strategies through the use of video modeling is an effective practice to develop social-emotional skills in adolescents with a moderate to severe diagnosis of Autism.
Adolescents increase their ability to cope, process, and problem solve. They decrease self-stimulatory and aggressive behaviors. Family and teacher/therapist reports indicate progress, and lower stress in most cases. These skills are generalized to multiple environments, and therefore effectively increase the adolescent's ability to successfully interact with her/his community.

66   **157.066** Tailored Behavioral Intervention for Children with ASD and Insomnia

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Background:
Children with ASD have demonstrated elevated rates of chronic insomnia, possibly stemming from an arousal dysregulation that produces a constellation of behavioral symptoms that include anxiety, sensory differences, and difficulties sleeping. Based on the theory that a subset of children with ASD are in a hyper-aroused state, nurses developed a **Tailored Behavioral Intervention (TAB)** for insomnia to supplement the **Standard Care (SC)** established by the Autism Speaks Autism Treatment Network Sleep Tool Kit. The **TAB** developed for this study includes: (1) positive routines, (2) the **Calming Module**, a novel component designed to decrease arousal levels with 12 soothing, relaxing activities, (3) faded bedtime protocol, and (4) **Performance feedback procedures (PFP)**, an effective consultative strategy used to support parents and foster study fidelity. Based on the child's arousal profile, developed by a multi-disciplinary team, selected activities from the CM are incorporated into the evening routine to relax the child and promote sleep.
Objectives: (1) Determine the feasibility of implementing a RCT of a **TAB and SC** (n = 20) or **SC only**(n = 20) protocol for children with ASD and insomnia, evaluating recruitment, randomization, retention, and implementation of interventions by a multi-disciplinary team with parents of a child with ASD. (2) Complete a comparative cost analysis of the interventions, in terms of training and parent resources needed to teach the interventions, measure fidelity, and collect data on the primary outcome, sleep, as measured by actigraphy. (3) Compare the effects of the interventions on sleep parameters.
Methods: Children ages 6-10 years with ASD and insomnia are screened and a comprehensive medical and sleep history is obtained by nurses. Children with unstable medical conditions that may disturb sleep are exluded. Measures for all participants include 10 days of Actigraphy, sleep diary, Sensory Profile, Children's Sleep Habits Questionnaire, and Pediatric Anxiety Rating Scale at baseline, 4 and 8 weeks post-intervention, and a Parent Acceptability Survey following completion. The multi-disciplinary team develops arousal profiles for each child. **SC** is lead by the nurse or Occupational Therapist. Families are randomized to either **TAB and SC** or **SC only**. The **TAB**group receives eight one-hour home-based sessions.
Results: To date, 27 families have been enrolled, with completed data sets for N = 8 **TAB** and N = 6 **SC**. Protocol is very acceptable to families (Mean (M) = 6.5, Scale: 0-7). Actigraphy shows **TAB** participants significantly increased their sleep minutes from baseline to 8 weeks (M = 43.15, standard deviation (SD) = 37.80, p = 0.016), while **SC** participants did not (M = -2.80, SD = 37.78, p = 1.00). Further, **TAB** participants decreased their sleep latency from baseline to 8 weeks (M = -13.94, SD = 14.93, p = 0.055), while **SC**participants did not (M = 1.05, SD = 17.93, p = 0.438)
Conclusions: Preliminary results suggest that the **TAB** intervention is feasible to implement by nurses, acceptable to families, and is associated with greater reductions in sleep latency and increases in sleep minutes than **SC only** for children with ASD and insomnia.

157.067 The Advancing Social-Communication and Play (ASAP) Intervention in Elementary School Settings: A Single Case Design Study

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Background:
With the rising prevalence of autism spectrum disorder (ASD), school programs are in need of evidence-based interventions to target core deficits in this growing population of children. Social-communication and engagement are key areas of need for children with ASD. These pivotal skills have been shown to positively impact development in other areas such as peer relationships, language abilities, and academic abilities. However, there are few interventions designed to address social-communication and engagement in school-age children with ASD with the most significant needs (e.g., Franco et al., 2013), and the research for interventions implemented by educators in school settings with this population is even more limited. The Advancing Social-Communication and Play (ASAP, Watson et al., 2011) intervention was designed for public preschools, and shows promise as an effective intervention in real-world settings. The ASAP intervention addresses a hierarchy of social-communication and play skills embedded in one-to-one and group settings within a classroom.
Objectives:
The purpose of this student is to examine the impact of the ASAP intervention on school-age children with ASD, and adapt the intervention for elementary school settings with the following specific aims:

1. Does implementation of the ASAP intervention improve social-communication and engagement of elementary school children with ASD?
2. Is the ASAP intervention feasible and acceptable in elementary school classrooms serving children with ASD?

Methods:
The study is using a multiple baseline, single case design across four elementary school students with emerging communication skills. The students range in age from 5 to 9 years old, with expressive language abilities ranging from 7 – 25 months based on the Receptive Expressive Emergent Language test (REEL-3). Teacher-student dyads are videotaped in 10-minute one-to-one sessions two times per week, first in the baseline phase, with staggered entry into the intervention phase. The videos of one-to-one sessions are being coded for joint engagement states (passive, single and joint) and social-communication behaviors (social interaction, requesting, and joint attention) using coding systems adapted from previous research (e.g., Adamson et al, 1998; Dykstra et al., 2012). Additionally, group sessions are being coded live one time per week to look for generalization of engagement into the group setting.
Results:
The study is currently in progress, with two of the four teacher-student dyads having moved into the intervention phase. Thus far, the first student showed increased time joint engagement with some decrease in recent sessions, as his teacher is targeting social interaction and requesting. The second student has just moved into the intervention phase, and has increased time in single engagement as his teacher focused on social interactions and pretend play skills. See Figure 1 for engagement data. Social-communication data is currently being coded.
Conclusions:
The study will offer valuable information about interventions for students with ASD with the most significant interventions that are implemented in school settings by school personnel. The data for the study so far suggests that the intervention is improving engagement in the students, and the training and coaching sessions have been well-received by teachers and teaching assistants.

68 **157.068** The Effectiveness of Interventions for Adults with ASD: A Meta-Analysis

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Background:
Most intervention research for individuals with Autism Spectrum Disorder (ASD) has focused on children. There are relatively few studies of interventions for adults with ASD, and even fewer that utilize group designs (Shattuck et al., 2012; Howlin & Moss, 2012).
Objectives:
A meta-analytic framework was applied to synthesize the literature from group-based interventions for adults with ASD. Both between-groups design and pre-post design studies were included.
Methods:
Computer-based database and ancestry searches, and manual searches of peer-reviewed articles and dissertations were used to identify studies meeting inclusion criteria. To be included studies had to: (1) use a group design to evaluate the outcomes of a treatment or intervention for adults (≥ 16 years, and/or mean age ≥ 18 years) with ASD, (2) report original data, (3) be published in English, and (4) include five or more participants in their experimental groups. We followed the Preferred

Reporting Items for Systematic Reviews and Meta-Analyses guidelines in conducting and reporting analyses (PRISMA guidelines; see Moher et al., 2009). Studies were coded for outcome effects, demographic variables (e.g., mean age, ethnicity), categorical moderators (e.g., intervention type, outcome category) and continuous moderators (e.g., duration, intensity, and length of sessions). A second rater coded twenty percent of the studies ($k = 8$). Using a random effects model, we calculated standardized mean difference effect sizes for studies reporting between-group data, and standardized mean gain effect sizes for studies reporting pre-post data.

Sampling bias was assessed using fail-safe N analyses (see Rosenthal, 1979) and Egger's test of the symmetry of funnel plots (see Egger et al., 1997). The trim and fill procedure (see Duval & Tweedie, 2000) was used to account for areas of bias in the data. Effect size heterogeneity was tested using both the Q statistic and I^2.

Results:
We identified 39 group design intervention studies including data from 1,086 participants (Intervention group: $n = 757$; Control group: $n = 329$). The mean sample size across studies was 27.85 ($SD = 24.16$; $k = 39$) and the mean age of study participants was 25.70 ($SD = 6.20$; $k = 37$). Most participants were Caucasian ($M = 83.44\%$, $SD = 16.22$; $k = 9$) and male ($M = 80.35\%$, $SD = 13.46\%$; $k = 39$).

The average effect sizes were medium both for studies reporting between-group data ($g = .74$, $k = 21$) and for studies reporting pre-post data ($g = .60$, $k = 34$). The studies reporting pre-post data were heterogeneous, as shown by an asymmetrical funnel plot; however, none of the moderators explained the variation in study effect sizes.

Conclusions:
Interventions are moderately effective in improving outcomes for adults with ASD. The homogeneity across the controlled studies ($k = 21$) and non-significant moderation across the studies reporting pre-post data ($k = 34$), suggests that interventions for adults with ASD, in general, are effective, and that any differences observed were not due to differences in the tested moderators (e.g., type of outcome being assessed, type of intervention, intensity of treatment).

69   **157.069** The Effects of Auditory Integration Training (AIT) on Mismatch Negativity in Children with Autism

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Background:
Children with autism are featured by sensory over-sensitivity including excessive reactivity to sounds. Reactivity to sound can be measured using auditory evoked potentials recorded during presentation of the sounds of different frequency and recording EEG responses. Mismatch Negativity (MMN) is one of the early auditory potentials reflecting differences of evoked potentials between rare (20%) and frequent (80%) sounds. MMN is typically recorded at the fronto-central EEG sites and represents a difference wave (rare-minus-frequent tone) occurring within 130 – 190 ms post-stimulus.

Objectives:
The aims of the study was application of Berard's Auditory Integration Training (AIT) techniques in children in autism and assessment of AIT course outcomes using MMN, frontal P2a and P3a evoked potentials, and behavioral questionnaires (ABC,CPI).

Methods: EEG data were acquired with Electrical Geodesics EEG system. AIT was administered through the Earducator. Children listened to modulated music during 30 minute long sessions, twice a day for 10 days. We investigated evoked potentials before and after AIT in children between the ages of 5 and 21 (N=11 in AIT, mean age 13.6 yrs, SD=4.1). Eleven control subjects were used for evoked potential (MMN, P2a, P3a) measurements in MMN test (mean age 14.8, SD=3.2).

Results:
Berard's AIT resulted in significant decrease of Irritability, Hyperactivity and Lethargy scores on the Aberrant Behavior Checklist (ABC), and improved Emotion, Behavior and Receptive Language Scores on the Comprehensive Performance Index (CPI) scales. Auditory evoked potential test conducted at baseline and after AIT showed lower MMN (F=5.29, p=0.035), and significant decrease of the frontal P2a component (F=4.71, p=0.041 and longer latency of P2a (F=5.53, p=0.028), while the frontal and fronto-central P3a component showed amplitude decrease (F=9.22, p=0.006) without any latency changes. Comparison of auditory MMN test results between typical children and autism groups showed significant differences in MMN amplitude (higher in autism, F=4.75, p=0.043), P2a amplitude (higher in autism, F=5.65, p=0.03), P2a latency (shorter in autism, F=4.98, p=0.039), and amplitude and latency of P3a (smaller and prolonged in autism, F=5.31, p=0.033).

Conclusions:
Our study supports suggestion that Berard's AIT positively affects auditory stimulus processing reflected both in early (MMN) and late (P2,P3a) evoked potentials. The study contributes to the understanding of the neural mechanisms underlying auditory integration training in autism.

70   **157.070** The Effects of Embodied Rhythm and Robotic Interventions on the Repetitive and

Negative Behaviors of Children with Autism Between 5 and 12 Years of Age

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Background: Repetitive behaviors are one of the core diagnostic symptoms of Autism Spectrum Disorders (ASDs). Children with ASDs demonstrate stereotypies such as arm flapping and finger flicking, as well as sensory behaviors with objects such as atypical visual fixation and persistent mouthing (Leekam et al., 2013, Richler, 2007). In addition, children demonstrate negative and maladaptive behaviors including temper tantrums, self-injurious behaviors, and aggression towards others (Dominick et al., 2007, Hartley et al., 2008). Applied Behavior Analysis approaches are typically used to reduce the frequencies of repetitive behaviors in children with ASDs. Recently, novel interventions capitalizing on the predilections of children with ASDs, for example, robotic and rhythm interventions have been used to facilitate social communication skills. However, their effects on repetitive and negative behaviors have not been reported.

Objectives: In this study, we evaluated the effects of novel embodied rhythm and robotic interventions on the repetitive and negative behaviors of children with ASDs between 5 and 12 years of age.

Methods: 36 children with ASDs between 5 and 12 years of age were observed for 10 weeks with the pretest and the posttest visits conducted in the first and last weeks of the study respectively. Children were matched on age and level of functioning and were randomly assigned to one of the three intervention groups - rhythm, robotic, or academic. Training was provided for 8 weeks with 2 sessions provided each week. In the rhythm group, children engaged in music and movement-based activities focusing on whole body imitation and synchrony with an expert trainer and an adult model. In the robot group, children engaged in action imitation games with a 23-inch humanoid Nao robot, a trainer, and a model. Lastly, in the academic group, children engaged in standard-of-care tabletop activities that focused on promoting fine motor and academic skills with a trainer and an adult model. We coded an early, a mid, and a late training session for the frequencies of stereotyped, sensory, and negative behaviors over a 45-minute session.

Results: In the early session, the rhythm and robotic groups demonstrated greater frequencies of negative behaviors compared to the academic group, probably due to the novel activities practiced (Mean (SD) –Rhythm: 60.86 (46.81), Robotic: 35.39 (29.81), Academic: 13.39 (16.07)). In contrast, the academic group demonstrated higher levels of repetitive sensory behaviors with the supplies used for the training compared to the other groups (Rhythm: 12.33 (10.51), Robotic: 23.73 (30.94), Academic: 37.60 (27.63)). Across training weeks, the rhythm group demonstrated a significant decrease in negative behaviors (Early: 60.86 (46.81), Late: 27.76 (24.79)). No training-related improvements were observed in the robotic and academic groups.

Conclusions: Although children with ASDs found music and movement-based gross motor activities challenging to begin with, across training weeks they demonstrated a significant reduction in repetitive behaviors. Sedentary tabletop play seems to afford object-based perseveration and may influence opportunities for social interactions. Our positive findings from the rhythm group add to the literature supporting the inclusion of music and movement interventions in the treatment of autism.

71 **157.071** The Effects of Rhythm Interventions on Social Attention and Verbalization Skills of Children with Autism Spectrum Disorders

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Background: Social communication delays are primary impairments in children with Autism Spectrum Disorders (ASDs). Applied Behavioral Analysis (ABA) approaches are the standard of care to promote social communication in children with ASDs; However, music therapies are often used in home or school settings (Hess et al., 2008), There is limited evidence to support the efficacy of music therapies in facilitating social communication skills of children with ASDs (Srinivasan & Bhat, 2013)

Objectives: Therefore, in the present study, we systematically evaluated the efficacy of embodied rhythm therapies involving music and movement activities in promoting social communication skills in children with ASDs between 5 and 12 years of age using a randomized controlled trial

Methods: 24 children with ASDs between 5 and 12 years of age were included. The study lasted for 10 weeks with the pretest and the posttest conducted in the first and the last weeks of the study. Children were matched on age and level of functioning and then randomly assigned to either the "rhythm" or the "academic" intervention group. Each child received 8 weeks of training with 2 sessions provided per week. The rhythm group engaged in music-based whole-body activities involving imitation and rhythmic synchrony with an expert trainer and an adult model. The academic group engaged in tabletop, academic and fine motor activities including reading, building, and arts and crafts with the expert trainer and the adult model. We coded for social attention patterns as well as vocalization/verbalization patterns of children during an early, mid, and late training session. Attention and verbal communication were also categorized as spontaneous or responsive.

Results: Children in the rhythm group engaged in higher levels of socially directed attention

compared to the academic group across all sessions (Mean (SD): Rhythm - Early: 45.14 (10.00), Mid: 44.81 (9.09), Late: 46.74 (13.75); Academic - Early: 7.62 (6.84), Mid: 6.86 (5.34), Late: 6.95 (7.70)). In contrast, the academic group engaged in greater object directed non-social attention episodes across all sessions (Rhythm - Early: 31.74 (7.77), Mid: 29.56 (8.62), Late: 29.06 (10.48); Academic - Early: 83.46 (13.12), Mid: 83.30 (8.65), Late: 82.87 (10.76)). In terms of verbalization patterns, the academic context promoted greater socially directed verbalization compared to the rhythm context in the early session (Rhythm: 8.18 (7.05), Academic: 14.11 (2.90)). However, with training, children in the rhythm group demonstrated a significant increase in the amount of social verbalization from the early to the late session (Early: 8.18 (7.05), Late: 17.08 (15.34)). Lastly, music and movement-based activities afforded greater spontaneous social attention and verbalization, whereas academic activities promoted predominantly responsive attention and verbalization episodes.

Conclusions: We found significant improvements in social communication skills across weeks of training in the rhythm group. We believe that these findings support the notion that socially embedded motor activities have the potential to facilitate social communication development. Lastly, these data also support the inclusion of embodied music and movement interventions within the standard of care for children with autism.

72 **157.072** The Effects of Robot-Child Interactions on Social Attention and Verbalization Patterns of Children with Autism Between 5 and 12 Years of Age

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Background: Social communication delays are primary impairments of Autism Spectrum Disorders (ASDs). Clinicians often address these impairments during stationary tabletop play, whereas we propose that whole body movements within a group setting also have the potential to enhance social communication skills. Robot-child interactions have been used to facilitate social communication skills such as social attention, imitation, and verbalization in children with ASDs (Robins et al., 2005, Duquette et al., 2008). However, robots have not been used to facilitate interpersonal synchrony during whole body movements in autism.

Objectives: In this study, we evaluated the effects of a novel, embodied intervention involving robot-child interactions on the social attention and verbalization skills of children with ASDs.

Methods: 24 children with ASDs between 5 and 12 years of age were observed for 10 weeks with the pretest and the posttest conducted in the first and last weeks respectively. Children were matched on age and level of functioning and then randomly assigned to either the "robotic" or the "academic" intervention group. Each child received 8 weeks of training (2 session/week). In the robotics group, children engaged in whole body action imitation games with a 23-inch humanoid robot, Nao, an expert trainer, and an adult model. In the academic group, children engaged in tabletop, academic and fine motor activities with the trainer and the model. We coded an early, a mid, and a late training session for percent duration of attention to the robot, to social partners, to objects, and towards elsewhere. We also coded for percent of time spent vocalizing or verbalizing to the robot, to self, or to social partners during each session.

Results: In the early session, children in the robot group spent maximum time attending to the robot compared to all other attention targets (Robot: 47.51 (12.87), objects: 10.81 (3.35), social partners: 22.69 (7.12), elsewhere: 18.99 (9.69)). However, across training, there was a reduction in the attention towards the robot with a concurrent increase in attention to elsewhere in the room suggesting progressive boredom with the activities (Robot – Early: 47.51 (12.87), Late: 34.28 (12.02); Elsewhere – Early: 18.99 (9.69), Late: 30.52 (9.88)). Overall, the robot group engaged in greater social attention episodes compared to the academic group across sessions. In contrast, the academic group spent greater time attending to non-social objects across all sessions. In terms of verbalization, the academic context afforded greater levels of social verbalization compared to the robot group in the early session (Robot: 5.79 (4.69), Academic: 14.11 (10.04)). However, the robot group demonstrated a small increase in social verbalization across training sessions (Early: 5.79 (4.69), Late: 11.68 (7.80)).

Conclusions: Although standard academic contexts promote social verbalization skills in children with ASDs, they afford sustained bouts of non-social attention towards objects/supplies used. Our study suggests that robot-mediated contexts promoting whole-body imitation and synchrony are promising tools to promote social attention and verbalization in children with ASDs. However, future research should be directed at developing activities that are meaningful, enjoyable, and that can sustain children's interest across training sessions.

73 **157.073** The Impact of the PEERS® Intervention on Social Phobia in Young Adults with ASD

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Background: While literature suggests that children and adolescents with high-functioning ASD

report significantly more social phobia symptoms than their typically developing peers (Kuusikko et al., 2008; White, Oswald, Ollendick, & Scahill, 2009), there are very few studies that examine social phobia among young adults with ASD. The co-occurrence of social phobia and ASD can have a marked negative affect on social skills and relationships, however there is a paucity of studies evaluating the impact of social skills interventions on social phobia among young adults with ASD. Objectives: The objectives of this study were to examine changes in social phobia symptoms in young adults with ASD who underwent social skills intervention.

Methods: Eighteen young adults (n = 18; 14 male) between the ages of 18 and 28 with ASD and 14 typically developing young adults (n = 14; 7 male) between the ages of 18 and 22 participated in the study. The current study conducted a social skills intervention, the Program for the Education and Enrichment of Relational Skills (PEERS). PEERS focuses on improving friendship quality and social skills among young adults with higher-functioning ASD (Gantman, Kapp, Orenski, & Laugeson, 2012). Participants were high-functioning young adults with ASD, who comprised the Experimental Treatment Group (ASD), and typically developing young adults (TYP), who comprised the Control Group. Pre- and post-intervention measures included the *Social Phobia Inventory* (SPIN; Connor et al., 2000), which is a self-report measure that was given to all participants.

Results: Preliminary results include available data from the experimental treatment and control groups; ongoing analyses will include additional participants for both groups and a comparison waitlist ASD control group. Before PEERS intervention, young adults with ASD reported significantly higher levels of social phobia symptoms compared to TYPs, $t(30)$ = 2.03, p = .05 (ASD mean = 24.5, TYP mean = 14.4). However, after PEERS completion, young adults with ASD no longer significantly differed in social phobia symptoms from typically developing young adults, $t(28)$ = 1.37, ns (ASD mean = 20.8, TYP mean = 14.4).

Conclusions: Our results suggest that social phobia symptoms may decrease due to the PEERS social skills intervention. Initial results suggest that lower total scores on the SPIN at post-intervention may indicate less social phobia in young adults with ASD who completed PEERS. This finding will be examined further by comparing additional participants in the experimental treatment group to the typically developing control group, as well as to a waitlist control group of participants with ASD. This study has the potential to add to the literature regarding intervention effects on plasticity of social phobia in young adults with ASD.

74   **157.074** The Relationship Between Social Communication and Social Anxiety in Young Adults with Autism Spectrum Disorder

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Background:
Young adults with Autism Spectrum Disorder (ASD) often experience social communication deficits that impact their social skills and social reciprocity (Gantman et al., 2012). Moreover, their ability to decode non-verbal behaviors such as gestures in social situations often leads to fewer attempts to engage peers in social interactions and fewer friendships (Orsmond et al., 2004). The social exclusion young adults with ASD experience may also make them vulnerable to experience higher levels of social anxiety (White et al., 2012). While there is significant research to support a correlation between anxiety and the inability to decode non-verbal behaviors (Bellini, 2004), very little is known about the relationship between verbal social communication skills and social anxiety.
Objectives:
The present study examines the relationship between self-reported social communication skills and social anxiety in young adults with Autism Spectrum Disorder.
Methods:
Under the auspices of The Help Group – UCLA Autism Research Alliance, thirty-eight young adults (26 males;12 females) with ASD ranging from 17-24 years of age (M=19.84, SD=1.76) presented for treatment through the PEERS for Young Adults program, an evidence-based social skills intervention for individuals with ASD (Laugeson & Frankel, 2010). In order to examine the relationship between self-reported social communication skills and social anxiety, young adults completed baseline measures including the Social Skills Inventory (SSI; Riggo 1989) which assesses social communication skills, and the Social Anxiety Scale (SAS; La Greca, 1999), which measures social anxiety. Pearson correlations were calculated to examine the relationship between baseline social communication skills and baseline social anxiety prior to treatment.
Results:
Results reveal that lower Total Scores of social skills on the SSI are correlated with higher Total Scores of social anxiety on the SAS (p<.05). In particular, greater social anxiety is correlated with poorer Social Expressivity (p<.01), which involves verbal expression and the ability to engage others in social situations; poorer Social Sensitivity (p<.05), which includes the ability to interpret the verbal communications of others; and lower Social Control (p<.01), which involves the ability to adapt to various social interactions and situations.
Conclusions:
These results suggest that prior to entry into treatment, young adults with ASD with lower social communication skills; specifically social expressivity, social sensitivity, and social control are more

likely to experience greater social anxiety. These findings are important because they provide useful information about who may be more likely to benefit from targeted treatment to decrease social anxiety and improve social communication skills. In particular, improving social communication skills may lead to decreased social anxiety in young adults with ASD, just as decreasing social anxiety may also lead to greater social communication.

75   **157.075** Training Paraprofessionals to Improve Social Skills in Students with Autism Spectrum Disorders

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Background: The number of students with Autism Spectrum Disorders (ASD) requiring special education services in public schools has steadily increased over the last decade (U.S. Department of Education, National Center for Education Statistics, 2013). In response, the employment of paraprofessionals in schools has increased in order to support these students (National Center for Education Statistics, 2007). Although paraprofessionals often bear the responsibility to provide both academic and social support to students with ASD, they receive little to no training on how to successfully support these students (Giangreco, et al, 2001; Jones & Bender, 1993). Providing social support to students with ASD becomes especially important when considering the risk factors associated with not receiving appropriate social intervention (Bauminger, & Shulman, 2003; Kasari, et al, 2012).
Objectives: The present study addressed the following questions: (1) Can paraprofessionals be trained to meet fidelity of implementation (FoI) on three key components when implementing social activities/games during unstructured outdoor periods (standing in an appropriate proximity, providing cooperative arrangements, and incorporating child preferred interests)? (2) Will paraprofessionals and their supervising special education teachers consider this type of social intervention to be simple and easy to implement? (3) Will training paraprofessionals result in improvements in engagement and verbal initiations for students' with ASD? (4) Will students with ASD and typically developing peers enjoy participating in these specialized games/activities?
Methods: A multiple baseline across participants experimental design was used to evaluate the effects of training paraprofessionals to implement social activities/games during lunch recess by providing cooperative arrangements and incorporating the preferred/specialized interests of students with ASD, while standing in an appropriate proximity. The across-participant design with three dyads allowed for demonstrations of experimental effect at different points in time. Probes were collected once a week for Participant 1 and twice weekly for Participants 2 and 3. Systematically staggered baselines of 4, 8, and 11 sessions were recorded. Interobserver agreement was above 80% for all measures.
Results: The results of this present study suggest that paraprofessionals can be trained to fidelity to implement social intervention for students with ASD. Both special education teachers and paraprofessionals reported that this type of social intervention was simple and easy to implement. The results also suggest that when paraprofessionals are trained the level of engagement and rate of verbal initiations improves for students with ASD. Finally, both students with ASD and typically developing peers reported enjoyment when participating in the social activities/games.
Conclusions: This study demonstrated that, with minimal training, paraprofessionals could achieve FoI on an intervention for improving socialization for students with ASD. In addition, after paraprofessionals were trained, students with ASD showed improvements in their engagement with typically developing peers and spontaneously made a greater number of verbal initiations. The results are discussed in terms of their implications for using trained paraprofessionals to improve social skills for students with ASD in the school setting.

76   **157.076** Training Social Workers: Implementing Social Skills Programming within Schools

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Background:
As the number of children identified with autism increases, pressures on school districts to provide quality services magnifies. Within Illinois, school social workers are often the key professional within a school team that provides any kind of social skill training opportunities for those with Autism Spectrum Disorders. However, many professionals are inadequately prepared through their undergraduate training or professional experiences, to cope with the spectrum of autism deficits. During our training, participants learn how to apply interventions across a range of skill sets (concrete learners through to high functioning learners).   The training is multi-modal in that it includes lectures, real life examples, video demonstration, and opportunities to create social activities. At the end of training participants must be able to create social games, activities and opportunities for their pupils at their schools. 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 social workers competence in social skills programming. The study addressed (i) competence of social skills programming gained across the training period (ii) the implementation of specific social strategies following training.

Methods:
(i) Participating social workers (n= 97) 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 social communication and social skills interventions. Each of three sections described a student with skills sets at the concrete level (early learner); intermediate level; abstract level (advanced learner). Participants answered four questions in each section regarding that child. The final questionnaire had 12 questions, with a maximum total score of 72.
 (ii) 10-14 days following training, participants were contacted by email and asked to return a survey of social 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 social development (concrete, intermediate, abstract).
ii) A response rate of n= 58 (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 90% of responders.
Conclusions:
By attending the training, participants increased their confidence in their ability to teach social behavior, at any level of social ability, to individuals with ASD. Furthermore, once they returned to their home schools they implemented a multitude of social and social communication techniques. Although satisfaction of training was very high, desire for ongoing consultation at follow up is an issue that could be addressed. These results indicate the effectiveness of our training program. The training is now being provided to parents and other professionals in the field.

77 **157.077** Transcranial Magnetic Stimulation Provides a Means to Investigate Cortical Excitability and Plasticity in Autism Spectrum Disorder

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Background: The etiology and neurobiology of Autism Spectrum Disorders (ASD) is complex and insufficiently understood. Recent studies across multiple research areas, including 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. As compared with behavioral or neuroimaging methods, TMS offers the advantage of providing behaviorally independent results that are largely unaffected by attention or cognitive ability. Therefore, a TMS-based endophenotype may be applicable to all individuals across the autism spectrum: old as well as young, higher as well as lower functioning individuals.
Objectives: 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. As compared with behavioral or neuroimaging methods, TMS offers the advantage of providing behaviorally independent results that are largely unaffected by attention or cognitive ability. Therefore, a TMS-based endophenotype may be applicable to all individuals across the autism spectrum: old as well as young, higher as well as lower functioning individuals.
Methods: Our published and ongoing studies employ TMS-based measures of cortical excitability and plasticity in children and adults with ASD.
Results: Across multiple studies, application of a 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 group difference is so striking that when an independent sample of 15 adults with ASD and 15 age- and gender-matched controls was evaluated, using solely their response to TBS, the test was able to reliably classify the individual into either ASD or control with a sensitivity of 0.87 and a specificity of 0.93 based on the latency to return to baseline within 50 minutes following TBS. Additionally, we find that approximately a third of individuals with ASD show absent or paradoxical responses to paired pulse and rTMS protocols thought to be related to GABAergic tone. In one paired pulse study we found that a subgroup of adults with ASD showed a reduced or absent intracortical inhibition response and in another study over a third of children with ASD displayed paradoxical facilitation to the continuous TBS protocol, also thought to engage GABAergic inhibitory mechanisms.
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.

78 **157.078** Transcranial Magnetic Stimulation Treatment: Focusing on Core Pathological Features of Autism Spectrum Disorders

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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.

79 **157.079** Transition to University: An Intervention for Students with Autism Spectrum Disorder

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Background: Transition to University can provide opportunities to develop greater independence in living skills and social networks as well as gain valuable educational qualifications. University transition may present particular challenges for students with a diagnosis of an Autism Spectrum Disorder (ASD). Studies report students with ASD often do not seek entry to, or prematurely drop-out of, university (Glennon, 2001; VanBergeijk et al., 2008) despite good levels of educational attainment and reported aspirations to attend university (White, Ollendick & Bray, 2011). Social isolation and problems adjusting to living away from home are thought to contribute to poor outcome (Howlin, Goode, Hutton & Rutter, 2004). A recent review (Gelbar et al., 2014) highlights the scarcity of research into programs designed to support students with ASD in applying to, transitioning to and completing University.
Objectives: To develop and evaluate an intervention to increase student confidence to make the transition to University.
Methods: A 3-day residential program was developed to orient students with ASD to University life and delivered on 2 consecutive occasions. The program comprised sessions about academic, social, and cultural aspects of university life as well as managing stress, social anxiety, and university support services. Typically developing students (n=8) acted as social facilitators. Participants had a confirmed clinical diagnosis of ASD (n=50) and were currently in full time education. *Measures:*Prior to the intervention, participants were asked to identify specific worries about attending university and rate the intensity of these on a questionnaire developed for the study (The Pilot Transition to University Questionnaire: PTUQ). The Warwick Edinburgh Mental Well-Being Scale (WEMWBS) was also administered and an informant measure of ASD characteristics (Social Communication Questionnaire).
Results: A mean of 4.26 (sd=1.39) areas of worry about university transition were reported by participants, with concerns about socialising at university the most frequently reported and with the highest intensity ratings. There was a significant reduction in worries about socialising (Wilcoxon Signed Rank Test; z=3.346, p<.001) following the intervention but not in ratings of the other main areas of concern; i.e. academic demands, leaving home and self-care. Scores on the WEMWBS did not change significantly. The content of the intervention was broadly aligned with the areas of concern highlighted on the P-TUQ apart from practical aspects of self-care. There was a significant improvement (z=2.07, p<.05) in ratings of how positive participants felt about university attendance following the intervention. The intervention was rated as 'extremely helpful' by 33% of the students and 'slightly helpful' by 61% of the students. No students rated the intervention as 'unhelpful'. The majority (94%) of students rated the intervention as 'enjoyable'.
Conclusions: University transition is associated with worries in a number of areas for students with ASD, particularly socialising. Worries about socialising were significantly reduced and satisfaction with an intervention to ease transition was high. This study provides preliminary evidence to support interventions designed to aid university transition. Greater emphasis on practical life-skills should be included in future interventions with longer term follow-up.

80 **157.080** Treatment Compliance As a Predictor of Treatment Outcome in Adolescents with Autism Spectrum Disorder Following the PEERS® Social Skills Intervention

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Background:
Adolescents with Autism Spectrum Disorder (ASD) are known to have deficits in social functioning, impacting their ability to maintain reciprocal friendships (Laugeson & Frankel, 2010). Evidence has

shown that social skills training interventions that promote increased social initiations and skill generalization through the use of homework assignments may improve social competence for youth with ASD (White, Keonig, & Scahill, 2007). The Program for the Education and Enrichment of Relational Skills (PEERS[®]), which is an evidence-based, parent-assisted social skills intervention for adolescents with ASD, attempts to enhance skill generalization through the completion of weekly homework assignments (Laugeson & Frankel, 2010). Previous research indicates that adolescents who participate in PEERS[®] demonstrate increased social engagement post-treatment (Laugeson et al., 2009; 2012); however, the extent to which homework compliance impacts treatment outcome has yet to be examined.

Objectives:
The purpose of this study is to examine the impact of homework compliance as a predictor of treatment outcome in adolescents with ASD after participation in a 14-week parent-assisted social skills program.

Methods:
Participants in this study included 104 adolescents (males=87; females=17) with ASD ranging from 11-18 years of age (M=13.97, SD=1.78) and their parents who presented for social skills treatment through the UCLA PEERS[®] Clinic. Adolescent and parent participants attended weekly 90-minute group treatment sessions over a 14-week period. To assess homework compliance, adolescents reported on their completion of their homework assignments each week, including making phone calls, joining conversations, and having get-togethers with peers. In order to measure treatment compliance, the mean of these three homework assignments was computed for each adolescent. Treatment outcome related to social engagement was assessed using change in scores on the Quality of Socialization Questionnaire (QSQ; Frankel & Mintz, 2008) pre- and post-intervention. The QSQ measures adolescent social engagement with peers through self-reported frequency counts of hosted and invited get-togethers in the previous month. Pearson correlations were calculated to examine the relationship between homework completion and change in social engagement on the QSQ from pre- to post-treatment.

Results:
Results reveal mean homework completion was 69.79% (SD=21.39) for participants. Higher levels of homework completion appear to predict greater increase in number of hosted (p<.05) and invited (p<.10) get-togethers over the course of treatment. In particular, lower homework completers (< 1SD below the mean) had an average of 0.35 fewer hosted get-togethers and 0.25 more invited get-togethers, while high homework completers (>1SD above the mean) had an average of 2.40 more hosted get-togethers and 0.88 more invited get-togethers over the course of the intervention.

Conclusions:
This study appears to be the first to examine treatment compliance as a predictor of treatment outcome in an evidence-based social skills intervention for adolescents with ASD. These findings suggest that adolescents with ASD who exhibit greater homework compliance may be more socially engaged with peers following intervention, suggesting greater generalization of skills due to treatment compliance. These results underscore the importance of homework completion in behavioral interventions for adolescents with ASD. Hence, practice in real world settings is critical to treatment outcome and generalization.

81 **157.081** Usability Testing of ADD.lt, a Technology Based Intervention for Children with HFA and/ or ADHD

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Background: Children with high-functioning autism disorder (HFASD) and or attention deficit hyperactivity disorder (ADHD) have organizational skills deficits that impact their ability to successfully meet academic expectations. Organizational skills include the ability to manage materials (e.g., homework) and executive functions such as organizing, planning, and managing tasks. This study was a usability test of technology based behavioral reward intervention (ADD.it) designed to assist children with tasks and tracking . The study examined whether the technology was feasible, usable, beneficial, and valued by children and parents.

Objectives: To determine if children with HFASD and or ADHD will use a technology based intervention to support and enhance organizational skills. To assess parental interest and input related to the tecnhology based behavioral intervention.

Methods: A field-based usability test was conducted with quantitative and qualitative data collected. Sixteen children with ADHD and HFASD aged 8 to 12 years and their parents participated. The study was conducted in an 8-week summer treatment program. The usability test lasted 15 days, with data collected via observations, child and parent logs, surveys, and focus groups.

Results: During the usability test, children brought the prototype technology to camp 95% of the time and used it to record items to bring to camp 85% of the time. Parents completed a daily log simulating mobile functions 88% of the time. Using the prototype device for homework tracking resulted in 3 times the likelihood that homework was completed. Establishing a contingency between device game time and homework completion resulted in 4 times the likelihood that homework was completed. Children valued carrying the device, actively used the device to track tasks, and were motivated by having the ability to play games on the device as a reward. Parents valued the device as a contingent reward, desired novelty in the device's games and features, and expressed an urgent

need for help with their children's organizational skills.

Conclusions: Children will utilize and value a mobile technology for task management, with game time having a high reward value. Parents value the concept of using a mobile technology to improve their children's organizational skills. The use of mobile technology for building and sustaining organizational skills via performance rewards is a promising intervention for effective home and school-related task management. The effectiveness of a more fully developed technology needs to be assessed in future research.

82   **157.082** Using a Summer Robotics Camp to Reduce Social Anxiety and Improve Social/Vocational Skills in ASD

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Background: There is a dearth of evidence-based interventions specifically supporting adolescents with Autism Spectrum Disorder (ASD). Adolescents with ASD often experience difficulty making friends, generalizing the social skills that they learn, and maintaining relationships, even when succeeding academically in general education settings. For individuals with ASD who have developed the requisite social *skills*, there are limited opportunities to improve social *performance* in supervised settings (Koegel et al., 2012). Given that social demands become increasingly complex with age, it is imperative that we develop targeted interventions to improve social and vocational development.

Objectives: The objective of this study was to see if a Summer Robotics Camp supported the social/vocational development of individuals with ASD through: (1) a decrease in social anxiety, (2) an increase in social performance, and (3) an increase in robotics knowledge. The camp was designed to focus on the intrinsic interests of participants, rather than their social difficulties.

Methods: Participants were 25 individuals with ASD and 27 typically developing (TD) peers, ages 10-17, who received general education science instruction at school, and who expressed an interest in robotics. DSM-5 ASD diagnoses were independently confirmed using the ADOS-2, SCQ-L, and clinical judgment by a trained clinician. Participants completed a weeklong summer camp during which they learned robotic facts, actively programmed an interactive robot, and learned career skills (e.g., how to work collaboratively). While programming, participants worked in pairs (each ASD participant was paired with a TD peer) on a programming project that culminated in a presentation in front of campmates and family. Pairs were matched on robotics experience and age. Social/vocational training was given to all participants, regardless of diagnosis, and participants were not labeled as having an ASD. Pre- and post-treatment data were collected on participant-reported levels of social anxiety (Social Anxiety Scale), parent-reported social skills (Social Skills Improvement System), and a test of participants' knowledge of robotics. In addition, at pre- and posttest, participants were recorded during a novel social situation in which they interacted with a participant from a different week of camp who they had just met.

Results: A series of paired samples t-tests were conducted to compare the baseline data with posttest data. For both groups, there was a significant improvement on measures of social anxiety and robotics knowledge (see Table 1). On the total scores of parent-reported social skills, the ASD group reported a significant improvement ($p = .01$); TD group did not ($p = .31$), although it should be noted that the TD peers came in with above average parent-reported level of social skills. Data will also be presented on pre- and posttest differences in performance during novel social situations.

Conclusions: These results provide support for the effectiveness of a summer robotics camp at decreasing social anxiety, increasing social skills, and improving knowledge of science and robotics in adolescents with ASD. TD peers also showed specific gains in robotics knowledge and lower social anxiety at posttest. Future research should examine factors that contribute to improvement and include non-treatment control conditions.

83   **157.083** Who Responds to Cognitive-Behavioral Group Treatment? Associations Between Anxiety Symptom Reduction and Autism Symptom Domains

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Background: There is evidence that cognitive-behavioral therapy (CBT) is effective for reducing anxiety symptoms in some children with autism spectrum disorder (ASD) (Reaven et al., 2012; Storch et al., 2013). Delivery for these treatments differs by study; some are delivered individually, some in a group format. Approximately 50-93% benefit from CBT (regardless of modality), as defined by marked reductions in parent-reported anxiety symptoms (Storch et al., 2013. Little is known about who the best candidates for CBT are, especially when the treatment is delivered in a group context. Understanding the characteristics of treatment responders is helpful in determining who could benefit from group intervention.

Objectives: The goal of this study is to examine the associations between anxiety symptom reductions

observed through participation in a multi-family group CBT intervention (Facing Your Fears; Reaven et al., 2011) and quantitative autistic traits as defined by domain scores on the Social Responsiveness Scale (SRS). We hypothesize that there will be a negative correlation between the change in parent-reported child anxiety and severity of social awareness, social motivation, and social cognition; such that children with less social impairment will show greater reduction of anxiety symptoms after group treatment.

Methods: This is a secondary analysis of data collected as part of a larger study examining the effects of a multi-family CBT intervention targeting anxiety in youth with ASD. Inclusion criteria for these analyses were: data completeness, timeliness of data collection (i.e., within 3 months of starting treatment and within 4 months of completing), and attendance (i.e., 3 or fewer absences). Fifty-seven youth, ages 8-18 (M = 12.49, SD = 2.74), with confirmed ASD and their parents met eligibility criteria for this study. Parents completed the Social Responsiveness Scale (SRS) and the Screen for Child Anxiety Related Emotional Disorders (SCARED; Birmaher et al., 1999) before treatment, and then completed the SCARED again at post-treatment.

Results: A lack of normality in the distribution of the sample was observed, thus Spearman's rho was used to examine correlations. Preliminary results indicate a significant positive correlation between impairment in social motivation and anxiety symptom reduction (r_s = .36, p = .007); suggesting that strengths in social motivation are not required for group CBT to be effective. Results also indicate a trend towards significance for positive correlations between anxiety symptom reduction and impairments in social cognition (r_s = .23), as well as autistic mannerisms (r_s = .29), and the overall total autistic social impairment (r_s = .27). No significant correlations were found between anxiety symptom reduction and impairments in social awareness or social communication.

Conclusions: The results of this study suggest that social impairment does not preclude readiness for a structured, group treatment for youth with ASD. Contrary to our hypotheses, even if a parent reports that his/her child is not socially motivated, group treatment may be beneficial. Further implications, limitations, and future directions will be discussed.

Poster Session
158 - Adult Outcome
5:30 PM - 7:00 PM - Imperial Ballroom

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84   **158.084** A Longitudinal Examination of Adaptive Behavior in Youth with Autism Spectrum Disorder: Contributions of Executive Function

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Background:
Approximately half of all children with ASD do not have co-occurring intellectual disability (ID), yet outcome remains poor. Because outcome in ASD is more related to adaptive behavior skills than cognitive level, it is important to identify predictors of adaptive behavior. Prior cross-sectional research has demonstrated impairments in executive function (EF) abilities are associated with adaptive behavior deficits in youth with ASD. However, longitudinal research is needed to confirm predictors of adaptive behavior over time in ASD.

Objectives:
1) To characterize longitudinal change in adaptive behavior in children with ASD without ID, and 2) determine whether prior estimate of EF predicts future adaptive behavior scores.

Methods:
65 youth (13 females) with a DSM diagnosis of ASD were evaluated on multiple occasions (M=2.63, SD=0.80, range 2-5) separated by at least 6 months (M=3.40 years, SD=5.41) resulting in a total of 170 adaptive behavior observations. Participants had a prior assessment of EF for 92 subsequent adaptive behavior evaluations. Participants had a mean age of 8.01 years (SD=2.51) at first evaluation, possessed average IQ (M=107.03, SD=19.83), and met CPEA criteria for 'broad ASD' on the ADI-R and/or ADOS.

Adaptive behavior and EF were assessed via parent-report using the Vineland Adaptive Behavior Scales (VABS) and Behavior Rating Inventory of Executive Function (BRIEF), respectively. To assess longitudinal change, consecutive observations on the VABS were characterized as Improved, Deteriorated, or Unchanged based on reliable change indices (RCI). A multiple regression was conducted to determine whether global EF abilities predicted subsequent VABS scores after accounting for baseline adaptive behavior, age, IQ, length of time between assessment, and age*length of time between assessment (interaction term). An exploratory analysis examined which specific EF skills predicted adaptive behavior.

Results:
Most participants did not make significant improvements on VABS standard scores over time, despite

intact cognitive abilities (see Figure 1). While daily living skills declined across time, the relationship between age and communication/socialization skills was qualified by an interaction between age and length of time between evaluations. IQ was not a significant predictor of later adaptive behavior in any domain. Prior global EF abilities predicted later VABS Daily Living and Socialization scores, but not Communication scores (see Table 1). Exploratory analyses determined higher monitoring skills were a robust predictor of better subsequent adaptive behavior across VABS domains. Additionally, better inhibition skills predicted better subsequent daily living and socialization skills. Finally, better shifting (e.g., flexibility) predicted better subsequent socialization skills.
Conclusions:
For the majority of youth in the sample, adaptive behavior standard scores did not improve over time. Higher EF skills, but not cognitive ability, predicted better subsequent adaptive behavior scores in daily living skills and socialization. Results support the notion that EF skills are important to real world outcomes. It will be important to target adaptive skills, and EF skills that contribute to them, in individuals with ASD across developmental periods from childhood through adolescence in order to improve outcomes.
Note: We are currently in the process of collecting another wave of participant data to analyze with multi-level modeling techniques.

85 **158.085** A Mixed Methods Study of Physician Knowledge and Experience with Autism in Adults

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Background: As children with autism become adults their primary medical care will move from pediatrics to adult medicine. There is little evidence of knowledge about autism among adult healthcare providers, and of their readiness to provide optimal care for this adult population.
Objectives: To determine adult healthcare providers' general knowledge about autism, and gain an understanding of their experiences and needs in providing healthcare to adult patients with autism.
Methods: This mixed methods study consisted of a brief, online survey sent to Kaiser Permanente Northern California (KPNC) providers in adult medicine, mental health and Ob/Gyn, and semi-structured follow-up interviews with physicians in adult medicine. The 11-question survey assessed healthcare providers' ability to recognize autism, knowledge of autism, comfort level treating patients with autism, and training and resource needs. Follow-up interviews focused on autism training in medical school, experience caring for patients with autism, resources and training needs, challenges of clinical care, impact on visit schedule, screening for sex, drugs, and alcohol, concerns brought up by patients or caregivers, and transition from pediatrics to adult medicine.
Results: Overall, 922 providers completed the survey (response rate 25.3%). More than 90% indicated that they would explore the possibility of ASD in a patient who had limited eye contact, and the majority recognized other autism characteristics. A high proportion under-reported the actual number of patients with ASD in their panel and rated their knowledge/skills in providing care to ASD patients as poor or fair (77%). Only 13% agreed/ strongly agreed that they had adequate tools/referral resources to accommodate patients with autism in their practice. The majority indicated the usefulness of the following: an autism conference (66%), a checklist of community resources (77%), training on effective communication strategies with autistic patients (70%), a special primary care clinic to serve adults with developmental disabilities (64%), and training about use of psychotropic drugs for autistic patients (56%). Finally, 43% indicated willingness to participate in a follow-up telephone interview.
 Nine primary care physicians were interviewed. The majority reported receiving little or no ASD training in medical school or residency, yet many said they were comfortable treating their patients with ASD. Communication difficulties, primarily with patients with limited verbal abilities, were the most frequently experienced frustrations. Some made adaptations for their patients with ASD. Many indicated that longer office visits with low functioning patients were not a problem. Conservatorship and privacy issues were mentioned by physicians treating patients who bring caretakers to visits, and several stated that they did not bring up questions about sex, drugs and alcohol with their patients with ASD. All physicians stated that the hand-off between pediatrics and adult medicine requires improvement, and all highlighted a need for training.
Conclusions: Most adult healthcare providers recognized basic autism characteristics but reported not having adequate skills and tools to care for this growing population of adult patients. Provider training, resources, and improvements in the transition from pediatrics to adult medicine are essential to support the delivery of adequate and effective healthcare to adults with ASD.

86 **158.086** A Multi-Method Approach to Examining Correlates of Sleep Quality, Individual Well-Being, and Mother-Child Relationship Quality in Adolescents with Autism Spectrum Disorder

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Background: Sleep problems are more prevalent among children with ASD--about 50-80% of children with ASD experience sleep problems--relative to their typically developing peers (Goldman et al.,

2012). In children with ASD, poor sleep is chronic, often persisting into adolescence (Humphreys et al., 2013). Biological changes associated with adolescence, such as changing sleep architecture and circadian rhythms, can exacerbate sleep issues, as has been found among individuals without ASD (Colrain & Baker, 2011). Because of this, adolescents with ASD with poor sleep quality may experience more intense and/or more frequent sleep problems, which may compromise daytime functioning. Previous research examining sleep quality among children with ASD has relied on parent reports. Recent work has extended the measurement of sleep quality to include self-reports by adolescents with ASD; this approach has verified that adolescents with ASD experience greater sleep problems relative to their peers without ASD (Baker et al., 2013). The current study extends the literature by examining emotional, behavioral, and social correlates of objective sleep quality among adolescents with ASD.

Objectives: To examine associations between objective reports of sleep quality and well-being in adolescents with ASD, namely psychological well-being, adaptive functioning, and mother-child relationship quality.

Methods: Participants were 18 adolescents with ASD and their mothers. After confirming clinical reports of ASD using the ADOS-2 (Lord et al., 2000), adolescents used pre-programmed iPads to report on their psychological well-being. Mothers also completed measures reporting on their child's developmental history, including ASD symptomology and adaptive functioning. Participants were then instructed in the use of a MicroMini Motionlogger actigraph, which collected objective sleep data for 7 consecutive nights. Adolescents were also provided with a Smartphone, which contained an "app" that kept logs of entered sleep/wake times over the 7 days. The app also recorded adolescents' daily reports of closeness and discord in their daily interactions with their mothers.

Results: Spearman correlations were conducted to examine associations between sleep quality as measured by actigraphy and adolescent psychological well-being and adaptive functioning. More nocturnal wakefulness and disturbed sleep were associated with poorer adolescent well-being, including greater maladaptive behaviors and ASD severity, as well as more depressive symptoms and more loneliness with family members (Table 1). Correlations conducted between sleep quality and mother-child relationship quality found that adolescents who took longer to fall asleep reported feeling closer to their mothers but those adolescents with more night wakings felt less close to their mothers (Table 2). Together, these data suggest that disrupted sleep as measured by actigraphy is associated with adolescents' well-being and ability to function adaptively in expected ways but associations between sleep quality and mother-adolescent closeness are more complex.

Conclusions:
The current study showed the utility of using actigraphs and modern technology (e.g. Smartphones and iPads) for assessments conducted with adolescents with ASD. Although results are correlational and direction cannot be ascertained, they suggest a need for interventions to remediate sleep issues in adolescents with ASD.

87 **158.087** Adaptive Functioning during the Transition to Adulthood and Beyond

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Background: Cross-sectional studies indicate a cognitive functioning advantage over adaptive functioning that widens with age, and this pattern seems to be unique to autism spectrum disorder (ASD; Kanne et al., 2011). However, this pattern has been understudied during the transition to adulthood.

Objectives: To examine relative performance on Vineland Adaptive Behavior Scales, Second Edition (Vineland-II) domains by age and cognitive ability groups in a sample of older adolescents and adults with ASD.

Methods: Participants were 75 adolescents and adults (age M = 24.22, SD = 8.98, range = 16.08 to 58.17; 61 male) with a clinical DSM-IV diagnosis of Autistic Disorder, Asperger's Disorder, or PDD-NOS. All participants met criteria for Autism or Autism Spectrum on the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, & DiLavore, 1999; Lord et al., 2012). Participants were predominantly Caucasian and from middle- to upper-middle class families. The Kaufmann Brief Intelligence Test, Second Edition (KBIT-2) was administered to each participant. A parent or caregiver of each participant completed the Vineland-II. Retrospective chart review was conducted using de-identified data. All assessments were administered for clinical purposes and/or IRB-approved research projects at an autism center in the Southwestern United States.

Results: Results of separate mixed ANCOVAs are reported in Table 1. Composite IQ scores were significantly higher than standard scores for communication, daily living skills (DLS), and socialization in the full sample. Communication and socialization scores were significantly lower than DLS scores, but there was no difference between communication and socialization scores. Vineland-II performance profiles differed significantly among age groups, but not intellectual ability groups. In adolescents, DLS scores did not differ significantly from communication scores and were only marginally higher than socialization scores. Socialization scores were significantly lower than communication scores among adolescents and adults, but not young adults.

Conclusions: IQ scores were significantly higher than all adaptive functioning domains in each age group. Although the majority of the sample had IQs in the average to above average range, average

VABS domain standard scores were below 70 in all cognitive ability groups. Despite having similar IQ scores, adolescents had significantly higher average VABS domain scores than young adults and adults, which supports previous suggestions that the gap between cognitive and adaptive functioning skills continues into adulthood and increases with age (Kanne et al., 2011). DLS were observed to be a relative strength in young adults and adults, but not adolescents. The three groups did not differ in DLS; instead, adolescents had higher communication and socialization scores than young adults and adults. Standard scores represent functioning relative to same-age peers. Findings suggest that DLS continue to develop post-adolescence in individuals with ASD, whereas development of age-appropriate communication and socialization skills appears to slow with age. Relative performance on Vineland-II subdomains will also be presented. Together, findings provide valuable information regarding developmental trajectories of adaptive functioning skills, adult outcomes, and intervention targets for improving adult outcomes.

88   **158.088** Characterizing the Daily Life, Needs, and Priorities of Adults with ASD

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Background: Consensus among most reports is that the majority of adults with autism spectrum disorder (ASD) have poor outcomes in terms of independent living, employment, and friendship/social engagement. In a recent study by Pellicano and co-authors (2014), individuals with ASD and their families indicated that future priorities for autism research should lie in practical areas that make a difference in daily life. This study replicates and extends those findings from the adult perspective.
Objectives: Using survey data from a large sample of adults with ASD and parents/caregivers of the same, we aim to (1) describe the lives of both "high-functioning" and less-able adults with ASD in terms of education, jobs, housing, financial support, adaptive skills, strengths and special interests, physical and mental health, treatment and service use; and (2) summarize these stakeholders' priorities for future research.
Methods: Data were obtained from the Interactive Autism Network (IAN), an elective online registry for North American individuals with ASD and their families. The sample included self-report (SR) data from 255 adults with ASD aged 18-71 years (M=38.5; SD=13.1), as well as an additional 143 adults with ASD aged 18-58 years (M=25.0; SD=8.2) who were represented by their legal guardians (legally-represented, or LR). Though 90% of the LR subsample received initial ASD diagnoses in childhood, the majority of self-reporting adults (73%) was diagnosed in adulthood, and thus this subsample likely represents more mildly affected adults who are rarely represented in research due to minimal clinical contact. Additionally, 64% of the SR group was female.
Results: Within the SR subsample, 42% had a bachelor's degree or more education, and 47% had paid employment with various degrees of support, though only 25% held full-time jobs. Twenty percent lived alone. Of the LR group, 75% had achieved a high school degree or less; 22% held paid employment, though most for 1-9 hours per week. The most common physical health problems in both subsamples involved sleep, gastrointestinal problems, and allergies; high rates of anxiety, depressive, and attention deficit hyperactivity disorders were endorsed in both subsamples. The majority of participants were taking medication for ASD or co-occurring conditions, and 48% of the SR group received individual therapy. Participants placed greatest priority for future research on societal understanding and acceptance; mental and emotional health; and life, social, and vocational skills training.
Conclusions: Across self-reporting and legally-represented participants, both descriptive outcomes and rated priorities data converged to indicate that more adult research focus and support is needed in the areas of life skills, co-occurring mental and emotional health conditions, treatments, and vocational and educational opportunities. Priority was also placed on improving public services, health care access, and above all, public acceptance of adults with ASD. Ideally studies of this kind will result in greater opportunities for lifespan research. Such initiatives should incorporate information on the current needs, problems, and priorities of adults with ASD and their families in order to maximize impact on the next several age cohorts of adults with ASD.

89   **158.089** Conceptualizing an Effective Mentorship Program for University Students with Autism Spectrum Disorder

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Background:
University students with autism spectrum disorder (ASD) face unique challenges that negatively impact their social and academic adjustment to university (White et al., 2011). Indeed, a longitudinal study from the National Center for Special Education Research in 2010 found that less than 20% of students with ASD enrolled at a four-year university between 2001 and 2009 completed or were on track to finish their degree. As enrolment rates for students with ASD continue to increase, a stark

lack of research and services for these students remains (Gelbar et al., 2014). The approach of mentoring students with an ASD has gained popularity during the last three decades, however, few studies have examined in-depth how the experiences of mentoring participants can inform and refine existing frameworks for effective mentoring (Nora & Crisp, 2007). Importantly, the components that comprise the mentoring experiences of students with ASD and their mentors have not been identified.

Objectives:

To explore the stories of the participants involved in the Autism Mentorship Initiative (AMI) at Simon Fraser University (SFU) concerning the successes and challenges of students with ASD in navigating university life, and how participation in AMI has impacted those successes and challenges.

Methods:

Participants: Ten AMI mentors (a senior undergraduate or graduate student) and Ten AMI mentees (a student with a diagnosis of ASD) have been recruited for the 2014-2015 academic year. *Design*: Semi-structured 1:1 interviews will be conducted throughout the year to obtain participants' perspectives and experiences of AMI (preliminary data is presented for 4 mentor interviews). A grounded theory approach will be used to generate themes, identify trends, and construct theories based on the interview data.

Results:

Initial Interviews. Preliminary themes emerged from the four mentor interviews. Overall, mentors expressed positive feedback about the program itself and about their experiences as mentors. An overarching theme of *normalization* (offering personal experiences or examples of others facing the same problems in university) emerged as a potential core concept. Other themes include *comfortability* (creating a secure and trusting environment), *need for a social learning club* (involving group workshops and more social events so that both mentees and mentors could socialize and learn together), *sharing of information in a group setting* (collaborative meetings with mentors, mentees, and the AMI supervisors), *shared control* (of topics during discussions in meetings between mentees and mentors), and *learning about ASD in adulthood* (mentors expressed their interests in learning about ASD in adulthood). Collection of quantitative data assessing social and academic adjustment to university is currently in progress, yielding a mixed-methods approach.

Conclusions:

These findings are expected to enhance our understanding of the kinds of supports needed to ensure the success of students with ASD in post-secondary contexts. Initial data suggest that mentors perceive AMI to be an effective program that assesses the needs and goals of the mentees and benefits mentors simultaneously. A further exploration of common themes and categories, generated from the experiences of AMI participants, will guide the formation of a theoretical framework for mentorship of students with ASD.

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90 **158.090** Cross-Cultural Comparison of Everyday Participation in Males and Females with Asperger's Syndrome/High-Functioning Autism Living in Australia and Taiwan

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Background: Adolescents and adults with Asperger's syndrome (AS)/high-functioning autism (HFA) commonly have limited social participation stemming from social deficits and concurrent social anxiety. Previous researchers have identified better sociability in females with AS/HFA than males. Because of increased stigma, Chinese people with disability may experience more restricted daily participation than peers in Western countries. However, no comparison has been done regarding the social participation between males and females living in different cultural contexts. Exploring how the personal characteristics and country of residence affect participation will help identify person-centered intervention targets.

Objectives: The purpose of this study was to compare everyday participation of individuals with AS/HFA in Australia and Taiwan under the effects of autism symptoms and social anxiety.

Methods: Fourteen Australians (4 males; aged 16-43 years) and 16 Taiwanese (12 males; aged 19-45 years) with AS or HFA participated in the study. Participants carried an iPod Touch/iPhone which prompted them randomly, 7 times/day for 7 days, to record where they were, what they were doing, and who they were with. We conducted multilevel analyses to identify the relationships between the patterns of everyday participation and potentially associated factors which include gender, country of residence, and severity of autism and social anxiety measured by Social Responsiveness Scale and Social Interaction Anxiety Scale respectively.

Results: Taiwanese were more likely to stay at home than Australians and less likely to converse with people at school/work. Additionally, individuals with milder autism symptoms and/or higher levels of social anxiety had higher chances of *not* engaging in conversation. Conversely, females and/or individuals with more severe autism symptoms had higher probability of participating in social situations. Compared with Australian females, other participants were more likely *not* to engage in conversation. Males in both countries were less likely to participate in social activities, and Taiwanese males had the lowest chances of engaging in productive activities.

Conclusions: The findings of the study shed light on ways that culture and gender impact social engagement, and highlight the relationships of autism severity and social anxiety to social

participation. Researchers and service providers should consider different needs and targets for interventions that are specifically tailored for adolescents and adults with AS/HFA. Further research investigating their perception and experience in everyday participation is required.

91 **158.091** Diagnostic Specificity of Motor Impairments: Comparison of Adults with ASD, ADHD, and Healthy Controls

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Background: Neurobehavioral studies of motor abilities in ASD have potential to inform diagnostic, etiological, and translational research. Existing data suggest multi-faceted impairments in adults with ASD relative to healthy controls. However, the presence of persistent motor and neurocognitive impairments across developmental disorders suggests a need for research on the specificity of motor deficits to ASD.
Objectives: The purpose of this study was to investigate patterns of motor performance in ASD, ADHD, and healthy controls and evaluate neurocognitive variables associated with motor proficiency and skilled motor performance.
Methods: A motor and neurocognitive battery was administered by an inter-disciplinary team (e.g. neurology, neuropsychology). The study enrolled a well-characterized sample of adults (18-40 years) into three groups: ASD (n=24), ADHD (n=18), and typically developing (n=22). Participants were matched for age, gender, and IQ. Basic fine and gross motor skills were evaluated with neurological examinations, Purdue pegboard, and reaction time. Measures of skilled motor action included the following adult apraxia measures: the Kimura Movement Copying Test (MCT), Manual Sequencing Box (MSB), and Boston Diagnostic Aphasia Exam - Apraxia subtest (BDAE-Apraxia). In addition, measures of attention, memory, and executive function were assessed using the Cambridge Neuropsychological Test Automated Battery (CANTAB), Test of Variables of Attention Continuous Performance, and Controlled Oral Word Association (COWA).
Results: MANOVAs indicate no group differences on a composite measure of basic motor proficiency. Yet, results show differences on skilled motor composite scores with both ASD and ADHD groups underperforming relative to healthy controls (F=12.09, df=2, p=.00). Analyses of individual motor proficiency tasks suggest adults with ASD exhibit specific impairments in gait and manual dexterity. The neurological exam identified gait abnormalities in adults with ASD, but not ADHD and healthy control groups (F=4.974, df=2 p=.01). Adults with ASD performed worse than ADHD and healthy controls on dominant, but not non-dominant hand trials of the Purdue Pegboard. Further, laterality effects were not observed for adults with ASD. Adults with ASD and ADHD did not differ on several apraxia subtests. However, significant impairments were identified on pantomime tasks requiring ideation (BDAE-Apraxia subtest, command items) in adults with ASD relative to ADHD and healthy controls (F=9.251, df=2, p<.00). ADOS social communication scores were significantly correlated with performance on the BDAE command subtest in the ASD group. Significant correlations were also found between several neurocognitive domains and performance on skilled motor actions.
Conclusions: This study is consistent with prior findings of multiple motor impairments in adults with ASD relative to healthy controls. Previously reported findings of deficits in balance, bilateral coordination, and reaction time were only found relative to healthy controls, but not ADHD. In fact, results suggest several similarities in performance on motor tasks between ADHD and ASD adults. Data suggest ASD-specific motor impairments present in measures of gait, lateralized motor dexterity, and ideational apraxia. Further investigation of the relationship between ASD-specific deficits and other neurobehavioral domains (e.g. diagnostic, attention) are also indicated by these findings.

92 **158.092** Education and Employment Experiences of Adults with Autism Spectrum Disorder: Individual and Parent Perspectives

ABSTRACT WITHDRAWN

Background: Follow-up studies of adolescents and adults with an ASD show that they have poor long-term outcomes with particular problems in the areas of friendship, living arrangement outcomes, and employment, even when tertiary qualifications are obtained. Despite this, a significant portion of ASD individuals do achieve positive long-term outcomes. Factors that may account for variations within groups of individuals with autism and contribute to their successful adaptation are currently largely unexplored and poorly understood.
Objectives: The aim was to identify the factors associated with positive and negative outcomes in relation to education and employment in adults with ASD, from the perspective of both adults and parents.
Methods: The results presented here are a part of an ongoing project where individuals with ASD and their parents were invited to complete a qualitative online survey looking at the education and employment experiences of individuals with ASD. To date, 44 individuals (25 individuals with ASD and 19 parents) have completed the survey. Data collection is on-going till the end of 2014.
Results: The mean age of parents was 47.3 (*SD*=8.9) and adults with ASD was 40.5 (*SD*=13.4). 60% of adults and 89% of parents reported they/their children have experienced challenges during education. Anxiety, poor social skills and difficulties interacting with others, and bullying were the most important challenges reported by both adults with ASD and their parents. In addition to these,

the other challenge mentioned by parents was having unsupportive teachers or schools being unsupportive. Majority of adults and parents agreed having supportive and understanding teachers was the most helpful during education. 60% of adults with ASD have experienced challenges in finding employment and 40% of those reported the inability to succeed in interviews as the greatest challenge in finding employment, which was mirrored in parental reports. Some of the factors that helped adults in finding employment were having contacts to put in a good word, having skills and capabilities, being well prepared for interviews, doing volunteer work, maintaining persistence and positive outlook, and accepting positions that the individual is over-qualified for. 52% of adults and 33% of parents reported they/their children have experienced challenges in keeping a job. The greatest challenges experienced by adults were workplace bullying, difficulties in maintaining psychological health, juggling social demands outside of job description, and dealing with colleagues/customers. Parents identified unsupportive employers/colleagues and ignorance of others as greatest challenges for individuals with ASD for keeping a job. Parents also identified the following factors associated with the individuals with ASD themselves: taking the wrong initiatives, lacking accountability, having poor emotion regulation, and being taken advantage of at work. Many of the adults and parents believed having supportive work environment/managers/colleagues helped adults keep their jobs.

Conclusions: The results of this study indicate key individual and environmental factors associated with positive and negative educational and employment outcomes for adults with ASD. Although preliminary, these results suggest future directions for intervention research that focus on modifying the factors to improve outcomes for individuals with ASD.

93 **158.093** Embracing Neurodiversity in Higher Education: Creating an Inclusive College Campus for Neurodiverse Students

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Background:
Neurodiversity is an emergent philosophy that postulates neurological differences like autism are more than disabilities. Neurodiversity advocates believe that brain differences are a natural part of human diversity and that neurological diversity is essential for our continued success as a species. The recent increase in autism awareness means more students will enter college with the knowledge they are neurodiverse. We believe educators have an obligation to accommodate this population and an opportunity for growth by doing so.
Objectives:
We are devising and implementing a program to create a welcoming environment for neurodiverse students, faculty, and staff. We hope to benefit from expansion of the diversity of our population, and provide our neurotypical students with concepts of neurodiversity that will benefit them beyond graduation.
Methods:
We organized a neurodiversity group composed of faculty, alumni, administrators, and staff from Residence Life and Counseling Center. Several members are neurodiverse themselves. To our knowledge, this is one of the first university groups in the country to include people and resources across campus to ensure a multi-faceted approach to creating an inclusive campus. We also facilitated a student neurodiversity group and hosted several awareness events on campus.
A core component of our program is to provide online resources to students and faculty. We developed a "Hidden Rules" presentation that was designed to be shown at the beginning of the semester with the intention of making implicit social rules in seminars more explicit. We wanted to provide neurodiverse students, who may be less able to recognize the implicit rules of a small seminar, with detailed directives to ensure success in these classes. Topics for suggestions included seating arrangements, technology use and how to respectfully enter a discussion. We evaluated this presentation in four seminar classes ranging from a first-year seminar to a graduate-level course.
We developed a weekly neurodiversity course, plus a weekend course, and have more offerings in the works. Our present course covers topics such as: a definition of neurodiversity, neurodiversity in educational and workplace settings, advocacy, neurodiversity and the law, co-occurring conditions, impact on relationships, social cognition and neuroplasticity.
Results:
Students provided positive feedback regarding the "Hidden Rules" seminar. Most students had not had a similar previous presentation. In general, students found the presentation relevant, helpful and would recommend it for other students (Table 1). Our neurodiversity classes also received positive student evaluations (Table 2). Once started, the students picked up the neurodiversity and carried the student group forward into the current academic year. Interest in the program is building as we move through our second year as evidenced by a student group that is three times the size of last year's group and growing.
Conclusions:
The quantitative and qualitative feedback about our online materials and new course has been positive. The available data provide a strong foundation to build upon as we consider how to expand our efforts to increase awareness about the college experiences of neurodiverse individuals.

94 **158.094** Executive Function, Anxiety, and Depression and Their Relationship to Core Social Difficulty in College Students with an ASD Diagnosis

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Background:
Little is known about the characteristics of students with an ASD entering college or what factors significantly impact their transition. Adolescents and adults with an ASD tend to have poor executive function (Hill, 2004) and are at greater risk for anxiety and depression (Howlin, et al., 2000; Ghaziuddin, et al., 1998). Limited research exists regarding EF difficulty, anxiety, and depression in a high-functioning group of college students with an ASD diagnosis or how these challenges relate to their core symptoms.

Objectives:
The purpose of the current project is to: 1.) Provide updated information regarding a database for the long-term study of social, emotional, behavioral, academic, and EF skills in individuals with HFA at a major public university; 2.) Examine the characteristics of students with an ASD diagnosis who are entering college, focusing primarily on EF skills, anxiety, and depression, for the purpose of documenting strengths and weaknesses that may impact the college transition.; 3) Examine the relationship among these comorbid difficulties and core ASD symptomatology.

Methods:
The current study includes 16 students enrolled in a college support program for degree-seeking students with an ASD diagnosis at a public university. Each student is administered a battery of measures at summer orientation and the end of each Fall and Spring semester. The battery of measures includes parent-report measures (i.e., the BRIEF, SRS-2), self-report measures (i.e., the BASC-2, STAI, BDI-II, SRS-2, Brief Multidimensional Life Satisfaction Measure, and the Student Adjustment to College Questionnaire), information provided as part of the application process (i.e., previous testing, prior GPA), and their GPA and the end of each semester.

Results:
Preliminary analyses completed on the first 3 cohorts entering college between 2012 and 2014 indicated a mean Full Scale IQ of 114. SRS-2 scores confirm significant social difficulty (mean total SRS score = 72.13). Overall, 31% of the sample reported mild to moderate symptoms of depression on the BDI-II (<10), 40% reported elevated state Anxiety on the STAI, and 44% reported elevated levels of trait anxiety. The results of the BRIEF indicated significant difficulty in the areas of metacognition and behavior regulation (mean T-scores: 61.17 and 64.19, respectively). Specifically, the greatest difficulty appeared on the shift subscale (mean=65.74), the initiate subscale (mean=65.06), the plan/organize subscale (mean=63.81), and the Task monitor subscale (mean=64.19). Correlations between these three areas and core symptoms as measured by the SRS-2, indicated that EF and depression were significantly correlated with repetitive behaviors (r=.651, p=.009; r=.577, p=.024). Higher levels of depression and poorer EF skills were associated with greater levels of repetitive behavior. An additional 6-7 data points will be collected allowing for examination of these challenges as they relate to academic performance and adaptation to college over time.

Conclusions:
Overall, these results indicate that despite average or better intelligence, college students with an ASD diagnosis experience greater difficulty in the areas of EF, anxiety, and depression than the general population. Correlation analyses indicate that EF and depression may be related to greater levels of repetitive behaviors in individuals with an ASD diagnosis.

95 **158.095** Introducing the OBS-LDASC: An Innovative Tool to Monitor Behaviour That Challenges in Autism Spectrum Conditions and Learning Disability

ABSTRACT WITHDRAWN

Background: Behaviours that challenge are common in residential services for adults with Learning Disabilities (LD) and Autism Spectrum Conditions (ASC), and impact on quality of life. Behaviour monitoring is essential for clear identification of challenging behaviours and understanding factors which trigger and maintain behaviour. Existing monitoring tools for use in other populations require adaptation to reflect behaviours observed in LD/ASC. We present a new behaviour monitoring system, the Overt Behaviour Scale-Learning Disabilities and Autism Spectrum Conditions (OBS-LDASC), which was purposely designed for use with adults with ASC and/or LD. The OBS-LDASC is grounded on a Positive Behaviour Support framework and monitors challenging behaviour in residential settings. It is consistent with the existing evidence-base (e. g. Scotti et al., 1991; Didden et al., 1997; Ager and O'May, 2001) stating that a functional analysis must be conducted using detailed, accurate and up-to-date information about antecedents, behaviour and consequences. The unique flexibility offered by the OBS-LDASC allows it to be individualised to provide a truly person centred approach. The tool has been designed for use with people aged 16 years and over with ASC and/or LD. However, it has potential to be used in other clinical populations (e.g. forensic settings) and formats (e.g. self-monitoring). The OBS-LDASC is supported by a user manual, full training package and database, which allows automatic graphical presentation of data.

Objectives: The aims of this paper are: 1) to introduce a new behaviour monitoring system, the Overt

Behaviour Scale-Learning Disabilities and Autism Spectrum Conditions (OBS-LDASC), and 2) to present psychometric properties of the tool and demonstrate its clinical utility.

Methods: Using standard techniques for the development of new assessment instruments (e. g. Rust & Golombok, 1999), we adapted and extended existing tools for monitoring challenging behaviour in other clinical groups (e.g. OAS-MNR, Alderman et al., 1997; SASBA, Knight, 2008). The resulting OBS-LDASC provides continuous measurement of the severity, frequency and duration of 13 specific challenging behaviours (as defined by the UK Royal College of Psychiatrists, 2007), as well as the antecedents and consequences of behaviour. Inter-rater reliability was investigated from recordings made by support staff about ten video scenarios of behaviour that challenges. Test-retest reliability was established by asking the same participants to view the clips again four weeks later. Data from a clinical data sample established the validity of the tool.

Results: Estimates of test-retest reliability were moderate to strong. Inter-rater reliability was very good for type of behaviour and good for severity, but variable for antecedents and consequences. Clinical data demonstrate the type, prevalence and severity of challenging behaviour in those with LD/ASC, alongside the most common triggers and reducing factors.

Conclusions: The present results establish the robust psychometric properties of this innovative behaviour monitoring tool, as well as its utility for identification, understanding and informing intervention around challenging behaviours in clinical practice.

96 **158.096** Learner and Novice Drivers with Attention Deficit Hyperactive Disorder or Autism Spectrum Disorder

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Background: Potential learner drivers in Sweden with a disorder or a medical condition must present a medical certificate initially which states that the individual fulfils the legal medical requirement for a driving licence. In Sweden, medical practitioners have the legal obligation to consider a diversity of medical aspects of fitness to drive and specific pre-driving assessments can be used if in doubt. However, evaluating young people with Autism Spectrum Disorder (ASD) or Attention Deficit Hyperactive Disorder (ADHD) is difficult for clinicians as no guidelines or validated tool exists for these groups. These pre-assessments, in addition to the use of driving manuals and instructions that are not adapted to learners with ASD/ADHD, are likely barriers for individuals with these diagnoses in regards to learning to drive, hence, indirectly hindering social participation. However, no research has previously explored the experiences of individuals with ASD and/or ADHD who actually started as learner drivers.

Objectives: To explore and describe the experiences of adolescents and young adults with ASD or ADHD, who had passed a pre-driving assessment and engaged in the process of obtaining a driving licence

Methods: A questionnaire was sent out to 33 participants with ASD and/or ADHD (Table 1) and 9 of their driving instructors. In addition, interviews were conducted with the 42 participants in order to obtain in-depth information related to the process of learning to drive and of teaching individuals with ASD/ADHD to drive.

Results: There was a significant difference in the number of lessons and test required between the participants with ADHD, compared with participants with ASD, as shown in Table 1.

		Mean	Minimum	Maximum
ADHD (n=11)	Driving lessons (SD)	20,0 (12,8)	10	50
	Theoretical tests (SD)	2,8 (2,7)	1	10
	On-road tests (SD)	1,7 (1,0)	1	4
ASD (n=12)	Driving lessons (SD)	37,6 (24,4)	10	80
	Theoretical tests (SD)	1,8 (1,3)	1	5
	On-road tests (SD)	2,4 (1,8)	1	8

The individuals with ASD had on average twice as many driving lessons and more on-road tests than the individuals with ADHD. However, the group with ADHD required more written tests. This was consistent with the driving instructors' comments; in which they perceived that learning the driving licence theory was more challenging for individuals with ADHD. For the learners with ASD the largest challenge was translate the theory into practice, i.e., to 'read' other traffic users and traffic situations, and adjust the driving to "new" driving situations or areas.

Conclusions: The association between receiving a driving licence is not limited to stressful training experiences but also includes the cost as participants with ADHD and ASD compared with typically developing individuals find it more expensive. Additionally, driving instructions need to be specialised in different ways in order to suite learner drivers with ASD and ADHD. The instructor would need to adapt to accommodate drivers with ASD due to the difficulties experienced in social aspects and

possible short term memory. Training focusing on risk awareness for people with ASD and ADHD would be beneficial for promoting positive driving behaviour.

97 **158.097** Life Satisfaction of College Students with Autism Spectrum Disorders

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Background: Little is known about college students with autism spectrum disorders (ASD). Specifically, even less is known about these students' self-reported life satisfaction and perceived adaptation to college.

Objectives: The current study describes the self-reported life satisfaction and adaptation to college of college students with ASD across three cohorts and at various stages of their college careers.

Methods: This study includes 16 students enrolled in a college transition and support program for degree-seeking undergraduate students with ASD at a major public university. Of these 16 students, 12 entered the program as freshmen and 4 entered as transfer students. As part of the program, enrolled students meet 2-3 times per week with a therapist-mentor who provides services in academics, social skills, and daily living; attend 4 hours of weekly study hall; and participate in regular group meetings focused on issues important to college life, such as healthy eating on campus and dating. Each student is administered a battery of psychosocial measures at summer orientation and the end of each Fall and Spring semester during their college career. Included in this battery are the Brief Multidimensional Students' Life Satisfaction Scale and the Student Adaptation to College Questionnaire. Additionally, the students' GPA is collected every semester.

Results: Analyses of total life satisfaction for students with ASD entering college in 2012, 2013, and 2014 at their college orientation revealed mean scores in the neutral to mostly satisfied ranges ($M = 4.92$, $M = 4.15$, $M = 5.10$, respectively). After their second year of college, students reported a total mean life satisfaction in the neutral range ($M = 4.95$). With respect to life satisfaction, students with ASD reported total life satisfaction within 1.5 standard deviations of the normative college sample ($M = 5.55$, $SD = 1.14$; Zullig et al., 2005) at college orientation and two years later. Furthermore, family life satisfaction was the highest-ranking life satisfaction domain at various time points. Also, students with ASD reported average adaptation to college (mean T-score = 45.25) after their second year of college. In addition, mean GPAs ranged from 2.35 to 3.67 over the course of four semesters. Additional data for 6-7 students will be added for the current academic year prior to the IMFAR 2015 meeting. Differences, if any, in life satisfaction at college orientation to the end of year two with the larger sample will be examined and presented. Adaptation to college after their second year will also be examined for students who entered college in 2013.

Conclusions: Overall, these results indicate that college students with ASD enrolled in a transition and support program report adequate life satisfaction and adaptation to college throughout their college careers. Additionally, these results highlight that these college students appear to be functioning well compared to normative college samples, despite social difficulties associated with ASD, and that young adults with ASD can be successful in college when offered appropriate support services. Additional data collection and longitudinal analyses will be helpful in better understanding the lives of college students with ASD.

98 **158.098** Longitudinal Associations of Social Problem-Solving and Emotion Regulation on Depression and Anxiety in Adults with High-Functioning Autism

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Background: High-Functioning Autism-Spectrum Disorder (HFASD) is associated with increased susceptibility to depression and anxiety. It has been suggested that ASD-related social communication/interaction deficits, and resultant isolation/loneliness, and perceived social inadequacy could be at fault. Two studies have modeled the specific role of social problem-solving (SPS) deficits on this susceptibility by examining autistic-trait expression levels in neurotypical samples. Between these studies, it was found that SPS deficits play the role of a significant mediator between autistic-trait expression and both depressive and anxious symptomology.

Objectives: The current study aims to: (i) explore whether these findings will persist in a HFASD sample; (ii) utilize a longitudinal design to assess the directionality of the relationship between SPS and depression/anxiety; and (iii) examine what role, if any, emotion regulation plays in these relationships.

Methods: The study sample consists of 65 HFASD adults from the US (n=42) and the UK (n=24). Participant age ranged from 19-52 (M=31.51, SD=8.58). The study had two sessions (completed online), separated by three months. Participants were assessed on ASD-related social deficits (Social Responsiveness Scale, 2[nd]Edition), SPS ability (Social Problem-Solving Inventory, Revised), depressive/anxious symptomology (Depression Anxiety and Stress Scale), and emotion regulation (Difficulties in Emotion Regulation Scale).

Results: Session 1 data support findings of high rates of depression/anxiety in HFASD, with 80% of participants reporting at least one episode of diagnosed depression, and 72.3% reporting at least one episode of diagnosed anxiety in their lifetime. Consistent with neurotypical sample findings, increased ASD-related social deficits were significantly associated with increases in depressive

(r=.39, p<.001) and anxious (r=.40, p<.001) symptomology, as well as poorer SPS skills (r=-.32, p<.01). While a significant negative association between SPS and depressive symptoms was found (r=-.29, p<.05), there was essentially no association found with symptoms of anxiety (r=.01, p=.95). Mediation analysis results suggest that deficient SPS accounts for approximately 38% of the variance in depressive symptoms initially predicted by ASD-related social deficits. This mediation, however, did not reach statistical significance (Z=1.35, SE=.05, p=.18). Consistent with neurotypical models, ASD-related social deficits were found to be associated with increased utilization of impulsive (r=.25, p<.05) and avoidant (r=.25, p<.05) problem-solving styles, and a negative problem-solving orientation (r=.52, p<.001). The role of emotion regulation, and assessment of the SPS/depressive symptoms relationship directionality will be examined following the collection of Session 2 data (scheduled for completion by February, 2015).

Conclusions: This study provides further support to the increased susceptibility of HFASD populations to episodes of depression/anxiety. The finding that deficient SPS was significantly associated with increased depressive symptoms suggests that targeted therapies directed at the improvement of this skillset could be a beneficial treatment option for depressive vulnerability in HFASD. Recently, a pilot-study examining the feasibility of Problem-Solving Therapy (PST) for HFASD adults showed promise with regard to participant skill acquisition. In other populations, PST has been shown to be an effective treatment option for reducing depressed mood. Hopefully the results from this study can provide further support and insight for the use of PST to help alleviate the depressive vulnerability in HFASD populations.

99 **158.099** Marital Disagreements and Behavior Problems in Youth with Autism Spectrum Disorder: Natural Unfolding of Associations from Day-to-Day

ABSTRACT WITHDRAWN

Background: From a Family Systems perspective, the functioning of youth with autism spectrum disorder (ASD) is reciprocally connected to the functioning of other family members and family subsystems such as parents' marital relationship. Youth with ASD often present with a challenging profile of co-occurring behavior problems. These challenges may contribute to marital disagreements directly (i.e., youth with ASD is topic of disagreement) or indirectly (i.e., more prone to disagree about other topics). In turn, parents' marital disagreements have been shown to lead to increases in youth behavior problems in research on the general population. In this talk, we will discuss the importance of family context for youth with ASD by discussing the day-to-day associations between parents' marital disagreements and the co-occurring behavior problems of youth with ASD at a within- and between-family level.

Objectives: The aims of the present study were to use daily diary data from an ongoing longitudinal study to: 1) describe the marital disagreements of married couples who have a son or daughter with ASD; 2) examine between-family differences in marital disagreements based on family, parent, and youth variables; and 3) evaluate the same-day and previous-day (lagged) associations between marital disagreements and the severity of the youth with ASD's co-occurring behavior problems.

Methods: Analyses included 96 families of youth (aged 10-20 yrs) with ASD. All youth had a documented diagnosis of ASD by an educational or medical specialist, which included the Autism Diagnostic and Observational Schedule. Parents had a mean age of 45.38 yrs (*SD* = 4.32) and median household income of $70 to $79K. Youth with ASD had an average age of 14.23 yrs (*SD*= 3.53) and most were male (74.9%). Mothers and fathers independently completed a daily diary in which they reported on marital disagreements, including number, topic, and severity of negative emotions. Parents also independently completed the Scales of Independent Behavior–Revised (Bruininks et al., 1996) each day of the diary to assess the frequency x severity of the youth with ASD's co-occurring behavior problems.

Results: Multilevel multivariate modeling using HLM was conducted to examine within-person *same-day* associations between the youth with ASD's behavioral problems and marital disagreement variables within the 10-day daily diary. The between-couple effects of family, parent, and child variables on initial status of marital disagreement variables and their interaction with within-person predictors were examined. The youth with ASD's co-occurring behavior problems significantly co-varied with the number of marital disagreements and the severity of negative emotions, but not topic. The previous-day (lagged models) suggested a bi-directional pattern of effects.

Conclusions: Findings offer insight into the spontaneous 'real time' day-to-day interdependency of marital disagreements and the co-occurring behavior problems of youth with ASD. The youth with ASD's co-occurring behavior problems were related to between-family variability in marital disagreements as well as within-family day-to-day fluctuations in marital disagreements in bi-directional ways. Implications for interventions and next steps in research will be discussed.
Bruininks, R H, Woodcock, R, Weatherman, R, Hill, B. (1996). *Scales of Independent Behavior-Revised*. Chicago, IL: Riverside

100 **158.100** Mediators of Problem Behaviors and Psychosocial Outcomes in Siblings of Adults with Autism Spectrum Disorder and Down Syndrome

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Background: Research investigating caregiver burden has focused primarily on parental or spousal caregivers (e.g., Stuart & McGrew, 2009; Blood et al., 1994). Relatively little work has examined burden for non-disabled siblings who provide care (e.g., Bigby, 1997; Heller & Arnold, 2010; Heller & Kramer, 2009; Tozer et al., 2013).

Objectives: The study examined caregiver outcomes and potential mediators of those outcomes for sibling caregivers. Specifically, we tested whether two cognitive appraisal types (i.e., challenge and threat) and two coping strategies (i.e., problem-focused and passive-avoidant) mediated the relationships between (a) problem behaviors and caregiver burden, and/or (b) problem behaviors and reported benefits across three groups of siblings: (a) siblings of adults with Autism Spectrum Disorder (ASD), (b) siblings of adults with Down Syndrome (DS), and (C) siblings of adults in a Mixed diagnosis group, i.e., siblings who were reportedly diagnosed with both ASD and DS.

Methods: A web-based survey was administered to all participants. The ASD group (n = 44) consisted of non-disabled siblings who reported their siblings to have Autism, PDD-NOS, or Asperger syndrome and whose reports were confirmed using the Gilliam Autism Rating Scale- Second Edition (GARS-2; [Gilliam, 2006]). The DS group (n = 66) consisted of non-disabled siblings who reported their siblings to have DS. The Mixed group (n = 13) was comprised of sibling of adults with diagnoses of both ASD and DS. The three groups of non-disabled adult siblings were combined for analysis and referred to as the Disability group (N = 123). Eight tests of mediation were proposed.

Results: Hayes PROC procedure for SPSS was used to assess mediation (Hayes, 2009). Threat appraisal positively mediated the relationship between *problem behaviors* and *caregiver burden* (indirect effect = .44, SE = .10, 95% CI = .27, .65) and negatively mediated the relationship between *problem behaviors* and *reported benefits* (indirect effect = -.25, SE= .11, 95% CI = -.51, -.06). In addition, the use of *passive-avoidant* coping significantly positively mediated the relationship between *problem behaviors* and *caregiver burden* (indirect effect = .51, SE = .14, 95% CI = .26, .81) and significantly negatively mediated the relationship between caregiver burden and reported benefits (indirect effect = -.35, SE = .15, 95% CI = -.71, -.12).

Conclusions: The study confirms the important role of appraisal and coping style in explaining and understanding the associations between problem behaviors exhibited by individuals with disabilities and the psychosocial outcomes of their caregivers (Lazarus & Folkman, 1984). Specifically, the impact of problem behaviors on both positive (i.e., fewer reported benefits) and negative outcomes (i.e., greater caregiver burden) was significantly mediated by the use of a negative (*threat)* cognitive appraisal type and a negative (*passive-avoidant)* coping strategy. The findings suggest that interventions to help caregivers view stressors alternatively (e.g. challenge vs threat appraisal) or cope differently (e.g., problem focused vs avoidance coping) may reduce caregiver's experience of burden. Further exploration of these findings using larger samples of adult siblings and caregivers of individuals with ASD and DS is warranted.

101 **158.101** Mixed Methods Study with Latent Class Analysis on Identity and Post-Secondary Outcomes for Adults on the Autism Spectrum

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Background:
Adult life outcomes for individuals with autism spectrum disorder (ASD), such as education, employment, and psychosocial health, are a great concern to society. Previous research identifies several factors which predict positive outcomes; however, wide variation exists even for those whom best outcomes are predicted.

Objectives:
This poster combines the psychological framework of stereotype threat with the sociological theory of group stigma to ascertain within group ASD identity variation. This study examines how variation in adult ASD identity mediate self-esteem, feelings of disability, education and employment.

Methods:
Over 1000 adults (ASD) were recruited nationwide with the assistance of community providers of services for adults (ASD) as well as the disability services offices within post-secondary institutions. Using peer-reviewed research alongside of first-hand accounts from individuals (ASD), a questionnaire was designed to identify and explore possible candidate categories relating to ASD and identity and to inquire on the meanings of ASD constructed by adults (ASD). This questionnaire was included in a nationally-distributed, online survey to assess variation in how individuals identify with the autism spectrum and how this identity relates to other adult outcomes. In addition to the quantitative section of the study, a final open-ended question probed for further comments by the participants. A mixed method approach assessed response profiles from both quantitative and qualitative data.

Results:
A latent class analysis revealed five distinct styles of identification: 1) Disability-Non-adaptable 2) Disability-Adaptable, 3)Positive-Adaptable 3) Positive-Efficacious 4) Positive-Non-efficacious 5) Disability-Adaptable which respectively comprised 23%, 20%, 28%, 17%, and 12% of the surveyed individuals. These classes were informed by emergent themes. Themes included nuanced responses directly related to participants corresponding themes. In addition, two themes, Stigma/Society is Problem and Identity-First language, arose for all groups except for Disability–Non-adaptable. Both Disability groups commented regarding the need for services. All groups discussed problematic study assumptions inherent across the scale measures.

Conclusions:

Individuals (ASD) do not have a singular identification style with the autism spectrum. Crucial factors for differences included the degree individuals reported ASD characteristics as malleable and/or positive, and the degree they felt limited by ASD in their lives. The open-ended question allowed for nuanced responses, some of which were common across groups while others were group specific. These comments both provide social validation as well as insight for future research in study design for this population. Although autism severity likely relates to outcomes, this study indicates attitudes play an important role in outcomes for individuals on the autism spectrum. Future research should investigate the degree to which diagnosed autism severity relate to these identification differences.

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102   **158.102** Opening an Adult Autism Clinic: Understanding Patient Needs

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Background: Developing appropriate medical and mental health services for adults with Autism Spectrum Disorder (ASD) is a critical need. As children with ASD transition from pediatric practice, there are relatively few clinics designed to care for their adult needs. Little is known about utilization patterns, including if needs are diagnostic or therapeutic in nature or both. Outcomes from this study may help determine appropriate clinic staffing, and may guide other centers considering initiating specialized adult ASD clinic services.
Objectives: We sought to understand the patient characteristics and service needs of a medical center based adult autism clinic over its first 18 months of operation.
Methods: Information, including demographic and service utilization data (Aug 2012 to June 2014) were abstracted from 385 randomly selected patient's records. Data included primary and secondary diagnosis history, service utilization, medication use at presentation, education level, work status, living status, and communication ability. We compared patients with an established diagnosis of ASD and those seeking (SEEK) an evaluation for ASD using Chi-square analyses for categorical variables, and the Mann-Whitney U test for continuous variables.
Results: The average age of all clinic patients was 27 years (range 17-72), of which 68% were male. Almost half of patients (49%) had private insurance while 47% were dependent on government programs for medical care. In regard to overall functioning, 83% of patients lived with support from family or the community, while 16% lived independently. The majority (82%) were able to communicate with words or signs while 7% used a communication device. Sixty-eight percent were prescribed behavioral medication. At initiation of services, 50% reported ASD without a significant comorbid or etiological diagnosis , 18% reported a genetic or significant psychiatric condition in addition to ASD, and 25% were in the SEEK group. The vast majority of individuals had well-established care (93%). In comparison to the SEEK group, patients with an established diagnosis of ASD, were younger, less likely to be employed, less likely to be living independently, had higher clinic utilization), more phone visits per year, were more likely to be on behavioral medication, and were less likely to have well-established care (all p<0.01).
Conclusions: Adults with ASD often transition from specialty ASD pediatric care into a confusing landscape of adult health care networks. Our analysis distinguished two distinct types of patient needs in the Adult Autism Clinic- those with an established diagnoses of ASD and those seeking evaluation for ASD. Those with established diagnoses were lower functioning and more impacted. This highlights the importance of continuing well-established specialty care into adulthood. Our utilization data suggest that the majority of patients had well-established care networks; opening the opportunity for medical homes to partner with adult autism specialty care clinics. This study also emphasizes the need for ongoing diagnostic services for the relatively higher functioning group of adults seeking an ASD evaluation.

103   **158.103** Parent Vs. Self-Report of Social Difficulty in College Students with an ASD Diagnosis

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Background:
Theory of Mind is a core weakness in individuals with an ASD diagnosis. This difficulty may impact their awareness of their own social symptoms. Previous studies examining children and adolescents with an ASD found that these individuals demonstrated less insight into their own social skills than typically developing controls with reported levels of difficulty being significantly less than parent reported difficulty (Johnson, et al., 2009). Studies specifically focused on adults have examined self-report versus informant report regarding personality characteristics with similar findings (Schriber, et al., 2014); however, little research exists regarding self-perceptions of social difficulty in high-

functioning adults with an ASD diagnosis.
Objectives:
The purpose of the current project is to: 1.) to examine self-reported social difficulty in high-functioning college students with an ASD diagnosis; 2.) to examine the relationship between student and parent perceptions of social skills in a sample of college students with an ASD.
Methods:
The current study includes 10 students enrolled in a college transition and support program for degree-seeking students with an ASD diagnosis at a major public university. As part of the program, students meet 2-3 times per week with a therapist-mentor, complete 4 hours of study hall per week within the program, and participate in regular group meetings with other program participants. Each student is administered a battery of measures at summer orientation and toward the end of each Fall and Spring semesters during their college career. The current study focuses on the Social Responsiveness Scale, Second Edition, Informant and Self-report administered at summer orientation.
Results:
Preliminary analyses completed on the first 2 cohorts entering college in 2013 and 2014 indicated a mean Full Scale IQ of 116. Descriptive statistics indicated the following mean T-scores on the three summary scales of the SRS-2, Self-report: DSM-5 Social Communication, 63.1; DSM-5 Restricted Interests and Repetitive Behaviors, 69.70; SRS-2 Total, 64.60. Parents reported the following mean T-scores on the SRS-2, Informant Report: DSM-5 Social Communication, 69.4; DSM-5 Restricted Interests and Repetitive Behaviors, 75.8; SRS-2 Total, 71.50. Paired samples t-tests were conducted comparing parent and student report in each of the three domains. The results indicated statistically significant differences between parent and student report across all three areas (Social Communication $t(9)=3.150$, $p=.012$; Restricted Interests/Repetitive Behaviors, $t(9)=2.545$, $p=.031$; Total, $t(9)=3.712$, $p=.005$). Additionally, each pair was significantly correlated (Social Communication, $r=.719$, $p=.019$; Restricted Interests/Repetitive Behaviors, $r=.726$, $p=.017$; Total $r=.771$, $p=.009$) indicating a large correlation between parent and student report in each domain.
Conclusions:
Similar to previous studies with children and adolescents, college students reported elevated levels of social difficulty as evidenced by mean self-report scores in the range indicating mild to moderate social difficulty; however, they reported significantly less difficulty than that reported by their parents. Overall, students in the current sample demonstrate awareness of their social difficulty; however, they tend to underreport these symptoms in comparison to their parents.

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104   **158.104**   Parents and Adults with Autism Spectrum Disorder: A Dyadic Study of Parent-Child Sexuality Communication

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Background: Sexual relationships are associated with physical and mental health benefits[1] and risks. Despite the recent focus on improving adult outcomes in ASD and the interest most individuals with ASD have in sexuality,[2,3] research on parent-child sexuality communication (PCSC) in ASD remains limited.[4]
While parents are expected to be the primary source of sex education for children, some parents of youth with ASD are unsure of when and how to engage in PCSC and have concerns that PCSC could have unintended negative consequences (e.g., lead to inappropriate sexual behavior or fixation).[7] In a recent survey of parents of adolescents with ASD, we found that most parents cover basic topics such as sexual abuse prevention, privacy, and hygiene, but are less likely to cover other important topics such as sexual decision-making, contraception, and romantic relationships.[8] In addition, individuals with ASD may have a delayed relationship trajectory,[9] causing parents to delay PCSC until they perceive it as being relevant. Thus, many individuals are left to learn from less credible sources, [10,11] possibly explaining recent findings showing that individuals with ASD have lower sexual knowledge relative to their neurotypical peers, which has been shown to be associated with sexual victimization among adults with ASD.[11]Therefore, it is crucial to understand factors related to PCSC in families raising a child with ASD.
Objectives: In order to better understand how parent-child dyads engage in PCSC, we surveyed 56 parents and their adult children with ASD (mean age = 22 years, average or above IQ).
Methods: Regression models were used to determine the role of adult variables (i.e., sexual behavior, interest) and parent variables (i.e., sexuality-related concerns, self-efficacy) in predicting PCSC. Parents also reported reasons why they had not introduced specific sexuality-related topics to their child.
Results: Parents discussed a greater number of topics if their child expressed a desire for relationships or if they thought their child had engaged in intercourse ($F(3, 51)= 9.065$, $p= .000$, $R^2= .348$). Adult social motivation, cognition, communication, and awareness predicted parental self-efficacy for engaging in PCSC ($F(4, 49)= 2.586$, $p= .048$, $R^2 = .174$), and self-efficacy predicted number of topics covered ($F(1, 52)= 9.086$, $p= .004$, $R^2 = .149$). The most common reasons that parents chose not cover topics were that their child had not shown interest in the topic (34%) and parental belief that the topic was irrelevant (27%). Contrary to previous findings, parents rarely endorsed that they did not know how to cover a topic (2%) or were afraid it would lead to negative outcomes (1%), and concerns about negative effects of PCSC did not predict the number of PCSC

topics covered ($F(2, 49)= .334, p= .718$).

Conclusions: Parents rely on cues from their child to decide when and how to engage in PCSC. Support and resources may increase the frequency and depth of PCSC by enhancing parents' self-efficacy. Encouraging parents to engage in PCSC, especially for those whose children appear disinterested in sex, might reduce the likelihood of negative outcomes such as sexual victimization.

105 158.105 Predictors of Sexual Victimization and Perpetration in Adults with Autism Spectrum Disorders

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Background: While previous studies have found that compared to typically developing peers individuals with high functioning ASD have less sexual knowledge and are more likely to be victimized (Brown-Lavoie, Viecili, & Weiss, 2014), studies have yet to explore how other factors may contribute to this increased risk. Social deficits, misinterpretation of social cues, and social naivety may influence the susceptibility to sexual violence. Traditional sex-related stereotypes generally endorse the sexual entitlements of males (Hanson, et al., 1994), and these beliefs have been associated with sexual perpetration in adolescent males (Lichter & McClosky, 2004) and have been found to predict chronic sexual victimization in young females (Foshee, et al., 2004). Therefore, an examination of social deficits and gender role beliefs is an important next step in understanding victimization and perpetration in adults with ASD.

Objectives: The purpose of this study is to determine if social skills, empathy, and traditional gender role beliefs are associated with increased rates of sexual victimization and perpetration in individuals with ASD. It was hypothesized that individuals with ASD would be more likely to be victims and perpetrators of sexual violence.

Methods: Ninety-five individuals aged 19-43 with high functioning ASD (62% Males) and 117 individuals aged 18-35 without ASD (56% Males) were matched on mean chronological age. Participants completed the Autism Spectrum Quotient (AQ-adult; Baron-Cohen et al., 2001), the Sexual Experiences Survey (SES; Koss, Gidycz, & Wisniewski, 1987), the Toronto Empathy Questionnaire (TEQ; Spreng et al., 2009), the Family Roles Scale (FRS; Lichter & McClosky, 2004) and the Dating Script Scale (Crawford, 2000). The FRS measures egalitarian sex-role attitudes by assessing participants' beliefs about husband and wife relationships. The DSS assesses perceptions of normative dating behaviour.

Results: In a previous study using this data set, adults with ASD were found to be more likely to be victims of sexual violence than the comparison group. In the current study, adults with ASD were significantly more likely to report perpetrating some form of sexual violence compared to adults without ASD (χ^2 (1)= 26.56, $p < .001$), largely the result of reporting being more likely to engage in unwanted sexual contact, not coercion or rape. Two multiple mediation analyses were conducted, controlling for sex, with the variables of interest as mediators on the impact of ASD status on predicting victimization and perpetration. The Dating Scripts Scale total score was a full mediator of the relationship between ASD status and victimization, and was a partial mediator between ASD status and perpetration.

Conclusions: We found that the ASD sample has a higher rate of both perpetration and victimization. While social skills and empathy were not significant predictors, ideologies and agreement with patriarchal gender stereotypes was a significant predictor of both sexual victimization and perpetration, and explained why individuals with ASD were at increased risk of reporting both victimization and perpetration. This has important implications for prevention programs.

106 158.106 Preliminary Results of the Multi-Media Social Skills Project for Young Adults with ASD

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Background: Despite increases in research examining the efficacy of social skills interventions for children and adolescents with Autism Spectrum Disorder (ASD), few studies have targeted improving social skills in adults with ASD. This is particularly problematic as adult outcomes (e.g., employment, social contacts) for individuals with ASD have been identified as poor and services for adults are often inadequate or unavailable.

Objectives: The authors sought to examine the effectiveness of a pilot social skills intervention for adults with ASD. It was hypothesized that individuals who participated in the intervention would display a significant decrease in ASD symptoms and an increase in conversational social skills. Comorbid internalizing symptoms and intrusiveness were hypothesized to decrease following participation in the intervention. Finally, employment and social contacts were expected to improve.

Methods: Twenty-one adults diagnosed with ASD ages 18- to 35-years-old ($M = 22.57$, SD = 4.03) enrolled in the Multi-media Social Skills Project which was developed to increase social conversational abilities in adults with ASD. The manualized intervention included general skills building, video modeling and a peer generalization component. ASD diagnosis was confirmed via the Checklist for Autism Spectrum Disorders (CASD; $M = 22.67$; SD = 3.17) and verbal IQ was estimated through administration of the Kaufman Brief Intelligence Scale, Second Edition (KBIT 2; $M = 93.40$; SD = 18.84). Exclusionary criteria included verbal IQ below 70. Participants were included in one of four

cohorts of a 16-week intervention with four to six individuals in each group. 91% were male and 95% were Caucasian. Before and after the intervention participants and a primary caregiver completed the Adult Self-Report (ASR) or Adult Behavior Checklist (ABCL), as well as the Social Responsiveness Scale, Second Edition (SRS 2). Additionally, participants completed the Social Skills Inventory at both time points. Finally, participants were contacted three months following the end of the intervention to collect short-term life events data.

Results: Repeated-measures ANCOVAs were completed to assess for significant changes at post-intervention. Covariates included were cohort, age of participant, and verbal IQ. Participants reported a trend for decreased social communication symptoms (F = 3.91, p < .08) and participants' caregivers reported a trend for a decrease in intrusiveness (F = 4.90, p < .08). Participants reported a significant increase in social control/social self-presentation (F = 17.40, p < .01). Finally, three-month follow-up data found that 63% had attended informal social gatherings with fellow group members, 50% of participants had either obtained a volunteer or paid position of employment or were promoted, and 13% had received a driver's license.

Conclusions: The Multi-media Social Skills Project for adults with ASD was found to demonstrate significant improvements in social communication symptoms and social control/social self-presentation and a significant decrease in intrusiveness. Additionally, the majority of participants reported maintenance of relationships made through the social skills groups, as well as increases in status of employment and general independence. Current results indicate that this is a promising social skills intervention for adults with ASD.

107   **158.107** Profiles and Outcomes of Comorbid ASD and ADHD from Childhood to Adulthood (From ages 6 through 25)

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Background: With prevalence estimates ranging from 31 to 78%, Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most commonly co-occurring conditions in ASD (Ponde, Novaes, & Losapio, 2010). Existing literature is lacking in clarity as to whether children with ASD and ADHD have a unique profile and differential outcomes compared to their counterparts without ADHD. In particular, the appropriateness of stimulant medication as treatment for ADHD symptoms in ASD is still under debate (Frazier et al., 2011). Gaining a clear understanding of factors that contribute to adult outcomes in this population would be an important step to optimizing their potential.

Objectives: The present study examined (1) childhood profiles and adult outcomes of co-morbid ASD and ADHD (ADHD+), compared to ASD without ADHD (ADHD-) and (2) predictors of secondary and postsecondary outcomes. Based on the prevalent assumption that the additional burden of ADHD would lead to increased distress and functional impairment, we hypothesized that ADHD+ compared to ADHD- would yield poorer social skills and academic achievement in childhood and employment/college enrollment in adulthood.

Methods: Secondary data analysis was conducted on two separate yet closely related longitudinal datasets: Special Education Elementary Longitudinal Study (SEELS) and the National Longitudinal Transition Study-2 (NLTS2). These datasets comprise nationally representative samples of youth who received special education services in the U.S. (ages 6-17 and ages 13-25 respectively). The sample for this study was reduced to those with the primary diagnosis of ASD who were capable of producing valid standard academic achievement scores, which naturally limited the inclusion of most individuals with intellectual disability (n=340 in SEELS; n=473 in NLTS2).

Results: 15% of the sample had the additional diagnosis of ADHD at age seven; the rate steadily increased until it peaked at 33% around age 13 and then plateaued into adulthood. When the ADHD+ and ADHD- groups were compared across childhood characteristics (see Table 1), no statistically significant differences emerged in terms of gender, race, and income. ADHD+ outperformed their ADHD- counterparts on academic achievement measures in SEELS (children), especially in language arts; no statistical differences were found in NLTS2 (adolescents). Predictors of academic success portrayed a complex picture. Having ADHD itself did not seem to have a significant effect when other factors such as gender, income, and medication use were considered. Detailed results will be discussed in the final report. Childhood academic achievement was determined to be a highly significant predictor of adult outcomes for both groups (see Table 2). ADHD diagnosis was also a strong predictor of adult outcomes, with ADHD+ group demonstrating significantly lower rates of employment and postsecondary education enrollment. However, controlling for academic achievement, there was a strong interaction effect between having a dual diagnosis of ADHD and using ADHD medication, such that those who used ADHD medication (given an ADHD diagnosis) experienced similar odds of success regarding adult outcomes as the ADHD- group.

Conclusions: These results suggest that rather than experiencing a simple additive adverse effect of comorbid ADHD, ADHD+ group may experience differential outcomes depending on ADHD medication and other factors.

108   **158.108** Quality of Life in Emerging Adults with Autism Spectrum Disorder

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Background: Autism Spectrum Disorder is a neurodevelopmental disability that is associated with deficits in social interaction and communication and with restricted and repetitive behaviors (American Psyciatric Association, 2013). There has been a documented increase in the diagnosis of Autism Spectrum Disorders (ASD), making it to be one of the fastest growing disabilities in children (Hartley-McAndrew, 2014). In the United States, the prevalence of ASD is approximately 1 in 68 children, with 1 in 42 among boys (CDC, 2014). With this increase in prevalence, adult outcomes have become an increasing priority for this population. While the concept of quality of life has been used in the field of intellectual disabilities for decades, the factors contributing to quality of life of persons with autism spectrum disorder (ASD) have received relatively little attention.
Objectives: The aim of this study was to examine the influences of degree of disability, social and communication ability, academic success, employment, and independence and autonomy on quality of life in young adults with high-functioning autism.
Methods: Participants (n @ 230) were individuals from the dataset of the National Longitudinal Transition Study 2 (NLTS2) who had a diagnosis of autism spectrum disorder (ASD) (Cameto, et al, 2004).
Results: Results of hierarchical multiple regression analyses indicated that employment (F (@ 230) = 4.90, p < .05, adjusted R^2 = .05) , social involvement (F = 11.54, adjusted R^2 = .11), being able to communicate, converse, and understand (F = 7.03, adjusted R^2 = .18), in addition to age and gender, were significant in predicting higher quality of life. Factors found not to contribute to QoL included degree of disability (Woodcock-Johnson III) and education.
Conclusions: The prevalence of autism diagnosis is on the rise across the lifespan (CDC, 2014). While research continues to target diagnosis and early intervention for children, work needs to focus also on those who are approaching adulthood with respect to their quality of life. They are now out of school and many efforts to improve their functioning are finished. The mandate for school intervention is now ended, and what young adults get in their communities is highly variable but is often next to nothing. Our attention now needs to look at the quality of life that these young people have as they embark upon their adult years. This study helps to shed light on the development of higher quality of life in young adults with HFA and highlights areas for future research and training with these members of society.
The attached image illustrates two young men from this sample. Participant A has a relatively low quality of life. He is a 20-year old male with difficulty in communication, not belonging to a social group, not employed, still in high school, and with an average autonomy rating. Participant B is a 20-year old male, who does not have trouble communicating with others, belongs to a social group, has graduated from high school, has a job, and has an above-average autonomy rating. His QoL score is high.

109   **158.109** Research on Community Integration in Autism Spectrum Disorder: Lessons from Research on Psychosis

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Background:
For many individuals with an autism spectrum disorder (ASD) community integration is an important challenge in their adult lives (Howlin & Moss, 2012). Difficulties in community integration such as finding a paid job are also commonly found among individuals with a psychotic disorder. By comparing the literature on community integration of these two groups, we aimed to pinpoint gaps in our existing knowledge on community integration of individuals with ASD.
Objectives:
The study's objectives were to answer the following research questions:
1)   What are the potential gaps in the literature when it concerns community integration of adolescents and young adults with ASD?
2)   How do the research foci in psychosis research compare to research foci in ASD research?
3)   What can we - researchers in the ASD field - learn from research on community integration of individuals with a psychotic disorder?
Methods:
We systematically reviewed the literature on community integration of individuals with ASD or a psychotic disorder (publication period: 1990-2014). Following a literature search, abstract screening and full paper screening, we selected 76 eligible papers on community integration of individuals with ASD and 110 papers on individuals with a psychotic disorder. Papers were reliably categorized according to the following domains: housing, employment, education, social contacts, leisure, stigma, subjective quality of life, multiple domains, or other. To enable a direct comparison between the foci of interest in the research fields of ASD and psychosis, we compared the relative number (proportion) of publications in each domain.
Results:
There are clear disparities in research foci and gaps in the fields of ASD and psychosis. First of all, half (50%) of all selected publications on ASD address the social networks of adolescents and young adults with ASD or interventions to improve their social skills. However, only 5% of all selected psychosis papers address the social domain. Secondly, comparatively little research attention is devoted to (prevention of) stigma of ASD (7% of all selected ASD papers) compared to stigma of

psychosis (30% of all selected psychosis papers). Thirdly, relatively few papers on ASD address multiple domains of community integration (18%) compared to papers on psychosis (35%). Finally, more papers were found on employment of individuals with a psychotic disorder (15%) compared to ASD (11%).

Conclusions:
As anticipated, there is a stronger research focus on community integration of individuals with a psychotic disorder compared to individuals with ASD. Studies in the psychosis field have demonstrated a preference for social distance toward people with a psychotic disorder, varying effectiveness of different anti-stigma programs, and success of employment rehabilitation methods such as Supported Employment. Based on these findings we recommend future research on community integration of individuals with ASD, stigma of ASD and the effectiveness of anti-stigma programs and employment interventions. The outcomes of this systematic review demonstrate a need for more practical research focused on the daily lives of adolescents and adults with ASD.

110   **158.110** Self-Determination Skills in Transition-Age Youth with Autism Spectrum Disorder

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Background:
The transition to adulthood entails significant changes in expectations for autonomy, employment, and postsecondary education. For higher functioning youth with Autism Spectrum Disorder (HFASD), this transition is especially challenging due to core ASD symptoms (Ghaziuddin et al., 1998; Siminoff et al., 2008) and adult outcomes are poor (Howlin et al., 2004; Shattuck et al., 2012). Research on other clinical populations indicates that greater *self-determination*, or the skills, knowledge, and beliefs to engage in goal-directed and autonomous behavior, predicts positive adult outcomes (e.g., Wehmeyer & Schwartz, 1998). Research on self-determination in HFASD, though, is extremely limited. Such investigations may provide insights into the design of more effective transition interventions for youth with HFASD.

Objectives:
The aim of this study was to determine if self-determination is specific problem for youth with HFASD, or a more general tendency common to related clinical groups, such as ADHD.

Methods:
The study included 75 youth; 31 with HFASD, 26 with ADHD, and 18 TD (see Table 1). Participants had fullscale IQs ≥ 75. ASD diagnosis was confirmed with the ADOS-G. Self-determination was assessed with two scales. The 7 Component Self-Determination Skills parent report (**7 Skills**; Carter et al., 2013) addresses primary self-determination skills, such as Self-Advocacy or ''knowing one's rights, communicating them effectively''. The 7 Skills assesses the child's ability on each domain (i.e., **Performance** scale) as well as how important each domain is to a parent (i.e., **Importance** scale). The Air Self-Determination Scale *Parent* and *Student* Versions (**AIR**; Wolman et al., 1994) measured two dimensions of self-determination: **Capacity** refers to the students' knowledge, abilities, and perceptions that enable them to be self-determined, and **Opportunity** refers to the students' chances to use their knowledge and abilities.

Results:
A MANOVA with the Importance and Performance scales of the 7 Skills parent report as the dependent variables, Diagnostic Group, and IQ as a covariate revealed a significant group effect for only the Performance scale, Wilks' Λ = .48, $F (28, 110)$ = 1.65, p = .04, $\eta2$ = 0.30 (See Table 2). In particular, parents regarded Self-Advocacy/Leadership as specifically problematic for youth with HFASD compared to youth with ADHD or TD (see Table 2). The AIR Parent Version indicated that youth with developmental disabilities and typical development had a comparable amount of opportunities to demonstrate self-determination, but students with developmental disabilities had significantly less capacity for self-determination than TD peers (see Table 2). Correlations revealed that parent reports of level of children's self-determination capacity and self-awareness significantly decreased across age in the ASD but not the ADHD or TD groups.

Conclusions:
The data indicated that parents of youth with and without developmental disabilities thought learning self-determination skills was *important* for their children. *Self-advocacy and leadership* was identified as particularly problematic for youth with HFASD. Further, *self-determination capacity and self-awareness* may not be developing on par with age specifically for youth with HFASD, leaving them unprepared for adulthood. Self-advocacy and self-awareness are essential for adult autonomy and may be prime targets for transition intervention for youth with HFASD.

111   **158.111** Self-Determination and Quality of Life in Young Adults with Autism Spectrum Disorders

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Background: Autism Spectrum Disorder (ASD) is a lifespan diagnosis impacting adulthood

opportunities in the community. The vast majority of adults with ASD face significant obstacles as they attempt to transition their way into college, work, community, and independent living (Hendricks & Wehman, 2009). Self-determination (SD), which refers to the "volitional actions that enable one to act as the primary causal agent in one's life and to maintain or improve one's quality of life" (Wehmeyer, 2005, p. 177), has been associated with more positive adult outcomes (Wehmeyer & Palmer, 2003). As such, SD is best understood within the context of a person's overall quality of life (QoL). The constructs of SD and QoL are often investigated separately, yet they are inextricably linked. Only two studies have examined their association directly (Wehmeyer & Scwartz, 1998; Lachapelle et al., 2005). Lachapelle et al. found that the essential characteristics of SD (autonomy, self-regulation, self-realization, and psychological empowerment) were related to membership in the high QoL group for individuals with mild intellectual disabilities.

Objectives: To better understand the relation between SD and QoL for young adults with ASD using the *Quality of Life Questionnaire* (QOL-Q; Schalock & Keith, 1993), the *Arc's Self-Determination Scale* (SDS; Wehmeyer & Kelchner, 1995), and the *AIR Self-Determination Scale* (Air; Wolman et al., 1994).

Methods: Twenty-three young adults with high functioning ASD between 18 and 30 years old participated in the current study. Participants were administered the *Raven's Progressive Matrices* (Raven, Raven & Court, 2004), the *Wechsler Abbreviated Scales of Intelligence* (WASI; Wechsler, 1999), the *QOL-Q, SDS, and Air.*

Results: Participants ranged from 18 to 29 years old (M = 21.35, SD = 3.45) with verbal IQ (M = 109.74, SD = 15.214) and nonverbal IQ (M = 51.52, SD = 4.39) scores within the average range. All participants met the diagnosis for an ASD based on the *Social Communication Questionnaire* and the *Autism Diagnostic Observation Schedule*. QoL was significantly associated with SD, as measured by the *SDS* total score (r = .43, p = .04), but not the *Air* total score (r = .33, p = .12). Overall, QoL was correlated with the *SDS'* autonomy (r = .45, p = .03) and self-realization (r = .46, p = .02) scales, which include measures of social belonging and community integration and satisfaction. Additionally, opportunities to become self-determined at home and school, as measure by the *Air*, were significantly associated with autonomy (r = .51, p = .01) and self-realization (r = .43, p = .04) on the *SDS*, suggesting that greater opportunities to become self-determined might lead to better QoL.

Conclusions: These findings reflect a positive association between self-determined behaviour and increased life satisfaction and suggest a need to provide authentic SD opportunities for young adults with ASD. As such, QoL and SD together might be best viewed as a universal organizing concept to guide policy and practice in order to improve life conditions and to empower people with ASD to live the life that they desire. Implications for policy will be discussed.

112 **158.112** Self-Reported Interpersonal Violence Victimization in Adults with Autism Spectrum Disorders

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Background: While significant research has been done on the experience of interpersonal violence victimization in adults, research in the area has lagged behind when considering adults with autism spectrum disorders (ASD). There are clear gaps in the literature pertaining to the occurrence of interpersonal violence victimization in the ASD population. The current study is the first to thoroughly explore experiences of interpersonal violence utilizing self-report in a sample of those with and without ASD.

Objectives: This study sought to explore the occurrence of reported victimization in childhood and in adulthood for adults with ASD and how they compare to reported victimization in adults without ASD. This study also sought to determine the correlations among social skills, emotion regulation processes, and poly-victimization.

Methods: Forty-five participants with ASD (*Mean age* = 30.4, *SD* = 1.5, *Range* 18-53) and 45 participants without ASD (*Mean age* = 31.8, *SD* = 1.3, *Range* 19-54) were recruited through community agencies and advertising in Ontario, Canada, and matched on gender, age and IQ. ASD diagnosis was confirmed with the completion of the Autism Diagnostic Observation Schedule-2 (Lord et al, 2012). All individuals had IQ scores above 70, as verified by the Wechsler Abbreviated Scale of Intelligence (WASI-II; Wechsler, 2003). Participants completed The Juvenile Victimization Questionnaire-Adult Retrospective Questionnaire as a measure of childhood victimization and adult victimization (Hamby, Finkelhor, Ormrod, &Turner, 2004). Subscales include conventional crime, childhood maltreatment, peer/sibling victimization, and sexual victimization.

Results: Preliminary results indicate that participants with ASD were 9.8 times more likely report being the victim of conventional crime in childhood (Fisher's exact, p = .02), 3.5 times more likely to report experiencing childhood maltreatment (χ^2 (1) = 7.2, $p < .01$), and 8.1 times more likely to report peer victimization in childhood (Fisher's exact, p = .06) compared to those without ASD. Adults with ASD were not more likely to report experiencing the various forms of victimization in adulthood. When examining the samples combined, reported emotion dysregulation was correlated with greater number of types of childhood maltreatment experienced (r = .38, $p < .001$), sexual victimization in childhood (r = .24, $p < .05$), and peer/sibling victimization in adulthood (r = .23, $p < .05$). Social skills deficits in adulthood were related to childhood maltreatment (r = .28, $p < .01$).

Conclusions: The results of this study indicate that individuals with ASD report having experienced more conventional crime, childhood maltreatment, and peer/sibling victimization in childhood than those without ASD, but may not report more experiences of victimization in adulthood. Emotion

regulation and social skills were found to be associated with reported victimization, which has implications for understanding reported difficulties and conceptualizing effective interventions for adults with ASD. Further results and implications of the data will be presented.

113 **158.113** Sensory Processing Sensitivities and Personality in Adults with and without ASD

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Background: Although sensory processing sensitivity (SPS) is a criterion of ASD, and adults with ASD describe it as a highly salient part of their experience (Chamak et al., 2008; Henderson & Davidson, 2010; Robledo et al., 2012), no study has examined whether people with ASD are highly sensitive persons (Aron & Aron, 1997). College students with elevated autistic traits also tend to be more highly sensitive (Liss, Mailloux, & Erchull, 2008). Of the Five-Factor Model of Personality ("Big 5"), such sensitivities positively relate to Neuroticism and Openness to Experience (Smolewska, McCabe, & Woody, 2006). The Big 5 accounts for 70 percent of the variance in ASD symptomology at the facet level, as well as clusters that distinguish within the autism spectrum (Schwartzman, Wood, & Kapp, 2013). SPS may similarly help explain personality and heterogeneity within the ASD phenotype.
Objectives: (1) To determine how much correspondence exists between the HSPS and the Big 5 factors in adults with and without ASD (2) To determine the extent to which the HSPS accounts for variability in ASD symptomatology in adults with and without diagnoses of ASD (3) To empirically identify distinct personality and sensory profiles that exist within ASD in terms of HSPS variability.
Methods: A sample of 828 adults (364 with ASD; 464 without) completed an online survey consisting of the Highly Sensitive Person Scale (HSPS; Aron & Aron, 1997), Ritvo Autism Asperger's Diagnostic Scale Revised (RAADS-R; Ritvo et al., 2010), the International Personality Item Pool Representation of the NEO-PI-R (IPIP-NEO-120; http://ipip.ori.org), and demographic information. The HSPS is a 27-item scale which measures sensory reactivity to stimuli. The RAADS-R is an 80-item self-rated diagnostic scale for measuring autism based on the DSM-IV and ICD-10 diagnostic criteria. The IPIP-NEO-120 is an online, public domain tool for personality measurement which reports the individual level of personality under each of the five domains in the Five-Factor Model.
Results: (1) In adults with ASD, HSPS scores were found to be positively correlated with Neuroticism, and negatively correlated with Extraversion, Conscientiousness, and Agreeableness, while no significant correlation was found with Openness to Experience. Adults with ASD exhibited significantly higher HSPS scores (M=18.86, SD=5.17) than adults without ASD (M=12.21, SD=5.18) at $p < .001$ (2) HSPS scores accounted for 47.5% of the variance in RAADS-R scores in adults with ASD. (3) Based on *k-means* cluster analysis, four distinct Big 5 personality subtypes emerged within adults with ASD and each of these clusters exhibited unique sensory profiles in terms of the HSPS, with distinct associations with quality of life indicators.
Conclusions: Information gained from this study further emphasizes the importance of SPS to the "spectrum" nature of ASD. Considering that sensory issues have only recently been added to the ASD diagnosis, and are a relatively small and optional part of the criteria, they robustly contributed to the differences in ASD symptomology. These findings will help provide more targeted support tailored to individual differences.

114 **158.114** Sexual Orientation and Gender-Identity in High-Functioning Individuals with Autism Spectrum Disorder

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Background:
Clinical impressions indicate a sexual profile within the Autism Spectrum Disorder (ASD) population unlike that seen in the general population that is suggestive of a wide range of sexual orientations and an overrepresentation of gender-dysphoria.
Objectives:
We hypothesized that there would be an increased prevalence of non-heterosexual orientations and increased gender dysphoria.
Methods:
We surveyed sexual orientations with the Sell Scale of Sexual Orientation, and gender-dysphoric symptomology with the Gender Identity and Dysphoria Questionnaire, in an international sample of individuals with ASD (N = 159, M=50, F = 109), aged (M=31.8 years, SD=12.2) and compared these rates to those of typically-developing individuals (N =242, M = 63, F= 179), aged (M=27.2 years, SD=10.2).
Results:
When compared to controls, individuals with ASD demonstrated significantly higher sexual diversity, reported gender-identities incongruent with their biological sex, and higher gender-dysphoric symptomatology. Females with ASD reported higher rates of homosexuality and bisexuality than males with ASD, and higher rates of gender-dysphoric symptomatology. When compared to heterosexual and gender-normative ASD individuals, ASD persons with a minority sexual orientation who reported gender deviance were more likely to have lower levels of education; report the gender of their

romantic partner as not important; reported being on sex-hormone replacement therapy; experienced better friendship quality and higher social satisfaction with peers of the opposite-sex than with the same-sex during their schooling years; reported lower levels of personal well-being, and higher rates of depression, anxiety and stress. Overall, individuals who identified with a minority sexual orientation and reported gender-identity deviance demonstrated a higher loading of ASD traits.

Conclusions:

Individuals with ASD may be ambivalent about gender, which could be related to autistic-type cognition/behaviors and social experiences. Higher rates of homosexuality, bisexuality and gender-dysphoria among females in the sample with ASD may be partially supported by the fetal-testosterone theory of autism. These may be some of the factors underlying the high prevalence of minority sexual orientations among those with ASD.

115 **158.115** Speed-Dating with Autism: Initial Romantic Attraction with Adults with Autism Spectrum Disorder

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Background: The social dynamics of adulthood present unique obstacles for individuals with autism spectrum disorders (ASD). Adults with ASD desire romantic relationships but have difficulty initiating and achieving these relationships (Stokes et al., 2007). The processes of romantic attraction and relationship initiation for adults with ASD are currently unknown.

Objectives: To understand the processes associated with initial romantic attraction in adults with ASD, a speed-dating study was conducted with adults with ASD.

Methods: Three speed-dating events were held, incorporating a total of 24 participants (18 male, 6 female), ranging from 18-30 years old. Female participants were repeated across events. Participants went on 5-6 'dates' each lasting 5-minutes, with members of the opposite gender. After each date, participants rated their initial romantic attraction towards each partner. Follow-up data was collected 1-month after each event.

Results: Social Relations Model (SRM) analyses suggest that initial attraction was a function of the actor, partner, and the unique relationship between the couple, with greatest factor, for men, being the actor and the greatest factor, for women, being the unique relationship between the couple (Kenny & LaVoie, 1985). Findings suggest that initial romantic attraction for adults with ASD was positively associated with perceived similarity, ideal partner preferences, and dyadic reciprocity, negatively associated with generalized reciprocity, and not associated with actual similarity. Further, similar to speed-dating studies with typical adults, participants matched from speed-dating events led to electronic communication between couples, and dates for approximately one third of matches. Despite this similarity, the current study also suggests differences in initial romantic attraction for adults with ASD, including differences in relationship variance accounted for by the actor effect compared to the relationship effect for male participants, differences in actor and partner characteristics that lead to actor and partner attraction, and most strikingly, differences in the association between stated, ideal partner preferences and initial romantic attraction.

Conclusions: Understanding the initial processes of romantic attraction is essential in order to aid and support adults with ASD in the processes of dating and romantic relationship initiation. The limited research in the area of romantic relationships for adults with ASD has shown that many individuals with ASD desire romantic relationships, but few are in relationships (Koegel et al., 2014). This study lays the groundwork for future studies to investigate how romance, attraction, and date initiation develop and progress for adults with ASD.

116 **158.116** The Impact of Autism Spectrum Disorders in Higher Education: An Exploratory Study

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Background: Enrollment in a chosen course of study at an institution of higher education has been seen as a rite of passage for many young adults in the United States. Between 1999 and 2009, the number of 18- to 24-year-olds in the U.S. increased from 26.7 million to 30.4 million, an increase of 14 percent, and the percentage of 18- to 24-year-olds enrolled in college rose from 36 percent in 1999 to 41 percent in 2009 (National Center for Education Statistics, 2011). However, little is known about perceived needs of students on with autism spectrum disorder, or what constitutes the most appropriate accommodations for students on the autism spectrum at the college level

Objectives: The authors of this study sought to identify the specific needs of college students with an autism spectrum disorder, and more importantly how high school transition planning and college disability offices can better serve these students (academic, social, etc.) from college and university offices of disability services across Utah were asked to participate. Data from this study was obtained through the use of a survey created for this study.

Methods: Subjects in the current study have been recruited from four 2-4 year institutions located in a large metropolitan area in the Intermountain West offering undergraduate education. Undergraduate students were contacted using the college or university disability office at each respective institution. Each subject must have been presently enrolled at least half-time at the college or university with a current diagnosis of autism or Asperger's Disorder, and they had to be registered with their school's office of disability services.

Results: The mean age of participants was 23.60 (SD=6.924), with a minimum age of 18 and a maximum age of 47. The majority of participants were male (n=22, 73.3%) with fewer females (n=7, 23.3%). The mean total SRS-2 t-score for all participants was 68.2(SD=13.45), suggesting for the present sample that a majority of participants readily acknowledge deficits in reciprocal social behavior. There are implications for everyday social interactions occurring in a college or university setting (e.g., group projects, presentations) that may impair or impact likelihood of success, degree completion, etc. The means for the SRS-2 treatment subscales and DSM-5 compatibles scales are as follows: social awareness (M= 63.83, SD=11.82), social cognition (M=63.80-, SD=12.10), social communication (M=64.27, SD=15.32), social motivation (M= 64.87, SD=9.74), restricted interests and repetitive behavior (M=68.73, SD=14.27).

Conclusions: Results from this study indicate a substantial number of students with ASD self acknowledge difficulties in reciprocal social interaction in college environments. A large percentage of students are seeking degrees in science and math, with fewer pursuing social science or humanities degrees. Further evaluation of data regarding effective accommodations reported by this sample and potential influence of social support networks (family, peers, etc.) is forthcoming Some difficulty in recruiting available participants was noted, given the initial estimates of students with an ASD diagnosis initially provided. More research is needed in the area of autism spectrum disorders in higher education in order to establish best practices for these individuals.

117 **158.117** The Importance of Social Support for Young Adults with High Functioning Autism Spectrum Disorder Transitioning to Adulthood

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Background: The United States Department of Health and Human Services (2011) has stressed the importance of taking a lifespan perspective and investigating outcomes in adulthood for those with autism spectrum disorder (ASD). Although transitioning to adulthood is considered a time of risk for individuals with high functioning autism spectrum disorder (HF-ASD), as many of these young adults lose access to support programs (Taylor & Seltzer, 2010), little is known about how they perceive their own transition to adulthood. Identifying personal and contextual factors that young adults with HF-ASD believe support and challenge their transition to adulthood is an important step toward designing effective support programs for them.

Objectives: This study aimed to investigate similarities and differences in the personal (e.g., individual characteristics such as resourcefulness) and contextual factors (e.g., supportive relationships) that young adults with HF-ASD pinpointed as supporting and challenging their transition to adulthood, compared to their same-age typically developing (TD) peers. An additional aim was to identify personal and contextual factors associated with better developmental outcomes for those with HF-ASD.

Methods: Both HF-ASD and TD groups included 30 participants, aged 18 to 27-years-old (21 men and 9 women). Participants responded to (a) an interview that asked them to describe personal and contextual factors supporting and challenging their transition to adulthood and (b) an interview assessing developmental outcome, adapted from Howlin et al. (2004)'s composite measure of overall social functioning. Participants with HF-ASD were dichotomized into those with very good/good versus fair developmental outcomes. Data were analyzed with inductive content analysis.

Results: Compared to the TD group, the HF-ASD group was more likely to describe the importance of non-familial adults and formal support programs in facilitating their transition to adulthood. Only the HF-ASD group described how memories of bullying and teasing continued to haunt them, challenging their transition. Young adults with HF-ASD who had better developmental outcomes talked more about the positive influence of social support in their daily lives and had a greater number of caring relationships.

Conclusions: Although many young adults with HF-ASD lose access to support services (Taylor & Seltzer, 2010), results highlight the crucial importance of continued support for them. Support programs should be targeted specifically toward young adults with HF-ASD, as they perceived unique factors supporting and challenging their transition to adulthood. Developmental outcomes for the HF-ASD group may be facilitated by social support and exposure to a greater number of supportive relationships. Implications for support programs for young adults with HF-ASD will be described.

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118 **158.118** The Montreal Cognitive Assessment Is a Superior Office Cognitive Screening Exam for Adults with Autism Spectrum Disorders

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(5)Research, Southwest Autism Research & Resource Center, Phoenix, AZ

Background: Though neuropsychological performance in individuals with Autism Spectrum Disorders (ASDs) has been extensively described, there is no data evaluating performance of such individuals on routine office mental status examinations

Objectives: To determine the best cognitive screening exam for adults with ASDs by comparing patterns of performance on three commonly administered office mental status examinations

Methods: In this cross sectional study 51 adults with ASDs, mean age 32 +/- 12 years (range 20-58 years), 71% men, with mean educational level of 13.5 +/- 2.3 years (range 10-20 years), and mean WAIS Full Scale IQ 94 +/- 21, underwent three office mental status examinations – the Folstein Mini-Mental State Exam (MMSE), the Kokmen Short Test of Mental Status (STMS), and the Montreal Cognitive Assessment (MoCA). Scores on the exams were correlated with total scores on the Social Responsiveness Scale (SRS) and WAIS Full Scale IQ.

Results: Total scores (mean +/- SD) and percent correct (mean +/- SD of total possible points) for each of the mental status examinations were as follows: MoCA 25.2 +/- 4.3, 84 +/- 14%; STMS 34 +/- 4.4, 89 +/- 12%; MMSE 27.1 +/- 3.7, 90 +/- 12%. Recall was the domain most commonly missed on each of the mental status examinations: MoCA 65 +/- 33(%); STMS 76 +/- 27(%); MMSE 79 +/- 28(%). Total score on the SRS did correlate (r, P) with MoCA Total Score (-.29, .04) and Recall (-.34, .02), as well as STMS Attention (-.29, .04) and Calculation (-.35, .01). WAIS Full Scale IQ correlated (r, P) positively with performance on each of the office screening exams: MoCA (.54, <.001); STMS (.79, <.001); MMSE (.75, <.001).

Conclusions: In this sample of adults with ASDs, performance on the MoCA was worse relative to performance on the STMS or MMSE, and that performance was correlated with degree of social impairment. This suggests that the MoCA may be the superior office screening instrument for detection of cognitive dysfunction in adults with ASDs. Verbal recall was the most prominent cognitive deficit evident onroutine office mental status examination screening, which could imply a risk for misdiagnosis in those without an established ASD diagnosis. Abnormal office screening exams should be followed by confirmatory neuropsychological testing.

119 **158.119** The Prevalence and Correlates of Involvement in the Criminal Justice System Among Youth on the Autism Spectrum

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Background: Individuals with disabilities are involved in the criminal justice system at a higher proportion than the general population. Rates of youth who had ever been arrested among those with a learning disability were 32% and those with an emotional disturbance were 60% (Newman et al., 2011). Among youth on the autism spectrum, 10.3% have ever been arrested in their lifetime and nearly a quarter have been stopped by police for an offense other than a traffic violation (Newman et al., 2011). However, there is limited research into what factors and individual characteristics increase risk for criminal justice system involvement among youth on the autism spectrum and other disability types.

Objectives: We aim to answer the following questions about youth on the autism spectrum, ages 21-25. What is the prevalence of involvement in the criminal justice system? Which factors are associated with their involvement in the criminal justice system? Are there significant differences in rates of involvement for youth on the autism spectrum when compared to peers with other disabilities after adjusting for wide range covariates?

Methods: We used data from the National Longitudinal Study-2 (NLTS2), a nationally representative study of youth who were in special education at the start of the study. From 2001-2009 information was collected every 2 years from parents and youth. The study began with 11,270 youth nationwide, 920 were youth on the autism spectrum. We derived estimates from the final wave of the study, which included youth in their early- to mid-20s.

Results: Covariates included gender, Hispanic ethnicity, race, household income, how well youth communicated by any means, and how well youth understands what people say. About one-tenth of youth on the autism spectrum had ever been arrested and 20% had ever been stopped and questioned by police. Youth on the autism spectrum who were male, or who had no trouble conversing, or understanding what people say, had significantly higher odds of ever being arrested. Male youth on the autism spectrum had significantly higher odds of ever being stopped and questioned by police. After adjusting for covariates, youth with emotional disturbances had significantly higher odds of ever being arrested and ever being stopped and questioned by police.

Conclusions: Youth on the autism spectrum have a high prevalence of involvement with the criminal justice system. Our work suggests certain factors are associated with involvement in the criminal justice system and there are significant differences for youth on the autism spectrum when compared to peers with other disabilities. Further research should examine how the outcomes of youth with disabilities differ and how to reduce the prevalence of such involvement.

120 **158.120** Two-Year College Students on the Autism Spectrum: Characteristics and Services Experiences

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Background: Of youth on the autism spectrum who attend college, about 80% will attend a 2-year college. Despite this high prevalence of attendance, we understand little about the characteristics of these students, factors associated with their attendance, their educational experiences, and whether they receive the help they may need.

Objectives: We aim to answer questions about youth who attend a 2-year college in the first years after high school. What are the characteristics of this group? What are the differences between those who attend 2-year colleges versus other types of postsecondary institutions? What services / accommodations do they receive?

Methods: Data came from the National Longitudinal Transition Study-2. The study was conducted over 5 waves at 2 years apart (2001-2009). At baseline, all youth were ages 13-16 years and receiving special education services. The study began with over 11,000 students, including 920 in the autism special education category. Estimates come from Wave 5, conducted in 2009, when youth were in their early- to mid-20's, and were weighted to be nationally representative of the cohort of youth served in the autism special education category at the start of the study.

Results:

Students who attended 2-year colleges only were primarily male (84.5%), White (85.3%), and non-Hispanic (97.6%). Most (93%) had at least one parent who attended any postsecondary education, and 47.1% were from households earning $50,000-70,000 per year. Over 61.5% had good conversational skills or only a little trouble conversing. About 64.6% reported doing pretty well or very well with functional skills like counting change. Most (85.7%) were able to navigate to places in the community, and 93.8% had participated in extracurricular activities during high school. Significantly more youth who attended 2-year college were reported to have adequate functional, navigational, and participation skills during high school compared to youth who attended vocational/technical education or had no postsecondary education. Only 60.9% of parents of young adults who attended 2-year colleges predicted during high school that the youth would attend postsecondary education. Within the 2-year college setting, 56.1% took vocational courses. One-quarter (26.2%) pursued academic study in a STEM field. Half (50.4%) attended school full-time. One quarter (25.1%) did not consider themselves to have a disability, while 69.1% reported that the school was aware of their disability. Less than half (48.6%) reported receiving services, accommodations, or other help. Most (87.3%) felt they received enough help. Only 68.0% felt the services they received were somewhat or very useful.

Conclusions: About 85% of young adults on the autism spectrum attended a 2-year college at some point: 56.2% attended a 2-year college only; 29.4% attended both a 2-year and a 4-year college. Those who attended only a 2-year college reported a wide range of functional abilities; although less than half reported receiving services, accommodations, or other help for the disability. A greater understanding of this population is needed to provide anticipatory guidance for youth and their families to facilitate transition planning.

121 **158.121** Viewpoints on Driving of Individuals with and without Autism Spectrum Disorder

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Background: Independence in driving may substantially enhance people's opportunities in the areas of social, vocational and educational aspects, as it allows for participation in valued occupations. However, driving is a highly complex activity that requires effective executive functioning. Having a cognitive condition is likely to compromise a person's driving ability. A previous study reported that individuals with ASD were less efficient in executive functioning skills and underperformed in unexpected circumstances. However, it remains unknown how people with ASD actually perceive driving as a primary mode of transportation and what difficulties they face in driving. Indeed, no research has explored the area of driving as a primary mode of transportation for people with ASD from the viewpoints of young adults who are learning to drive or who are current and experienced drivers. Furthermore, very little is known about this population's independent community involvement.

Objectives: Understanding the viewpoints of drivers with Autism Spectrum Disorder (ASD) is crucial in the development of transport policies and driver training responsive to their needs.

Methods: Fifty young adults with ASD and 57 typically-developed contrasts voluntarily participated in the study. Q-methodology was used to understand viewpoints on using cars as a main mode of transportation. Data were analysed using by-person varimax rotation factor analysis.

Results: Although some ASD participants perceived themselves as confident and independent drivers, others preferred other modes of transportation, such as public transport and walking to travel. Anxiety was also found to be a barrier to driving. On the contrary, the contrast group revealed consistent viewpoints on their driving ability. They preferred driving as the main mode of transportation and believe that they are competent in driving independently and safely.

Conclusions: The results should be viewed from the insight that there was significant difference in the driving statuses between both groups. These results are important in the planning of transport policies for individuals with ASD.

122   **159.122** A Dynamic Systems Approach to Mother-Child Emotion Co-Regulation in Relation to Adaptive Functioning in Children with ASD

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Background: Emotion regulation plays a crucial role in the development of adaptive skills. Children's emotion regulation is believed to arise out of repeated emotional experiences with their caregivers (Sroufe, 1996). Few studies have conceptualized moment-to-moment emotion coregulation in dyadic interaction of parent and child with autism spectrum disorder (ASD). A dynamic systems method was chosen for this study because this approach is able to capture repeated moment-to-moment processes inherent in a dyadic interaction (DiDonato, England, Martin, & Amazeen, 2013; Hollenstein, 2011).
Objectives: To investigate the associations between emotion co-regulation and (1) communication, (2) daily skills, and (3) socialization among ASD children from a dynamic systems approach.
Methods: Sixty dyads of mothers and children with ASD were recruited to participate in the study. Mothers and children participated in a 10-minute Three Boxes procedure (Vandell, 1979; Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004), which was a low stress dyadic mother-child interaction. 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 (Mangold, 2007). Intercoder agreement in the assigned child and mother engagement code was 91.86% ($k = 0.81$) and 91.85% ($k = 0.82$). The observation data were imported into the State Space Grid (SSG) software (Lamey, Hollenstein, Lewis, & Granic, 2004) to operationalize structure of emotion co-regulation indicated by dispersion (an index of spread of emotional states), and content of emotion coregulation indicated by mutual positive interaction and mutual negative or disengaged interaction. The Vineland Adaptive Behavior Scales measure was used to measure adaptive behavior in the children (Sparrow et al., 2005). Spearman's rank correlations were used for analysis.
Results: As expected, mutual negative or disengaged interactions were negatively correlated with communication ($r = -.65$, $p = .002$), daily living skills ($r = -.51$, $p = .02$), and socialization ($r = -.55$, $p = .01$); additionally, mutual positive interaction was positively correlated with communication ($r = .54$, $p = .01$). Unexpectedly, flexibility was negatively correlated with communication ($r = -.55$, $p = .01$), daily living skills ($r = -.50$, $p = .03$), and socialization ($r = -.43$, $p = .059$).
Conclusions: To our knowledge, the current study is the first to operationalize emotional structure and content of interaction in dyads of children with ASD and their mothers using the State Space Grid method. The preliminary findings of emotional content suggest that involvement of mother in the intervention could be a critical component. An increase in mutual positive interaction and decrease in mutual negative or disengaged interaction may improve adaptive functioning in children with ASD. The results of structure of emotion co-regulation indicate that a wide change in emotional state in low stressful context may not be favorable for emotion regulation skill in child with ASD.

123   **159.123** A Multi-Method Study of Empathic Responding in High-Risk Siblings at Preschool Age

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Background: Individuals with autism spectrum disorder (ASD) show deficits in social and emotional reciprocity. The younger siblings of children with ASD (high-risk siblings) are at elevated risk for the disorder and for subclinical deficits in social-emotional functioning. Empathy is an essential component of social-emotional development. Previous studies have shown that higher levels of empathy in high-risk siblings during the second and third years of life predict lower ASD symptomatology and likelihood of diagnosis.
Objectives: We examined whether observed and parent-reported empathy and prosocial behavior related to ASD outcome and symptom severity in high- and low-risk siblings at 4- to 6-years of age.
Methods: Participants were 35 children between 4 and 6 years old who participated in a longitudinal study of children at risk for ASD. High-risk siblings had at least one older sibling with ASD and low-risk siblings had no known family history of ASD. Children were assigned to one of three outcome groups based on a diagnostic assessment at 4-6 years: Low-Risk ($n=13$), High-Risk/No ASD ($n=14$), or ASD ($n=8$). Symptom severity was assessed with the ADOS. Empathy was measured through behavioral observation and parent report. For the behavioral observation, children's responses to an examiner's distress after an accident resulting in feigned injury and dropped toys were reliably rated from 1-4 on three scales: Empathic Concern (ICC=.95), Prosocial Behavior (.78), and Personal Distress (.96). For the parent report, we used the Empathy/Prosocial Response scale

from the Conscience Measure (Kochanska et al., 1994), yielding a mean score of 13 items rated from 1-7 (n=38).

Results: Children did not differ by outcome group in Empathic Concern or Prosocial Behavior. Children did, however, differ by outcome group in Personal Distress; high-risk children with ASD showed lower levels of distress than high-risk children without ASD, p<.05 (see Table 1). For parent-reported Empathy/Prosocial Response, outcome group differences approached significance (see Table 1). Additionally, higher levels of Empathic Concern, r(30)=-.40, p<.05, and Personal Distress, r(31)=-.42, p<.05, but not Prosocial Behavior, r(31)=-.01, ns, were associated with lower levels of ADOS severity. Likewise, children with higher parent-rated empathy tended to have lower ADOS severity, r(25)=-.34, p<.10, when examined within the high-risk group only.

Conclusions: Results suggest that children with ASD continue to show deficits associated with empathy, as well as some areas of strength at preschool age. Prosocial behavior was unimpaired in the high-risk children who were diagnosed with ASD at our 4- to 6-year time point and was not associated with ASD symptom severity. In contrast, children's emotional responses to the examiner's distress did relate to ASD diagnosis and symptom severity. Somewhat unexpectedly, self-focused rather than other-focused responses related more strongly to ASD. This suggests that the personal distress rating may have functioned as a more age appropriate index of affective response in this sample. Findings are consistent with previous reports (McDonald & Messinger, 2012) suggesting that empathy may be a protective factor in the social-emotional development of children at elevated familial risk for ASD.

124   **159.124**   A Novel Measure of Social Metaperception for Adolescents with and without High Functioning Autism: Reliability and Validity

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Background: Our understanding of social cognitive processes is limited by retrospective, informant-based measurement. However, these dynamic internal processes may be better measured by self-reported ratings of impressions after a social interaction. Theory of mind may be necessary but not sufficient for this ability. A novel self-report measure was designed to capture an individual's ability to perceive what a social partner thinks of him/her, or social metaperception (Laing et al., 1966). Scores on this measure will be examined in relation to theory of mind, narcissism, and loneliness as characteristics associated with other-perceptions, self-perceptions, and interpersonal relationships, respectively.

Objectives: The goal of this study was to examine reliability and validity of a novel measure of social metaperception in typically developing adolescents and those with high functioning autism (HFA). We hypothesized that metaperception accuracy would be positively associated with theory of mind and negatively associated with narcissism and loneliness.

Methods: Preliminary analyses were conducted on eleven dyads comprising gender-, age-, verbal IQ-matched adolescents with HFA (9 males, M_{age}=13.69, SD=1.17) and unfamiliar comparison adolescents (COM; M_{age}=13.45, SD=1.26). Final sample size is estimated to comprise 20 dyads.

Immediately following a five-minute unstructured interaction, each participant completed the Perceptions and Metaperceptions Questionnaire (PAMQ) indexing positive and negative *perceptions* of the social partner and *social metaperceptions*, or predictions of peer's impressions. Participants completed assessments of theory of mind and questionnaires assessing narcissism and loneliness. Results: The measure demonstrated good reliability, positive perceptions α=.93; negative perceptions α=.75; positive metaperceptions α=.94; negative metaperceptions α=.87. Metaperception accuracy was calculated by separately standardizing positive and negative metaperception totals, and positive and negative perceptions from peers. Peer standardized perceptions were subtracted from target standardized metaperceptions to compute standardized difference scores (SDSs; De Los Reyes & Kazdin, 2004). SDSs further from zero indicate greater discrepancies (positive=overestimation, negative=underestimation). In addition, when interpretation of SDSs was not possible, absolute values were examined, with larger absolute values indicating greater discrepancies.

Across the full sample, absolute values were significantly different from zero, t(19)=8.47, p<.001, positive impressions and t(18)=6.60, p<.001, negative impressions, indicating discrepancies between metaperceptions and peer's perceptions for both groups. HFA and COM adolescents did not differ on mean SDSs.

Bivariate correlations were used to examine validity of the PAMQ across the full sample. Surprisingly, SDSs were unrelated to theory of mind. As expected, SDSs related to narcissism, r(16)=.51, p=.046, positive words and r(15)=-.46, p=.08, negative words, reflecting an association between narcissism and both overestimation of peer's positive impressions and underestimation of peer's negative impressions. SDSs were related to loneliness, r(17)=-.61, p=.01 for positive words and r(16)=.59, p=.02 for negative words, indicating underestimation of positive impressions and overestimation of negative impressions.

Conclusions: Preliminary analyses demonstrate that the novel PAMQ is a reliable and valid social metaperception index for adolescents with and without HFA. PAMQ scores' associations with narcissism and loneliness demonstrate that social metaperception relates to within-person attributes and interpersonal relationship characteristics. Final analyses will be conducted separately by group to examine differences. Future studies should include longitudinal analyses to parse direction of

159.125 A Pilot Study – Better Performance of Autism Spectrum Disorder Girls Compared to Boys in a Theory of Mind Test

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Background:
Autism spectrum disorders (ASD) occur in more males than females, with a ratio of 4to 1. Recent literature raised the possibility that the female presentation of ASD differs from the male presentation, More specifically ,clinical observations suggest that females with ASD superficially demonstrate better social and emotional skills than males with ASD, which may camouflage other diagnostic features. This may explain the under-diagnosis of females with ASD.

Objectives:
The aim of the present study was to examine the female presentation of ASD by examining the Theory Of Mind Skills of children with ASD.

Methods:
We hypothesized that girls with ASD would display better theory of mind skills than boys with ASD on a theory of mind test . 48 6- to 18-year-olds (ASD girls , n = 12; typically developing (TD) girls, n = 12; ASD boys, n = 12; TD boys, n = 12) were administered the social attribution task (SAT).

Results:
The current study tested six measures of ToM (Theory of Mind) using the SAT. A one-way ANOVA was conducted to determine the differences between the two groups. This test revealed a significant main effect of sex (=3.24, p<.05, =.53).
Variance analysis of each index of ToM revealed a significant effect of sex for the Person Index variance (=12.19, p<.001). Comparison of the mean scores on the Person Index showed that girls scored significantly higher than boys (Table 1).
Since the standard deviations were larger than the mean scores, a Mann-Whitney test was conducted. This analysis also revealed a significant difference between girls and boys for the Person Index measure (p< 0.001; Table 1). The difference in Person Index measure remained significant following Bonferroni correction for multiple comparisons.

Mann Whitney		Boys with ASD		Girls with ASD		Measures
		Mean	SD	Mean	SD	
65.00	0.01	0.43	0.16	0.44	0.23	Salience
54.00	0.39	0.14	0.15	0.18	0.12	Pertinence
46.00	3.51	0.09	0.10	0.17	0.12	ToM Cognitive
67.50	0.03	0.07	0.07	0.07	0.06	ToM Affective
67.00	0.07	2.92	1.56	3.08	1.44	Animation
**24.50	**12.19	1.67	0.89	3.67	1.77	Person

**Table 1

**p<.001, remains significant following Bonferroni correction for multiple comparisons

These findings are preliminary; further results of the typically developing groups will be presented in the conference.

Conclusions:
This study investigated the female phenotype of ASD by assessing gender differences in a Theory of Mind task.
It was predicted that girls with ASD would score higher than boys with ASD on the SAT task.
This study found that ASD girls perform better on the Person index of the SAT task, a test measuring ToM. The Person index specifically captures the child's capability to confer personal traits to the geometric shapes presented in the task.

. The findings support the observations that differences exist between ASD boys and girls Further research is needed to examine the causes for this phenomenon in order to develop gender-appropriate diagnostic tools and interventions for ASD girls.

126 **159.126** Acceptance of Emotions As a Buffer for the Negative Effects of Inconsistent Discipline on Externalizing Behaviors in Children with ASD

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Background:
Early parenting discipline techniques influence the presence of externalizing behaviors in children (Hektner et al., 2014). In at-risk populations, inconsistent parental discipline contributes to disruptive behavior and problems with emotion regulation in children. Research has demonstrated that behavior problems are common among children with autism spectrum disorder (ASD; Boonen et al., 2014). Children with ASD display more severe externalizing behaviors when parents express greater criticism and hostility in parenting (Bader & Barry, 2014). Parenting techniques focusing on the emotions associated with children's externalizing behaviors can increase behavioral compliance and decrease externalizing behaviors in ASD (Buckley, Ente & Ruef, 2014), however, emotion-specific parenting behaviors have yet to be explored (Maljaars et al., 2014).
Objectives:
The current study sought to explore the relations among inconsistent discipline, parent acceptance of their child's emotions, and externalizing behaviors in young children with ASD.
Methods:
Participants included 25 children diagnosed with ASD (3:0-6:11 years) and their parents. Parents completed the Behavior Assessment System for Children, 2nd Ed (BASC-2) Parent Report form to assess child's externalizing behaviors, the Alabama Parenting Questionnaire (APQ) to assess consistency with discipline, and the Meta-Emotion Interview to assess level of acceptance of child's emotions.
Results:
Preliminary correlational analyses found that gender correlated with parent acceptance of child's emotions ($r = .45$, $p = .02$) and it was entered as a control variable.
A moderational analysis using Model 1 in PROCESS (Hayes, 2013) was run to examine the conditional effects of inconsistent parenting on children's externalizing behaviors at levels of parental acceptance of their child's emotions. Results indicated the main effect of both inconsistent parenting ($B = 20.97$, $SE = 5.52$, $t = 3.80$, $p < .001$) and parental acceptance ($B = 3.94$, $SE = 1.47$, $t = 2.68$, $p = .01$) significantly predicted children's levels of externalizing problems. We examined the cross-product term of inconsistent parenting and low, mean, and high levels of parental acceptance. The interaction between inconsistent discipline and externalizing behavior was significant at low ($B = 3.35$, $SE = .70$, $t = 4.82$, $p = .001$) and mean ($B = 1.56$, $SE = .49$, $t = 3.19$, $p = .004$) levels of parental acceptance but non-significant at high levels parental acceptance ($B = -.23$, $SE = .72$, $t = -.33$, $p = .75$). Our findings indicated that high levels of parental acceptance of a child's emotions buffered children from increased rates of externalizing problems regardless of inconsistent discipline style.
Conclusions:
These results support previous research suggesting early parenting techniques can affect externalizing behaviors in children (Hektner, et al., 2014). Our study elucidates the buffering effects of parental acceptance of child's emotions on externalizing behaviors in ASD, even in the presence of inconsistent discipline style. Research investigating parenting styles in ASD is needed to better understand parenting techniques and behavioral outcomes in ASD.

127 **159.127** Adolescent Judgments and Reasoning about the Failure to Include Peers with Social Disabilities

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Background: Adolescents with ASD are often located on the periphery of social networks. To mitigate this reality, there is a need for an improved understanding of the reasoning process in which typical peers engage as they make decisions about whether or not to include peers with ASD in social experiences. According to the domain theory of moral reasoning, there is a relationship between the features of events and individuals' conceptualization of them as moral, conventional, personal, or multi-dimensional (Turiel et al., 1987). Given this relationship between reasoning and context, this study was conducted to discern how adolescent reasoning about the failure to include a peer with social disabilities varies as situational features in which the event occurred vary.
Objectives: To determine: 1) if there are differences in judgments about whether the failure to include is acceptable or unacceptable across four contexts representing a continuum of public and private spaces, including a public school classroom, a casual soccer practice on school grounds, a lab group in a science class, and a home; 2) whether the probability of giving moral versus non-moral justifications (including personal, societal and prudential domains) differed by context, the ultimate judgment of the participant, and the side of the argument to which the justification was applied; and 3) if there is an interaction between the context and side of the argument to which the justification was applied.

Methods: A clinical interview involving 4 vignettes depicting each context was used to elicit judgments and justifications across in 38 adolescents aged 13 – 18. Each interview was coded for justifications as they were applied to each side of the argument, as well as the ultimate judgment. Within-subjects ANOVA was used to determine differences in judgments across contexts. Logistic regression was used to determine if the propensity to give moral justifications differed across contexts.

Results: Participants were more likely to judge the failure to include as acceptable in personal as compared to public contexts. Personal choice was proposed as a counter-argument in the home context, while societal concerns were proposed in the soccer context. Using logistic regression, we found that participants were more likely to provide moral justifications as to why failure to include was acceptable in a classroom as compared to home, lab group, and soccer practice contexts. There was also a significant interaction between the side of the argument and the context. Non-moral justifications were more prevalent for why failure to include was acceptable in the classroom contexts as compared to other contexts.

Conclusions: The findings provide evidence that adolescents engage in complex reasoning that is sensitive to contextual features of the situation in which the failure to include occurs. Our approach provides detail on how students perceive and prioritize moral and non-moral justifications for their decisions across contexts. This information can be used to optimize intervention practices aimed at increasing the degree to which typically developing peers choose to include peers with social disabilities such as ASD in social endeavors.

128   **159.128** Adolescent Peer Inclusion in Community Settings Versus Social Skills Group Training

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Background:
Autism Spectrum Disorder (ASD) is a developmental disorder that is characterized by behavioral and social deficits. Much research has been done to determine the best interventions in helping children learn and apply social skills. Direct instruction and therapy groups have been traditional approaches for social skills intervention in children; however, peer-mediated training may be more effective for social skill development than more traditional methods of direct instruction. While these techniques have proven effective for children with ASD, little has been done to test their efficacy with adolescents.

Objectives:
This study extends research on peer-mediated intervention beyond school settings to community groups, addressing the needs of adolescents with ASD in particular. Direct instruction in social skills is compared to peer-mediated training in community settings such as Boy Scouts of America. An additional benefit of the research is the provision of a model for community inclusion that can be applied in a variety of settings as a low cost, but effective alternative or addition to direct instruction approaches to social skills intervention.

Methods:
A single-subject, randomized control design was used. Participants were required to have an ASD diagnosis or educational classification (verified by ADOS, SCQ,and SRS), language levels consistent with an ADOS-2 Module 3 (Fluent Speech), and an ability to participate in group settings independently. Existing community group membership whas also required. Groups were randomly assigned to either direct instruction (using the PEERS® curriculum for 8-12 weeks) or peer-mediated (two 1-hour sessions) groups. Psychoeducation (awareness), peer initiation, and peer prompt and reinforce techniques were used as the bases for peer training. At the end of the initial intervention period, the groups were crossed over to the other treatment condition, allowing all participants access to both interventions. Wait list controls participated in both treatment conditions subsequently. Measures of social functioning (Bellini's 2006 Autism Social Skills Profile and SRS) and social inclusion (Kasari's 2012 Social Network Salience measures) were taken at baseline, at crossover, and at follow up. Social interaction data taken from video recordings of the community group meetings and direct instruction sessions were coded for analysis.

Results:
Results reported include participant characteristics, autism symptoms and longitudinal social functioning. Video observations quantified social interactions within community group settings at baseline, at crossover, and at follow-up. In addition to these probes, social interactions during intervention in both conditions are reported. Results in each condition separately, and in combination (after crossover) are reported. Social validity results are also reported.

Conclusions:
If peer-mediated inclusion interventions in natural environments can be delivered efficiently, in less time, and show positive effects, such interventions may prove beneficial to the general population, and be better suited for generalization of skills in adolescents with ASD. Using existing community groups to deliver peer-mediated interventions is a low cost, low intensity, easily accessible method of delivering intervention, especially for families who are not able to access more traditional direct instruction social skills groups due to barriers of income, location, or opportunity.

129   **159.129** Age and Cognitive Functioning Moderate Sex Differences in School-Age Children with Autism Spectrum Disorder

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Background: Clarifying how the clinical phenotype of Autism Spectrum Disorder (ASD) differs across sexes is necessary to fully evaluate hypotheses proposed to explain the disproportionate number of males relative to females with ASD. Studies directly examining the clinical phenotype have suggested subtle differences. Females with ASD have, on average, lower cognitive abilities. Controlling for cognitive functioning though, many studies report that males and females with ASD have largely similar levels of autistic symptomatology across development, from early childhood through adulthood. Similarly, preliminary eye-tracking research in our lab has suggested that males and females with ASD attend to others' eyes for similar amounts of time. However, the social adaptive value of attention to the eyes differs based on sex, suggesting differences in developmental mechanisms of social engagement. To help clarify the effect of sex on the clinical phenotype of ASD, the current study sought to identify factors influencing the magnitude of sex differences.
Objectives: The current study aims to (1) determine factors moderating the social adaptive value of attention to the eyes across sexes and (2) examine specific mechanisms of social engagement underlying differences across subgroups.
Methods: Eye-tracking data were collected while 161 children with ASD (114 male, 47 female) and 49 typically-developing peers (27 male, 22 female) viewed social scenes of children and adults engaged in naturalistic, age-appropriate social interaction within everyday settings. The ASD sample represented a broad range of ages (mean=10.1(2.8), range=5 to 17 years), cognitive functioning (Full-Scale IQ: mean=94.5(22.8), range=32 to 149), and level of social disability (ADOS Calibrated Severity Score: mean=7.1(2.3), range=1 to 10). Both across and within diagnostic groups, males and females were matched on chronological age. Within diagnostic groups, the sexes did not significantly differ in cognitive functioning or in level of social disability. Consistent with our preliminary findings, there were also no significant differences in attention to the eyes based on sex within the ASD group.
Results: Within the full ASD sample, sex moderated the relationship between attention to the eyes and level of social disability (B=15.95, p=0.04). However, age and cognitive profile differentially influenced the relationship between attention to the eyes and level of social disability in males and females with ASD. Further analysis indicated that sex was only a significant moderator for older children (age>11.5 years) and children with higher full-scale IQ (>94.0). Within these subgroups, males with ASD showed the pattern expected from past research, in which more attention to the eyes predicted less social disability (r=-0.401, p=0.01). In contrast, for females, more attention to the eyes trended toward association with greater social disability (r=0.57, p=0.10). Ongoing analyses using more time-sensitive measures of social visual engagement are examining how the timing of attention to the eyes may mediate differences across subgroups.
Conclusions: The current study finds that sex differences in ASD are magnified in older children with higher cognitive functioning. These results also indicate that differences in mechanisms of social engagement may be present even in the absence of manifest mean differences across males and females with ASD.

130 **159.130** Attention to Emotional Faces in Adults As a Function of Autism-Related Attention Switching Abilities

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Background:
Research examining autism spectrum disorders (ASD) has demonstrated that autistic individuals experience attentional and emotion identification impairments (Gross, 2004; Keehn, Mueller, & Townsend, 2013). Absent in the literature, however, is an examination of how the combination of both constructs is related to autism. Studying these two variables in concert is an important, innovative step, as individuals with autism are challenged in tasks assessing emotional processing, yet have been shown to perform equally well or better than neurotypical individuals in attentional tasks requiring the identification of a particular stimulus among distractors (e.g., Plaisted, O-Riordan, & Baron-Cohen, 1998). Also, it remains poorly understood how those with high, but subthreshold clinical, levels of autistic behaviors respond in an attention-demanding task with emotional identification.
Objectives:
The goal of this research was to test whether adults with varying levels of self-reported autistic behaviors would perform differently on a task that combined attentional processing and emotional identification.
Methods:
Participants were 111 college students (41.3% men) who were not formally diagnosed with ASD but completed the Autism Quotient (AQ) that assesses the presence of autistic behaviors. The AQ has five sub-scales assessing different autistic behaviors including social skill, attention switching, communication, imagination, and attention to detail (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). Participants completed a modified visual search task that typically measures attention by assessing the response speed if there is a discrepant stimulus amongst stimuli displaying the same properties (Plaisted et al., 2010). We modified the task by using emotional faces as stimuli that allowed us to simultaneously assess emotion identification and attention. The faces displayed either

basic emotions (i.e., happiness or sadness) or complex emotions (i.e., surprise or fear). For each trial, a face displaying a target emotion was surrounded by 8 or 16 faces displaying a discrepant emotion; stimuli stayed on the screen until the participant identified the target emotion.
Results:
Results of a mixed-model ANOVA indicated a significant target emotion x discrepant emotion x AQ Attention Switching subscale group interaction, $F(1, 65) = 5.28$, $p = .025$. The results demonstrated that participants with good attention-switching ability had faster reaction times (RTs) to basic vs. complex emotions, $F(1, 43) = 52.15$, $p < .001$, and quicker RTs when the discrepant emotions were basic vs complex, $F(1, 43) = 8.41$, $p = .006$. Participants with poor attention-switching (strong focus of attention) showed these same main effects but also had a target emotion x discrepant emotion interaction, $F(1, 22) = 18.80$, $p < .001$. Specifically, these participants demonstrated slower RTs when both target and discrepant emotions were complex (see Figure 1).
Conclusions:
These results indicate that undergraduates with poorer attention-switching ability have a difficult time identifying discrepant emotions when all faces display complex emotions. Individuals with more autistic behaviors specific to attentional control may perform less well in situations involving multiple complex emotions. These findings may help shed light on the social processing challenges associated with ASD in terms of interpreting facial emotions.

131   **159.131** Atypical Theory of Mind in Children with Autism and Their Siblings

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Background: The ability to understand and reason about people's mental states, known as Theory of Mind (ToM), is impaired in individuals with Autism Spectrum Disorders (ASD). To test ToM in children, Wellman & Liu (2004) developed a five-item scale of ToM and showed that in typical children, ToM development involves progressive acquisitions of mental-state concepts, in the following order: Not-Own-Desire (NOD, others can have a different desire than one's own), Not-Own-Belief (NOB, others can have a different belief than one's own), Knowledge Access (KA, someone without perceptual access to an object will not know the identity of the object), Content False Belief (CFB, people can hold a belief that is incorrect and in contrast to reality) and Real Apparent Emotions (RAE, people can hide their emotions, expressing an external emotion that does not match their internal emotion). By comparison, children with ASD show significant deficits and delays on these ToM tasks, and most interesting, progress in an atypical reversal of the last two categories, i.e., NOD, NOB, KA, RAE, CFB, (Peterson, Wellman, and Liu, 2005).
Objectives: The current study extended these previous studies by examining the sequence of ToM development in both children with ASD and their unaffected siblings, as a way of determining whether ToM deficits are part of the broader autism phenotype (BAP) early in development. To this end, we tested children with ASD, their siblings, and typically-developing control children on the 5-item ToM scales.
Methods: Our sample included three groups of 4- to 6-year-olds: children with ASD (n = 12); children without ASD who had an older sibling with ASD (SIBS) (n = 12); and typically-developing children (TD) from families with no history of ASD (n = 24). For each subject, we ran two trials of each of the 5-item ToM scales. The two trials had the same item structure and scenario with different story characters, objects, and locations. Each item could result in a score of 0 (neither trial correct), 1 (one trial correct), or 2 (both trials correct). Data were analyzed using mixed-design 2-factor ANOVAs (2 subject groups: ASD vs. TD and SIBS vs. TD, and 5 ToM tasks: NOD, NOB, KA, CFB, RAE).
Results: For all three subject groups, performance varied with task item (main effect of task: p<0.001). However, subject groups differed in two important ways. First, both the ASD and the SIBS groups exhibited worse overall performance than the TD group (main effect of subject group: ASD vs. TD: p=0.024, SIBS vs. TD: p=0.039). Second, whereas both the TD and SIBS groups followed the pattern of NOD=NOB=KA³CFB>RAE, ASD children exhibited a significantly different pattern: NOD=NOB>KA=RAE³CFB.
Conclusions: By 4 to 6 years of age, both children with ASD and their unaffected siblings show significant deficits in ToM skills, suggesting that ToM impairments are part of the BAP early in development. However, the nature of the impairment differs between ASD children and unaffected siblings, in that only children with ASD show an atypical progressive acquisition of mental-state concepts. Supported by HD052804.

132   **159.132** Autism Spectrum Disorder Profile in Neurofibromatosis Type 1

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Background: Neurofibromatosis Type 1 (NF1) is a common autosomal dominant single-gene disorder, in which the co-occurrence of Autism Spectrum Disorder (ASD) has attracted considerable research interest recently with prevalence estimates of 21-40 %. However, detailed characterization

of the ASD behavioral phenotype in NF1 is still lacking. NF1 has a well described neurobiology and a number of putative interventions have shown to reverse the cognitive phenotype in NF1 rodent models

Objectives: The aim of this study is two-fold: characterize the ASD profile in NF1 and to compare it to idiopathic ASD.

Methods: Participant data were gathered from existing databases with the following inclusion criteria (i) Diagnosis of NF1 AND (ii) Meeting the ASD cut-off on the Social Responsiveness Scale (T scores ≥ 60) AND on ADOS-2 Module 3 (overall total of social affect and restricted and repetitive behaviors ≥ 7). The NF1+ASD phenotypic profile was compared to the two reference groups in the original ADOS validation sample- autism and autism spectrum disorder groups.

Results: The mean SRS T-score of the NF1 sample was 78.58(SD 11.37). Based on selection criteria, all children met ASD cut-off scores on ADOS-2. In terms of severity using the ADOS-2 *comparison* scores, 11% (n = 4) had a low level of autism spectrum symptoms, 66% (n = 24) had moderate symptoms and 23% (n = 8) had a high level of symptoms. On the Social Affect (SA) algorithm items, there were no significant differences between the NF1+ASD group and the autism group apart from unusual eye contact, which was worse in the autism group. On all of the *RRB* items, NF1+ASD children had significantly lower scores compared to autism group. The NF1+ASD group in comparison to the reference ASD group was more impaired on the *SA* algorithm items for *language and communication* items including conversation and use of gestures and *reciprocal social interaction* items including facial expressions directed to examiner, shared enjoyment in interaction, quality of social overtures, quality of social responses, amount of reciprocal social communication and overall quality of report. In contrast, the ASD group was significantly more likely to have poorer eye contact in comparison to NF1+ASD group.

Conclusions: Behavioural phenotyping in genetic syndromes is a promising approach to illuminating the pathogenesis for ASD. NF1 is an important single gene disorder model for studying ASD with well-described neurobiology and the exciting possibility of interventions capable of reversing the phenotype. Within this context, our study sheds light in the profile of ASD in NF1 thus continuing the pursuit of a biological underpinning of the disorder. Using two standardized and well-validated ASD instruments, the findings support previous suggestions of subtle but significant overall differences in ASD symptomatology between NF1 and polygenic autism. Differences include, comparatively in NF1, overall improved eye contact, less repetitive behaviors and better language skills.Results highlight that the use of clinical cut-off scores and total scores alone may mask more subtle, but potentially significant, differences in the precise nature of ASD symptomatology in different genetic syndromes.

133   **159.133** Characterizing Play in Children with ASD: Differences in Joint Attention and Requesting Across Play Levels

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Background: Joint attention and play are often reported as intervention targets in many studies, but there has been little research that investigates the relationship between social communication variables (e.g., joint attention and requesting) and play. It is important to understand the role that social communication may have in play skills, as these both represent primary deficits in children with an autism spectrum disorder (ASD).

Objectives: The aim of this study was to investigate the differences in children's quality of responding and initiating joint attention and requesting skills depending on a child's highest level of play mastered (e.g., simple, combination, presymbolic, or symbolic play).

Methods: Baseline data was collected from six studies between 2007 to 2014 that measured children's social communication and play skills. Participants included 488 children with ASD, ages 1.8 to 5.75 years, with a mean age of 3 and half years old (SD = 9.213 months), 75% of the sample was male, and parents came from varied educational backgrounds. Children in the study came from diverse ethnic backgrounds (35.5% Caucasian, 18% Hispanic, 16.6% African American, 14.1% Asian, and 15.9% other/mixed). The Structured Play Assessment (Ungerer and Sigman, 1984) was used to measure the highest level of complex play mastered based on flexibility and frequency coding, and then children were classified into four major groups of play: simple, combination, presymbolic, and symbolic play (Lifter, 2000). The Early Social Communication Scale (Mundy et al., 2003) was used to measure high and low complexity levels of initiating and responding to joint attention (JA), and initiating requesting.

Results: Regression analyses revealed that there were significant differences in social-communication skills across play levels, except for low level requesting, holding study differences constant(p<.0001). Children that played at a simple or combination level did not differ in frequency of the JA or requesting variables, except for responding to high complexity JA points. Children that played pre-symbolically had greater frequency of initiating JA skills, responding to JA, and high level requesting compared to children that played at a simple or combination level. Children that mastered a level of symbolic play had greater frequency of all high level skills (initiating and responding to JA and requesting) compared to children of all other play levels. Children that played presymbolically or symbolically had the same frequencies of initiating and responding to low level JA. Overall, as children mastered higher levels of play, they demonstrated more social communication skills.

Conclusions: These results suggest that there is a strong relationship between social communication and play skills. Initiating low level JA and requesting skills, such as eye contact or reaching, are not frequently used by children that use higher level skills. The relationship between joint attention and play was more significant than the relationship between requesting and play. These data suggest that targeting these developmental deficits in young children with ASD may accelerate change in both play and social communication skills (Kasari, Freeman, & Paparella, 2006).

134 **159.134** Characterizing Social Cognitive Deficits in High-Functioning Autism Spectrum Disorders and Schizophrenia

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Background: Traditionally, Autism Spectrum Disorders (ASDs) and Schizophrenia (SZ) are considered separate clinical entities. However, recent evidence suggests that both are neurodevelopmental disorders characterized by core deficits in social cognitive processes independent of other cognitive impairments. It is not yet clear if the groups differentiate on the specific social cognitive deficit (e.g. theory of mind, affect recognition, empathy processes) they exhibit.
Objectives: To compare performance on tasks probing theory of mind (ToM) and affect recognition in individuals with ASDs, individuals with SZ and matched healthy controls (HC).
Methods: Eighteen high functioning individuals with ASDs, sixteen individuals with SZ and twenty-eight HC, ages 18 to 30 were recruited to date. The groups matched on age, gender and race but not on an IQ estimate (as measured by WAIS-III vocabulary and block design subtests). We administered a battery of social cognition tasks, including the Hinting task and the Social Attribution task (SAT) to measure ToM, as well as the Reading the Mind in the Eyes test (RMET) and the Bell Lysaker Emotion Recognition test (BLERT) to asses affect recognition. A repeated measure ANCOVA was performed with group as a between-subject factor and social task as within-subject factor, while controlling for IQ.
Results: Results demonstrated a main effect of group (F=7.64, p=0.001) with no main effect of task or a group by task interaction. Follow-up *t*tests demonstrated that both SZ and ASD groups showed impaired performance compared to controls on all 4 tasks. Notably, the ToM tasks tended to show a differentiation between the patient groups, such that ASD performed worse than SZ, while they were equally impaired on the affect recognition tasks.
Conclusions: Our data support overall social cognitive deficits in individuals with high-functioning ASD and SZ compared to matched controls. Moreover, our results suggest similar deficits on affect recognition but potentially more severe ToM deficits in ASD. These results have implication for future research on the neurobiology mechanism, endophenotypes and treatment of ASD and SZ.

135 **159.135** Clinical Utility of the Relationship Development Assessment - Research Version (RDA-RV) for Children with Autism in a Preschool Setting

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Background: Recent studies have demonstrated the reliability and clinical utility of the Relationship Development Assessment - Research Version (RDA-RV) for assessing quality of parent-child interaction among children with autism and their caregivers. The RDA-RV has been strongly associated with calibrated severity scores on the ADOS, and shown sensitivity to change in parent-child dyads taking part in Relationship Development Intervention (RDI). However, to date, clinical comparisons on the RDA-RV between matched children with and without autism have been limited to a school-age, verbally able sample. These comparisons revealed areas of strength (e.g. sustaining coordinated attention) alongside areas of weakness (e.g. rigid co-regulation, and action-focused interpersonal engagement) for verbally able school-age children with autism and their parents.
Objectives: The first aim of this study was to compare matched groups of young children with and without autism, attending a developmentally-based preschool, on the RDA-RV. We predicted that the RDA-RV would reveal areas of difficulty in coordinated attention, co-regulation, and interpersonal engagement. Our second aim was to ascertain whether the RDA-RV revealed patterns of change in a subset of the children with autism, those who (with their parents) received Relationship Development Intervention in a preschool setting.
Methods: The study included 32 children, between the ages of 3 - 6 years, and their parents. There were 16 children (8 girls) who were diagnosed with developmental disabilities but did not show features of autism, and a matched group of 16 children (7 girls) with a previous diagnosis of autism. At the beginning of the school-year, children were administered the ADOS, RDA-RV (a semi-structured play-based assessment of parent-child interaction), and a language assessment. The children with autism were in two separate classes (each class *n* = 8) in the same preschool. One of the classes added RDI to the daily curriculum. RDI was delivered within the classroom, and via parent sessions provided on site throughout the school year. At the end of the school year, all of the children with autism (and their parents) were assessed again, with the ADOS, RDA-RV, and a language

assessment.

Results: Coding on the RDA-RV is underway, and is being conducted by two experienced researchers blind to the diagnosis and clinical status of the children. Children with autism made gains in their language over the course of the school year (RDI, *M* = 9 months; non-RDI, *M* = 7 months). On a group level, ADOS calibrated severity scores remained stable, although there was also individual variability among the children.

Conclusions: Results of the present study should prove useful in extending previous results of the RDA-RV downward to a younger, more language-impaired, sample of children with autism. Profiles on the RDA-RV in these children, compared with matched developmentally delayed children without autism, will be helpful in elucidating the specific effects of autism on quality of parent-child interaction. In addition, the RDA-RV may reveal improvements in quality of parent-child interaction when this is a treatment focus.

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136   **159.136** Concurrent Validity Evidence Supporting the Theory of Mind Inventory

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Background: Theory of Mind abilities are a well-known challenge for individuals with autism spectrum disorder (ASD). Assessing Theory of Mind abilities with standard behavioral tasks can be problematic, due to language constraints and the binary nature of most task responses. To address these limitations, the *Theory of Mind Inventory* (*ToMI*) was designed as a caregiver report measure, in which caregivers rate their child's theory of mind abilities using a graphic rating scale (Hutchins et al., 2010). Assessed behaviors range from early-emerging behaviors (e.g., joint attention, emotion recognition) through later-emerging behaviors (e.g., understanding sarcasm, understanding second-order false beliefs). Strong correlations between *ToMI* scores and measures of social impairment in adolescents with ASD support the *ToMI*'s use in this population (Lerner et al., 2011). However, this concurrent validity evidence was limited in three ways: 1) data was only gathered in adolescents; 2) ASD diagnoses were not confirmed through a gold-standard diagnostic assessment; and 3) no evidence was collected in controls.

Objectives: To provide concurrent validity evidence for using the *ToMI* with children with and without ASD.

Methods: To determine eligibility for a larger study, parents of 20 children with ASD (4;0-6;7) and 20 children with typical development (TD, 3;1-6;5), matched for verbal ability and gender, completed a series of interviews and questionnaires: the *Vineland Adaptive Behavior Scales-Second Edition* (*Vineland-2*; Sparrow et al., 2005); the *Social Responsiveness Scale-Second Edition* (*SRS-2*; Constantino & Gruber, 2012) and the *ToMI*. Parents of children with ASD also completed the *Autism Diagnostic Interview-Revised* (Lord et al., 1994) to confirm ASD diagnoses. Pearson product moment correlations (*r*) were calculated between the *ToMI* Composite score and the following: *Vineland-2* Communication and Socialization subscales scores and the *SRS-2* Total score and Social-Communication Index. Correlations were calculated for the combined sample and for each group separately.

Results: In the combined sample (ASD + TD), the *ToMI* composite score was found to correlate highly with *Vineland-2* Communication (*r*=.59, *p*<.001) and Socialization (*r*=.64, *p*<.001) subscale scores as well as the *SRS-2* Total score (*r*=-.68, *p*<.001) and Social Communication Index (*r*=-.68, *p*<.001). When analyzed as separate groups, correlations remained for the ASD group and, to a lesser extent, for the TD group. In the ASD group, the *ToMI* Composite score was correlated with the *Vineland-2* Communication (*r*=.45, *p*=.049) and Socialization (*r*=.59, *p*=.006) subscales as well as the *SRS-2* Total score (*r*=-.48, *p*=.032) and Social Communication Index (*r*=-.49, *p*=.030). In contrast, within the TD sample, *ToMI* composite scores were only significantly correlated with the *Vineland-2* Communication scores (*r*=.54, *p*=.015).

Conclusions: The accumulated evidence supports the concurrent validity of the *Theory of Mind Inventory*. In the present sample, correlations were especially strong when ASD and TD groups were combined, likely due to the increased representation of data points across the spectrum of possible scores. Yet, even when groups were examined individually, some correlations remained high. Overall, evidence supports the *ToMI*'s use as a valid indicator of target social and communication skills.

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137   **159.137** Context Effects on Facial Affect Recognition in Autism and Schizophrenia

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Background: Impairments in facial affect recognition for individuals with autism spectrum disorder (ASD) and those with schizophrenia (SCZ) are often reported based upon their reduced accuracy in the identification of emotional expressions presented in isolation. Real-world affect recognition, however, is informed by contextual factors that can modulate these inferences. For example, interpretation of a person's emotional state will differ if he/she is crying at a wedding compared to at a funeral. Prominent cognitive theories (e.g., weak central coherence) have suggested that both ASD and SCZ are characterized by a reduced tendency to integrate contextual information, a bias that may affect emotional evaluation within real-world environments.

Objectives: The present study investigated the effects of congruent and incongruent emotional contexts on facial emotion recognition in ASD and SCZ.

Methods: Three groups not differing on estimated I.Q. participated: 44 adults with SCZ, 24 with ASD, and 39 nonclinical controls. Participants completed a novel "Emotions in Context" task in which emotional faces were displayed across three conditions: in isolation, within scenes with emotionally-congruent information, and within scenes with emotionally-incongruent information. In the congruent and incongruent conditions, faces were not superimposed on scenes or shown beside them, as has been done previously, but rather realistically integrated into the scene as the face of a primary character. Both behavioral (i.e., accuracy and response time) and eye-tracking data (e.g., percentage of fixation time on the face) were collected.

Results: Across all three conditions, controls were significantly more accurate ($p = .001$) and faster ($p = .024$) than both clinical groups, who did not differ from each other. A group x condition interaction on accuracy ($F (4, 206) = 3.90$, $p = .004$) emerged, driven by accuracy improving between the isolation and congruent conditions for controls but not the clinical groups (Controls: $p = .007$; ASD: $p = .380$; SCZ: $p = .572$). In contrast, all three groups showed significant decreases in accuracy between the isolation and incongruent conditions (all ps < .02). Discrepancy in RT between the incongruent and isolation conditions was significantly higher in controls (M difference = .23s) than the ASD (M difference = -.39s; $p = .023$) and the SCZ groups (M difference = -.36s, $p = .045$). Estimated I.Q. was a significant predictor of accuracy on each condition for the SCZ group (isolation: r = .46; congruent: r = .41; incongruent: r = .50; all ps < .006), but this did not occur for controls or the ASD group.

Conclusions: Context effects were greater in the control group than both the ASD and SCZ groups. Complementary contextual information facilitated emotion recognition in controls only, and although all three groups demonstrated reduced accuracy in the incongruent condition, only controls showed an increase in processing time when presented with conflicting emotional information. Further, because I.Q. only predicted accuracy in the SCZ group, emotion recognition may rely upon general neurocognitive abilities in SCZ to a greater degree than in ASD. Analysis of eye-tracking data is underway and will be completed in time for the conference.

138 **159.138** Correlates of Emotion Recognition Task Performance in Autism: A Meta-Analysis

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Background: Emotion recognition is thought to be an important skill necessary for successful social interaction (Harms et al., 2010), a core area of difficulty in ASD. Yet, few studies have examined the degree to which emotion recognition ability in ASD is associated with other theoretically related constructs that would provide support for the construct validity of existing measures of emotion recognition. Hall et al. (2009), for instance, conducted a meta-analysis to examine the extent to which *interpersonal sensitivity* (i.e., perceiving others accurately) in typically developing individuals correlates with psychosocial variables (e.g., personality traits, indicators of mental health, and social and work-related competencies) of the perceiver. The present meta-analysis takes a similar approach, focusing on correlates of emotion recognition in participants with ASD. To date, no meta-analysis has examined the convergent validity of emotion recognition tasks used in autism research.

Objectives: The present meta-analysis seeks to examine the convergent validity of measures of emotion recognition in ASD.

Methods: Studies were extracted from searches in PsycINFO, Web of Science, PubMed and PsycARTICLES using keyword combinations including, *autism, Asperger syndrome, pervasive developmental disorders, emotion recognition, facial affect,* and *emotion perception*. Additional articles were extracted from reference lists of recently published review articles. Articles were included if they a) were accessed for free and published in English, b) contained an experiment that examined emotion recognition performance from faces, vocal tones or body cues, and c) reported a Pearson's *r* correlation coefficient for associations between task performance and psychosocial variables. Given the paucity of research in this area, we were only able to identify three main categories of psychosocial correlates for which at least five effect sizes for one outcome measure were obtained: (1) ASD symptomology, (2) caregiver ratings of social skills, and (3) self-reported difficulties in identifying and describing one's own emotional experiences (variations in *alexithymia*, Bagby et al., 1994). Data was analyzed using Comprehensive Meta-analysis Software (CMA). Data collection and variable coding are still in progress. Attempts will be made to code for methodological variables, such as stimulus and task characteristics, which may moderate the relationships between task performance and psychosocial correlates.

Results: Although data collection and analyses are still in progress, preliminary results are provided in Table 1.

Conclusions: Preliminary results indicate relatively modest significant correlations in the expected directions. Emotion recognition performance was negatively correlated with ASD symptomology; positively correlated with caregiver-reported social competence; and negatively correlated with alexithymia. Preliminary results provide support for the convergent validity of emotion recognition tasks, although the strength of correlations may be exaggerated by publication bias. In addition, the relatively small number of studies that examined relationships between emotion recognition and theoretically related constructs suggests more research is needed to examine the convergent validity of measures of emotion recognition used in autism research.

139 **159.139** Depression As a Predictive Factor of Emotion Recognition in High-Functioning Autism

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Background:
Depression is one of the most frequently diagnosed comorbid psychiatric disorders in individuals with autism spectrum disorders (ASD; Ghaziuddin et al., 1992). It is firmly established that both depression and ASD manifest distinct abnormal emotion recognition impairments. For example, depressed individuals tend to negatively interpret neutral valence (Ashwin et al., 2006), whereas those with ASD tend to mislabel negative or ambiguous emotions (George et al., 1998). Some findings report high-functioning individuals with ASD (HFA) are as adept at emotion recognition tasks as typically developing (TD) individuals. This has been attributed to the use of compensation strategies such as greater effortful processing (Tracy, et al., 2011). However, effortful processing may not be effective in comorbid ASD and depression, as it appears to be disrupted by depression (Hartlage, et al., 1993).
Objectives:
The primary aim of this study was to investigate the combined effect of ASD and depression on emotion recognition ability. We hypothesized that individuals with HFA and mild-to-no depression would perform comparable to TD individuals on emotion recognition tasks; whereas, individuals with HFA and depression would exhibit emotion recognition impairment.
Methods:
Participants were 18 to 26-year-old males with an IQ>80. Eighteen individuals with HFA and 30 TD controls completed the Wechsler Abbreviated Scale of Intelligence to estimate IQ, the Wechsler Adult Intelligence Scale – IV ACS Emotion Recognition task, and the self-report Beck Depression Inventory (BDI). Autism diagnosis was confirmed using the Autism Diagnostic Observation Scale. A multiple regression analysis with moderation was implemented to analyze depression severity score as a moderator of the relationship between group (TD vs. ASD) and emotion recognition ability. Predictors included depression severity and group affiliation, while the emotion recognition score was the outcome.
Results:
The multiple regression analysis revealed no main effects for depression severity or group on predicting the emotion recognition score. However, there was a significant interaction between group and depression severity on the prediction of emotion recognition ability. The model predicted 26% of the variance in emotion recognition score. Post-hoc, a Johnson Neyman technique revealed HFA and TD groups differed in emotion recognition ability when BDI depression scores were 18.34 and greater (moderate to severe symptoms). Finally, a simple slopes analysis revealed a significant negative relationship between depression and emotion recognition score in the HFA group (p=.001), but not in the TD group.
Conclusions:
Results of the current study indicate that it may be important to consider depression symptomology when investigating emotion recognition in ASD. In our study, emotion recognition skills in individuals with HFA were comparable to those of TD individuals in the absence of depression. However, those with HFA and moderate to severe depression symptomology showed greater impairment in emotion recognition than in similarly depressed TD controls. Additionally, these findings raise questions as to whether depression disrupts otherwise successful compensatory strategies for emotion recognition in ASD individuals. Further research is needed to investigate the specific mechanisms affected in the interaction between depression and ASD on emotion recognition.

140   **159.140** Developmental Trajectories in Attention to Socially Relevant Information Differs for Infants at Risk for ASD

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Background: Preferential attention to biological motion and faces are socially adaptive, phylogenetically preserved behaviors that appear early in typical development. Attention to these types of socially relevant information is not only compromised among individuals with autism spectrum disorders (ASD), but also independently associated with autism symptomatology. One theory postulates that communicative cues provided by the face (e.g., gaze, facial expressions, and visual speech) constitute a special class of biological motion. Here, we examine that possibility by evaluating the developmental trajectories of visual social attention to biological motion and faces among infants at high (HR) and low risk (LR) for ASD.
Objectives: This study investigates the developmental progression of visual attention to biological motion and faces of people engaging in social interactions among HR and LR infants. We aim to quantify the extent to which visual attention to various types of socially relevant information serve as converging indices of social functioning.
Methods: Eye movements of HR and LR infants (HR: n = 17; LR: n = 10) were recorded at 3, 6, 9, and 12 months of age while infants engaged in two free-viewing tasks. The stimuli for the biological motion task consisted of side-by-side panels featuring colored circles moving in what appears to be a chase in one panel and random movement in the other. Relative time spent looking at the chasing scene

was measured. Infants also viewed a video excerpt of *Sesame Street*. Visual social attention for communicative cues was operationalized as relative time spent looking at faces during social interactions versus faces in a crowd. At 12 months, the Autism Observation Scale for Infants (AOSI) was administered.

Results: Linear mixed models evaluating the effects of risk and age for each task were conducted. While the developmental trajectories in attention for the two tasks did not differ between LR and HR infants, the first derivative of best fit lines revealed that the rate of developmental change for face-looking was significantly slower for HR infants ($F_{1,64.47} = 3092.32$, $p < 0.001$). An additional model including attention to biological motion as a covariate for predicting developmental changes in face-looking revealed a significant interaction. Visual attention for socially relevant information was only associated among LR infants ($F_{1,24.79} = 4.36$, $p = .047$). Bivariate correlations revealed that attention to biological motion was only associated with AOSI scores for HR infants ($r = .53$, $p = .04$).

Conclusions: The data suggest that HR infants process socially relevant information differently than LR infants. The stunted developmental rate of change in monitoring social engagements may cascade into social difficulties for infants who develop ASD. The association between AOSI scores and attention to biological motion found only among HR infants may be attributed to a greater heterogeneity in social and cognitive development within this group. Some HR infants may not glean the social relevance behind biological motion. The data inform the utility of examining associations between types of social attention to identify endophenotypes of autism symptomatology specific to social communication.

141   **159.141** Differences in Processing Emotional Facial Stimuli in Young Adults with High Versus Low Autism Quotient Scores

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Background: Autism spectrum disorders (ASD) are characterized by difficulty with social responses which may contribute to trouble forming social relationships. These challenges may be due to differences in interpreting facial emotions. Social anxiety, often comorbid with ASD, may also contribute to social difficulties (Tyson & Cruess, 2011). College students who self-report high levels of autistic-like behaviors tend to have higher social anxiety levels (Min Liew, et al. 2014).

Objectives: The goal of this study was to understand the relationship between self-reported autistic characteristics, self-reported social anxiety and the ability to attend to and correctly identify a target emotional stimulus amongst other emotional stimuli.

Methods: Participants were 70 undergraduate students (19 males; $M_{age} = 19.5$; 65.7% White) who completed the Autism Quotient (AQ; Baron-Cohen et al., 2001) and the Abbreviated Social Phobia and Anxiety Inventory (SPAI-23; Roberson-Nay et al., 2007). Participants also completed a flanker task designed to assess the ability to control attention to a target stimulus amongst competing stimuli. The flanker task assessed attention to a target face expressing an emotion (i.e., happy, surprise, anger, fear) when surrounded by four distracter emotional faces. Participants' task was to identify the target face emotion. Reaction times for accurate trials were compared between those students with AQ scores in the top third (AQ scores > 24.44) with those in the bottom third (AQ scores < 15.56) as well as for the five AQ subscales.

Results: A mixed-model ANOVA yielded a significant target x flanker x Social Skill AQ subscale group interaction; $F(9, 396) = 1.90$, $p < .05$ (*Figure 1*). There was also a significant target x flanker x Communication AQ subscale group interaction; $F(9, 378) = 1.93$, $p < .05$ (*Figure 2*). When the flanker displayed an angry face, those in the low Social Skill group showed a significant main effect of target emotion ($F(3, 81) = 4.94$, $p = .003$) but those in the high Social Skill group had no significant effect of target emotion ($F(3, 66) = .29$, $p = .83$). Similarly, in trials that contained angry flankers, those with low Communication scores displayed a significant effect of target ($F(3, 75) = 3.49$, $p = .02$). However, those with high Communication scores did not show this effect ($F(3, 66) = 1.65$, $p = .19$). SPAI scores were significantly higher for those in the high AQ groups for both subscales compared with the low AQ groups (Social Skills $t(47) = 5.73$, $p < .05$; Communication $t(47) = 5.90$, $p < .05$). When SPAI scores were included as a covariate, the target x flanker x AQ interaction remained significant for Social Skill ($F(9, 378) = 1.95$, $p < .05$) but not for Communication.

Conclusions: Adults undiagnosed with ASD who report higher levels of social characteristics associated with ASD do not differentially attend to target emotions whereas those who report lower levels of these characteristics do exhibit differences when the target face is surrounded by angry emotional faces. These effects may be due to overlapping traits associated with social anxiety and ASD.

142   **159.142** Differences in Social Conversation Structure and Behaviors for Adolescents with ASD As Compared to Typically Developing Peers

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Background: Autism Spectrum Disorder (ASD) is a persistent and debilitating condition which frequently affects social ability and conversational fluency. Better understanding of areas of social deficit would be helpful to understand limitations adolescents with ASD may face when communicating

with peers, especially at an age when social communication or "hanging out" becomes much more valued than the structured play typical of childhood.

Objectives: This study examined the differences in unstructured conversations between adolescents with ASD and typically developing adolescents; specifically, conversations were coded for eye contact, words spoken, silence, questions asked, validation statements, commenting statements, topic changes, and run-on statements.

Methods: Fifty-nine adolescents between the ages of 13- and 18-years-old completed a 5-minute unstructured conversation with a same-age peer confederate prior to participating/volunteering in a social skills intervention. Forty-seven of the adolescents (81% male, 97% Caucasian) were diagnosed with Autism Spectrum Disorder (ASD), while the remaining 12 (67% male, 92% Caucasian) were typically developing adolescents. Adolescents were screened for ASD using the parent-report of social impairment (Social Responsiveness Scale, Second Edition; SRS 2). Finally, five-minute conversations were coded for seconds of eye contact, number of words spoken in conversation, number of words spoken by the target adolescent, and seconds of silence. Additionally, the number of questions asked, number of validation statements, number of commenting statements, number of topic changes, and number of run-on statements made by the target adolescent were coded.

Results: ANCOVAs were completed to compare adolescents with ASD to typically developing adolescents. Gender was included as a covariate. Seconds of eye contact (F = 5.07, p < .01), number of words spoken in conversation (F = 12.27, p < .001), number of validation statements (F = 5.18, p < .01), and number of commenting statements (F = 11.24, p < .001) were all significantly higher, while seconds of silence (F = 3.90, p < .05) was significant lower, in typically developing adolescents. Number of words spoken by the target adolescent and number of questions asked were not significantly different between groups.

Conclusions: Although adolescents with ASD spoke as many words and asked as many questions in a conversation as typically developing adolescents, the two groups differed in other areas related to the quality of the conversation. It is important to understand problem areas in conversation and target these specific skills in treatment. These results suggests that social skills interventions should target eye contact and statements that validate or affirm a peer's statement or provide comments on peer statements as likely modes of improved conversation quality. Another area of focus for individuals with ASD would be to target unnatural pauses in order to increase social fluency. Understanding these differences in conversation skills may be helpful in designing more effective social skills interventions which target social communication.

143   **159.143** Differential Physiological Responses to Appropriate Vs Non-Appropriate Social Stimuli in Neurotypical Adults with Different Level of Autistic and Empathy Traits

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Background: Understanding others' intentions is evolutionary developed in human and it represents the basic principle of social interaction, for example, pretending not to understand someone's intentions is considered socially non appropriate. Researches suggest that people with ASD have difficulties in understanding other people's intentions. However, these social difficulties can be seen as a continuum in the neurotypical population that correlates with the amount of autistic traits. Previous researches underlined how activity in the prefrontal cortex (PFC) plays a role in the attribution of intentions to others. The PFC activity is modulated from subcortical structures (i.e. autonomous nervous system responses) and different physiological responses may be involved while understanding others intentions.

Objectives: This study aims to test how neurotypical adults with different levels of autistic and empathy traits physiologically respond to socially appropriate stimuli compared to socially non-appropriate stimuli.

Methods: The experimental procedures were designed measure how components of the autonomic nervous system respond to social and non-social dynamic scenarios (12 videos of 25sec). We employed three convergent methodologies. (i) Physiological assessments of excitability were conducted monitoring cardiac dynamics via Hearth Rate (HR). (ii) Promptness to action was measured as temperature changes on left and right hand; left and right chick and tip od the nose, which are associated with arousal and activation. (iii) Behavioral assessment: adults where asked to judge how predictable and how intelligible the stimuli were. These assessments were performed on neurotypical adults (N=20) with high vs low levels of autistic and empathy traits (measured using: Autism-Spectrum Quotient-ASQ and the Empathy Quotient-EQ).

Results: Analysis revealed that those with a lower AQ and higher EQ had significantly greater HR changes and temperature changes to socially inappropriate stimuli (p<.001), and the higher the EQ, the higher the difference between the judgments of predictability and intelligibility appropriate vs non-appropriate social interactions (p<.001). Using tree-based models we found that the judgments of the level of predictability and intelligibility are mainly accounted for by changes of body temperature in the right side of the body (chick and hand) as well as from the EQ traits.

Conclusions: This is the first study to identify the relationship between AQ, EQ and physiological response to dynamic stimuli of appropriate and non-appropriate social interactions. The differential physiological responses to of appropriate and non-appropriate social interactions, suggest that physiological responses may underlie the atypical drive toward non-appropriate social interaction seen in ASD.

144 **159.144** Differing Patterns of Emotional Intelligence in Teens with and without Autism Spectrum Disorders

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Background: Adolescence presents challenges for many youths. In light of the increased focus on social relationships at this time, it can be an especially difficult period for teens with autism spectrum disorders (ASD). While many studies have described the social functioning of children on the spectrum, fewer have discussed the social strengths and weaknesses of teens. Emotional Intelligence (EI), a construct related to the way we perceive, use, understand, and manage emotions (ability EI) as well as to our self-perceived performance in social situations (trait EI), has been found to be related to social outcomes for adults with Asperger Syndrome as well as typical teens. As such, it may offer important information about the social-emotional skills of teens with ASD.
Objectives: The primary purpose of this study was to gather additional information about the social-emotional strengths and weaknesses of teens with ASD and their relationship to social outcomes.
Methods: Teens with and without ASD between the ages of 13 to 17 years, with a VIQ > 80, were recruited for this project. Participants completed 1) a measure of trait EI, the BarOn Emotional Quotient-Inventory: Youth Version, 2) a measure of ability EI, the Mayor-Salovey-Caruso Emotional Intelligence Test: Youth Revised Version, and 3) a social outcome measure, the BASC-2: Self-Report of Personality, in a randomized order. Parents of the adolescents completed 1) a screening instrument for ASD, the Social Communication Questionnaire, 2) a Participant Information Questionnaire, and 3) a social outcome measure, the BASC-2: Parent Rating Scale.
Results: Compared to teens without ASD, teens with ASD obtained significantly poorer overall scores on measures of ability and trait EI. More specifically, they performed significantly poorer on subtests measuring the ability to facilitate thought, manage emotions, and understand emotions and self-reported lower levels of interpersonal and stress management skills. With regards to the social outcome measures, teens with ASD scored significantly lower on the scales measuring self-reported interpersonal skills and parent-reported social skills and adaptability. Further analyses using multiple regressions revealed that whereas the total score from the self-reported EI measure was a significant predictor of parent and self-reported social outcomes for teens with ASD, the best predictors of social outcomes for teens without ASD were the ability to perceive emotions and their self-reported stress management skills.
Conclusions: The results from this project highlight particular social-emotional weaknesses that may be important to consider when planning interventions for teens with ASD. That is, whereas typical teens' ability to perceive emotions and handle stress predicted social skills, a unique pattern emerged for those with ASD, with self-reported EI predicting social outcomes. Given that only trait EI variables predicted social outcomes for teens with ASD, it may be more important to select and implement interventions that focus on application of EI through role-playing social situations and practicing stress management and adaptive skills, as opposed to building the knowledge and skills captured on ability measures.

145 **159.145** Dissociable Components of Imitation Underlie Learning Abilities in Autism Versus William Syndrome and Mediate Treatment Outcomes

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Background:
Imitation abnormalities have been consistently documented in young children with ASD; however, it is not yet clear whether there is a pattern of imitation difficulties that are specific and unique to ASD. Moreover, as early educational intervention programs often require children to imitate actions and behaviors that are demonstrated to them, differences in imitation are likely to impact on response to educational programs in this population. Given that imitation is a multifaceted process, a more fine-grained analysis of the separable components of imitation, and their relevance to learning is necessary to advance knowledge on imitative learning and outcomes in ASD.
Objectives:
In this ongoing study we investigated multiple processes underlying imitative learning in preschoolers with ASD and a matched sample of children with Williams syndrome (WS) with the aim to identify which imitation processes are (1) specifically impaired in children with ASD, and (2) linked to learning outcomes in response to early intervention in ASD.
Methods:
We tested the spontaneous propensity to imitate others and the accuracy of imitation performance in preschoolers with ASD and WS in response to a series of novel eye-tracking-based imitation tasks, in which the following factors were manipulated 1) motor demands, 2) social connectedness to the model demonstrating the action, 3) reward value associated with the outcomes of the actions, 4) presence/absence of clear goals, 5) attentional demands, and 6) social-processing demands. In the ASD group, we also examined the extent to which individual differences in imitative learning mediated response to intensive early intervention.
Results:
Preliminary findings suggest that spontaneous propensity for social imitation and lack of modulation

in imitative response to a socially engaging versus a neutral model might be distinctively impaired in ASD and linked to early intervention outcomes. In contrast, instrumental (e.g. understanding of action goals and outcomes) and motor aspects of imitation seem to be relatively spared in ASD in comparison to core impairments in these components of imitation seen in WS, and appear not to be related to intervention outcomes.

Conclusions:

This study is the first to tease apart the dissociable components underlying imitative learning to identify which imitation processes are (1) specifically impaired in ASD and (2) linked to intervention outcomes. Preliminary results suggest that social and motivational factors underlying imitation might be uniquely impaired in young children with ASD and linked to early intervention outcomes.

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146 **159.146** Diverse Population of Young Children with Autism: Play and Language

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Background: Studies have found that children with autism often display deficits in symbolic play skills where play is often rote and repetitive (Jarrold, Boucher, & Smith, 1993; Williams, Reddy, & Costall, 2001). Thus, researchers have targeted play skills in early intervention, finding increases in play skills that in addition have been found to be associated with gains in language development (Kasari, Paparella, Freeman, & Jahromi, 2008; Toth et al., 2006). However, most studies examining play skills in children with autism are limited by small sample sizes that lack ethnic and socio economic diversity.

Objectives: This study will extend the research by examining a more diverse sample of young children with autism and explore the relationship between language and types of spontaneous play skills.

Methods: Participants included 507 young children (ages 2-5) with autism spectrum disorder and are of a diverse background (32.94% Caucasian, 23.27% Hispanic, 15.38% African American, 15.61% Other, and 12.03 Asian American,). All children were administered the Mullen Scales of Early Learning (MSEL; Mullen, 1989) to assess receptive and expressive language abilities. A composite score for language ability was created by averaging the mental age scores for receptive and expressive language subscales. Children were also administered the *Structured Play Assessment* (SPA; Ungerer & Sigman, 1981) to assess their play skills. Children's spontaneous play behaviors including the number of different spontaneous novel play types were coded from videotaped SPAs by blind raters. Children's highest level of spontaneous play attained was also measured. Highest level was defined as demonstration of at least two different types, each occurring at least five times per level. Play level ranged from 1 (indiscriminant play) to 16 (fantasy/ thematic play). This measure has shown excellent reliability and validity across a range of studies (Kasari et al. 2006; Sigman & Ruskin, 1999).

Results: Bivariate correlations revealed that language abilities and play skills are significantly related. Higher language skills were associated with more spontaneous number and types of play acts within each play level: Simple play ($r = .18$, $p < .01$, $r = .20$, $p < .01$, respectively), Combination play ($r = 0.40$, $p < .01$, $r = 0.37$, $p < .01$, respectively), Presymbolic play ($r = .46$, $p < .01$, $r = .50$, $p < .01$, respectively) and symbolic play ($r = 0.48$, $p < .01$, $r = 0.48$, $p < .01$, respectively). Language abilities were also significantly correlated with attainment of highest level of play skill ($r = .51$, $p < .01$).

Conclusions: The results from the study demonstrate that within a diverse sample of children with autism, there were moderate relationships between language abilities and levels of play skills. Children demonstrated greater frequency and diversity of spontaneous play acts when they had higher language abilities. Additionally, children with higher language skills also achieved higher play levels. Similar to previous studies, this study suggests that children with autism can play symbolically. Future studies, particularly early intervention studies, should incorporate developmentally appropriate play to target and foster meaningful social communication, a core deficit, in children with autism.

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147 **159.147** Do Abnormal Eye Movements Account for Impaired Social Cognition in Adults with ASD?

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Background: Individuals with autism spectrum disorder (ASD) generally under-perform on a variety of social cognitive tasks relative to neurotypical (NT) controls. Individuals with ASD also exhibit differences in gaze to social images and videos. While there are correlations between atypical gaze and social cognitive abilities, to date, the causal nature of the relationship is unknown – in other words, does abnormal gaze result in abnormal social cognitive performance, or does altered social cognitive processing result in abnormal gaze?

Objectives: Using a novel "windowed viewing" experimental paradigm whereby individuals view stimuli through another person's viewpoint, the present study investigated whether differences in social gaze in ASD underlies their social cognitive deficits.

Methods: Eye tracking data was collected from 5 high functioning ASD adults and 5 neurotypical (NT) adult "gaze donors" while they freely viewed an episode of *The Office.* New stimuli were created

whereby for each video frame, the point of the donor's fixation was used to create a window with a 3° visual angle around that point, thus approximating the foveal gaze pattern of each of the gaze donors. 107 NT undergraduates subsequently watched 20 video clips through ASD windows, 20 through NT windows, and 40 with full view (all without sound). After each clip, participants completed a multiple-choice task where they were asked to identify the complex emotion displayed by a particular character. All participants also completed the reading the mind in the eyes (RME) task (Baron-Cohen et al., 2001), which assesses the ability to use information from the eyes of faces to make social emotional judgments. The 5 ASD gaze donors were all in the bottom 10th percentile of RME performance, confirming their social cognitive deficits.

Results: Surprisingly**,** participants' emotion recognition was equally accurate across the ASD-windowed (M=0.57[0.13]) and NT-windowed conditions (M=0.58[0.12]; t[106]=0.99, p=0.33). As expected**,** all participants performed significantly better in the full view condition (M=0.87[0.08]; t[106]=25.1, p<0.001). Emotion recognition accuracy was positively correlated with RME performance, suggesting both tasks assess related social cognitive abilities (r=0.46, p < 0.001). Typicality in the pattern of gaze by the donor was negatively correlated with participants' emotion recognition performance (r=-0.68, p=0.03).

Conclusions: These findings suggest that differences in gaze alone cannot account for difficulties ASD individuals have in recognizing complex social emotions. Not only do these results suggest that the point of foveation in both ASD and NT gaze patterns contains enough visual information for participants to perform equally well, but also that atypical patterns of gaze may actually facilitate performance. Thus, social deficits may not be caused by differences in selection of visual input, but rather the subsequent processing of this information. From these results we cannot conclude that differences in gaze alone cause deficits in social emotion recognition in high functioning adults with ASD, and suggest greater caution when interpreting the meaning of gaze differences in ASD.

148   **159.148**   Dyspraxia and Autistic Traits in Adults with and without Autism Spectrum Conditions

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Background: Autism Spectrum Conditions (ASC) are frequently associated with motor and coordination difficulties. Dyspraxia is characterized by pronounced difficulties in motor coordination. To date, there have been no studies that have explored the prevalence of dyspraxia in a large sample of individuals with and without ASC, or the impact of dyspraxia on autistic traits in ASC and the general population.

Objectives: 1) To quantify the prevalence of dyspraxia in a large sample of adults with ASC in comparison to controls; 2) To explore the effect of dyspraxia on autistic traits in ASC and controls.

Methods: 2,871 adults with ASC and 10,706 controls (without ASC) self-reported whether they have been diagnosed with dyspraxia. A sub sample of participants then completed the Autism Spectrum Quotient (AQ; 1,237 ASC and 6,765 controls) and the Empathy Quotient (EQ; 1,148 ASC and 6,676 controls) online through the Autism Research Centre website. Prevalence of dyspraxia was compared between those with and without ASC. AQ and EQ scores were compared across the 4 groups: 1) adults with ASC with dyspraxia; 2) adults with ASC without dyspraxia; 3) controls with dyspraxia; and 4) controls without dyspraxia.

Results: Adults with ASC were significantly more likely to report diagnosis of dyspraxia (7%) than those without ASC (1%) (OR 9, 95% CI 6.7 – 11.2, p<0.001). In the ASC group, those with co-morbid diagnosis of dyspraxia did not have significantly higher AQ (p=.22) or EQ (p=.1) scores than those without co-morbid dyspraxia. However in the control group (without ASC), those with dyspraxia had significantly higher AQ (p<.01) and EQ scores (p<.05) than those without dyspraxia.

Conclusions: Dyspraxia is significantly more prevalent in adults with ASC compared to individuals without ASC, confirming reports that coordination difficulties are significantly more common in this clinical group. Interestingly, in the general population, dyspraxia was associated with significantly higher autistic traits, and with significantly lower empathy. These results suggest that the addition of motor coordination difficulties in ASC does not further impact their high levels of autistic traits. However dyspraxia is associated with high autistic traits in individuals without ASC.

149   **159.149**   Emotion Recognition Trajectories in Autism Spectrum Disorders: Effects of Internalizing and Externalizing Comorbidities

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Background: Summer months are crucial for youth with autism spectrum disorders (ASD; Cross, 2013). Schools often mandate services in the summer to avoid "significant regression" of core deficits (Etschiedt, 2002). Facial emotion recognition (FER) is a deficit domain in ASD that worsens over time (Lozier et al., 2014), and may be prone to such regression. FER varies by intensity (e.g., Mazefsky, 2002) and stimulus type (child vs. adult; Nowicki & Mitchell, 1998), revealing information

about FER dynamics. Internalizing and externalizing symptoms are common in ASD (e.g., Noordhof et al., 2014), and negatively correlate with FER in non-ASD individuals (e.g., Rodemaker, 2000; Schmitt, 2000). Longitudinally (in non-ASD samples), internalizing symptoms predict greater deficits in FER over time (e.g., Székely, 2014); externalizing symptoms show similar effects over time, though results are inconsistent (e.g., Bowen & Dixon, 2010; Székely, 2014). Thus, internalizing and externalizing symptoms may affect trajectories of FER in ASD during summer months.

Objectives:
1) To use longitudinal, objective measures to examine whether FER deficits in ASD worsen during the summer months. We hypothesized that FER deficits would increase over time.
2) To examine the effects of internalizing and externalizing symptoms on FER trajectories. We hypothesized that these symptoms would predict greater FER regression, with internalizing evincing a larger effect.
3) To explore if obtained patterns vary by stimulus type (intensity & age of faces).

Methods:
Seventeen adolescents (ages: 10-17, M_{age} = 14.31, SD_{age} = 1.58) with ASD completed the computer-based Diagnostic Analysis of Nonverbal Accuracy-2 (DANVA-2; Nowicki, 2004) to assess FER every 3 weeks over an 18-week summer period. Parents completed the Child Behavior Checklist (CBCL; Achenbach, 1991) as a measure of internalizing and externalizing symptoms at baseline. Hierarchical Linear Growth Modeling was used to examine longitudinal change across DANVA-2 faces, with externalizing and internalizing symptoms as predictors. Significant results were explored in terms of variation in intensity (high vs. low) and stimulus type (adult vs. child).

Results:
FER errors on the DANVA-2 decreased over time (β_{10} = -.32, $p < .01$). Greater internalizing symptoms predicted fewer errors (β_{12} = -.04, $p < .01$); greater externalizing symptoms predicted more errors (β_{13} = .04, $p < .01$; Figures 1 & 2). When probing FER stimuli, the internalizing effect was found for low intensity (β_{12} = -.03, $p < .01$), child (β_{12} = -.03, $p < .01$) and adult (β_{12} = -.01, $p = .03$) faces. The externalizing effect was found for low intensity (β_{13} = .02, $p < .01$) and adult (β_{13} = .03, $p < .01$) faces.

Conclusions:
Contrary to our hypotheses, youth with ASD improved in FER over the summer, and this effect was especially great among higher internalizing symptoms; as expected, externalizing attenuated this trajectory. The internalizing effect was strongest among subtle faces, while the externalizing effect was strongest among subtle and child faces. This suggests that ASD youth with internalizing symptoms may become especially attuned to subtler faces over the summer, while those with externalizing symptoms may become especially insensitive to subtle faces and those of their peers.

150 **159.150** Emotion Recognition and Mentalising Impairments in Adolescents with ASD and Co-Occurring Alxithymia

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Background:
Recent research has shown a high proportion of adults with ASD manifest a difficulty in identifying and describing their emotional experiences. This difficulty is encapsulated in the personality trait *alexithymia*. Nowadays the condition is more broadly conceptualised as an emotion dysregulation disorder, defined by a difficulty in cognitively mapping feeling states onto internal bodily responses. The incidence of alexithymia in ASD is much higher than in typically-developing populations and this has led researchers to speculate whether the difficulties in representing emotional experiences could contribute to other cognitive difficulties within ASD.

Objectives:
The present study aimed to examine if: 1) adolescents with ASD exhibited elevated levels of alexithymia, as is reported in studies with adults 2) all ASD participants had elevated alexihymia or if this was limited to a subgroup 3) the high-alexithymia subgroup was impaired in emotion recognition and if this was emotion specific or if it generalised to broader mentalising ability and ToM.

Methods:
54 participants aged 15 years with a diagnosis of ASD were compared to 32 adolescent controls. Participants completed the Toronto Alexithymia Scale-twenty items (TAS-20, alexithymia) and four cognitive-behavioural tasks, used to test the attribution of mental states to others: Strange Stories(SS), Animated Shapes(AS), Children's version of Reading the Mind in the Eyes(RME) and Test of Affect Recognition(TAR). Subsequently, the ASD group were split into those with high (TAS score >52, N= 30) and low (TAS score <52, N = 24) alexithymia and their performance on each task was compared.

Results:
Adolescents with ASD exhibited higher levels of alexithymia compared to the controls and had poorer performance on all mentalising and emotion recognition tasks (Table 1). When the ASD group was divided on alexithymia severity, the high-alexithymia group exhibited poorer ability to discern emotional states from faces

on the Test of Affect Recogniton than the than the low-alexithymia group, t (54) = 2.01, $p < .05$. However, there were no significant differences on any of the mentalising tasks (Table 2).
Conclusions:
This study provides evidence that a subgroup of individuals with ASD have high levels of alexithymia. Furthermore, these individuals have difficulties recognising emotions in both self and others. However, other mentalising abilities remain preserved, indicating that the impairments in alexithymia are emotion specific. This is an important development, as previous studies have only been able to make speculative claims on the relationship between difficulties in cognitively representing emotions in self and mentalising.

Table 1 Means, *T*-Test and *P*-Values for the Cognitive-Behavioural Tasks

Task	ASD(SD/n=)	Controls(SD/n=)	t-test
SS	3.77 (.50/56)	5.31 (.42/32)	$t(86) = 3.69, p < 0.001$
AS(intentionality)	12.55 (.81/55)	14.34 (.73/32)	$t(85) = 2.59, p < 0.05$
AS(appropriateness)	2.64 (.48/55)	4.28 (.49/32)	$t(85) = 3.85, p < 0.001$
RME	18.45 (3.10/55)	20.28 (3.35/32)	$t(85) = 2.57, p < 0.05$
TAR	45.18 (5.64/56)	47.66 (4.67/32)	$t(86) = 2.10, p < 0.01$

Table 2 Mean Scores on Cognitive-Behavioural Tasks for ASD groups with high and low Alexithymia

	SS	AS(intent)	AS(approp.)	RME	TAR
Low-alexithymia(*SD/n=*)	3.92(.48/25)	12.54(.68/24)	2.67(.47/24)	19.04(2.66/24)	46.88(5.29/25)*
High-alexithymia(*SD/n=*)	2.07(.52/31)	12.55(.80/31)	2.61(.47/31)	18.00(3.38/31)	43.81(5.62/31)*

*p<.005

151 **159.151** Emotion Recognition in Children with and without Autism Spectrum Conditions: Cross Cultural Findings

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Background: Children with Autism Spectrum Conditions (ASC) have emotion recognition deficits when tested in different expression modalities (face, voice, body). However, these findings usually focus on a narrow range of emotions, using one or two expression modalities. In addition, cultural similarities and differences in emotion recognition patterns in children with ASC have not been explored before.
Objectives: To compare the similarities and differences in the recognition of 18 emotions by children with ASC and typically developing (TD) controls across three cultures: Israel, Britain, and Sweden.
Methods: In each of the three countries, 20 children with high-functioning ASC, aged 5-9 were compared to 20 TD children, matched on age, sex, and IQ. Children were tested using 4 tasks, examining recognition from voice recordings, videos of facial and bodily expressions, and emotional video scenarios including all modalities in context. An established emotion recognition task, the Frankfurt Test of Facial Affect Recognition (FEFA-2), was used as an external validity criterion.
Results: Children with ASC scored lower than TD controls on all tasks. Tasks strongly correlated with

each other, positively correlated with the FEFA-2, and negatively correlated with autism symptomatology. Some cross cultural differences were found, mostly in the vocal domain, but there was considerable cross-cultural universality of these deficits

Conclusions: This study demonstrates the clinically significant multi-modal deficits in interpreting emotional cues in children with ASC. Cross-cultural research has the potential to reveal both autism-specific universal deficits, and the role that specific cultures play in the subtle differences in how empathy operates in different countries.

152   **159.152** Emotional Understanding and Perception in Cognitively Able 6-8 Years Old Children with and without Autism Spectrum Disorder

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Background:
It is commonly assumed that emotion recognition and processing deficits are present in individuals with autism spectrum disorder (ASD) although DSM 5 criteria do not specify them directly. Failure of fundamental early emotion recognition skills would have profound consequences for a child's social development. However, research on generalized or specific emotion recognition along the past 20 years has not come to a consensus whether basic emotion recognition is a fundamental difficulty in ASD. Some studies reported fear and other negative emotions recognition are most difficult for individuals with ASD. Most studies used either emotion labelling tasks or emotion matching tasks.
Objectives: The aim of the current study was to compare the understanding of four basic emotions, by assessing the coherence, content and the internal feeling these emotions provoked, in cognitively-able children with ASD and typical development.
Methods:
The study included 60 children, age ranged 6-8 years (M=72.0; SD=7.9 months). The ASD group consisted of 30 children (28 males, 2 females) diagnosed with ASD using standardized tests, all with IQ scores within the normal range (M=99.7; SD=12.1). The control group included pair-matched for age and sex, 30 typically developing children without documented developmental problems. Information on emotional understanding of four basic emotions (happy; fear; anger; sad) and the internal feeling they provoke was retrieved from the Autism Diagnosis Observation Scales (ADOS) test video-tapes for the ASD group, and from recorded interviews on this part of the ADOS for the control group. A coding system for rating the emotional questions responses was developed by the researchers and included codes for coherence, content and the internal feeling each emotion provoked.
Results:
The two groups were significantly different in the coherence of their responses to all the four basic emotions. Almost all the control group (96%) had coherent responses in comparison to only 70% of the ASD group (P<0.05 for 'happy', 'fear' and 'anger'; P<0.01 for 'sad'). Specifically, for the 'fear' emotion, 30% of the ASD group responded "none" (never experienced) in comparison to only 3% in the control group (P<0.01). Analyzing the content of the responses revealed the control group reported more interpersonal content than the ASD group only for the 'happy' and 'sad' emotions (P<0.05). The ASD group had significantly more response of 'none' in comparison to the control group for the "fear" (P<0.05) and "anger" (P<0.001) emotions. Of the responders, for the "fear" emotion both groups gave technical or related to an event response, and for the "anger" emotion, both gave an interpersonal content. The perception of the internal feeling was significantly different between the groups for the 'fear' (P<0.05), 'anger' (P<0.01) and 'sad' (P<0.05), but not for 'happy' emotion.
Conclusions:
Typically developing children in 6-8 years age-range fully conceptualize the nature of their basic emotions. In ASD understanding the nature of fear and sad emotions are not fully acquired and less interpersonal content is noted for happy and sad emotions. These specific findings can help in the diagnosis process of cognitively-able children with ASD.

153   **159.153** Ensemble Perception of Emotions in Children with Autism

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Background:
Ensemble perception, the ability to rapidly and automatically assess the summary or 'gist' of large amounts of information presented in visual scenes, is crucial for navigating an inherently complex world (Haberman & Whitney, 2011). Given the processing limitations of the human brain, it is more efficient to lose representations of individual elements of visual scenes in favour of a concise summary representation. Ensemble perception is employed for low-level visual information (e.g. size,

texture), as well as high-level social stimuli (e.g., emotion) and is available early in development. A recent theoretical account proposed that individuals with autism present limitations in their ability to maintain summary statistics for the recent history of sensory input, which might explain their unique perceptual experience. We therefore predicted that ensemble perception in children with autism might be compromised compared to typically developing children.

Objectives:
We investigated ensemble perception of emotions in children with autism and typically developing children. We also employed eye-tracking methodologies to investigate cognitive mechanisms underlying ensemble perception of emotions.

Methods:
We have so far tested 17 children with autism and 17 typically developing children, aged between 6 and 14 years, and individually matched on age and on verbal and reasoning abilities. Each child received three child-friendly tasks (see Figure A): 1) an average emotion discrimination task, assessing their ability to judge the average happiness of a set of 'morphs' (variations of the same face) drawn from a continuum of emotional faces, from happy to sad; 2) a non-average happiness discrimination task, evaluating baseline emotion discrimination; and 3) a face identification task, estimating children's ability to identify morphs previously presented to them.
We predicted that children with autism should present difficulties in the average emotion discrimination task, where performance relies upon the efficient use of summary statistics for facial emotions, but no difficulties in non-average emotion discrimination. We also predicted that children with autism, who rely upon detailed representations of individual items rather than condensed summary statistics representations, might present better performance than typical children in the face identification task.

Results:
Analyses showed that children with autism were just as precise and as fast as typical children in the average and non-average emotion discrimination tasks. Children with autism, however, presented lower accuracy than typical children in the face identification task, suggestive of more general weaknesses in facial emotion processing. On eye-movement variables, the two groups were indistinguishable in terms of the average number of fixations, the number of morphs sampled per trial, and their preferences in their first fixation. In their last fixation, however, children with autism showed a looking preference for happier rather than sadder morphs.

Conclusions:
We show here that, contrary to our predictions, autistic children's ability for ensemble perception of emotions is similar to that of typically developing children. We further demonstrate that, while children with autism show no difficulties in non-average emotion discrimination, they present certain weaknesses in face identification, as well as a pronounced preference for sampling the happier rather than the sadder morphs in their last fixation.

154 **159.154** Evidence for Specificity of Visuomotor Sequencing Deficits and Relation to Cognitive Outcomes in Autism and Williams Syndrome

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Background: Although social communicative impairments are defining characteristics of children with ASD, delayed or atypical motor learning has been consistently documented. The extent to which motor learning difficulties are specific to ASD in terms of their association with cognitive outcomes is as yet unexplored. Cross-disorder comparisons between young children with ASD and Williams syndrome (WS) provide a unique opportunity to examine specificity of motor learning deficits in disorders with divergent social and cognitive abilities.

Objectives: Here we compare the spontaneous engagement of goal-directed actions on objects and visuomotor sequence learning in young children with ASD when compared to a matched sample of children with WS. Specifically, we aimed to identify whether deficits in goal-directed actions and visuomotor sequencing are specific to children with ASD, and explore interrelationships with cognitive and adaptive outcomes.

Methods: Using novel experimental behavioral tasks that were video-recorded, we explored both spontaneous propensity to engage with objects in a goal-directed way and ability to learn a novel visuomotor sequence in preschoolers with ASD and WS during manipulation of the following factors: 1) different objects and toys that afforded opportunities for goal-directed versus purposeless actions, 2) trial and error learning during a specific sequence to retrieve a toy with efficiency of action sequence measured across trials, and (3 generalization of the action sequence to a different context.

Results: Preliminary findings suggest that children with ASD show specific difficulties in goal-directed object use and detecting a sequence by trial and error. The impaired performances in organizing actions around goals and visuomotor sequence learning will be examined in relation to links with cognitive outcomes in response to early intensive behavioural intervention in ASD.

Conclusions: These findings will improve our understanding of autism-specific patterns of motor and visuomotor sequence learning that contribute to cognitive and adaptive outcomes. A clearer understanding of both propensities and abilities in motor learning will inform early motor interventions that go beyond primary social communicative concerns in young children with ASD.

159.155 Examination of an Imitation-Based Intervention for Adolescents with ASD and Significant ID

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Background:
Individuals with ASD have significant difficulty with social skills across the lifespan. Few social interventions have been developed or evaluated for older individuals with ASD who also have a significant intellectual disability (ID).   A developmental perspective would suggest that techniques that promote social interaction in younger children with ASD would likely also benefit older individuals with significant ID who are functioning at a similar developmental level. Reciprocal imitation training (RIT) is a naturalistic developmental-behavioral intervention that targets imitation and imitation recognition, key social processes that emerge in infancy and are thought to facilitate the development of more advanced social communication skills in typical development. Previous research suggests RIT improves imitation and other social-communication skills in young children with autism.
Objectives:
This set of studies examined whether RIT could be used to improve imitation and social behaviors in adolescents with ASD and significant ID.
Methods:
Study 1 used a multiple-baseline design to examine the functional relationship between RIT and imitation, joint engagement, and challenging behavior in 4 adolescents with ASD and significant ID living in a residential treatment facility.   Study 2 examined the feasibility of conducting an RCT to evaluate RIT with 20 additional adolescents with ASD and significant ID in a residential facility. Primary outcomes included metrics of feasibility of the assessment and treatment protocol. Secondary outcomes included a preliminary analysis of the effect of RIT on imitation, social interaction skills, and challenging behaviors.
Results:
Results of Study 1 indicated that all 4 adolescents improved their imitation skills. Improvements were also noted in joint engagement and challenging behavior for a subset of the adolescents. Results of Study 2 indicated that the assessment protocol was feasible and that RIT was well-tolerated by the adolescents and implemented with fidelity by teaching staff. Preliminary findings indicate that treatment had moderate to large effects on social interaction and challenging behavior.
Conclusions:
Results suggest that RIT is a promising approach for improving social interaction and decreasing challenging behavior in adolescents with ASD and significant ID. A larger RCT of RIT for this population is feasible and warranted.

159.156 Examining and Comparing Social Perception Abilities in Children and Youth with Autism Spectrum Disorder, Attention Deficit Hyperactivity Disorder and Obsessive Compulsive Disorder

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Background: Several neurodevelopmental disorders are associated with social processing deficits.
Objectives: The objective of this study was to examine and compare patterns of social perception abilities across obsessive-compulsive disorder (OCD), attention deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD), and control subjects.
Methods: A total of 265 children (mean age 11.4 years; n=34 control subjects, n=42 with OCD, n=71 with ADHD, and n=118 with ASD) completed the Reading the Mind in the Eyes Test-child version (RMET). Parents/caregivers completed established trait/symptom scales. Predicted percent accuracy on the RMET was compared 1) across disorders, 2) by item difficulty and by item valence (i.e. positive/negative/neutral mental states), and then analyzed for associations with trait/symptom scores.
Results: Percent correct RMET scores varied significantly between diagnostic groups (p <0.0001). On pairwise group comparisons controlling for age and sex, children with ADHD and ASD scored lower than other groups (p<0.0001). When IQ was also controlled for in the model, the OCD group performed better than controls (p< 0.001), although differences between other groups were less pronounced. The ASD group scored lowest on easy items. The ASD and ADHD groups scored significantly lower than other groups on items with positive valence (p< 0.01). Greater social communication impairment and hyperactivity, but not OCD traits/symptoms, were associated with lower scores on the RMET, irrespective of diagnosis.
Conclusions: Social perception abilities in neurodevelopmental disorders exist along a continuum. Children with ASD have the greatest deficits, while children with OCD may be hypersensitive to social

information. Social communication deficits and hyperactive/impulsive traits are associated with impaired social perception abilities; these findings highlight overlapping cognitive and behavioral manifestations across disorders.

157 **159.157** Examining the Relationship Between Oxytocin and Cortisol in a Double-Blind, Placebo-Controlled, Randomly Assigned Hydrosome Challenge Study in Autism Spectrum Disorder

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Background: The hormones, cortisol and oxytocin (OT) are key neuromodulators of biological and behavioral responses and both have been implicated in the neuropathological profile of children with autism spectrum disorder (ASD). Cortisol, a primary "stress hormone" is more variable and often elevated under conditions of social stress in ASD, when compared to typically developing (TD) children. OT known as the "social hormone" is a key moderator of social behavior and stress responsivity, and has been associated with social deficits in ASD. In addition to mediating complex social behavior, OT plays an important role in stress buffering. However, the extent to which OT may moderate stress responsivity in ASD is uncertain.
Objectives: The purpose of the investigation was to evaluate the relationship between cortisol and OT in children with ASD under baseline and physiological stress (hydrocortisone challenge) conditions.
Methods: Participants included children between 8 to 12 years of age with ASD (N = 14) and typical development (N = 11) each exposed to a single dose Hydrocortisone (pharmaceutical cortisol) challenge and placebo. A double-blind, placebo-controlled, randomly-assigned, crossover design was employed. The study was conducted over two visits with one-week intervals. A low dose of Hydrocortisone and placebo were administered via liquid suspension that was prepared by investigational pharmacy. Height and weight were assessed to calculate body surface area (m^2) to determine the administration of a single dose of Hydrocortisone in levels considered to be mild (5 mg per m^2). Demonstrable effects are detectable within one hour; thus, repeat blood sample collection for cortisol and OT was taken at baseline and at 60 min post administration. For each blood draw 6 ml was collected. The analysis of variance (ANOVA) statistical model included the within subject factor 'Condition' (Experimental/Placebo) and 'Time' (Pre and Post) and the between subject factor 'Group' (ASD vs. TD). Due to skewed distribution, cortisol was log transformed.
Results: Regarding OT, there was a significant difference for Time F(1,23) 8.95, p = 0.007) indicating the expected difference for both groups based on pre and post administration levels. There was a trend for Condition x Group F (1,23) 3.64, = .07. Notably, there was a significant Time x Condition x Group Interaction F(1.23) = 4.18, p = 0.05 showing a rise in OT during the experimental condition (hydrocortisone) and a drop during the placebo condition for the TD group but not the ASD group.
Conclusions: For the TD group, an inverse relationship was observed such that OT decreased during placebo and increased during physiological challenge suggesting that OT played a stress-buffering role during cortisol administration. In contrast for the ASD group, OT decreased during both the physiological challenge and the placebo condition suggesting that OT failed to serve as a stress buffer under conditions of physiological stress. While OT has been tied to the social ability of children with ASD, the diminished moderating effect of OT may play a contributory role in the heightened stress responsivity often observed in children with ASD especially under conditions of social stress.

158 **159.158** Examining the Relationship Between Social Communication on the ADOS and Real-World Reciprocal Social Communication in Children with ASD

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Background: Autism Spectrum Disorder (ASD) is characterized by two sets of symptoms: deficits in social communication and restricted and repetitive interests. One measure used to aid in the diagnosis of ASD is the Autism Diagnostic Observation Schedule (ADOS). The ADOS uses structured and unstructured activities to elicit specific behaviors, which are then coded on several different dimensions with two subdomains (Social Communication, Restricted Interests and Repetitive Behaviors) that together achieve a total score. Although naturalistic play can be difficult to observe and measure, remote observation equipment and detailed behavioral coding paradigms can record and quantify the social behavior of ASD children in a realistic play setting.
Objectives: We aimed to look at how well the two subscales of the ADOS predicted actual reciprocal social behavior in children with ASD during play with same-age peers using the Peer Interaction Playground paradigm. We predicted that higher scores on the Social Communication subscale of the ADOS (more severe autism symptomology) would be associated with less reciprocal communication with peers on the playground.
Methods: The participants included 30 children with ASD. Each child was given the ADOS by a trained, research-reliable clinician as a part of a neuropsychological assessment. The children with ASD were paired with a typically developing participant and a typically developing confederate for a 20-minute session on a playground. The participants were remotely audio and video recorded so as not to

interfere with natural play. Reliable coders conduced a comprehensive, in-depth analysis of playground behavior of the child with ASD, including variables such as Reciprocal Communication with peers and Self-play. Separate linear regressions models were performed with Reciprocal Communication with peers or Self-play as the dependent variables and diagnostic and demographic variables (verbal IQ, age, the ADOS Social Communication and the Restricted Interests and Repetitive Behaviors subscales) as predictors.

Results: Linear regression for Reciprocal Communication was found to be significant [$F_{(4, 29)}=3.68$, $p=0.018$], with ADOS Social Communication as the primary significant predictor of reciprocal communication with peers during play [$t_{(4, 29)}=-3.317$, $p=.003$]. The other variables, including the Restricted Interests and Repetitive Behaviors subscale, were not found to be significant. The diagnostic and demographics variables did not predict Self-play behavior on the playground [$t_{(4, 29)}=1.158$, $p=.258$].

Conclusions: We found that higher scores on the ADOS Social Communication subscale were predictive of the amount of communication with peers on the playground. Higher ADOS scores were associated with less time talking during play. The specificity of the relationship between Social Communication on the ADOS and Reciprocal Communication with peers in a real world setting provides support for the reliability and validity of the diagnostic instrument for predicting day-to-day functioning.

159 **159.159** Exergaming to Improve Physical and Mental Fitness in Children with Autism Spectrum Disorders

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Background:
Although differences in executive function (EF) and motor skills are not included in the diagnostic criteria for ASD (American Psychiatric Association, 2013), impairments in these areas have been consistently observed in individuals diagnosed with ASD (David, Baranek, Giuliani, Mercer, Poe & Thorpe, 2009; Dziuk, Gidley-Larson, Apostu, A., Mahone, Denckla, & Mostofsky, 2007; Ghaziuddin & Butler, 1998; Hilton, Zhang, White, Klohr, & Constantino, 2012; Ming, Brimacombe, & Wagner, 2007; Provost, Thibadeau, & Rose 2007). EF refers to higher order cognitive processes that are used to guide behavior in a changing environment, and includes the constructs of planning, inhibition, impulse control, working memory, cognitive flexibility, creativity, and initiation of action (Sachse, et al., 2013).
Motor deficits are recognized as symptoms associated with ASD by the World Health Organization (2001). Motor deficits often associated with ASD may include problems in motor planning, coordination difficulties, and an inability to participate in developmentally appropriate activities, which affect the child's ability to initiate motor activities or switch between motor tasks (Abu-Dahab, Skidmore, Holm, Rogers & Minshew, 2013; Lloyd, MacDonald & Lord, 2013; Hilton et al., 2012; Wiggins, Robins, Bakeman, & Adamson, 2009).
Objectives:
We investigated the effects of using the Makoto arena intervention, a speed-based exergame, on EF, motor skills, and response speed in 17 school-aged children with ASD.
Methods:
We used a single-group, pretest–posttest intent-to-treat research design for this study. 17 children with ASD between 8 and 18 years old participated in this pilot study. A diagnosis of ASD, a full-scale IQ score of at least 65, and a willingness to participate in the Makoto arena intervention approximately 3 times per week were required for inclusion in this study. Individuals with lower IQs were excluded to avoid the potential for confusion between impaired intelligence and impaired EF. Participants were evaluated before and after intervention on the Behavior Rating Inventory of Executive Function (BRIEF) and the Bruininks-Oseretsky Test of Motor Proficiency- Second Edition (BOT-2). Average reaction speed was recorded at each Makoto intervention session. Participants completed two minutes of Makoto intervention a minimum of three times per week until thirty intervention sessions were completed, with a total of approximately 1,800 repetitions for each participant.
Results:
All areas of EF improved, with significance in the overall *global executive composite* and in the *metacognition index*, and in specific areas of *initiate, working memory* and *plan/organize*. All motor skills improved except *fine manual coordination*, with significance in *strength and agility*. Participants increased response speed showing a large effect size.
Conclusions:
Findings suggest that use of exergaming may be a valuable addition to standard intervention for children with ASD who have motor and EF impairments, although further examination of dosage, alternative exergames, long-term effects, and specific effects on school performance are warranted. Significant correlations between certain EF and motor scores suggest a relationship between the two constructs and continued work addressing this line of inquiry to further understand and possibly increase the benefits of various types of exergaming for people with ASD will be valuable steps toward best practice.

160 **159.160** Eye-Tracking Differences in Social Stimuli in Patients with Rett Syndrome and Autism Spectrum Disorders

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Background:
Although Rett syndrome (RETT) was considered a manifestation of Autism Spectrum Disorders (ASD), many aspects peculiar to each of these conditions make them very different and deserve to be even more clarified, so that diagnosis and therapeutic and educational interventions can be as effective as possible for one and other condition.
Objectives:
In this study, we used eye tracking technology to compare the visual fixation in social stimuli in patients with RETT and ASD.
Methods:
Visual fixation at social stimuli was analyzed in 14 Rett syndrome (RETT) female patients (age range 4-30 years), 11 Autism Spectrum Disorders (ASD) male patients (age range 4-20 years), and 17 children with typical development (TD). Patients were exposed to three different pictures (two of human faces and one with social and non-social stimuli) presented for 8 seconds each on the screen of a computer attached to an eye-tracker equipment.
Results:
Percentage of visual fixation at social stimuli was significantly higher in the RETT group compared to ASD and even to TD groups. Older RETT patients looked shorter time at social stimuli (human faces) and longer time at non-social stimuli (clock). Also, positive correlations were significant in TD group regarding all three social stimuli, without any correlation regarding non-social stimuli (clock); that is, older typically developing children looked at target areas longer than younger ones.
Conclusions:
Visual fixation at social stimuli seems to be one more endophenotype making RETT to be very different from the ASD. Now we can add to such objective and systematic findings that patients with RETT are undoubtedly more socially engaged than those with ASD and even than younger TD children, although such social engagement tends to decrease with age in RETT and to increase in young TD children. RETT patients present social domain more preserved than other cognitive aspects, at least regarding what we know up to now, indicating probably more functional areas which may be focused on in the development of new therapeutic and leisure strategies.   It is a fact that eye tracking technologies have made possible to understand ever better not only the cognitive pathways of patients without verbal communication and, in the case of RETT, without motor possibilities, but also the different outcomes involving RETT and ASD.

161   **159.161** Face Recognition Accuracy, Response Time and Visual Search Strategies of Adolescents with and without Autism Spectrum Disorders

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Background: The development of face recognition was theorised to continue to improve from childhood and adulthood, suggesting different face processing styles along the developmental trajectory. Although several studies have investigated face recognition ability of individuals with autism spectrum disorders (ASD), evidence of the differences between individuals with and without ASD in face recognition accuracy has been inconsistent. It is possible that the inconsistent evidence can be attributed to the differences in face recognition abilities along the developmental trajectory. However, few had investigated face recognition in ASD from a developmental perspective.
Objectives: The current study replicated the methodology of previous studies involving children and adults with ASD. The aim of the study was to compare accuracy, response time and visual search strategies, i.e., number of fixations and fixation duration during recognition of unfamiliar faces in adolescents with and without ASD.
Methods: The current study recruited 28 adolescents with ASD and 30 matched typically developing (TD) peers. Participants viewed of 12 pairs of face stimuli cut into puzzle pieces (encoding); followed by a face recognition phase. Half of the puzzle pieces were presented with the eyes bisected and the other half with eyes as a whole. The accuracy and response time in face recognition tasks were recorded. Measurements of visual search strategies were recorded using a remote eye tracker.
Results: Adolescents with ASD demonstrated increased difficulty in face recognition compared to their TD counterparts, despite showing similar response time. TD adolescents showed increased accuracy when the eyes were whole but decreased when eyes were bisected. Adolescents with ASD demonstrated no differences in accuracy in the two eye conditions. Adolescents with ASD were less likely to derive effective processing using the 'face information triangle', as reduced scanning to the eyes but increased on other areas of the face were observed.
Conclusions: When compared with the studies involving children and adults, this study highlighted that face recognition differences between individuals with and without ASD first appear during adolescence. This provided evidence on the importance of the consideration of face recognition abilities in ASD from a developmental perspective.

162   **159.162** Facial Emotion Recognition from Videos with Varying Intensity in Autism

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Background : Autism Spectrum Disorders (ASD) are defined by impairments in social communication and interaction, including non-verbal communication such as emotional expressions. However, behavioural studies comparing ASD to controls on facial emotion recognition have shown mixed results; some show group differences, some do not. This might be attributed to the differences in methodology applied, with many investigations including only certain basic emotions, based on static displays, and small numbers of trials and facial stimuli. Complex emotions are experienced on a daily basis and are important to correctly recognise for effectively functioning within social interactions, as are subtle displays of emotional expressions. Moreover, reports are generally based on raw hit rates, not taking into account both correct and incorrect responses. For example, choosing surprise for both fear and surprise expressions, which can bias recognition rates. To date, no published work exists on facial emotion recognition including both subtle emotional expressions based on dynamic video recordings, and including basic and complex emotions.
Objectives : To identify whether people with ASD differ from controls in facial emotion recognition using videos including six basic and three complex emotions across three intensity levels (low – intermediate – high). It was expected those with ASD would show reduced accuracy from videos, especially at high intensity due to the diminished ability to use the additional emotional information appropriately that is available for more intense expressions.
Methods : Twelve adolescents and adults with a current diagnosis of ASD (9 male; *Mean age* = 16.92, *SD* = .29) and 12 matched controls (9 male; *Mean age* = 17.25, *SD*= .75) completed 360 trials of a facial emotion recognition task (9 emotions: anger, disgust, fear, happiness, sadness, surprise, contempt, embarrassment, pride x 3 intensities x 12 faces). Unbiased hit rates were the DV, to take into account both correct and incorrect responses to the emotion categories, and entered in a repeated measures ANOVA.
Results : Overall, the ASD group had reduced accuracy compared to controls on the facial emotion recognition task. Both groups showed significantly higher accuracy for the high intensity than the intermediate intensity expressions, as so for the latter compared to the low intensity expressions. Significant group differences were found for the intermediate and high, but not low intensity expressions. Although there were no group differences for specific emotions, group differences emerged for the three-way interaction; level of intensity impacted differently upon specific emotions of both basic and complex emotions.
Conclusions : A facial emotion recognition deficit in ASD was identified, but the level of intensity at which group differences occurred varied between emotion categories. Both groups benefitted from the additional emotional information in intermediate and high intensity expressions compared to low intensity expressions, as shown by increased accuracy. Despite this increase and the comparable performance at low intensity, the controls benefitted from the additional emotional information at intermediate intensity more than the ASD group. This suggests the control group showed superior ability to utilise the greater emotional information available in intensities than the ASD group, over both basic and complex emotions.

163   **159.163** Firm Evidence for Facial Identity Recognition Deficits in ASD Using a Task with No Memory Component

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Background:
Impairment in facial identity recognition is a widely reported feature of autism spectrum disorders (ASD), and may be a core component of the social deficits that characterize ASD (Schultz, 2005). Recently, some have argued that these facial recognition deficits arise from face-specific memory impairments rather than perceptual processes (Weigelt, Koldewyn, & Kanwisher, 2012, 2013); however, findings of atypical visual search patterns (Chawarska & Shic, 2009) and neural activation (Dawson et al., 2005) during face perception, as well as evidence of impairments on face processing tasks without memory demands (Annaz et al., 2009; Wolf et al, 2008) contradict this claim. Moreover, some identity perception tests used in prior studies may have been too easy, such that most participants performed close to ceiling.
Objectives:
The present study aimed to resolve these inconsistencies by examining the performance of a very large sample population on the Benton Facial Recognition Test (BFRT; Benton et al., 1994), a challenging simultaneous-presentation recognition measure.
Methods:
The BFRT was administered to participants ages 5 to 50 (*n* = 419 ASD and 500 typically developing controls, TDC) as a part of a core phenotyping battery used across studies by the PI at two different

sites (Yale and UPenn). Other core measures included a standard IQ test chosen based on age and language level (e.g. DAS, WISC) and gold standard diagnostic measures (ADOS and ADI-R). During BFRT administration, participants were prompted for a response after 12 seconds and item booklet page was turned after 16 seconds, a cutoff chosen from extensive pilot testing with TDCs. Participants over 20 years of age (nearly all TDC) or with unusually low Benton scores (< 23; chance=27) were excluded from analyses, bringing the final sample size to 410 ASD and 400 TDC. ANOVA revealed a significant main effect of gender; thus, gender was included in the final model. There were significant main and diagnostic group interaction effects of site on BFRT scores, but these effect sizes were tiny (η_p^2s <.01). Regression analyses revealed significant association between BFRT, age (r=0.55) and IQ (r=0.27, with no significant difference by diagnostic group). Thus, an ANCOVA for BFRT score with diagnosis, gender, and site as explanatory variables and age and IQ as covariates was used to evaluate diagnostic group differences.

Results:

Analysis revealed a highly significant main effect of diagnosis, with participants with ASD scoring lower than TDCs, $F(1, 800) = 71.18$, $p < .001$, $\eta_p^2 =0.08$, $d=0.60$. Regression analyses (controlling for age) showed that lower scores on the BFRT were associated with greater ADOS total scores in the ASD group (partial r=-0.25).

Conclusions:

Despite recent claims that difficulties with facial identity in ASD are restricted to tasks with a memory component, we find that youth with ASD have significant facial recognition deficits compared to TDCs (with a medium effect size), controlling for age, IQ, and gender, on a task that requires discrimination of identity from simultaneously presented face pictures, with no overt memory component.

164   **159.164**   Friends for Foes: How Friendship May Buffer the Effects of Victimization on Depression in Adolescents with High Functioning Autism

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Background: Adolescents with autism spectrum disorders are more likely to be victims of bullying than typically developing individuals (TD; Wainscot et al., 2008). Research has highlighted the importance of friendships in preventing an escalating cycle of peer victimization in TD children (e.g., Ernest, et al., 1999). However, these findings may not generalize to children with high-functioning autism (HFA) because of unique deficits in social abilities.

Objectives: This study sought to examine victimization and depression differences, as well as investigate variations in the presence and quality of friendships in HFA and TD adolescents.

Methods: Twenty HFA and 36 TD participants 10-21 years of age were matched on chronological and mental age. The ADOS was used to confirm diagnosis. The ADOS Friends and Marriage questions were transcribed and analyzed using thematic analysis (Braun & Clarke, 2008) and focused on three main themes: Poor Quality Friendships, Limited Social Network, and Difficulty Understanding Friendship. A Negative Friendship Total was also calculated. Participants completed the Social Experiences Questionnaire (Crick & Grotpeter, 1996) yielding Overt Victimization (Overt_Vict), Relational Victimization (Relational_Vict), and Prosocial Support (Prosocial_Sup) scores. Depression was assessed using the Child Depression Inventory (Kovac, 1992) or the Center for Epidemiological Studies-Depression inventory (CESD; Radloff, 1977) depending on chronological age. Depression scores underwent z-score transformations to ensure that they were on the same scale.

Results: Separate hierarchical regressions predicting depression revealed: (1) a significant main effect for Relational_Vict and a significant interaction effect for Relational_Vict by Prosocial_Sup and (2) significant main effect for Overt_Vict but no significant Overt_Vict by Prosocial_Sup interaction. Main effects for Prosocial_Sup were not observed in either regression model (see Table 1)[1]. To understand the influence of friendship on Prosocial_Sup, additional regression analyses were conducted. Results suggested that higher Negative Friendship Totals significantly predicted the lower Prosocial_Sup (see Table 2). Regression models predicting Prosocial_Sup from Limited Social Network, Understanding Friendship, and Poor Quality Friendships were not significant.

Conclusions: These finding indicate that the amount of prosocial support provided by one's peers can buffer the negative effects of social exclusion and alienation (relational victimization) on depression symptoms in adolescents. Furthermore, the presence and quality of friendship significantly predicted the amount of prosocial support from peers. These findings were similar across groups, however it should be noted that HFA adolescents had poorer quality friendships and more limited social networks than their TD peers. Thus, it may be that creating and maintaining meaningful friendships can reduce internalizing symptoms in victimized adolescents, regardless of diagnostic group. However, because HFA adolescents have poorer friendship quality, receive less prosocial support and are more victimized by their peers than TD adolescents, it may be particularly important to understand how friendship buffers the negative effects of victimization to inform research and clinical practice for families affected by autism.

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[1] Regression models examining group effects were also conducted, but group main effects and interactions were not significant in any model, and these predictors were removed from the models.

159.165 Imitation Abilities in 12-Month-Old Infants at High Risk for Autism Spectrum Disorder (ASD): Parents Provide a Vital Perspective

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Background:
Imitation is an early-emerging and fundamental behavior associated with the development of communication and social cognition. Deficits in imitation in very young children with ASD are thought to play a primary role in the abnormal development of social communication. Younger siblings of children with ASD (high-risk siblings, HR) are at higher risk of developing ASD and other developmental problems than those in the general population. Experimental studies of HR infants with ASD suggest group differences across domains by the first birthday, particularly in the areas of communication and social interaction (Ozonoff et al., 2010; Rozga et al., 2011; Zwaigenbaum et al., 2005). A recent study suggested that imitation is compromised in all HR infants and not specifically HR siblings who develop ASD (Young et al., 2011), but little is known about early imitation skills according to parents.
Objectives:
We examined imitation based on parental report (First Year Inventory; FYI; Baranek et al., 2003) in 12-month-old HR and low-risk (LR) infants.
Methods:
Participants included 96 families of 12-month-old infants: 71 at HR and 25 at LR for ASD. Questions on the FYI comprise two domains (Social Communication (SC) and Sensory-Regulatory), each domain consisting of four constructs. The current study focused on the SC domain and its Imitation construct which taps into early-emerging motor, vocal, and social imitation skills. At 36 months, the infants were assessed by a team of expert clinicians and classified as having ASD (n=16); other delays, subclinical autism symptoms, or a history of either (HR-ATYP; n=36); or typical development (HR-TYP, n=19; LR-TYP, n=25). Analysis consisted of between-group ANOVAs followed by post-hoc tests.
Results:
The groups differed on the Social Communication domain ($F(3,92)$=5.2, p=.002) and two of its constructs: Social Orienting and Receptive Communication $(F(3,92)$=3.0, p=.021) and Imitation $(F(3,92)$=6.0, p=.001). Post-hoc analyses showed that infants with ASD had significantly higher (worse) scores on SC compared to HR-ATYP (p=.025, d=.75) and LR-TYP (p=.001, d=1.18) but not HR-TYP infants. The ASD group had higher scores on the Imitation construct than the HR-ATYP $(p$=.004, d=.94), HR-TYP $(p$=.002, d=1.17), and LR-TYP $(p$=.002, d=1.10) groups, with large effect sizes for each comparison.
Conclusions:
These results suggest that, although other skills at this age may also be impaired, parent-reported imitation discriminated the ASD group from all other groups of HR and LR infants with large effect sizes. Parents have the advantage of observing their children across highly familiar contexts, including during well-practiced routines. Motor and vocal imitation games constitute integral components of these playful routines, which often take on a trial-like structure. Thus, missed opportunities for imitation are readily noticeable and reportable. These findings suggest that parent-reported information about imitation skills at 12 months may help identify infants at highest risk for an ASD among HR siblings. Our study has implications for early screening instruments, as imitation can be easily operationalized, typically occurs frequently across modalities (motor, vocal), and is readily observable and reportable by parents.

166 **159.166** Impact of Perceived Gaze Direction and Duration on Fixations during an Impression Formation Task in High-Functioning Autism

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Background:
Gaze behaviour is a salient aspect of nonverbal communication in social encounters and is essential for initiating and maintaining interpersonal reciprocity. Moreover, atypical use and interpretation of this nonverbal cue is a specific diagnostic feature in High-Functioning Autism (HFA).
Objectives:
To investigate the impact of the two factors gaze direction and gaze duration on gaze behavior during an impression formation task in an observer, we determined the fixation frequencies of individuals with HFA in comparison to those of matched typically developed controls while they performed an impression formation task. Impression formation, a concept much less investigated in HFA (compared to that of Theory of Mind, which requires inferences about another's mental states), implies that inferences about another's social traits have to be made.
Methods:

For the present study, the stimulus material used were dynamic computer-generated characters, that displayed either averted or direct gaze of varying durations (1 s, 2.5 s, 4 s). While the participant's eye-movements were recorded using eye-tracking technology, they were required to evaluate the likeability of the virtual faces on a four-point rating scale.
Results:
Behavioral ratings revealed that HFA participants showed no significant difference in likeability ratings depending on gaze duration, while the control group rated the virtual characters as increasingly likeable with increasing gaze duration. Furthermore, the analysis of the eye-tracking data showed that individuals with HFA explored the presented stimuli in a similar manner, compared to control participants. This results contribute to the ongoing debate in the literature on the circumstances under which individuals with HFA actually present atypical fixations of another's face.
Conclusions:
The present findings suggest that, in the case of an impression formation task, where the social information is conveyed facially and with the explicit instruction to form an impression, individuals with HFA show similar scan paths compared to typically developed participants.

167 **159.167** Implicit Social Evaluations in Toddlers with Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) show pervasive social and communicative deficits. The current study investigates what social abilities may underlie these difficulties. Specifically, we test whether toddlers with ASD form implicit expectations about third-party social interactions.
Objectives: The goal is to clarify whether toddlers with ASD construct social evaluations similarly to their typically developing (TD) peers, using two methodologies that were originally designed for use with preverbal infants (Kuhlmeier, Wynn, & Bloom, 2003; Hamlin, Wynn, & Bloom, 2008).
Methods: Both the ASD (n = 14; 10 males; M = 24.13 months, SD = 4.46) and TD (n = 21; 8 males; M = 23.44 months, SD = 3.04) participants were recruited from a larger study using the Modified Checklist for Autism in Toddlers, Revised and Follow up (M-CHAT-R/F; Robins, Fein, & Barton, 2009). Each child habituated to a live display in which a red circle started at rest at the bottom of the hill and tried repeatedly to climb to the top (see Figure 1). Sometimes the red circle was pushed up to the top by a helper, and other times it was pushed down to the bottom by a hinderer; the helper/hinderer identity and order of events was counterbalanced between children. In six subsequent test trials, children saw the red circle move toward either the helper or the hinderer and looking time was recorded. After the looking time procedure, children were presented with wooden versions of the helper and hinderer and were asked to choose one.
Results: A repeated-measures 2x2 ANOVA of looking times during test trials revealed a significant main effect of actor, $F(1, 33)$ = 4.84, p = .035 (see Figure 2). Children across groups looked longer when the circle approached the hinderer than when it approached the helper. There was no main effect of diagnostic group, $F(1, 33)$ = .10, p = .69, and no interaction, $F(1, 33)$ = .16, p = .75. In the choice task, TD children showed a reliable preference for the helper over the hinderer. Of the 19 who made a choice, 15 chose the helper (one-tailed binomial p < .001). Children with ASD did not show a reliable preference (5 of 12 chose the helper; p = .39).
Conclusions: Across diagnostic groups, children showed surprise when the red circle approached the shape that had previously hindered it, as evidenced by prolonged looking. Future larger samples will allow for more detailed analyses of within-group effects. Results from the choice task paint a clearer picture; TD children reliably preferred the helper, whereas children with ASD did not. These results suggest that TD two-year-olds are capable of making implicit social evaluations after viewing live displays, and 2-year-olds with ASD have at least some ability to do so. However, unlike their TD peers, children with ASD fail to integrate these judgments in their explicit behaviors. This study will add to the greater knowledge of the underlying social processes affected in children with ASD.

168 **159.168** Insight in Social Relationships in Cognitively-Able 6-8 Years Old Children with and without Autism Spectrum Disorder

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Background:
Impairments in social interaction, such as difficulties in forming peer relationships, constitute an important core deficit in autism spectrum disorder (ASD). Friendship is defined as an intimate relationship providing companionship, mutual support, and affection. To build and maintain a friendship requires high-level interpersonal skills. Age related norms of these concepts have not yet been thoroughly examined. Additionally, it is still not clear to what degree the social insight skills in cognitively-able children with ASD are different from their peers.
Objectives:
The aim of the current study was to compare the understanding the concepts of friendship and long-term relationships by assessing the coherence and the content of these concepts in cognitively-able groups with ASD and typical development.

Methods:
The study included 60 children, age ranged 6-8 years (M=72.0; SD=7.9 months). The ASD group consisted of 30 children (28 males, 2 females) diagnosed with ASD using standardized tests, all with IQ scores within the normal range (M=99.7; SD=12.1). The control group included 30 typically developing children pair-matched for age and sex, without documented developmental problems. Information on social insight in understanding the concepts of friendship and long-term relationship was retrieved from the Autism Diagnosis Observation Scales (ADOS) test video-tapes for the ASD group, and from recorded interviews on this part of the ADOS for the control group. A coding system for rating the coherence and content of the responses to questions on friendship and long-term relationship, such as marriage, was developed by the researchers. The coherence was divided to coherent and incoherent answers (does not know, incoherent). The content of the responses was judged based on the following answers: no response/does not know, technical, activity/function and emotional descriptions.
Results:
Regarding understanding the concept of friendship, the ASD group had significantly more incoherent responses in comparison to the control group for the item "what is friendship?" (66% vs. 6.7%; P<0.001), and for the item "how a friend is different from an acquaintance?" (56.7% vs. 16.6%; P<0.001). For understanding the concept of marriage, the ASD group gave significantly more incoherent responses (44.7%) in comparison to in the control group (16.6%) (P<0.01). Analyzing the content of the responses to the item "what is friendship?" revealed that the control group reported significantly more emotional (P<0.001) and activity (P<0.05) related content than the ASD group. The control group reported significantly more activity-related content for the items "how a friend is different from an acquaintance" (P<0.01). The control group provided more emotional content and collaborative activities to explain the nature of friendship while in ASD there is more reliance on technical explanations. For long-term relationships, the two groups provided more functional responses than technical and emotional descriptions. However, higher percentage of this type of response was noted for the control group (P<0.05).
Conclusions:
In ASD, significant deficits in understanding the concepts of friendship and long-term relationships are noted even in cognitively-able population. The coherence of the responses and understanding the nature of friendship best discriminates between TD and ASD in 6-8 years age range.

169 **159.169** Interoceptive Awareness, Alexithymia and Empathy in Autism
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Background:
Autism is often co-morbid with alexithymia, an impaired ability to recognise, describe and understand one's own emotions. Considering inconsistent findings in emotion processing research in autism, it has been proposed that alexithymia may be a contributory factor to the emotional deficits of autism. Here, the role of interoception - the sense of one's bodily state - in alexithymia and empathy was investigated in a sample of 52 adult participants (26 with high-functioning autism).
Objectives:
To establish if people with autism differ in sensitivity to interoceptive signals compared to those without autism and if interoceptive sensitivity (IS) and interoceptive awareness (IA) are related to symptoms of alexithymia, empathy and autistic traits.
Methods:
IS was measured with heartbeat tracking and heartbeat detection tasks. Heartbeat tracking consists of counting one's heartbeats during brief intervals, without taking one's pulse. This count is compared to the actual number of heartbeats, giving an accuracy score. Heartbeat detection involves the identification of one's own heartbeats from a series of sound beeps, which are synchronous or asynchronous w.r.t. one's heartbeats. An emotion recognition task and an affective empathy task were also administered. Participants completed questionnaires measuring autistic traits, alexithymia, IA, empathy, and their sensory profile. Data was analysed for differences between people with and without autism, and regression-based conditional process analyses were conducted to investigate the relationships between IS, IA, alexithymia and empathy.
Results:
Participants with autism were less accurate than the control group in the heartbeat tracking task, indicating lower IS. No differences were found in the heartbeat detection task. There was no difference between groups in identifying emotions and levels of affective empathy. Participants with autism scored significantly lower on the empathy questionnaire and significantly higher on the alexithymia questionnaire. All empathy scores were moderately correlated to autistic traits and alexithymia. While IS scores were not related to autistic traits, empathy or alexithymia, self-reported IA was related (r –values ranging from|.45| to |.57|), as were active and reactive strategies towards bodily feelings (r-values ranging from |.27| to |.57|). Conditional process analyses confirmed that reduced awareness of bodily feelings and a lower tendency for helpful strategies towards those feelings contribute to higher alexithymia, which in turn contributes to lower empathy (R^2 = .32). The negative effect of helpful strategies on alexithymia is moderated by autism, i.e. lower levels of helpful strategies is associated with a significantly higher level of alexithymia for people with autism compared to those without autism.

Conclusions:

These findings suggest that interoceptive awareness, but not interoceptive sensitivity, and active and reactive strategies towards bodily feelings contribute to empathy. Importantly, alexithymia fulfils a mediating role in this relationship, suggesting that understanding of one's own emotions contributes to empathy. The data is also suggestive of an alexithymic subgroup in autism, whose emotion processing may differ from non-alexithymics with autism. Further research could examine whether interoceptive awareness training could be a beneficial intervention approach.

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170   **159.170**   Interpersonal Sensory-Motor Synchrony in Adults with and without ASD during an Open-Ended, Joint Motion Game: A Pilot Study

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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 setup – the mirror game (MG) – that allows high-resolution temporal and spatial motion tracking during an open-ended joint improvisation game adapted from a traditional theater exercise (Noy et al., 2011).

Objectives : To investigate the ability of adults with ASD, as compared with typically developing (TD) adults, to attain interpersonal synchrony in an open ended, joint motion game.

Methods:

Participants: preliminary data from 3 participants with high-functioning ASD was compared with that of 48 TD adults.

MG procedure: two players face each other holding handles which can move along parallel tracks (Fig 1a, b), and are told to "imitate each other, create synchronized and interesting motions, and enjoy playing together". Participants are instructed to lead the motion (3 min), then follow the experimenter's motions (3min), and then engage in joint improvisation, with no designated leader (3min). All participants played against the same expert improviser. The motion of the two handles was sampled at 50 HZ (Fig 1c, d).

Data analysis: The degree of motion complexity in participants' Leader rounds was computed using a wavelet-based complexity measure (WD). Following previous studies of the MG (Noy et al., 2011; Hart et al., 2014), periods of high interpersonal synchrony were defined as periods in which two players exhibited co-confident (CC) motion tracks (Fig1d) without any 'jitter' (2-3Hz oscillations around the leader's trajectory, Fig 1c).

Results:

ASD participants' motion patterns were significantly less complex and more repetitive than TD participants' motion patterns (U=0.67, p<.01). Furthermore, while 73% of TD participants attained moments of highly-synchronous, CC motion with the other player when they acted as leaders, none of the ASD participants attained CC when leading. By contrast, during Follower and Joint Improvisation rounds, 2 of the 3 ASD participants attained CC. Clinical observations suggest that the individual who never attained CC in any of the rounds had lower social skills and less motivation than the other two ASD individuals.

Conclusions:

Some individuals with ASD are capable of attaining high interpersonal synchrony when following or co-creating motion with an experienced player. The fact that none of the individuals with ASD attained interpersonal synchrony when leading suggests that they may have difficulty adapting their leading motions to another player. Indeed, when leading, ASD individuals exhibited less complex, repetitive motions. Further data collection and analysis are currently underway to determine whether ASD participants differ from TD participants in their patterns of interpersonal sensory-motor synchrony, and whether these interpersonal motion patterns are associated both with background characteristics such as autism severity, IQ, motor coordination and with more complex social and communication abilities.

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171   **159.171**   Intimate Relationships and the Broad Autism Phenotype in Young Adults

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Background: Autism Spectrum Disorder (ASD) is characterized by social and communication impairments and this can lead to difficulties in relationships. Studies suggest there is often a strong motivation for social connection in those with ASD (Hellemans et al., 2007; Henault, 2005), and for many young adults with or without ASD, intimate relationships provide an important source of companionship (Shulman & Kipnis, 2001). Studying intimate relationships and the broad autism phenotype (BAP) in a large sample of young adults with subthreshold ASD symptoms can contribute to our understanding of those with clinically significant impairments.

Objectives: This study examines how subthreshold ASD symptoms relate to intimate relationship

experience, satisfaction and interest. We hypothesized that a) adults with higher self-reported BAP scores would be less likely to report being in an intimate relationship, b) happiness in current relationship would be negatively related to BAP, and c) the desire to be in a relationship would not relate to BAP.

Methods: Participants included 578 young adults, 18 to 25 years of age, without an ASD diagnosis (M = 22.4 years, SD= 2.0, 48.6% men). Participants completed an online survey of demographics and the 24-item Subthreshold Autism Trait Questionnaire (SATQ; Kanne, Want, & Christ, 2011), with higher scores indicating a higher expression of BAP. SATQ subscales include Social Interaction and Enjoyment, Oddness, Reading Facial Expressions, Expressive Language, and Rigidity. Participants were also asked to report on their current relationship status, happiness in current relationship (7-point likert scale from very unhappy to very happy), and desire for an intimate relationship (yes/no).

Results: Preliminary results suggest that those currently in a relationship (N = 302) had significantly lower autism phenotype scores (M = 23.66, SD = 9.60) compared to those not in a relationship (M = 27.05, SD = 9.34), $t(502)$ = -3.93, p < .001; d = .36. All SATQ subscale scores were significantly higher for those not in a relationship, with the exception of rigidity. Of those in a relationship, higher autism phenotype scores were negatively correlated with relationship happiness (r = -.14, p < .05). When specific SATQ subscales were examined, relationship happiness was negatively correlated with expressive language (r = -.16, p < .01) and social interaction and enjoyment (r = -.14, p< .05). The vast majority of participants (87.7%) reported a desire for an intimate relationship. Overall, autism phenotype did not distinguish between those interested and those not.

Conclusions: The BAP appears to relate to relationship status and satisfaction, although individuals with stronger ASD symptoms do not necessarily lack an interest in intimate relationships. Effect sizes were consistently small, and may have been larger if considering not only those with subclinical symptoms, but those with diagnosed ASD as well. This study suggests that symptoms of ASD may be related to intimate relationship experiences, though causality cannot be inferred by the current methodology alone. More research is needed to parse out the specific characteristics and social difficulties of ASD that have the greatest impact on relationships.

172   **159.172** Linking the Emotional Self-Control of Children with ASD to ADHD Symptomology: A Moderated Mediation Analysis

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Background: Children diagnosed with autism spectrum disorder (ASD) often exhibit ADHD symptomology (Leyfer et al., 2006) and have higher rates for externalizing behaviors than typically developing (TD) children (Tureck et al., 2013). Externalizing behaviors in young children are thought to manifest from an inability to regulate emotionality (Yerys et al., 2013). Further, certain individual characteristics such as high negative emotionality can increase children's risk for externalizing problems and necessitate that children have good skills for regulating emotion in order to avoid negative outcomes (Eisenberg et al., 2005; Valiente et al., 2003). Given that prior research suggests ADHD symptoms also increase children's risk for externalizing problems (Tureck et al., 2013), we reasoned that children's skills to regulating emotion would serve to buffer them against externalizing problems. Thus, the purpose of our study was to examine associations among emotional self-control, diagnostic status (TD vs. ASD) and ADHD symptomology.

Objectives: We hypothesized that children with ASD would exhibit higher rates of externalizing behaviors than TD children and that this relation would be mediated by their emotional self-control. Furthermore, we hypothesized that the link between status and emotional self-control would be conditional on children's levels of ADHD symptomatology.

Methods: Participants included 88 children, ages 3:0 to 6:11, their parents, and teachers. Fifty-seven children (28% female) were TD and the remaining 31 were diagnosed with ASD (6% female). The Behavioral Assessment System for Children – Second Edition Teacher Rating Scale (BASC-2; Reynolds & Kamphaus, 2004) was used to assess children's emotional self-control and children's externalizing behaviors as reported by their parents. The ADHD Index from the Conner's Parent Rating Scale (CPRS-R-S; Conners, 1997) was used to assess ADHD symptoms.

Results: We investigated the conditional indirect effects of status on externalizing behaviors through emotional self-control, as moderated by ADHD symptoms (see Figure 1). We tested this moderated-mediation model using Model 7 in PROCESS (Hayes, 2013). The overall model was significant. Although status was a significant predictor of children's externalizing behaviors (B = -4.45, SE = 1.13, t = -3.94, p < .001), the relation between status and externalizing behaviors was mediated by children's emotional self-control but only at mean (B = -3.99, SE = 1.20, t = -3.33, p = .001) and high levels (B = -8.01, SE = 1.71, t = -4.69, p < .001) of the moderator, ADHD symptoms, and not at low levels (B = -1.76, SE = 1.87, t = -.95, p = .35).

Conclusions: Our findings help to clarify relations among diagnostic status, ADHD symptoms, emotional self-control, and externalizing behaviors in young children with and without ASD. Most notably, children with higher levels of ADHD symptomatology required effective emotional self-control in order to buffer them from externalizing behaviors. This pattern was most pronounced for TD children. Further research should examine the role of emotional self-control in treatment for children with and without ASD who exhibit ADHD symptoms.

173   **159.173** Longitudinal Stability of Social Interaction Styles in Children and Adolescents with Autism

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Background:
According to Wing and Gould's sub classification system (1979), the autism spectrum may include individuals with aloof, passive and active-but-odd social interaction styles (SIS). Recently, it was found that these interaction styles can be meaningfully distinguished in children and adolescents with autism and average or above average IQs (Scheeren, Koot & Begeer, 2012). However, we do not know whether the social subtypes are stable over time.
Objectives:
To assess the longitudinal stability of social interaction styles in children and adolescents with autism.
Methods:
Four year follow up data were analyzed on 53 children and adolescents with autism using the parent completed Wing's subgroup Questionnaire (WSQ) and longitudinal measures of verbal ability (Peabody Picture Vocabulary Test-III) and autism severity (Social Responsiveness Scale).
Results:
Social interaction styles were found to be stable, with most participants remaining in the same Wing subtype category over a period of 4 years. Most children (45%) showed active-but-odd SIS. Transitions from participants originally showing active-but-odd SIS occurred mostly onto the typical SIS, indicating that they no longer show behavior representing any of the three Wing subgroups. Participants with a higher verbal IQ were found to show more stable active-but-odd SIS. Higher SRS scores were associated with a decrease in passive SIS over time.
Conclusions:
Children and adolescents with autism who actively pursue social interaction, albeit in an often idiosyncratic manner, can be reliably differentiated from those who remain passive. Our study findings show a stability of social interaction style over a period of 4 years. Individual differences in social interaction style likely have a large impact on children's social learning and social experiences. We propose that the social subtype of children with autism should be integrated in clinical practice to tailor interventions to the child's individual needs and social motivation.

174   **159.174**   Miss Alida M Acosta Ortiz

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Background: Behavioural economics offers experimental paradigms to shed light on the complexities of social decision making. In the Ultimatum Game (UG; Fehr & Schmidt, 2006), for example, participants are asked to share a given amount of money (£10) with another person in whatever proportions they wish. If the second person accepts the offer, money is paid out accordingly but if she rejects, neither player receives anything. Rationally players should offer as little as possible because other players should rationally accept any offer greater than 0. However, most people tend to offer equal shares and tend to reject offers of less than 30% of the total. Since many social-emotional (e.g, empathy) and social-cognitive (e.g., Theory of Mind) processes are at play in these scenarios (Takagishi, 2009; Sanfey 2007), one would expect individuals with ASD to behave differently in the UG. A study by *Sally & Hill (2006)* is the only one addressing this question to date and suggests that ASD children tend more to accept unfair offers in the UG, although this was unrelated to their ToM
Objectives:

- To identify whether there is a difference between ASD and TD adults in the rate of acceptance/rejection of an unfair offer (£3-£7) in the Ultimatum Game.
- To examine the link between an individual's decisions during the UG and their ToM, empathising and systemising skills; their propensity to adhere to principled moral rules, and their tendency to avoid punishment and/or seek rewards.

Methods: 40 ASD and 32 TD adults, matched on age and IQ, participated in a real-life one-shot UG. They were asked to decide whether to accept or reject an offer of £3 out of £10. Participants also completed some cognitive tasks including the Reading the mind in the eyes test **(Baron-Cohen et al 2001)**, the empathising and systemising questionnaires **(Baron-Cohen, 2009)**, the behavioural inhibition/activation scales **(Carver & White, 1994)** and an ethics position questionnaire (EPQ; **Forsyth, 1980)**.
Results:
Overall, our results indicated no group difference in the proportion of participants who rejected the unfair offer (ASD = 47%; TD = 45%). As expected, ASD participants scored lower on ToM and empathising and had significantly higher scores on the behavioural inhibition scale, suggesting that they might be more sensitive to losses. No group differences were observed on systemising, the BAS scale or the EPQ. 2x2 ANOVAs of the various dependant measures showed that in both groups those

who accepted unfair offers score higher in ToM and lower in BIS. Interestingly, the only group difference emerged in relation to the EPQ where only ASDs who rejected unfair offers scored higher than those who accepted.

Conclusions: The current data do not suggest that ASDs respond differently to 'fairness' than TD participants in the Ultimatum Game. ToM abilities and sensitivity to losses appeared to motivate decisions to reject unfair offers to similar extents in both groups. Interestingly, however, results from the EPQ suggest that ASDs may be more reliant on a moral heuristic than TD individuals in reaching their decisions

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175   **159.175** Moral Judgment in Adolescents with Autism Spectrum Disorders

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Background: Individuals autism spectrum disorders (ASD) have difficulties in social interaction and communication. Research shows that their difficulties in communication may result from theory of mind, i.e., understanding what other people's thought. However, to make moral judgment, we often need to refer people's intention during our moral and social reasoning.

Objectives: The study investigated moral and social reasoning in adolescents with ASD. It was aimed to explore the relation between theory of mind and moral judgment. The second goal was to examine whether moral judgment of adolescents with ASD differed from that of typically developed adolescents? An instrument Moral Decision-making Test (MDT) was developed to compare performance of adolescents with ASD with typically developed adolescents.

Methods: 21 adolescents with ASD (ages 15.03±1.75) and 33 typically developed adolescents (ages 14.08±1.33) participated in the study. There were recruited from schools in Kaohsiung city in Taiwan. All participants' IQs were in the normal range and passed the first-order false belief questions. Their family's socioeconomic status was also controlled. All participants with ASD were re-diagnosed by two clinical psychiatrists as Asperger syndrome or autism spectrum disorders. The average scores of Peabody Picture Vocabulary Test were 113.62 for the ASD group. The instrument used to assess participants' moral judgment was self-developed Moral Decision-making Test (MDT). The MDT consisted of 12 questions. Each question represented one situation which the participants were asked whether they would offer help. People in the questions who needed help included participants' mothers, friends, enemies, or strangers.

Results: The moral judgment for the ASD group did not tend to be context-dependent. A significant difference between the ASD and typically developed groups is taking actions according to interpersonal relationships. The ASD group seldom took the interpersonal relationships into account when they made moral judgment. As to the relation between MDT and advanced theory of mind questions, the two scores were significant related for the typically developed group and not significant related for the ASD group.

Conclusions: The moral judgment of participants with ASD differing from the typically developed participants may be resulted from deficits in executive functioning, theory of mind, and weak central coherence. They all took part in the process when participants with ASD make social reasoning and moral judgment.

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176   **159.176** No Evidence of Emotion Dysregulation or Aversion to Mutual Gaze in Pre-Schoolers with Autism – an Eye-Tracking Pupillometry Study

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Background: Reduced engagement in mutual gaze is a consistently documented feature of autism. One theoretical account of this phenomenon, the "gaze aversion hypothesis", suggests that people with autism actively avoid eye contact because they experience mutual gaze as aversive and/or hyper-arousing.

Objectives: We aimed to test this hypothesis in a representative mixed-ability group of pre-schoolers with autism.

Methods: We showed videos of faces displaying mutual and averted gaze to 23 pre-schoolers with autism and 21 typically developing pre-schoolers using eye-tracking technology to measure visual attention and emotional arousal (pupil dilation).

Results: We found no evidence of emotion dysregulation or aversion to mutual gaze in the children with ASD. The ASD group looked less to the faces across eye gaze conditions and face regions (eyes and mouth) and there were no group differences in pupil dilation. The children with ASD, like the TD children, dilated their pupils more to mutual compared to averted gaze. More internalizing symptoms in the children with ASD related to less emotion arousal to mutual gaze.

Conclusions: The pattern of results suggests that people with ASD are not dysregulated in their responses to mutual gaze and do not find direct gaze to be aversive or hyper-arousing.

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177   **159.177** Perceptions of Playground Engagement with Peers: How Do Child Reports Compare to Recess Observations for Children with ASD?

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Background: Given their various social impairments, children with autism often have a different experience than typically developing children in unstructured social situations at school, like recess. Children with ASD are more likely to be unengaged or in solitary play than their typically developing peers on the playground. While the majority of the measures used in playground observation studies implement the observations of a third party assessor, the child's report of engagement with peers is also a vital measure of engagement and friendships. However, child report of social networks and surveys of loneliness among children with ASD often differ from third party observations (Chamberlain, Kasari, & Rotheram-Fuller, 2007; Bauminger, Shulman, & Agam, 2003). The current study builds upon previous research by comparing recess observations of peer engagement with self-report of interactions with peers for the same time period.

Objectives: We aimed to further explore the relationship between perceived and actual peer engagement of children with ASD in public elementary schools during lunchtime and recess. Furthermore, we examined which self-reported and observed factors of play contributed to greater recess satisfaction for children with ASD.

Methods: We analyzed part of a larger dataset gathered by the Autism Intervention Research Network on Behavioral Health (AIR-B). Participants included 76 children with ASD (diagnosis verified by the ADOS) enrolled in mainstream classes from kindergarten through fifth grade (mean age = 8.61) at three different sites across the U.S. The Playground Observation of Peer Engagement (POPE; Kasari, Rotheram-Fuller, & Locke, 2005) measured the quality of children's play and peer engagement during a ten to fifteen minute period of recess as rated by a reliable blind observer. Quality of peer engagement as measured by the POPE was compared to the Child Report of Peer Engagement (CROPE, AIR-B pilot measure), a questionnaire administered after the lunch period by a blind assessor to measure child-reported quality of recess (e.g., number of peers with whom the target child played, number of games played, overall recess satisfaction).

Results: The findings suggest that playing with a greater number of peers was associated with greater child-reported satisfaction with recess ($r = .236$, $p \leq .05$). No other significant correlations were found between observations of peer engagement and questions from the child survey.

Conclusions: The lack of significant correlations between the POPE and CROPE reveals a disparity between children's perceptions of the playground events and blind observers' reports. One possible explanation for these discrepancies may be the wide variation of social awareness among our sample of children who represent a broad spectrum of autism severity despite functioning in the normal range of IQ. They may also flag a difference in perceptions (based on many experiences by a child) and the observers' limited observations, or to differences in desired or believed perceptions by children despite the reality. These findings highlight the importance of interventions for children with autism that include naturalistic support on the playground, since their difficulties with forming friendships may lead to lower recess satisfaction.

178   **159.178** Playing with Peers at Recess: Are Children with Autism Playing Their Favorite Games?

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Background: The activities children engage in during recess at school vary by school, age, and individual child preference. Research has identified preferred games for children who are typically developing, but little attention has been paid to the preferences that children with ASD have. However, this information is important since the games children play should be considered in developing targeted social skills interventions that take place at school.

Objectives: The goal of this study was to determine if children from the same schools (typical classmates and children with ASD) would report the same favorite games they liked to play at recess. Secondly, we determined the extent to which children actually played the games during recess that they had identified as favorites.

Methods: As part of a broader study through the Autism Intervention Research Network on Behavioral Health (AIRB), we surveyed 1,652 elementary school students in 4 major metropolitan areas within the U.S. 126 (23 female) of the children had ASD (determined by independent research evaluations with the ADOS) and were included in the general education population for a minimum of 50% of the school day. Children with ASD along with 1,526 (767 girls) of their classmates were given a friendship survey asking them to list their favorite games they played at school. Recess behaviors were then examined for a matched sample of typical children and children with ASD in the same schools using the Playground Observation of Peer Engagement (POPE) by blinded observers.

Results: In the larger sample, children listed as many as 29 different categories of games. However, the most popular consistent game listed by all girls and boys with and without ASD combined was Tag (13%) followed by Pretend Play (11%), Soccer (10%) and Board Games (6%). The popularity of these games changed across ages. Tag and pretend play were top games for the 6-9 year old children whereas soccer and organized games became more popular for the older children. Board games stayed fairly consistently listed across ages. Some differences were noted between boys and girls, with boys more likely to choose soccer and girls more likely to choose talk/hang out. However, the children with and without ASD generally chose similar games.

Observations of a matched sample of 104 children with ASD and 126 typical participants who were observed at recess noted that only 14% of the children with ASD were seen playing their favorite game with a peer(s) compared to 26% of typical children. These differences were significant for ASD

versus Typical, X^2 (1, N=230)=4.479, p<.04.

Conclusions: Children with and without ASD reported very similar favorite games at school. However, the majority of children were not observed playing these games at school. It may be that these games were not offered regularly enough for children, that school rules prevented some favorite games (e.g, Tag or computer games) or the observations were too infrequent. Targeting favorite games at school maybe useful for interventionists aiming to improve peer engagement for children with ASD.

179   **159.179**   Positive Bias for Eye Contact in Adolescents with Autism Spectrum Disorders during Conversation with an Android Robot

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Background: Adolescents with autistic spectrum disorders (ASD) often fail to make eye contact, which is one of the most important social communication cues. Researchers have recently considered using humanoid robots to treat ASD-associated deficits in social communication. Although small humanoid robots have been programmed to teach social cues such as head-gaze and hand-pointing, they have not been generalized for interactions with humans. An "android" is another type of humanoid robot that has the appearance of a real person. Due to their similar appearance to humans, it is expected that they could be useful partners for adolescents with ASD to learn social interaction with humans.
Objectives: It is important to determine whether it is easier for adolescents with ASD to establish eye contact or more gaze at another's eyes when they face with an android than when they do with a person. Therefore, we analyzed the eye-gaze patterns of subjects when they talk to human and android partners.
Methods: Four adolescents with ASD diagnosed based on DSM-5 and six adolescents with typical development (TD) participated in the experiment. All of them were high-school age. They were asked to alternately talk to interlocutors (a female person and a female-type android) five times totally, where the first and the last sessions were conducted with the human interlocutor. The utterances of both interlocutors were scripted in an ambiguous way so that the conversations were appropriate for the various possible replies of the subjects. When the android spoke and where it looked was controlled by tele-operation. Its voice was based on recordings from the same human interlocutor. In each booth, an eye-tracker device was set to detect the subjects' fixation points during the conversations. The areas of interests (AOIs) were identified around the faces of the interlocutors by manual registration, and the characteristics of fixation inside the AOIs were analyzed.
Results: All participants could talk with both interlocutors and totally spent about 11.5 minutes for five sessions on average. The "looking-eye bias" was calculated as the ratio of time when the subjects' eye fixations stayed on the upper region of AOI (i.e., approximately on the eyes) with respect to time when they stayed within the AOI (face). The average looking-eye bias of adolescents with ASD in the android sessions (M=.61, SD=.29) was significantly higher than that measured in the human sessions (M=.17, SD=.17) (t[3]=3.78, p<.05). There was no significant difference between the android and human sessions for TD adolescents (M=.65, SD=.26 versus M=.75, SD=.35, respectively; t[5]=.83, p>.05).
Conclusions: Unlike TD adolescents, those with ASD seemed to avoid human eyes but not android eyes. This result encourages the future application of androids for improving eye contact and social communication. Therefore, it is important to identify aspects of android behavior and subjects' symptoms that underlie this tendency. Furthermore, it will be necessary to confirm whether and how such interactions with androids can be generalized for humans.

180   **159.180**   Respiratory Sinus Arrhythmia: A Moderator of Emotion Regulation and Social Motivation Deficits in ASD

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Background: The *social motivation theory of autism* posits that the social deficits observed in autism spectrum disorder (ASD) may be attributed to dysfunctions in the social reinforcement mechanisms that are seen in typically developing individuals (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). Furthermore, individuals with ASD often have self-regulation difficulties, particularly in areas such as emotion regulation (ER; Samson, Huber, & Gross, 2012). Deficits in ER strategies are associated with social withdrawal and seem to contribute to the lack of social motivation observed in ASD (Laurent & Rubin, 2004). In typically developing populations, higher levels of respiratory sinus arrhythmia (RSA) are thought to promote flexible behavior necessary for navigating social interactions (Thayer &

Friedman, 2004). Studies have similarly shown that higher baseline RSA is related to better social functioning in children with ASD (Patriquin, Scarpa, Friedman, & Porges, 2013). For this reason, higher baseline RSA may be a protective factor that moderates the relationship between emotion regulation deficits and social motivation in ASD.

Objectives: The study aims to establish whether emotion regulation significantly predicts social motivation in children with ASD. We also assess baseline RSA as a moderator of this relationship.

Methods: Baseline RSA was collected for three minutes in 22 children (4-7 years old, 17 males, 5 females) with an ASD diagnosis. Parents completed the Social Responsiveness Scale (SRS; Constantino, 2002) and the emotion regulation (ER) subscale score from the Emotion Regulation Checklist (Shields & Cicchetti, 1997). Linear regression analysis was used to predict the influence of ER and baseline RSA on social motivation SRS subscale scores, and simple slopes were calculated to assess the moderating effect of baseline RSA.

Results: In a multiple regression equation where ER and baseline RSA were entered as predictors for social motivation, the main effect of ER approached significance, β = -1.297, $t(21)$ = -1.997, p = 0.06. There was no main effect of baseline RSA on social motivation. A significant interaction effect of baseline RSA x ER was also present, β = 1.246, $t(21)$ = 2.21, p = 0.04. Simple t-tests were performed to compare the slopes of ER onto social motivation regression lines at different levels baseline RSA. There was a negative relationship between ER and social motivation scores at lower levels of baseline RSA, $t(20)$ = -3.71, p = 0.002. At higher levels of baseline RSA, ER did not significantly predict social motivation score.

Conclusions: Baseline RSA moderates the predictive ability of ER on social motivation in children with ASD. Higher baseline RSA levels act as a protective factor for the effect of ER on social motivation, such that poor ER did not significantly predict social motivation difficulties in ASD. However, at lower baseline RSA levels, poor ER significantly predicted more severe social motivation deficits. These findings suggest that children with ASD, who also have low baseline RSA, may benefit from emotion regulation interventions.

181   **159.181** Revealing Sub-Categorization Strategies Used By Children with Autism Spectrum Disorders to Decode Facial Expressions of Emotion

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Background:
The ability of individuals with Autism Spectrum Disorder (ASD) to accurately recognize expressions of emotion from faces has attracted a large amount of research over the past 30 years (Harms, et al., 2010, Neuropsych. Rev., 20, 290-322), a large number of which propose a deficit in the perception of dynamic facial expressions in this group. However, the assertion that ASD emotion research has been "slow and confusing" because "the methodology lags woefully behind the questions we would like to ask" (Frith, 2003, Blackwell Publishing) still chimes with the current state of the research in this field.

Objectives:
We apply a novel methodology to answer fundamental questions about facial expression recognition (FER) in ASD, which have yet to be satisfactorily answered. In particular we:

1. Reveal detailed information about the facial components utilized in FER
2. Decode specific timing parameters exploited for FER
3. Determine both 1. and 2. at multi-level emotion decoding, i.e. including sub-categories of each emotion (e.g. 'subtle', 'flirtatious' or 'overjoyed' as sub-categories of 'happy')

Methods:
Sixteen children with ASD viewed a total of 19,000 dynamic facial stimuli [http://www.psy.gla.ac.uk/~kirstya/emotions/example_stim2.html]. The stimuli were produced using a Generative Face Grammar (GFG; Yu, et al., 2012, Comput. Graph., 36, 152–162) where, on each trial, the GFG randomly selects a set of action units (AUs; Ekman & Friesen, 1978, Consulting Psychologists Press) from 41 possible AUs and 6 temporal parameters. By combining these parameters, a random, but physiologically plausible, facial animation is produced. Each child categorized the 'random' stimuli as being happy or angry (yes/no). Ultimately, the children used their own subjective understanding of what 'happy' and 'angry' represent to produce subjectively driven models of these expressions.

The data were analyzed used a non-negative matrix factorization (NMF): a dimensionality reduction technique that uses the group's responses to identify a number of 'categorization strategies'. By 'strategies' we mean the sub-categories of facial expressions and we determine their number by fitting them to the presented facial animations for each emotion and group. The trials were averaged prior to the NMF analysis to give the average response across participants for each trial. We then render the NMF output back into face models to create results that are easily visualized.

Results:
The face models can be viewed here [https://db.tt/ZnioWX83], where the rows depict 'happy', 'non-happy', 'angry' and 'non-angry' respectively. These results indicate that atypical AU components and timing parameters are utilized for facial expression perception in children with ASD. Five sub-categories were revealed for the ASD group's categorization of 'happy' and 'non-happy' but only three emerged for 'angry' and 'non-angry'.

Conclusions:
Here we present a novel methodology to better understand facial expression recognition in ASD. The findings indicate that children with ASD utilize several sub-categories of happy and angry with notable atypicalities in AU use and timing in many of these. We reveal AU and timing information not only for monosyllabic emotion categories but for specific, subjectively driven sub-categories of emotions: a novel finding which is unique to this method.

182   **159.182** Social Anosimia: Altered Social Chemosignaling in Individuals with Autism Spectrum Disorder

ABSTRACT WITHDRAWN

Background: Social chemosignals are volatiles secreted by one individual to affect behavioral, physiological and hormonal state of other individuals. Growing evidence implies that social chemosignals likely play a large role in human behavior, mostly without conscious awareness.
Objectives: Because individuals with autism spectrum disorder (ASD) exhibit difficulties in social communication, we hypothesized that a portion of their inability to read social cues may reflect an inability to read social chemosignals.
Methods: We measured chemosignal modulation of the startle response in 19 typically developed (TD) and 11 high-function ASD young adults. Startle response is a particularly appealing paradigm because it is non-verbal, independent of comprehension and motivation, intact in ASD, and influenced by chemosignals in TD subjects. We measured the startle response using EMG of the orbicularis oculi muscle (eye blink) twice; once following administration of the putative chemosignal hexadecanal and once following neutral control odor.
Results: An analysis of variance uncovered a significant interaction ($F_{1,28} = 6.05$, $p < 0.05$) whereby hexadecanal reduced startle in TD ($t(18) = 2.99$, $p < 0.01$) but not in ASD ($t(10) = 0.76$, $p = 0.46$). In other words, whereas TD subjects respond to a social chemosignal, ASD subjects do not.
Conclusions: These results imply that ASD individuals are differently tuned to olfactory social signals. We propose a novel term: Social Anosmia, which may be involved in part of the symptoms of ASD.

183   **159.183** Social Attention As a Baseline Measure of Social Motivation in Toddlers with Autism Spectrum Disorder

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Background: Diminished social attention is a well-established early-emerging feature of autism spectrum disorder (ASD). Decreased eye contact is among the earliest observable behaviors in toddlers and children with ASD and eye-tracking technology has captured decreased attention to social stimuli as one of the earliest behavioral indicators of ASD in infancy (Chawarska, Macari, & Shic, 2013; Jones & Klin, 2013). It is suggested that these patterns of attenuated social attention are indicative of reduced social reward sensitivity and reduced social motivation, a core feature of ASD (Chevallier et al., 2012). A greater understanding of how social motivation is related to the behavioral manifestation of autism symptoms could elucidate developmental pathways contributing to social-communicative skills and reveal behavioral profiles that uniquely predict differential treatment outcome.
Objectives: The current study presents baseline data from an early intervention study in which eye-tracking was used as a behavioral indicator of social motivation prior to onset of treatment in a group of 24-48-month-old toddlers with ASD. Baseline levels of social motivation were measured and compared to performance of age-matched typically developing toddlers. Social attention was then compared to behavioral performance on standardized measures and parent-child interactions.
Methods: Participants were 24-48-month-old toddlers with ASD and age-matched typically developing (TD) toddlers. All participants were presented with a social preference paradigm modeled after the social preference task created by Pierce et al. (2011). Six 5 s videos depicted clips of children engaging in high-motion behaviors presented side-by-side with clips of non-social high-motion geometric patterns. Social preference ratios across the six videos were calculated for each participant and compared both between and within groups. Within-group analyses for participants with ASD included correlations between social preference ratios and standardized measures (ADOS, Mullen Scales of Early Learning, and Vineland Adaptive Behavior Scales) and social-communication during naturalistic parent-child interactions.
Results: Results were consistent with Pierce et al. (2011) demonstrating a significantly lower mean social preference ratio for the ASD group (M=.57; SD = .08) compared to the TD group (M=.70; SD=.12). Additionally, social preference ratios were negatively correlated with parent-reported socialization and positively correlated with frequency of undirected vocalizations during naturalistic parent-child interactions. Finally, total attention to any part of the screen during this task was moderately associated with nonverbal developmental quotient, expressive language, and fewer autism symptoms.
Conclusions: These results extend previous findings and suggest that toddlers with ASD have significantly lower baseline levels of social motivation than TD toddlers measured through a simple

social preference task. Additionally, it provides evidence for hypotheses that increased social motivation may serve as a protective factor associated with more advanced social-communicative skills and decreased autism symptomology that may lead to enhanced treatment effectiveness. Results also suggest that overall attention may be associated with autism severity and therefore could play a mediating role in tasks attempting to capture social motivation in this population. Additional post-intervention data will enhance these findings and reveal how social motivation may be a prognostic indicator for treatment outcome for toddlers with ASD.

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184   **159.184** Social Skills, IQ, and Depression Among Boys Aged 8-12 with ASD

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Background: Children with ASD have been consistently found to be at elevated risk for internalizing disorders, including depression and anxiety (Strang et al., 2012), with some research indicating that these symptoms may place children with ASD at higher risk for suicidality (Mayes, Gorman, Hillwig-Garcia & Syed, 2013). Findings to date as to factors that may contribute to elevated levels of internalizing symptoms in this population suggest a correlation between IQ and internalizing symptoms, with higher IQ predicting higher levels of depression and anxiety (Mazurek & Kanne, 2010). Similarly, children with ASD who have higher IQs and stronger social skills have been found to rate themselves more negatively across domains of social and athletic competence and overall self-worth than those with lower IQs and lower social skills (Capps et al., 1995), suggesting that higher social skills may actually be linked to higher levels of internalizing symptoms. Further investigation of the specific relation between IQ, social skills, and internalizing symptoms is warranted in order to develop interventions geared toward improving well-being in this population.
Objectives: We will compare the relation of IQ, social skills, and internalizing symptoms among boys aged 8-12 with and without ASD.
Methods: Measures used for the current analyses were collected for each participant during either a home or in-clinic visit as part of a larger scale study on the friendships of 8-12 year old boys with ASD. The Behavior Assessment System for Children, Second Edition (BASC-2; Kamphaus & Reynolds, 2007) was used to measure internalizing symptoms. social skills were measured using the Social Skills Rating System (SSRS; Gresham & Elliott, 1990). IQ was measured using the Kaufman Brief Intelligence Test (KBIT; Kaufman & Kaufman, 2004). 19 boys with ASD and 12 neurotypical controls participated, with 20 in each group anticipated by the time of presentation.
Results: A unique relation between social skills, IQ, depression, and anxiety was evident in the ASD sample, but not in the neurotypical sample. Among the 19 boys with ASD, IQ was significantly and positively related with depression ($r(18)=.477$, $p=.039$). Additionally, overall social skills as rated on the SSRS were positively associated with depression ($r(18)= .525$, $p=.021$) and anxiety ($r=(18)$. .518; $p=.023$). Lastly, verbal IQ was significantly and positively associated with social skills only in the ASD sample ($r(18)=.539$, $p=.017$). A Sobel test of mediation among the ASD sample indicated that social skills mediated the relation between IQ and depression.
Conclusions: Findings from this investigation replicate findings from previous studies indicating a significant relation between IQ, social skills, and internalizing symptoms among children with ASD, with verbal IQ playing an especially important role. Children with ASD and high verbal IQs may be more aware of their own social shortcomings and demonstrate stronger social skills. This awareness, however, may be a double-edged sword that leaves them more aware of social rejection than their peers and at elevated risk for depression and anxiety as a result.

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185   **159.185** Spontaneous Goal Attribution in Children with ASD: A Comparative Eye-Tracking Study

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Background: Typically developing infants are able to spontaneously encode the actions of human agents as goal-driven (Canon & Woodward, 2011). In contrast, individuals diagnosed with Autism Spectrum Disorder (ASD) have demonstrated limited ability to interpret the actions of human agents in terms of goals and intentions (Senju et al., 2009), which may be tied to a well-documented decrease in attention to social stimuli. Early interventions seek to develop these abilities in children with ASD, but to date the majority of outcome studies have used performance-based measures to assess, leaving open the possibility of examining less directly observable mechanisms underlying the disorder.
Objectives: The present study examines the degree to which toddlers with ASD encode the motion of a human hand as goal-directed prior to the onset of an early intervention program. Performance on an established eye-tracking paradigm is compared to that of an age-matched group of typically developing toddlers, with the aim of demonstrating a significant deficit in goal attribution.
Methods: An eye-tracking video paradigm modeled after Woodward (1998) was used to measure goal encoding. Participants were 24-48 month-old toddlers who had previously received a diagnosis of ASD and age-matched typically developing (TD) toddlers. Each participant first watched six

familiarization videos in which a hand repeatedly reached for one of two toys (a penguin and a ball). A single test trial followed in which the location of the two toys was reversed and the hand was shown resting in between as if just about to reach for one or the other. Anticipatory looks and total looking time toward each of the two toys were recorded using an SMI infrared eye tracker.

Results: A differential looking score (DLS) was calculated to provide a comparative measure of looking times across the two toys (possible scores ranged from -1 to 1, with a score closer to zero indicating lower preference for either toy). Analysis revealed that while the typically developing group showed a strong preference for the goal-directed toy (M=0.60, SD=0.68), looking times for the children with ASD were distributed roughly equally across the two (M=-0.16, SD=0.62). This same pattern followed for anticipatory (first) looks towards either toy; on average the ASD group had fewer first fixations to the goal-directed toy (M=0.56, SD=0.53), compared to the TD group (M=1.00, SD=0.00).

Conclusions: Taken together, these results suggest that prior to intervention children with ASD have difficulty interpreting the reaching and grasping motion of a human hand as goal-directed, compared to typically developing counterparts. Moreover, our finding that the ASD group appeared to show no preference for either toy may be driven by a more general reduction in social motivation, which is believed to be one of the core deficits of the disorder. In examining the underlying mechanisms of such social abilities, both in the present study and with the collection of post-intervention data, we ultimately hope to contribute to the existing characterization of ASD and provide direction for the further development of treatment programs.

186   **159.186** Strong Emotions Cause Social Problems; Or Is This the Other Way Around in Children and Adolescents with ASD?

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Background: Many children with ASD report being bullied, but also increasing evidence suggest they participate in bullying themselves. Bullying and victimization in normal development are related to emotion dysregulation, but the causality of this relationship is yet unclear. Although social impairments are part of the diagnosis ASD, it would be important to examine the extent to which bullying and/or victimization are also related to emotion dysregulation in children and adolescents with ASD, and what the causal direction of this relationship is.

Objectives: In a short-term longitudinal study, we examined the contribution of emotion dysregulation to the prediction of bullying and victimization problems in boys with ASD and an age matched control group.

Methods: Eighty-nine boys (ASD: n=50; TD: n=39) and their parents were asked to fill out questionnaires regarding emotion dysregulation on baseline and self-reported frequencies of bullying behaviors and victimization problems at an 18 months follow-up. The mean age of the boys was 12 years old during the first data collection (age range: 9 – 15 years). Correlation and hierarchical regression analyses were performed to examine the predictive relation between emotion dysfunction at baseline and bullying problems at follow-up; and vice versa.

Results: To date only the cross-sectional data has been analysed. These outcomes showed that more anger is related to more bullying behaviors in both groups, children with ASD and controls; but whereas victimization is related to more feelings of fear in the control group, the dominant emotion related to victimization for the ASD group is anger.

Conclusions: The longitudinal outcomes will shed light on different hypotheses that can be formulated based on these cross-sectional outcomes. The main cross-sectional finding that needs explanation is the strong relationship between anger and victimization in children with ASD. Possibly, children with ASD are more easily angered and make a good victim for bullies; alternatively, children with ASD might use anger as a defence strategy for anticipated bullying.

187   **159.187** Taking a Dimensional Measurement Approach to Test the Imitation Impairment Hypothesis in Autism

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Background:
Despite more than 60 years of research which has consistently demonstrated an imitation impairment in autism spectrum disorders in many studies, the significance of imitation in social cognitive development remains poorly understood. It remains debated as to whether impairment in autism stems from an imitation-specific mechanism or is just an epiphenomenon of impaired social motivation, memory, attention or motor skills. Furthermore, studies of the imitation impairment have focussed on non-social or symbolic actions rather than social communication behaviours.
Objectives:

- To develop a robust experimental design for the measurement of imitation ability, that can control for other non-specific factors.
- To develop a method for measuring facial imitation ability in autism.
- To use these methods to examine imitation ability in autism.

Methods:

We recorded the movement of a pen on a computer tablet screen to provide accurate measures of movement parameters involved in drawing regular geometric shapes drawn at different sizes and speeds. By comparing the movement parameters of a model with those drawn by participants attempting to imitate these actions, measures of imitation fidelity could be provided. In a "ghost" control condition, relying on end-point re-enactment rather than imitation, the models actions were used to generate a dot which moved on the screen. Therefore, the 2 conditions were closely matched for demands placed on memory, attention and motor skills but one involved imitating an action, whilst the other required reproducing the movement of a dot. The experiment was conducted with 2 successive groups of young people, mainly adolescents with autism spectrum disorder, and age, sex and IQ matched controls.

In a second experimental design, designed to measure facial imitation ability, 2 sets of morphed facial expressions were generated. In each, 3 archetypal emotional expressions were blended in systematically varied amounts, such that each facial stimulus differed from the others to variable degrees, from being closely similar to markedly different. Imitation ability was measured by the accuracy with which blind raters could match an attempt at imitation to the correct model.

Results:

In the first experiment, error measures were generated for path-length (shape size) and movement speed (how fast the shape was drawn). For shape-size (but not speed), the error was significantly greater for both imitation and control conditions, but a significant interaction demonstrated a greater impairment specific to imitation ($F(2, 70) = 8.36$, $p = .001$, $\eta p2 = .19$). In a second study with a different group of adolescents, principal component s analysis was used to extract an overall index of imitation ability which showed greater error in the ASD group compared to controls showed a group difference ($t(36) = 2.42$, $p = .021$). The ASD group also scored significantly higher on Facial Imitation Error ($t(41) = 3.55$, $p = .001$).

Conclusions:

There are deficits of imitation in autism above and beyond those associated with more general impairments that are evident in control conditions. Hence, hypotheses that problems with imitation might be explained through inadequate attention or motivation, or impairments of motor control are not supported by these studies.

188   **159.188** Temperament Similarities and Differences: A Comparison of Factor Structures from the Behavioral Style Questionnaire in Children with ASD, DD and Typical Development

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Background:

Despite growing interest in the relationship between temperament and autism spectrum disorders (ASD), no studies have investigated the factor structure of temperament in ASD. Lower internal reliability for temperament scales in children with ASD compared to typical children in some studies indicates that differential covariance patterns may exist across groups.

Objectives:

Data from the Study to Explore Early Development (SEED), the largest case-control study to date of the etiologic factors contributing to the development of ASD, to examine the factor structure of temperament (Behavioral Style Questionnaire; BSQ) in children with ASD relative to Typically Developing children (TYP) and children with other Developmental Disabilities (DD).

Methods:

Authors conducted three Ordinary Least Squares Exploratory Factor Analyses (EFA) with oblique rotation on polychoric correlation matrices of the 100 item BSQ for TYP (N = 826), ASD (N = 652), and DD groups (N = 657). To determine the number of factors, authors considered scree breaks, Kaiser's criterion, and parallel analysis. Lower item communality threshold for factor inclusion was .40 and items were allowed to cross-load (communalities >= .32).

Results:

For TYP and ASD, authors chose an 8 factor solution (34% of variance in the TYP group, 34% for ASD); for DD, authors chose a 7 factor solution (33% of variance). For TYP, the first factor (6% of variance) was labeled Inattention/Activity, the second (5% variance) was Adaptability, the third was Neuroticism (5% of variance), the fourth was Distractibility (4% variance), the fifth was Shyness (4% variance), the sixth was Persistence (4% variance), the seventh was Positive Affect/Activity (4% variance), and the eighth was Rhythmicity (3% variance). For ASD, the first factor (5% of variance) was Persistence, the second (5% variance) was Neuroticism, the third (5% of variance) was Activity (5% variance), the fourth was Adaptability (5% variance), the fifth was Distractibility (5% variance), the sixth was Shyness (3% variance), the seventh was Rhythmicity (3% variance), and the eighth was Sensory Sensitivity. For DD, the first factor (6% of variance) was Inattention/Activity, the second (5% variance) was Adaptability, the third was Distractibility (5% of variance), the fourth was Neuroticism (4% variance), the fifth was Rhythmicity (4% variance), the sixth was Shyness (4% variance), the seventh was Learning/Attention (4% variance).

Conclusions:

No group's factor structure replicated the BSQ's purported 9 factors and many BSQ items did not

load strongly on any factor. All groups had Adaptability, Neuroticism, Distractibility, Shyness, and Rhythmicity factors; both TYP and ASD had a Persistence factor; both TYP and DD had an Inattention/Activity factor. TYP had a unique Positive Affect/Activity factor, ASD had a unique Activity and a Sensory Sensitivity factor, and DD had a unique Learning/Attention factor. Results indicate that children with ASD and DD display unique temperament factors relevant to features associated with their conditions (respectively, Sensory Sensitivity and Learning/Attention). Future research should determine whether the common temperament factors identified here display measurement invariance across TYP, ASD, and DD groups so that researchers can make accurate inferences when comparing temperament factors between TYP, ASD and DD populations.

189 **159.189** The Broad Autism Phenotype Predicts Relationship Outcomes in Previously Unfamiliar College Roommates

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Background: Milder but qualitatively similar subclinical traits of autism known as the "broad autism phenotype" (BAP) have been associated with difficulties forming and maintaining quality relationships (Wainer et al., 2013). However, the process by which the BAP influences relationship outcomes remains unclear.
Objectives: The current study examined how BAP traits in previously unfamiliar college roommates were associated with their interpersonal behaviors during relationship development and their relationship quality after several months of cohabitation. Social BAP traits (i.e., aloofness and pragmatic language abnormalities), but not nonsocial BAP traits (i.e., rigidity), were hypothesized to be associated with decreased relationship satisfaction and commitment to the relationship by the end of the study. Drawing upon Interpersonal Theory (Horowitz et al., 2006), the behaviors of warmth and dominance were hypothesized to mediate the effects of social BAP traits on relationship outcomes.
Methods: Newly formed same-sex roommate dyads with limited to no previous familiarity *(N* = 160 individuals) were assessed every two weeks for 10 weeks. Participants initially completed the Broad Autism Phenotype Questionnaire (BAPQ), and subsequently reported on the warm and dominant behaviors exchanged within the dyad, as well as their overall relationship satisfaction and commitment at the end of the study.
Results: We used Actor-Partner Interdependence Models (APIMs) to evaluate our hypotheses. An interaction of roommates' aloof traits predicted relationship satisfaction, and simple slopes analyses revealed that low aloof participants were less satisfied with high aloof roommates (b = -.34 [95% CI: -.62, -.07], SE = .14, p = .016). Aloof traits were associated with both warmth (b = -.32, 95% CI [-.53, -.15], SE = .09, $p < .001$) and dominance (b = -.35, 95% CI [-.53, -.18] SE = .09, $p < .001$), with warmth mediating the effects of aloofness on relationship outcomes measured through indirect effects (i.e, ab). Participants' aloofness predicted their own expressions of warmth, which subsequently predicted relationship satisfaction (ab = -.08, 95% CI [-.15, -.02], κ^2 = .17). Also, high aloof participants evoked less warm behaviors from roommates, which led participants to feel less satisfied (ab = -.16, 95% CI [-.26, -.07], κ^2 = .10) and less committed (ab = -.29, 95% CI [-.51, -.11], κ^2 = .07). Neither pragmatic language abnormalities nor rigidity were associated with mediators or outcomes.
Conclusions: Aloof traits in unfamiliar roommates were associated with relationship quality after 10 weeks of cohabitation, with behaviors of warmth mediating some of these effects. Roommates more similar on aloof traits, including those both high on aloofness, were more satisfied, suggesting that compatibility on this BAP feature may be particularly relevant to relationship satisfaction. Despite constituting an additional social BAP trait, pragmatic language abnormalities were not associated with relationship satisfaction. This suggests that not all social BAP traits are equally predictive of relationship outcomes, with social motivation (aloofness) more predictive than social competence (pragmatic language abnormalities).

190 **159.190** The Effects of Violent Video Games on Adults with and without Autism Spectrum Disorder

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Background: A number of concerns have been raised by the lay public regarding the potential negative effects of violent video game exposure among adults with ASD. These concerns have been heightened by research indicating that youth with ASD spend more time playing video games per day than typically developing (TD) youth, are more likely to be at high risk for video game pathology than TD youth, and often report playing games with violent content. However, no study to date has examined whether acute exposure to violent video games increases aggression (a laboratory analogue of violent behavior) among adults with ASD or whether such games elicit more aggression among adults with ASD compared to TD adults. This is the first study to provide evidence bearing on these issues.
Objectives: 1) To test whether there is an effect of violent game content on aggressive behavior and on two proposed mechanisms of this behavior – aggressive cognition and aggressive affect – and 2) to test whether these effects are more pronounced for adults with ASD compared to TD adults.

Methods: Participants included 120 adults (60 with ASD, 60 with TD; 9 women in each group) ranging in age from 17 to 25 years (M = 20.48; SD = 1.71). All participants received $20 in exchange for their participation. Adults with ASD were recruited from an interdisciplinary academic medical center specializing in the treatment and diagnosis of ASD; TD adults were recruited primarily through email advertisements and flyers distributed on a university campus. Participants were assigned to play a violent video game or a nonviolent video game prior to completing three aggression-related outcome variables (aggressive behavior, aggressive cognition, and aggressive affect). Additional measures included the Stanford-Binet Intelligence Scales (5[th]Edition) Abbreviated Battery and the Autism Spectrum Quotient – Short Form.

Results: Bayes factor model comparisons including aggressive behavior (unprovoked, reactive, and average aggressiveness) as the outcome variable showed modest evidence against any effect of violent content. Model comparisons examining unprovoked aggression indicated that the best-fitting model included group diagnosis only, such that adults with ASD behaved more aggressively than TD adults on this measure, but that the group diagnosis model was only slightly preferred to the null model. Model comparisons examining reactive aggression, average aggressiveness, aggressive cognition, and aggressive affect indicated that the null effects model was preferred to a model with violent content only and, importantly, preferred to the model with the interaction term. Follow-up contrasts within each diagnostic group also indicated that the null effects model was slightly preferred to the model with violent content.

Conclusions: We found modest evidence against the hypothesis that violent video games affect adults with ASD differently than nonviolent video games. Moreover, we found strong evidence against the hypothesis that violent video games affect adults with ASD differently than TD adults. Findings from the current study do not support societal concerns that violent games differentially affect adults with ASD compared to TD adults.

191   **159.191** The Mediating Role of Empathy on Broader Autism Traits and Prosocial Behavior

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Background: The Broader Autism Phenotype (BAP), characterized as subclinical symptoms and personality traits associated with Autism Spectrum Disorder (ASD), includes aloofness, rigidity, and pragmatic language difficulties (Piven et al., 1997; Landa et al., 1992). Studies have shown that BAP characteristics are present to varying degrees in non-clinical samples (Baron-Cohen et al., 2001; Jobe & Williams-White, 2007; Wainer, Ingersoll, & Hopwood, 2011). While research has shown that college students who exhibit BAP traits experience difficulties in social skills and social cognition (Sasson, Nowlin, & Pinkham, 2013), very few studies have examined the relationship between BAP traits and pro-social behavior while accounting for related characteristics. One study, however, showed that individuals with high levels of autistic traits engaged in fewer pro-social behaviors during open-ended responses to hypothetical situations (Jameel et al., 2014).

Empathy, as a whole, has been conceptualized as a motivating source that predicts pro-social behavior (Eisenberg and Miller, 1987). That is, when you understand another person's emotional state and can predict their response, you may engage in helping behavior. Individuals with ASD have been shown to demonstrate impairments in cognitive empathy while emotional empathy remains intact (Blair, 2008). As such, determining the influence of both empathy subtypes may elucidate the relationship between decreased pro-social responses by individuals with increased levels of ASD traits.

Objectives: The purpose of the investigation was to determine whether cognitive and/or affective empathy mediated the relation between BAP traits and pro-social behavior.

Methods: A predominantly female sample (N = 505, 75.8% female), ages 18-60 (M = 20.9, SD= 4.28) was recruited from an undergraduate student population at a public mid-Atlantic university. Participants completed self-report measures on BAP traits (Broader Autism Phenotype Questionnaire; Hurley et al., 2007), cognitive and affective empathy levels (Questionnaire of Cognitive and Affective Empathy; Reniers et al., 2011), and pro-social behaviors (Prosocial Tendencies Measure; Carlo & Randall, 2002). Mediation was tested using hierarchical regression analysis and bootstrapped estimation of confidence intervals around the indirect effect (PROCESS; Hayes, 2013).

Results: Mediational analyses were run for both components of empathy as mediators between BAP traits and pro-social behavior. As hypothesized, BAP traits predicted decreased pro-social behavior (total effect = B = -.122, SE = .018, p<.001, 95% CI = -.148 to -.076). However, only cognitive empathy significantly and uniquely mediated the effect of BAP traits on pro-social behavior (indirect effect B = -.068, Boot SE = .011, 95% CI=-.091 to -.048). Furthermore, even when controlling for affective empathy, cognitive empathy still mediated the relationship between BAP and pro-social behavior (indirect effect B= -.054, Boot SE = .010 95% CI=-074 to -.036).

Conclusions: Cognitive empathy appears to play a unique role in mediating the relation between BAP traits and pro-social behavior whereas affective empathy does not demonstrate the same effect. Limitations, and clinical implications are explored

192   **159.192** The Relation Between Theory of Mind and Self-Perceptions in Adolescents with Autism Spectrum Disorders

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Background:
Research has demonstrated that, despite problems in multiple domains, children with Autism Spectrum Disorders (ASD) show a lack of awareness of their difficulties (e.g., Johnson & Filliter, & Murphy, 2009). This lack of awareness may make it difficult for individuals to adjust their behaviour in accordance with feedback, leading to greater impairments over time. Much of this research on individuals with ASD has utilized discrepancy analyses from parental reports on abstract measures. However, it is possible that these overly-inflated self-perceptions may be a result of rater bias on part of the parent or due to the participants' inability to understand abstract criteria.
While there is a growing body of literature examining positively-biased self-perceptions in individuals with ASD, little research has focused on examining mechanisms underlying this phenomenon. Theorists suggest that the same cognitive mechanisms required for attributing thoughts and feelings to others are the same as those required for attributing and reflecting one's own mental states (Frith & Happé, 1999). Therefore it is possible that deficits in theory-of-mind (ToM) abilities may be related to positively-biased self-perceptions in ASD.

Objectives:

1. To extend research on self-perceptions held by adolescents with ASD using a novel methodology, which aims to eliminate potential biases.
2. To investigate ToM as a possible underlying causal mechanism related to positively-biased self-perceptions.

Methods:
Forty-one participants, 19 with ASD and 22 typically-developing control (TD) adolescents (age range =12-18 years), participated. Self-report questions were utilized after participants completed two academic-type tasks. Participants were asked how well they thought they did prior to completing the tasks (pre-task prediction). After they completed each task they were asked how well they thought they did (immediate post-performance) and how well they thought they would do in the future (hypothetical future post-performance). Difference scores between actual performance and predicted performance were used to assess self-perceptions. The Reading the Mind in the Eyes task (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) was used to assesse ToM abilities.

Results:
Results indicated that the ASD group had more positively-biased self-perceptions on all three measures (pre-task prediction, immediate and hypothetical future post-performance), compared to TD controls. In the ASD group, ToM abilities were significantly correlated to the pre-task prediction question.

Conclusions:
Examining self-perceptions in ASD, using a concrete and objective measure, furthers our understanding of the causal mechanisms underlying this phenomenon. Results suggest that individuals with ASD who have greater ToM abilities have more accurate pre-task predictions. Pre-task predictions tend to be global in nature, as participants must recall similar past experiences and create a concept based on these experiences. Post-performance ratings are based on more concrete experiences, as participants' have already completed the task. It is possible that ToM abilities are more directly related to these global types of questions. Deeper understanding of the mechanisms that underlie this phenomenon will not only help us understand more about these positively-biased self-perceptions and why they exist, but may also inform the development of intervention strategies.

193 **159.193** The Relationship Between Adaptive Functioning and Social Responsiveness in Children with Autism Spectrum Disorder (ASD) and Caregiver Quality of Life (QoL)

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Background: The difficulties individuals with Autism Spectrum Disorder (ASD) experience generally present across multiple contexts and may have an impact on their quality of life (QoL). QoL is a complex, multidimensional concept that has a variety of definitions, one of which is a comprehensive approach to measuring outcomes that evaluates an individual's psychosocial, emotional, and physical well-being (Fayers & Machin, 2007). It is important to understand the impact of ASD diagnosis on QoL in both individuals diagnosed with ASD and their caregivers (Humphrey & Lewis, 2008). Research indicates that many factors are expected to influence an individual's QoL and has indicated that individuals with ASD are expected to have lower QoL due to functional difficulties associated with the diagnosis (Clark, Magill-Evans, & Koning, 2014). However, minimal research has been completed on additional factors that may impact QoL in both children diagnsoed with ASD and their caregivers.
Objectives: This study explored how caregivers' report of child adaptive functioning and social responsiveness is related to caregiver QoL.
Methods: Children with previous diagnosis of ASD (aged 8-11 with caregiver-reported functional verbal and cognitive skills) and their caregivers completed questionnaires prior to participation in a social skills group. Caregivers (n=25) completed questionnaires that assessed child adaptive functioning (BASC-2) and social responsiveness (SRS-2) and caregiver QoL (Health Related Quality of Life and Generic Core Parent Report on the PedsQL). Children (n=25) completed a self-report questionnaire of their QoL (Generic Core Child Report on the PedsQL).

Results: Caregivers' and children's self-report of QoL was similarly high (caregiver: M =56.39 out of 81.52, SD =13.64; child: M =73.90 out of 96.73, SD =15.58). Children's adaptive functioning (BASC-2) was positively correlated with caregivers' QoL (Health Related Quality of Life: [$r(24) = .56, p = .020$]; Generic Core Parent Report: [$r(14) = .69, p = .003$]). Children's social responsiveness (SRS-2) was negatively correlated with caregivers' Health Related Quality of Life [$r(14) = -.53, p = .034$]. Conclusions: Preliminary data indicate that stronger child social skills are correlated with lower health-related QoL in caregivers, suggesting that increased social insight may be related to increased caregiver awareness of health-related concerns. Additionally, stronger child adaptive functioning was correlated with higher caregiver QoL, which implies that child adaptive functioning and quality QoL in caregivers may be related.

194 **159.194** The Relationship Between Discourse Processing and Autistic Symptomatology in Adolescents with ASD

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Background: Discourse processing is integral to appropriate communication and social interactions, which are known to be impaired in individuals with an autism spectrum disorder (ASD) (APA, 2000). A recent study using the Pittsburgh Inference Test (PIT), a measure of discourse processing, reported impaired physical- and emotion-related inference making abilities in adolescents and adults with ASD (Bodner, Engelhardt, Minshew, & Williams, under review). The relationship between discourse processing and more general ASD symptomatology and temperament, however, remains unclear.
Objectives: The objective of the current study was to replicate and extend previously reported findings of impaired functioning on the PIT in adolescents with ASD. The current study investigated the relationship between inference making abilities (as assessed by the PIT) and ASD symptomatology and temperament.
Methods: A sample of 33 adolescents with ASD and 16 typically developing (TD) adolescents between the ages of 11 and 15 years (mean = 13.2 years), group-matched for age [$t(47)=.158, p=.88$] and IQ [FSIQ, VIQ, & PIQ, $ts(47)<.956, ps>.34$] participated. Autism diagnosis was determined with the ADOS and/or ADI, and clinical impression. All participants attained Full Scale IQ's > 70. The PIT and parent questionnaires were administered, including the Social Responsiveness Scale (SRS), Social Communication Questionnaire Lifetime (SCQ-L), and Early Adolescent Temperament Questionnaire (EAT-Q). The PIT consists of short stories and questions about typical life situations to which the participant is expected to give a verbal response. The PIT is comprised of questions designed to elicit responses that described physical relationships only or responses that describe physical, mental or emotional inferences (ToM). The responses for each story categorized as a physical or ToM response, and further categorized by type: emotion-ToM or other-ToM response.
Results: Hierarchical regressions confirmed previously reported findings that individuals with ASD performed worse on the PIT in comparison to TD participants, particularly in ascertaining physical and emotional states ($pr^2>.10$, $ts(45)>2.20$, $ps<.03$), while other types of inference making abilities remained intact ($pr^2=.002$, $t(45)=.283$, $p=.78$). Furthermore, adolescents with ASD displayed improvements in performance with age for other-ToM responses ($pr^2=.13$, $t(42)=2.55$, $p=.02$), but no improvement with age in physical or emotion-ToM responses ($pr^2<.02$, $ts(42)<.805$, $ps>.45$). Significant negative correlations were evident between all PIT variables (except physical responses) and SCQ-L (r range = -.683 to -.445, $ps < .02$). In addition, significant negative correlations were evident between PIT variables (except physical and emotion totals) and SRS Social Cognition subdomain (r range = -.565 to -.400, $ps < .03$). Finally, PIT variables (except physical and emotion totals) were positively correlated with EAT-Q Shyness subdomain (r range = .498 to .589, $ps< .02$).
Conclusions: The current study replicated and extended previous findings that verbally able individuals with ASD display impairments in physical and emotion related inference making abilities. These findings further highlight the utility of the PIT in teasing apart underlying difficulties in discourse processing. In addition, poorer performance on the PIT appears to be related to more significant impairments in Social Cognition and ASD lifetime symptoms. Furthermore, higher levels of shyness are related to better performance on the PIT.

195 **159.195** The Role of Language in Second-Order Theory of Mind Reasoning in Children with Autism Spectrum Disorder and Children with Optimal Outcomes

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Background:
Theory of mind (TOM) refers to the ability to attribute different mental states to oneself and others. While difficulties with TOM reasoning have been found in children with autism spectrum disorder (ASD), studies have also found a subgroup that can pass TOM tasks (Happé, 1995). Language has been proposed as a potential factor in explaining this variability. However, some studies have found a relationship between lexical knowledge and children with ASD's TOM reasoning (Happé, 1995), while others have found syntactic knowledge to be important (Paynter & Peterson, 2010). Many of these studies have focused on first-order TOM reasoning; the relative importance of lexical and syntactic

knowledge on second-order TOM in children with ASD is unclear.
Objectives:
The study investigates the role of language (lexical and syntactic knowledge) on second-order TOM reasoning in children with ASD. Additionally, we compare high-functioning children with ASD (HFA) and those children with a previous history of autism, but who no longer exhibit any symptoms of ASD (i.e., optimal outcome children, OO, Fein et al., 2013).
Methods:
Twenty-three typically developing (TD) children, 27 children with HFA, and 26 children with OO, matched on age (M=13.24, $S.D.$=2.90 years) and non-verbal IQ (Table 1) participated. Two second-order TOM tasks involving short stories similar to those in Perner and Wimmer (1985) were administered. Each included nonlinguistic and/or linguistic control questions, followed by an ignorance question (IG), false belief question (FB), and a justification question. The CELF-4 and PPVT were also administered to gather standardized language measures.
Results:
Groups did not differ on control items (p=.11) but differed on their performance of IG, FB, and justification questions (ps<.05; Figure 1). Post-hoc comparisons revealed that the HFA group performed significantly more poorly than the TD group on all three TOM questions (ps<01). Performance by the HFA group did not differ from that of OO group on any TOM questions (ps>.05). OO group differed from the TD group only in performing more poorly on justification questions (p<.001).
No significant correlations were found between performances on any TOM questions and scores on CELF-4 subtests examining syntax (ps>.05) for any groups. For the TD and HFA groups, PPVT scores did not correlate with TOM performance (ps>.05). For the OO group, performances on the three TOM questions were significantly positively correlated with PPVT scores (ps<.01, r's>.40). Additionally, performance on IG questions was positively correlated with CELF-4 receptive word class subtest scores (p<.05, r=.49).
Conclusions:
Consistent with previous literature, some children with HFA continued to have difficulties with TOM reasoning. While children with OO could engage in second-order false belief and ignorance reasoning, difficulties with providing correct justifications for false beliefs remain. Thus, despite no longer exhibiting ASD symptomology, residual difficulties from their previous ASD diagnosis may remain. Lastly, correlational analyses between the OO group's TOM and language measures suggest that at least for a subgroup of children, lexical but not syntactic knowledge is related to their second-order TOM reasoning. This may reflect the use of a unique compensatory verbal strategy to solve TOM tasks.

196 **159.196** The Strange Stories Film Task: A New Measure of Social Cognition

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Background: Autism Spectrum Disorders (ASD) are characterised by difficulties in social interaction. High functioning (HF) adults with an ASD diagnosis often report subtle social cognitive difficulties.
Objectives: The main aim of the study was to develop and validate a novel measure of social cognition (The Strange Stories Film Task (SSFt) and in doing so overcome a number of limitations to available measures in the field.
Methods: The measure consisted of acted scenarios designed to capture the subtle mentalizing difficulties observed in adults with high functioning ASD. 20 participants were recruited to pilot the new measure. A final test set was produced and shown to a group of 20 well diagnosed HFASD adults and matched controls. Participants also completed well established measures of social cognition and questionnaire measures of empathy, alexithymia and ASD traits.
Results: The SSFt was more effective at differentiating the HFASD group from the control group showing greater levels of sensitivity. Group differences could not be attributed to general cognitive factors. The SSFt was associated with the traditional measures of social cognition. Performance on the SSFt was associated with measures of empathy and ASD symptomatology. No associations with alexithymia were observed
Conclusions: The SSFt is a potentially useful tool to identify mentalizing difficulties in HFASD samples. In addition, the measure was sensitive to individual differences in mentalizing abilities in non-autistic adults. The SSFt showed adequate convergent validity. The elements of the measure targeting social interaction abilities rather than understanding proved the most sensitive. These findings are discussed with regard to clinical implications and future research.

197 **159.197** An intense world? Heightened affective empathy for pain in ASD

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Background: Empathy shapes our social behaviour, and is often thought to be reduced in autism spectrum disorder (ASD). However, reports of reduced empathy in ASD usually centre on cognitive empathy (i.e., thinking about others' emotions) and largely neglect affective empathy (i.e., sharing or mimicking others' emotions). Anecdotally, many adults with ASD report strongly experiencing emotion

when viewing others' emotions or being overwhelmed by feelings when seeing someone in pain. However, previous empirical research on affective empathy has yielded conflicting results; with some evidence for heightened, intact and reduced affective empathy. Evidence from multiple convergent methods is necessary to better describe the affective empathy profile in ASD.

Objectives: We investigated affective empathy in individuals with varying levels of autism traits using three different paradigms: muscle mimicry, sympathetic nervous system response, and self-report.

Methods: We assessed 52 participants (ages 14 - 45) on the Autism Diagnostic Observation Schedule 2 (ADOS-2) and Autism Spectrum Quotient (AQ). Participants were classified, according to these measures, as having ASD (n = 15), having high ASD traits but no ASD diagnosis (n = 17), or having low ASD traits (n = 20). Participants were shown videos of painful stimuli (a needle stabbing a hand) and neutral stimuli (a static hand, a cotton bud touching a hand, or a needle stabbing a tomato). Muscle activity over the first dorsal interosseous (FDI; the muscle stabbed in the videos) and abductor digiti minimi (ADM; control muscle) was measured at 100ms intervals during the stimuli. Skin conductance was measured during the videos as an indicator of sympathetic arousal. Afterwards, participants rated the intensity of pain that they felt actors experienced.

Results: Regression analysis of the EMG activity showed significantly higher FDI activation while viewing painful stimuli in the ASD group than in the low-ASD-traits group; $F(2, 1807)$ = 5.65, p = .004. A mixed factorial ANOVA (condition x group) indicated that skin conductance was, on average, higher in the ASD and high-ASD-traits groups than in the low-ASD traits group, $F(2,111)$ = 6.04, p = .005. The ASD and high-ASD-traits groups reported significantly higher perceived pain than the low-ASD-traits group; $F(2,184)$ = 4.07, p = 0.019.

Conclusions: Affective empathy for pain, as measured by muscle mimicry, skin conductance levels and self-report, is intact in ASD. Contrary to statements that individuals with ASD have reduced empathy, we found heightened reporting of others' pain and heightened sympathetic arousal and mimicry in individuals with ASD and those with high ASD traits. Current evidence suggests that, rather than being insensible to others' pain, individuals with ASD experience it more intensely.

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198 **159.198** Trait Anxiety in ASD: Implications for Empathic Understanding

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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, specifically perspective taking. These individuals also often feel significant anxiety which may interfere with their ability to empathise.

Objectives: This study aimed to examine the relationship between trait anxiety and different components of empathy, and whether this differs in individuals with ASD compared to controls.

Methods: Twenty-four individuals aged 16 or older (22 males; mean age 28 years) with a diagnosis of ASD and 24 matched controls (21 males, mean age 27) completed two self-report questionnaires the Interpersonal Reactivity Index (IRI; Davis, 1980) and the State Trait Anxiety Index (STAI; Spielberger, 1983) as part of a larger project examining empathy and social motivation in ASD.

Results: The ASD group scored lower on all subscales of the IRI, with the exception of the Personal Distress subscale, on which they scored significantly higher (p < .05 for all). The ASD group also scored significantly higher on the STAI (p < .001). The STAI was positively correlated with the Personal Distress subscale in the ASD group only (r = .55, p = .002) and negatively correlated with the Perspective Taking subscale in both groups, though more strongly in ASD (ASD: r = -.53, p = .003; Control: r = -.38, p = .03).

Conclusions: Trait anxiety is strongly associated with one's ability to empathise with another, on both a cognitive and emotional level. Specifically, those with higher anxiety appear to have greater difficulties adopting another person's perspective. Individuals with ASD experience greater trait anxiety and higher personal distress, which together may be barriers in taking on board another person's thoughts or feelings.

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199 **159.199** Understanding the Relationship Between Social Anxiety and Bullying Against Others in Adolescents with Autism Spectrum Disorder

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Background:
Bullying is an epidemic that affects over five million adolescents in the U.S., often resulting in negative outcomes for perpetrators and victims (Fried & Sosland, 2009). Bullying includes negative behaviors toward others, which can include physical, verbal, or social aggression (Fried & Sosland, 2009). Research suggests that social anxiety may be related to bullying behaviors. Fear of negative evaluation, a subcategory of social anxiety, focuses on concerns that adolescents will not be accepted, that their peers will mock them, or that they will embarrass themselves (La Greca, 1998). Adolescents with autism spectrum disorder (ASD) are known to frequently experience social anxiety (Wood et al., 2014) and are often involved in the bullying dynamic (Sterzing et al., 2012), yet the degree to which social anxiety and fear of negative evaluation influence bullying toward others has yet to be explored.

Objectives:
This study examined the relationship between social anxiety and bullying behaviors in adolescents with ASD. Understanding the relationship between social anxiety and bullying behaviors in adolescents with ASD is expected to provide useful clinical information, possibly leading to more targeted treatments.
Methods:
Participants included 175 adolescents (131 males; 44 females) from 11-18 years of age (M=13.9, SD=1.9) and their parents who presented for treatment through the UCLA PEERS Clinic, which is an evidence-based social skills intervention for adolescents with ASD without intellectual disabilities. Adolescent participants had a previous diagnosis of ASD, which was confirmed by a Social Responsiveness Scale (SRS; Constantino, 2005) Total Score at or above 65. To assess adolescent social anxiety and fear of negative evaluation, parents completed the Social Anxiety Scale (SAS; La Greca, 1998) prior to treatment. The SAS includes a total score of adolescent social anxiety and three subscales: fear of negative evaluation, social avoidance and distress specific to new situations, and generalized social avoidance and distress. To assess adolescent instances of bullying others, parents completed the Social Skills Improvement System (SSIS; Gresham & Elliot, 2008) prior to intervention. The SSIS includes standard scores of adolescent social skills and problem behaviors, which includes a bullying subscale. Pearson correlations were calculated to examine the relationship between adolescent social anxiety on the SAS and reports of bullying others on the SSIS prior to treatment.
Results:
Results suggest that adolescents with higher parent-reported total anxiety on the SAS demonstrate significantly higher instances of bullying others as reported by parents on the SSIS (p<.05). Results further indicate that adolescents with higher parent-reported fear of negative evaluation by peers on the SAS exhibit significantly higher parent-reported instances of bullying others (p<.01) on the SSIS.
Conclusions:
These findings suggest that adolescents with ASD that exhibit greater social anxiety and fear of negative evaluation by others are more likely to be the perpetrators of bullying against their peers, possibly leading to greater rejection by their peer group. Identifying factors that may lead to increased bullying behavior, and ultimately peer rejection, will enable us to develop more targeted interventions to decrease maladaptive social behavior and peer rejection in a highly vulnerable population.

200 **159.200** University Students' Explicit Stereotypes of Peers on the Autism Spectrum

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Background: Students on the Autism Spectrum (AS) often face difficulties in higher education contexts due to problems with social interactions, changes in routines and expectations, and difficulties living independently that are greater than those encountered by neurotypical students (Lai et al., 2014). Little research has examined the explicit stereotypes that college students may hold towards AS students. These attitudes likely negatively affect neurodiverse students' feelings of acceptance by their peers and integration into college life, further compounding their challenges.
Objectives: The goal of this study was to evaluate college students' attitudes towards students on the AS within a classroom setting and their relations to self-reported autistic behaviors.
Methods: Participants were 1143 university students (61.9% female, 64.2% freshman) recruited from introductory Psychology classes across three semesters. Students completed the Autism Quotient (AQ; Baron-Cohen et al., 2001) to assess autistic behaviors. In addition, participants were asked whether autistic students had influenced their classroom experiences, and then responded to the question: "What behaviors do you feel are characteristic of an autistic college student?" Responses were first categorized as reflecting negative or positive qualities. They were then coded into five categories based on the AQ subscales (*Communication Difficulties*, lack of *Social Skills*, poor *Attention Switching*, exceptional *Attention to Detail,* poor *Imagination*), and six codes reflective of students' responses that did not fit within the AQ model (high *Intelligence and Exceptional Specific Skills*, repetitive *Habits and Routines*, *Distractibility, Variable Moods*, *Sensitive to Stimuli*, and *Difficulty Understanding Tasks*). Inter-rater agreement between three coders was established at 90% with disagreements resolved through discussion.
Results: When asked whether their classroom experience had been influenced by an autistic student, 35.3% of the sample did not respond. Of the responders, 52.2% answered in the affirmative. All students responded to the open-ended question. The majority of students (97.9%) cited negative behaviors as being characteristic of an autistic student whereas 22.4% also provided positive characteristics. Females reported significantly more negative characteristics than males, t(1142) = 2.59, p < .001. The frequencies of responses to the 11 categories are presented in Table 1. There was one gender difference in which girls cited more Communication Difficulties than males, t(1142) = 3.93, p < .001. The most frequently cited behaviors were Communication Difficulties (78.8%), poor Social Skills (33.1%), high Intelligence and Specific Skills (24.9%), and poor Attention Switching (extreme focus, 15.3%). Partial correlations (controlling for gender, academic year, social anxiety) between AQ scores and the 11 codes (see Table 2) indicated that the AQ was significantly negatively

correlated to: *Negative Behaviors, Positive Behaviors, Communication Difficulties, Social Skills, Attention to Detail, Intelligence and Specific Skills*, and *Variable Moods*.
Conclusions: The findings indicate that students on the AS are perceived to exhibit more negative than positive characteristics. However, students who report fewer autistic behaviors hold these perceptions more strongly than those who report more autistic behaviors. These findings suggest that more effort is needed to develop welcoming college environments for neurodiverse students.

201 **159.201** Using Interactive Eye-Tracking and fMRI to Investigate Joint Attention in Children and Adolescents with and without Autism Spectrum Disorder

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Background: Joint attention (JA) refers to the shared attentional focus of at least two people on a specific object and is an essential prerequisite for the development of early social interaction skills. Concurrently, deficits in JA are considered the earliest sign to be at risk for autism spectrum disorder (ASD), suggesting a more protracted development in ASD. The neurodevelopment of JA is poorly understood (Schilbach et al., 2013), in particular with respect to influences such as the familiarity of the interaction partner and self- vs. other-initiation of JA. Only recently, JA has been investigated in adults using interactive fMRI paradigms (Redcay et al., 2010; Schilbach et al., 2010).
Objectives: We examined neural correlates of JA and its modulation by a familiar and unfamiliar interaction partner and by self- and other-initiated JA during typical development, and atypical patterns in patients with 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 one of the three targets. In the *JA Self-Initiated* condition, the interaction partner followed the participant's gaze. In the *Control Self-Initiated* condition, the interaction partner shifted her gaze downwards. In the *JA Other-Initiated* condition, participants were instructed to follow the interaction partner's gaze. In the *Control Cue-Initiated* condition, participants were instructed to shift the gaze towards the target that changed color while the interaction partner shifted her gaze downwards. Our current analysis includes 39 TD (8-18 years) and 10 ASD subjects (8-18 years). 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: Irrespective of age, TD subjects recruited a JA network comparable to findings in adults with only minor effects of age. The JA network encompassed areas related to reward and motivation (ventral striatum, bilateral Acc, pallidum, OFC), spatial orientation and movement control (e.g. superior and inferior parietal lobe) as well as motor processing (precentral gyrus). Our data indicates that the degree of familiarity of the interaction partner significantly modulates brain activity, in particular during self-initiated interactions. These effects were mainly confined to brain areas recruited by JA across conditions (inferior parietal lobe extending into to precuneus), suggesting enhanced processing for familiar interaction partners, which is functionally specific for JA. Furthermore, additional emotion processing areas (e.g. insula) were activated significantly stronger during self-initiated interactions than during other-initiated interactions suggesting enhanced emotional involvement. Further data analysis with respect to atypical development in ASD will follow.
Conclusions: Our results suggest early maturity of JA in typical development not only on the behavioral but also on the neural level. However, modulation by familiarity and self- vs. other initiation of JA reveals further insights into the neural underpinnings of JA and its development. Comparison to atypical (potentially protracted) development in ASD will further advance the understanding of JA deficits in ASD.

202 **159.202** Visual Orientation during Game Play: Using Eye-Tracking and Conversation Analysis to Examine the Interactional Use of Eye-Gaze in Children with Autism Spectrum Disorders

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Background: Children with autism spectrum disorders (ASD) are characterised as having challenges in the social use of eye-gaze (e.g., Chawarska, Macari, & Shic, 2013). The research on eye-gaze behaviours is often conducted in carefully controlled settings; less is known about the use of eye-gaze during naturally occurring interactions (but see Noris, Nadel, Barker, Hadjikhani, & Billard, 2012). Such examination can provide valuable insight into the contingencies under which social use of eye-gaze might occur in children with ASD.
Objectives: Our study utilises mobile eye-tracking technology to map the use of eye-gaze in a multiparty Kinect game playing environment. In this game, the children are gazing at a screen

displaying their full-body movements. Rather than identifying children's gazing practices *within* the game, the study focuses on instances of eye-gaze shifting *away* from the screen. The aim is to identify the location of such gaze shifts and what (if anything) is accomplished interactionally. The gaze shifts are mapped in relation to the events on the screen and the actions of the co-present adults. Thus, the study considers the wider interactions within the playroom, moving beyond the interactions between the user and the technology.

Methods: Seven children with ASD, aged six to 13 years, participated in the study. Our data corpus consists of approximately 8 hours of video material capturing the children playing Microsoft Kinect-based body movement games. The games required the children to independently catch virtual objects using their hands and feet in the presence of other people, namely, school staff members and researchers. Mobile eye-tracking glasses were used to objectively measure the eye-gaze of the children. Our analysis draws on multimodally informed Conversation Analysis (CA) (Sidnell & Stivers, 2005) to examine the video-recorded interactions. CA is concerned with the *sequential* organisation of interactions: how participants produce initiating (e.g., questions, requests) and responsive (e.g., answers) actions (Schegloff, 2007). Multimodally informed CA research considers how body movement and eye-gaze relate to the production of these actions, for example, how eye-gaze can pursue a response. CA uses detailed transcription of the occurring events, capturing talk, eye-gaze, and other bodily conduct of the participants. The present study extends prior CA work on eye-gaze in interactions (e.g., Korkiakangas & Rae, 2014) by using eye-tracking technology to map the children's gazing activity during these interactions.

Results: The detailed examination showed that the children with ASD used eye-gaze for interactional work during the game play. The gaze shifts away from the screen and towards a co-present adult were used to pursue a response from the adult. The adults responded to these gaze shifts, indicating that they treated the child's gaze aversion from the screen as an interactionally relevant action.

Conclusions: The study shows that children with ASD can demonstrate social orientation to others during a game play. The findings contribute to the few existing CA studies that have elaborated on the interactional use of eye-gaze in children with ASD. The combination of CA and eye-tracking suggests a new fruitful approach to study eye-gaze behaviours in naturally occurring contexts.

203   **159.203** Who Believes in (Bayesian) Ghosts? a Study of Interpersonal Predictive Coding in High-Functioning Autism

T. von der Luehe[1], V. Manera[2], I. Barisic[3], C. Becchio[4], K. Vogeley[5] and L. Schilbach[5], (1)Department of Psychiatry, University Hospital Cologne, Cologne, Germany, (2)EA CoBTeK Cognition Behaviour Technology, University of Nice Sophia Antipolis,, Nice, France, (3)Cognitive Science Department, ETH Zürich, Zürich, Switzerland, (4)Department of Psychology, University of Turin, Torino, Italy, (5)Department of Psychiatry and Psychotherapy, University Hospital Cologne, Cologne, Germany

Background: Communicative actions reveal information about an actor, but they also help to predict the presence and behavior of a second agent. This has been referred to as "interpersonal predictive coding". High-functioning autism (HFA) is characterized by impairments in social interaction, which are assumed to be related to an inability of automatically responding to social cues, while more explicit capacities to relate to others may be intact.

Objectives: This study was conducted to examine the presence of interpersonal predictive coding in HFA.

Methods: 16 adults with HFA and 16 matched controls (HC) observed point-light displays on an eye-tracker monitor. Stimuli belonging to the communicative (COM) condition showed an agent (A) performing a communicative gesture toward a second agent (B) who responded according to it. In the individual (IND) condition, agent A´s communicative actions were replaced by non-communicative actions. Using a simultaneous masking detection task, we asked participants to report the presence of the second agent B.

Results: A mixed repeated measure ANOVA revealed a significant main effect of condition with higher sensitivity in the COM than in the IND condition and a significant interaction effect between condition and group. A simple effect analysis demonstrated a significant effect of condition in the HC group with higher sensitivity in the COM condition, while no such effect was observed in the HFA group. Analysis of the gaze data confirmed that both HC and HFA always looked at both agents.

Conclusions: The present study replicates and extends previous findings of a "second agent effect", which demonstrates that communicative actions of one agent may help to predict the presence and behavior of a second agent. This has been related to prior expectations that are built up through participation in social interactions. Furthermore, our results demonstrate that individuals with HFA are able to recognize and label communicative actions presented by means of point- light displays, but do not automatically respond to them in such a way that it would facilitate the detection of a reaction of a possible respondent to a given communicative gesture.

204   **159.204** Young Autistic Children in a Stimulating Play Situation: Nature and Frequency of Emotions

C. Jacques[1,2], V. Courchesne[2], S. Mineau[2], S. Lajeunesse[2], S. Ferguson[2], C. Cimon-Paquet[2], V. Bilodeau[2], M. Dawson[2] and L. Mottron[3], (1)Universite du Quebec en Outaouais, Gatineau, QC, Canada, (2)Centre d'excellence en Troubles envahissants du développement de l'Université de Montréal (CETEDUM), Montréal, QC, Canada, (3)Centre d'excellence en Troubles envahissants du développement de l'Université de Montréal (CETEDUM), Montreal, QC, Canada

Background:
Kanner originally described unusual facial expressions in autistic children (Kanner, 1943). Since then, autism research has emphasized neutral, negative, and/or awkward affect in autistic children, at the expense of positive emotions (Capps et al. 1995; Grossman et al. 2013; MacDonald et al, 1989; Snow et al. 1987; Yirmiya et al. 1989). While typical children show increased positive affect when they are exposed to personal interests (Silvia, 2006; Chen et al. 2001), most studies assessing autistic children's emotions use pictures and videos in laboratory situations or standardized diagnostic assessments, and thus feature limited availability of autistic materials of interest. Current understanding of autistic children's positive emotions may therefore be inadequate and their frequency underestimated.

Objectives:
To document the nature and frequency of emotions expressed by young autistic children, as manifested during a semi-standardized play situation involving exposure to their potential materials of interest.

Methods:
The final sample included 20 autistic and 20 typical children aged between 18 and 72 months. Participants were recruited through the Hôpital Rivière-des-Prairies clinical database and exposed to the Montréal Stimulating Play Situation-Revised (MSPS; Jacques et al., submitted). MSPS-R includes two sessions of free play, one of semi-free play, and one of semi-structured play, for a total period of 30 minutes. Forty objects (e.g.: letters and numbers, books, dictionary, cars, airplane, i-Pad, calendar, music box, dinosaurs, bubble gun) are freely accessed by children under the guidance of an adult. MSPS-R sessions were DVD recorded and coded (Noldus Observer) by two naive raters. Coding is based on the Restricted and Repetitive Behaviors Repertoire-Revised (Jacques et al., submitted) which is comprised of five subscales (sessions, objects, emotions, physical contact, and behavior). Emotions are coded as positive, negative, neutral, and unknown in relation to the exploration of the forty objects available to children in the MSPS-R.

Results:
Results already analyzed, based on 10 autistic children (mean age: 49.7 months, SD 13.0; mean MSEL: 61.3, SD 14.4) and 5 typical children matched on chronologic age (mean age 44.4, SD 16.6, p=0,35; mean MSEL 114.3, SD 16.9, p<0.01), indicate that autistic children expressed a similar number of positive emotions (mean frequency: 15.4, SD 16.5) as did typical children (mean frequency: 12.4, SD 5.7; p=0.7). Emotions coded as negative or unknown were infrequent in both groups (typical children: 0; autistic children: negative mean frequency 1.8, SD 2.9; unknown mean frequency 0.4, SD 0.5).

Conclusions:
If these results are confirmed in the full sample, they would indicate that when potential materials of interest are available to explore, young autistic children express a similar high frequency of positive emotions, and very low frequency of negative emotions, as do age-matched typical children. Thus, young autistic children, even with relatively low MSEL scores, may competently regulate their emotions when given access to information that autistics process well. The next step of this study will be documenting which objects trigger which emotions, and which behaviors are associated with positive and/or negative emotions, in each group.

Keynote Address
164 - Pathways to New Treatments for Autism Spectrum Disorder
9:00 AM - 10:00 AM - Grand Ballroom

Speaker: J. Veenstra-Vander Weele, Psychiatry, Columbia University / New York State Psychiatric Institute, New York, NY

Two main approaches are being pursued to identify new medication treatments that may benefit children with Autism Spectrum Disorder. The first and most common approach is to evaluate a treatment in the total group of people affected by ASD, usually with a small number excluded due to the presence of a known genetic syndrome. This strategy is challenged by the lack of support for common genetic or environmental risk factors that contribute substantially to risk in the entire group of children with ASD. Therefore, treatment studies in the overall group of children with ASD are largely tied to brain systems and pathways that may modulate social function or repetitive behavior but that are not necessarily implicated in autism risk. The second approach is almost the exact opposite, to study a medication for ASD-related symptoms in a defined genetic syndrome that confers substantial risk of ASD but comprises <2% of individuals with ASD. Since animal models are providing an understanding of the underlying neurobiology that leads to autism-related symptoms in these populations, treatments targeted the root cause of these syndromes is possible. Transformative treatments, though possibly not "cures," seem most likely to emerge from the second approach, but in a small group of children. In contrast, if the first approach is successful, we can expect a treatment that benefits a larger group of children, but likely benefits them less. With emerging knowledge of brain systems and intersections with genetic data, we can hope for a third approach that is somewhere in the middle, with a treatment being studied in a larger subgroup of individuals with ASD that share a common biomarker. This could result from extension outward from treatments studies in rare genetic syndromes, or it could result from identification of subgroups that benefit from treatments studied in ASD as a whole. I will

discuss current challenges and opportunities as we seek new treatments in autism, including specific examples of each approach.

9:00 **158.001** Pathways to New Treatments for Autism Spectrum Disorder
J. Veenstra-Vander Weele, *Psychiatry, Columbia University / New York State Psychiatric Institute, New York, NY*

Two main approaches are being pursued to identify new medication treatments that may benefit children with Autism Spectrum Disorder. The first and most common approach is to evaluate a treatment in the total group of people affected by ASD, usually with a small number excluded due to the presence of a known genetic syndrome. This strategy is challenged by the lack of support for common genetic or environmental risk factors that contribute substantially to risk in the entire group of children with ASD. Therefore, treatment studies in the overall group of children with ASD are largely tied to brain systems and pathways that may modulate social function or repetitive behavior but that are not necessarily implicated in autism risk. The second approach is almost the exact opposite, to study a medication for ASD-related symptoms in a defined genetic syndrome that confers substantial risk of ASD but comprises <2% of individuals with ASD. Since animal models are providing an understanding of the underlying neurobiology that leads to autism-related symptoms in these populations, treatments targeted the root cause of these syndromes is possible. Transformative treatments, though possibly not "cures," seem most likely to emerge from the second approach, but in a small group of children. In contrast, if the first approach is successful, we can expect a treatment that benefits a larger group of children, but likely benefits them less. With emerging knowledge of brain systems and intersections with genetic data, we can hope for a third approach that is somewhere in the middle, with a treatment being studied in a larger subgroup of individuals with ASD that share a common biomarker. This could result from extension outward from treatments studies in rare genetic syndromes, or it could result from identification of subgroups that benefit from treatments studied in ASD as a whole. I will discuss current challenges and opportunities as we seek new treatments in autism, including specific examples of each approach.

Panel Session
165 - On the Road to Translational Treatments in Autism-Related Genetic Syndromes
10:30 AM - 12:30 PM - Grand Ballroom B

Panel Chair: Jeremy Veenstra-Vander Weele, *Psychiatry, Columbia University / New York State Psychiatric Institute, New York, NY*

Discussant: Jeremy Veenstra-Vander Weele, *Psychiatry, Columbia University / New York State Psychiatric Institute, New York, NY*

Our understanding of autism risk factors has grown exponentially in the past few years. Cellular and animal models based upon some of these risk factors are providing clues to the underlying neurobiology. The most advanced work has emerged in rare genetic syndromes that often include autism symptoms: tuberous sclerosis, fragile X, Rett, and Phelan-McDermid syndromes. In each syndrome, hypothesized neurobiological mechanisms are now being tested in human treatment studies. This panel will outline insights from specific studies in these rare syndromes, but it will also provide a perspective on the pathway from risk factor to mechanism to potential treatment. Presentations in this panel will highlight (1) candid evaluations of model systems for dissecting the biology of neurodevelopmental disorders and testing potential treatments; and (2) perspectives on assessing potential benefits and risks in the context of developmental change and the placebo effect. These rare syndromes offer the first opportunity to test treatments based upon an understanding of neurobiological mechanisms. By finding treatments that show benefit in these rare syndromes, we may also gain an understanding of how to develop and test treatments in neurodevelopmental disorders more broadly. Potentially, some treatments may even benefit a larger subgroup of children with ASD.

10:30 **165.001** Progress and Hurdles in Development of Targeted Treatments for Fragile X Syndrome
E. Berry-Kravis, *Pediatrics, Neurological Sciences, Biochemistry, Rush University Medical Center, Chicago, IL*

Background: Fragile X syndrome (FXS) is the most common known genetic cause of intellectual disability and autistic spectrum disorder. Recent major advances have been made in the understanding of the neurobiology and functions of the *Fragile X Mental Retardation 1* (*FMR1)* gene product, the fragile X mental retardation protein (FMRP), which is absent or reduced in FXS. These advances, based largely on work in the *Fmr1* knockout mouse model, have revealed FXS to be a disorder of synaptic plasticity associated with abnormalities of long-term depression, long-term potentiation and immature dendritic spine architecture, related to dysregulation of dendritic translation typically activated by group I mGluR and other Gq-linked receptors.
Objectives: To test whether neuroactive molecules that target pathways dysregulated in the absence of FMRP in FXS animal models, can be translated to treat humans with FXS.

Methods: Multiple pilot open label, phase 2 and a few phase 3 clinical trials of various designs have been performed with FXS subjects to evaluate safety and efficacy of compounds that rescue molecular, spine, and behavioral phenotypes in the animal models and target underlying biological mechanisms in FXS.

Results: Pilot open label trials of lithium (reduces translation pathway signaling), minocycline (reduces MMP-9 activity) and acamprosate (GABA-A and –B agonist), lovastatin (indirect reduction of ERK and translation pathway signaling), and fenobam (mGluR5 blocker, Neuropharm LTD) suggested drug benefits in FXS and identified possible biomarkers. Small phase 2 proof of concept trials with arbaclofen (GABA-B agonist, Seaside Therapeutics), AFQ056 (mGluR5 blocker, Novartis), and minocycline suggested efficacy in FXS in some primary and post-hoc analyses. Phase 3 trials with arbaclofen, AFQ056, and RO4917526 (mGluR5 blocker, Roche) failed to meet primary behavioral endpoints in older populations. Arbaclofen demonstrated benefits in the 5-11 year old group however financial issues have stalled further development. Results not currently published from some of these trials will be presented as well as an autopsy conducted by Fragile X Clinical and Research Consortium investigators of the arbaclofen trials to better define areas of subject responses.

Conclusions: Attempts to translate findings in animal models of FXS to humans have raised complex issues about trial design and outcome measures to assess disease-modifying changes that might be associated with treatment. It will be important to adjust future trial designs and drug development plans to better test effects on synaptic plasticity by studying younger subjects for longer periods of time; studying cognition, developmental, language and functional measures in addition to behavior; implementing more objective clinician administered and direct observational outcome measures instead of parent rating forms; identifying biomarkers to detect response and identify potential responders; and by comparing drug vs placebo effects on response to intensive training interventions embedded in trials. Genes known to be causes of autistic spectrum disorders interact with the translational pathway defective in FXS, and it is likely that there will be substantial overlap in molecular pathways and mechanisms of synaptic dysfunction. Thus targeted treatment and clinical trial strategies in FXS may serve as a model for ASD and other cognitive disorders.

10:55 **165.002** Translational Studies in Tuberous Sclerosis
M. Sahin, *Neurology, Boston Children's Hospital, Boston, MA*

Background: Accumulating evidence suggests that tuberous sclerosis complex (TSC) patients have non-tuber abnormalities that contribute to the development of the neurological and behavioral phenotype. Using mouse models of TSC, work from our lab with our collaborators has started to shed light on the cellular and neural circuit abnormalities underlying the neurobehavioral problems. We have shown that TSC1/2 proteins regulate axon specification, guidance, myelination and regeneration, suggesting that TSC-deficiency will lead to circuit-level abnormalities and contribute to autism-related phenotypes in TSC mouse models and patients.

Objectives: We set out to test the safety and efficacy of mTOR inhibitors first on mouse models.

Methods: We treated neuronal-specific or cerebellar Purkinje cell-specific *Tsc1* knockout mouse models, which displays autistic-like features, with rapamycin starting at the time of *Tsc1* deletion. We also initiated a placebo-controlled double-blind Phase II trial of everolimus, a rapamycin homolog, in TSC patients with neurocognition as the primary endpoint.

Results: mTOR inhibitor treatment trial starting early in life can prevent autistic-like behaviors in the Purkinje cell-specific knockout.

Conclusions: Taken together, these preclinical studies have lead to collaborative biomarker and treatment trials that are currently ongoing. Updates will be provided from the results of the ongoing biomarker and treatment trials with patients with TSC.

11:20 **165.003** Initial Trials of Translational Medicine in Rett Syndrome
W. E. Kaufmann, *Neurology, Boston Children's Hospital, Boston, MA*

Background: Rett syndrome (RTT) is a neurodevelopmental disorder characterized by severe autistic behavior (autism spectrum disorder, ASD) during its regression period. It is linked to mutations of the transcriptional regulator *MECP2*, which has led to the development of mouse models of *Mecp2* deficit that have increased our understanding of the neurobiology of RTT. During the last decade, multiple strategies for correcting the consequences of *Mecp2* deficiency have been tested. Particularly promising have been growth factors that modulate synaptic plasticity, such as BDNF and IGF-1. The latter has the advantage of good central nervous system penetration when administered systemically and is clinically available as a treatment for growth deficiency.

Objectives: To determine the safety and tolerability of IGF-1 for the treatment of core manifestations of RTT through early phase clinical trials. Both trials were based on mouse model data showing that IGF-1 can reverse many RTT-relevant phenotypical features.

Methods: A phase I trial involving 12 girls with *MECP2* mutations, most of them with RTT, tested safety, tolerability, and potential efficacy (covering multiple neurobehavioral manifestations) of IGF-1. Encouraging results from the phase I study have led to an ongoing randomized, controlled, cross-over phase II trial including 30 girls with RTT, after the regression stage. The design, based on significant and trend-level improvements observed during a 20-week open label period, includes anxiety symptoms as the primary endpoint and a wide range of secondary and exploratory outcome measures. This trial is expected to be completed by early 2016.

Results: The phase I trial demonstrated that IGF-1 was safe and well tolerated in girls with RTT. It also showed that IGF-1 reached the CNS compartment and distributed following non-linear kinetics. As mentioned above, preliminary analyses of efficacy, including both clinical and automated biomarker-type outcome measures, demonstrated that IGF-1 improved anxiety and social avoidance behaviors as well as breath-holding. Consequently, the phase II trial measures breathing abnormalities using pletysmography, as in phase I. Multiple biomarkers are tested as exploratory outcome measures in the ongoing trial; among them are right frontal alpha band asymmetry on EEG, an index of anxiety and depression that correlated with behavioral ratings in phase I, and other electrophysiological and psychobiological measures.

Conclusions: We have entered a new era of targeted treatments in RTT, which target fundamental neurobiological processes disrupted as a consequence of *Mecp2* deficit. Initial findings suggest that some but not all major symptoms could be improved. Because IGF-1 and other drugs under examination target major synaptic processes, underlying most genetic forms of ASD, there is hope that these treatments will be efficacious beyond RTT. An example of this are ongoing trials with a shorter (tripeptide) form of IGF-1 (vs. the full-length form we used in our studies) in RTT and fragile X syndrome. While this is an exciting time in ASD therapeutics, we should be cautious since the work in RTT and other monogenic causes of ASD focuses on mechanisms present in all affected individuals, not only in those with severe autistic behavior.

11:45 **165.004** Novel Findings in Phelan-Mcdermid Syndrome and Their Translation into Therapeutics

J. D. Buxbaum, *Seaver Autism Center for Research and Treatment, Department of Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY*

Background: Phelan-McDermid syndrome (PMS) is a neurodevelopmental disorder characterized by intellectual disability, hypotonia, delayed or absent speech, and autistic features. Within the chromosomal region implicated in PMS, *SHANK3* has been identified as the critical gene whose haploinsufficiency causes the neurological and behavioral symptoms.

Objectives: We investigate all aspects of the PMS pathophysiology through an integrated approach that includes patient assessments, genetics and genomics, design and characterization of cell and animal models, and drug screening. Basic scientists work closely with clinicians and clinician scientists with the ultimate goal of translation of research findings into improved therapeutics.

Methods: The genetics of PMS is investigated with tools that can identify a wide spectrum of mutations, from single-nucleotide variants to copy number variants. We also characterize, molecularly and phenotypically, cell models for PMS, including neural progenitor cells (NPCs) differentiated from iPSC cells isolated from patients with PMS and control individuals, and control NPCs silenced for *SHANK3*. We use various mouse and rat lines as models to study the changes in gene expression, cell and circuit physiology and behaviors due to *Shank3* reduction or loss. All these models are also used for drug testing. We carry out deep phenotyping of patients and have begun both a multi-site study of PMS, and a longitudinal study in PMS.

Results: The integration of genetic and clinical findings is extending the mutational landscape for PMS and is revealing genotype-phenotype relationships in PMS. Three iPSC-derived NPCs lines have been derived from PMS patients and respective controls, and we expect a total of 12 to be completed by the end of next year. These cells, as well as iPSC-derived NPCs silenced for *SHANK3*, will be subjected to deep characterization, including RNAseq and phenotyping of cellular readouts. The generation and characterization of the *Shank3* mouse and rat models demonstrated the deleterious effect of *Shank3*-deficiency on social behavior, synaptic plasticity, and seizures. IGF-1 treatments in the *Shank3*-mouse model showed significant beneficial effects on motor performance and synaptic plasticity deficits and oxytocin treatment in the *Shank3*-rat model reversed the synaptic plasticity and the social behavior deficits. Pilot clinical trials of IGF-1 in PMS show safety and some preliminary evidence of efficacy. Larger trials are underway.

Conclusions: Our studies are uncovering the pathways and brain circuits altered in the PMS and are revealing the beneficial effects of IGF-1 and oxytocin in PMS models. We see preliminary evidence of efficacy of IGF-1 in patients with PMS.

Panel Session
166 - Translational Developmental Research in Restricted and Repetitive Behaviors: From Basic Mechanisms to Intervention
10:30 AM - 12:30 PM - Grand Ballroom A

Panel Chair: Clare Harrop, *University of California, Los Angeles, Los Angeles, CA*

Discussant: James Bodfish, *Vanderbilt Brain Institute, Nashville, TN*

Restricted and Repetitive Behaviors (RRBs) are a core symptom of autism spectrum disorders (ASD) (ICD-10, World Health Organization 1992; DSM-5, American Psychiatric Association, 2013). While research into this symptom domain has grown in recent years, considerably less is known about the function and etiology of RRBs relative to the social-communication impairments of ASD. This hinders researchers ability to develop effective, targeted interventions for this core deficit. This panel will address these issues and present a

series of innovative studies with the overarching goal of providing a comprehensive and translational update on the current state of the field. The panel brings together talks spanning neuroscience, early detection and intervention and the use of novel technologies to study RRBs. Our four panelists will discuss a) the trajectories of RRBs and their neural correlates in early development, b) explore novel methodologies for quantifying the presence of RRBs as well as their response to intervention, and c) the effect of targeted interventions on behavioral changes in RRBs.

10:30 **166.001** Exploring the Neural Correlates of Repetitive Behavior in Babies with Autism

J. J. Wolff[1], *J. T. Elison*[2], *M. R. Swanson*[3], *G. Gerig*[4], *M. A. Styner*[5], *K. N. Botteron*[6], *S. Dager*[7], *A. M. Estes*[8], *H. C. Hazlett*[9], *R. T. Schultz*[10], *L. Zwaigenbaum*[11], *J. Piven*[5] and .. The IBIS Network*[12], (1)Department of Educational Psychology, University of Minnesota, Minneapolis, MN, (2)Institute of Child Development, University of Minnesota, Minneapolis, MN, (3)University of North Carolina - Chapel Hill, Carrboro, NC, (4)School of Computing & Scientific Computing and Imaging Institute SCI, University of Utah, Salt Lake City, UT, (5)University of North Carolina at Chapel Hill, Chapel Hill, NC, (6)Washington University School of Medicine in St. Louis, St. Louis, MO, (7)University of Washington, Seattle, WA, (8)Speech and Hearing Sciences, University of Washington, Seattle, WA, (9)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Chapel Hill, NC, (10)Departments of Pediatrics and Psychiatry, University of Pennsylvania, Philadelphia, PA, (11)University of Alberta, Edmonton, AB, Canada, (12)Autism Center of Excellence, Chapel Hill, NC*

Background: Restricted and repetitive behaviors (RRBs) are central to the behavioral phenotype of autism spectrum disorder (ASD). Once believed to emerge after core social symptoms, recent evidence suggests that atypical RRB may be an early emerging symptom of ASD (Elison et al., in press; Wolff et al., 2014). Separate work involving both human and non-human animal models indicates that repetitive behaviors, from primarily motor forms to more complex patterns of behavior, are differentially linked to parallel but functionally distinct cortico-striato-thalamo-cortical circuitry (for a review, see Langen et al., 2011). It is yet unknown whether or how this putative neural circuitry may underlay early emerging repetitive behaviors among infants who develop ASD.
Objectives: To test the predictive relationships of white matter microstructure in select fiber pathways at age 1 year, measured using diffusion tensor imaging, and repetitive behavior at age 2 years in a prospective, longitudinal sample of children with ASD.
Methods: The present study included 32 infants meeting clinical best-estimate criteria for ASD at age 2 years. Diffusion tensor brain imaging data were collected during natural sleep as part of an ongoing study. White matter pathways of interest were deterministically segmented and microstructure characterized by fractional anisotropy (FA), a measure reflecting magnitude of directional diffusion based on tensor shape (Verde et al., 2014). Pathways examined included thalamo-frontal, cortico-striatal-spinal, and midcerebellar pathways. A mean value was created for the former two bilateral pathways. Repetitive behaviors were characterized at 24 months of age using the Repetitive Behavior Scales, Revised (RBS-R; Bodfish et al., 2000). Predictive relationships between targeted white matter pathways and repetitive behaviors were examined using a hierarchical regression model controlling for age, sex, and scan site.
Results: Results from the primary analysis are presented in Table 1. Control variables alone did not significantly predict repetitive behavior inventory at age 2. There were no significant additive effects for either the thalamo-frontal or cortico-striatal pathways. The addition of the midcerebellar pathway resulted in a significant model change, $p = .002$. To further explore this result, we conducted two follow-up analyses. First, we calculated two gross divisions of repetitive behavior (lower and higher-order) based on the RBS-R. The midcerebellar pathway was significantly correlated with lower ($r = .49$, $p = .005$) but not higher order ($r = .18$, $p = .36$) repetitive behavior. We then examined an additional cerebellar pathway, mean bilateral superior cerebellar peduncles. This too was uniquely correlated with lower ($r = .41$, $p = .02$) but not higher-order ($r = .26$, $p = .17$) RRB.
Conclusions: These findings suggest that structural connectivity of the cerebellum in infancy may underlie later repetitive behavior in children with ASD. This conclusion is supported by converging data implicating both the midcerebellar pathway (linking pontine nuclei and supporting cortico-cerebellar feedback) and superior cerebellar peduncles (the primary afferents to midbrain/thalamus). It is possible that repetitive behavior in infancy is initially associated with primary sensorimotor circuitry, with cotrico-striato-thalmo-cortical circuits assuming (dys)regulation of RRB through an experience-dependent process of cortical-subcortical development.

10:55 **166.002** Eye-Tracking Restricted Behaviors and Interests in Autism

N. J. Sasson[1], *K. Unruh*[2] and *J. W. Bodfish*[3], (1)School of Behavioral and Brain Sciences, University of Texas at Dallas, Richardson, TX, (2)Vanderbilt Brain Institue, Nashville, TN, (3)Vanderbilt Brain Institute, Nashville, TN*

Background: Although eye-tracking studies of autism spectrum disorder (ASD) have primarily focused on the social domain, recent work is also using this technology to examine and quantify restricted behaviors and interests.
 Objectives: This talk will present an overview of recent studies using eye-tracking to explore restricted behaviors and interests in ASD, as well as highlight some new findings from our group.
 Methods: Over a series of studies, our group has used eye-tracking to quantify the visual attention

patterns of children with ASD during several passive viewing tasks of competing social and nonsocial stimuli. Nonsocial content includes commonplace items (e.g., furniture) as well as objects related to circumscribed interests (CI; e.g., trains), a diagnostic characteristic of ASD defined by an intense and interfering preoccupation within a narrow range of topics.

 Results: We have shown that school-age children with ASD explore fewer images within complex arrays than typically-developing (TD) children, while exhibiting greater perseverative and detail-oriented attention to the images they do view, particularly when those images depict CI objects (Sasson et al., 2008). These effects have been largely replicated with preschool children with ASD (Sasson et al., 2011), with differences in visual exploration increasing developmentally into adulthood (Elison et al., 2012). More recently, a simplified "paired preference" design demonstrated that CI objects disproportionately reduce attention to concurrently presented social information in very young children with ASD (Sasson & Touchstone, 2014), suggesting that certain object categories may unduly capture attention in children with ASD from a very early age and perhaps "crowd out" the social input associated with normative development. Data from a subsequent paired preference design has just been analyzed, and demonstrate that related effects extend into adolescence. Compared to the TD group (n=32; M age=166.6mos), the ASD group (n=33; M age=168.3mos) spent a greater proportion of their fixation time on objects ($F(1,63)=15.4$, $p=.005$) and less on faces ($F(1,63)=20.1$, $p=.001$), and demonstrated an orienting advantage for prioritizing objects ($F(1,63)=3.65$, $p=.026$). Further, the presence of CI objects delayed orienting to faces for the ASD group but not the TD group (diagnosis X object type interaction; $F(1,63)=4.3$, $p=.042$).

Conclusions: Collectively, these studies suggest early-emerging imbalances in social and non-social attention in ASD that extend at least through adolescence. Most notably, we have now replicated across several studies using various tasks and samples that social prioritization in ASD is modulated by the salience of competing nonsocial stimuli. This finding suggests that the effect of CI is not only pertinent to the study of repetitive behaviors, but may influence the social domain as well. Increased salience of nonsocial aspects of the environment, coupled with evidence of an over-focused attentional style, may restrict the visual experiences associated with normative social development in ASD, and over time may reinforce both the repetitive and social behaviors associated with the disorder. In this sense, the social motivation theory of autism appears narrowly correct (i.e., social stimuli hold reduced reward value in ASD) but may not account entirely for the broader pattern of motivational differences that characterize autism.

11:20 **166.003** Automated Detection of Stereotypical Motor Movements in Individuals with Autism Spectrum Disorder Using Wireless 3-Axis Accelerometers and Computerized Pattern Recognition Algorithms

M. S. Goodwin, *Northeastern University, Boston, MA*

Background: A primary barrier to understanding and successfully intervening upon Stereotypical Motor Movements (SMM) in individuals with autism spectrum disorder (ASD) is a lack of tools for researchers, clinicians, and caregivers to easily, accurately, and consistently measure them. Traditional measures of SMM rely primarily on paper-and-pencil rating scales, direct behavioral observation, and video-based coding, all of which have limitations.

Objectives: To further explore whether wireless accelerometer sensing technology and pattern recognition algorithms can provide an automatic measure of SMM that is more objective, detailed, and precise than rating scales and direct observation, and more time-efficient than video-based methods.

Methods: This investigation is a direct replication of Goodwin, Albinali, & Intille (JADD, 2011), wherein the same six individuals with ASD were observed again three years later in their classrooms while wearing three, three-axis accelerometers and engaging in body rocking, hand flapping, and/or simultaneous body rocking and hand flapping. We evaluated automated recognition results compared to manually coded video records at both study time points that yielded an overall average of 0.90 inter-rater reliability, and thus served as ground truth, for two different classifiers – Support Vector Machine and Decision Tree – in combination with different feature sets based on time-frequency characteristics of accelerometer data.

Results: Average automated recognition accuracy across all participants over time ranged from 81.2% (TPR: 0.91; FPR: 0.21) to 99.1% (TPR: 0.99; FPR: 0.01) for all combinations of classifiers and feature sets. We also conducted analyses of kinematic parameters associated with observed SMM over time using raw acceleration data. These included observed SMM within a bout (i.e., contiguous time range in which an individual is engaged in SMM) and across bouts (i.e., pooled SMM bouts) per participant. Intensity (i.e., how vigorously a participant engaged in SMM), duration (i.e., how long a participant engaged in SMM), latency (i.e., time delay between bouts), and estimated movement frequency (i.e., number of moves within a SMM) for rocking, flapping, and "flaprock" were also derived. Finally, we calculated engagement proportion as the percentage of time a participant engaged in SMM while being observed.

Conclusions: Person-dependent algorithms can accurately and consistently measure and describe SMM automatically in individuals with ASD over time in real-word settings. An algorithm that consistently achieves good automated recognition performance across settings and over time could advance autism research and enable new intervention tools that help researchers, clinicians, and caregivers monitor, understand, and cope with these behaviors. For research, automating SMM detection could free a human observer to concentrate on and note environmental antecedents and

consequences necessary to determine what functional relations exist for this perplexing and often disruptive class of behavior. For intervention, mobile classifiers could be integrated into a real-time intervention system where just-in-time feedback is provided when SMM are detected to better manage or reduce the occurrence, duration, and/or intensity of these episodes. Finally, such a system could facilitate efficacy studies of behavioral and pharmacological interventions intended to decrease the incidence or severity of SMM by evaluating change in kinematic parameters over time.

11:45 166.004 Restricted and Repetitive Behaviors in Toddlers with ASD: The Impact of Caregiver-Mediated Jasper on Child Behaviors and Caregiver Strategies

C. Harrop[1], A. Gulsrud[2], W. Shih[3], L. Hovsepyan[3] and C. Kasari[4], (1)University of California, Los Angeles, Los Angeles, CA, (2)Semel Institute, UCLA, Los Angeles, CA, (3)University of California Los Angeles, Los Angeles, CA, (4)UCLA Center for Autism Research & Treatment, Westwood, CA

Background: Restricted and repetitive behaviors (RRBs) are a core feature of autism spectrum disorder (ASD). While research into this symptom domain has increased, considerably less is known about the function, treatment and etiology of RRBs relative to the social-communication impairments characteristic of ASD. As a result, social-communication deficits are often viewed as a more tangible target within early intervention.

Objectives: We know of no study that has explored the potential impact of a caregiver-mediated early intervention focused on social-communication behaviors on the core deficit of RRBs. The purpose of this study was to operationalize child RRBs and the strategies caregivers use in response to these behaviors within a free play session following a caregiver-mediated joint attention and symbolic play (JASPER) intervention which found beneficial effects on social-communication behaviors (Kasari et al., 2014).

Methods: 86 toddlers (means age = 31m) with a diagnosis of ASD and their caregivers were recruited. Caregivers were randomized to receive a caregiver psychoeducation intervention based on Brereton & Tonge's (2006) model (n=43) or JASPER (n=43) which involved hands on one-to-one coaching of the caregiver with their toddler with ASD. Child RRBs (object, motor, visual, verbal) were coded from a caregiver-child play interaction (CCX) at entry and following treatment, 10 weeks later. A caregiver behavior was selected for each child behavior (ignore, did not notice, physical, verbal and redirection).

Results: Using a mixed effects ordinal logistic model controlling for total number of RRBs, overall frequency of child RRBs reduced over the course of the intervention (F $(3, 1399)$= 9.14, p <0.001). Children in the psychoeducation group were more likely to reduce in their expression of motor RRBs compared to children receiving JASPER (F $(3, 1399)$= 4.80, p = 0.0025). All caregivers employed more active strategies to child RRBs over the course of the intervention (F $(1, 1569)$= 36.88, p <0.001); however, this was greater for caregivers in the JASPER group than caregivers receiving the psychoeducation model (F $(1, 1569)$ = 13.09, p <0.001). This was specific to object RRBs (F $(3, 1569)$ = 40.75, p <0.001).

Conclusions: Despite increases in child engagement and social-communication variables in the JASPER condition (Kasari et al., 2014), reductions in RRBs were not observed. Still caregivers in the JASPER group employed more active strategies in response to object RRBs within the free play session – most likely a consequence of the strategies implemented within JASPER and the potential interference these behaviors may have on play-based routines. In comparison, there was a reduction of motor mannerisms in the psychoeducation group, suggesting that child and caregiver behaviors may vary as a result of intervention content and focus. While RRBs represent a concrete behavior in early childhood these may be harder to change within intervention than social-communication. Given the social-communication gains observed in the JASPER group (Kasari et al., 2014), our results suggest that these core deficits can "co-exist" and improvement in one domain may not be dependent upon improvement in the other. The relationship between these core deficits warrants further investigation.

Panel Session
167 - The Value of Registries and Biobanking to the ASD Community within the Social and Cultural Landscape
10:30 AM - 12:30 PM - Grand Ballroom C

Panel Chair: Louise Gallagher, *St. James's Hospital, Trinity College Dublin, Dublin, Ireland*

Discussant: Avraham Reichenberg, *Psychiatry and Preventive Medicine, Mount Sinai School of Medicine, New York, NY*

ASD registries and biobanks provide critical support for research and clinical service development. Different models exist reflecting varied social and cultural contexts. For example national registries, e.g. in Scandinavian countries, integrate publicly available health data while elsewhere other registries have been driven by a specific research agenda, e.g. genetics research. Important insights have already been obtained from registries and linking phenotypic data with biological data, can potentiate biomedical research. However successful registries/ biobanks rely on engagement by the ASD community and are as much about necessity

as are trust, engagement and ethical considerations. Here we discuss four experiences of registries/ biobanking. A successful researcher led UK registry, ASD UK has leveraged engagement with clinical services. A parent advocacy group for a rare ASD related condition, Phelan McDermid Syndrome, showed that parents could inspire scientists to research the condition. A national consultation with ASD Stakeholders in Ireland revealed strong support but also mistrust that a registry/ biobank could be used prejudicially. In China a biobank/ registry project will enhance autism awareness and research but faces huge geographical challenges. We will discuss the challenges encountered and how social and cultural contexts has been influential in shaping these initiatives.

10:30 **167.001** Recruitment of Families to ASD Research Databases through the UK Publicly Funded Healthcare System

J. R. Parr[1] *and H. McConachie*[2], *(1)Institute of Neuroscience, Newcastle University, Newcastle, England, (2)Newcastle University, Newcastle upon Tyne, United Kingdom*

Background:
Large numbers of representative families of children with ASD are needed to make significant advances in some research areas. However, researchers frequently struggle to recruit adequate numbers of participants, and some families have more opportunity to contribute to research than others.
Objectives:

1. Present the database recruitment methods (including the challenges identified)
2. Provide evidence that those registered are representative of UK families of children with ASD
3. Demonstrate the utility of collecting data from all families as they join
4. Show how in subsequent projects, we can recruit very large number numbers of families from the databases, allowing effective subgroup analysis

Methods:
The Autism Spectrum Database-UK (ASD-UK) and the Database of Children with ASD living in North East England (Dasl[n]e) aim to increase researchers' access to families, and families' access to research studies. Dasl[n]e has a population sampling frame and commenced recruitment from multidisciplinary publicly health and education services in 2003; it now includes 1450 families (around 55% of local families). ASD-UK started recruiting through the National Health Service in 2011 and has recruited 1350 families. Following approval by the databases' research committee, almost 3000 families can be contacted by UK ASD researchers. Data about child and family characteristics are collected from parents and clinicians. Dasl[n]e and ASD-UK have now supported more than 30 UK research projects.
Results:
Representativeness: Characteristics of children recruited to ASD-UK and Dasl[n]e are similar, and representative of families with ASD in the UK on gender, DSM-IV ASD diagnosis, schooling type, and proportion with learning disability. Children of parents who declined participation in ASD-UK and those whose parents consented are very similar in year of birth, ASD diagnosis, gender and social deprivation score. Thus database families are representative of ASD families, and not a biased sample.
Utility of collecting data when parents join:
1. Analysis of over 2100 families showed that children's median age at ASD diagnosis has not reduced over recent years, and fewer than one fifth of children were diagnosed before age 3 years (Brett et al., in preparation).
2. An investigation of recurrence risk for ASD revealed that 7% of 2300 families have two or more children with ASD. Subgroup analysis revealed this rose to 10% when only families who have finished having children were included. There was strong evidence for an association between reproductive stoppage and ASD (Wood et al., 2014).
Effective subgroup analysis can be undertaken through large research databases: Koshy recently recruited 650 families to the ASD+ study of co-existing conditions in children using postal questionnaires. More than two-thirds of families had at least one clinical unmet need. Parents of children with moderate to severe impairment in co-existing emotional and behavioural conditions had greater unmet needs than parents of children with no/minimal impairment.
Conclusions:
Through publicly funded UK health and education teams, very large numbers of children and families representative of the overall ASD population can be recruited. Large samples are needed to collect high quality data and undertake subgroup analyses in relation to children's ASD/family characteristics.

10:55 **167.002** International Registry Models: Phelan-Mcdermid Syndrome International Registry

M. O'Boyle[1] *and S. Lomas*[2], *(1)Phelan-McDermid Syndrome Foundation, Arlington, VA, (2)Phelan McDermid Syndrome Foundation, Venice, FL*

Background:
The Phelan-McDermid Syndrome Foundation (PMSF) was established in 2002. Phelan-McDermid

Syndrome (PMS), is a genetic disorder caused by deletions or rearrangements on chromosome 22 and is characterized by global developmental delay, absent or severely delayed speech, epilepsy, and hypotonia. **It is estimated that 80% of patients with PMS have ASD.** In addition to several support services the foundation also funds research fellowships, symposiums and programs including the Phelan-McDermid Syndrome International Registry (PMSIR). PMSIR is the most comprehensive PMS patient database worldwide.

Objectives:
PMSIR, an on-line IRB approved patient registry, was established 3 years ago for the purpose of collecting demographic, genetic, clinical and developmental data on patients diagnosed with PMS longitudinally. The PMSIR advances knowledge of PMS and related conditions and accelerates the translation of knowledge into improvements in meaningful health outcomes by centralizing data provided by families into a richly populated, high quality database and research community resource.

Methods:
PMSF reaches out to patients in the PMS community through the PMS Foundation membership, as well as non-members participating in social media. Caregivers provide web-based informed consent for various levels of data sharing. They then respond to PMSIR clinical and developmental surveys and upload genetic reports and other documents to supplement the data they provide.

Results:
Researchers with IRB approved studies apply to the Registry for access to de-identified data entered by Registrants. Approved researchers must abide by the terms in a data access agreement, which must be signed upon approval of applications before data are released. All researchers are asked to share their findings with the Foundation. Further, as described in the informed consent for participation in the Registry, the Foundation may share de-identified registrant entered data with IRB-approved research databases designed to advance knowledge in PMS and related health conditions.
Today, there are:
- ~1,100 diagnosed cases of PMS worldwide
- 937 patients are members of the Foundation (524 in US).
- over 750 registered in registry (**over 67% of known diagnosed cases worldwide**)

Conclusions:
PMSF has pioneered the concept of the patient-driven registry through the perseverance of devoted parents and guidance from the research community. Over the nearly three years since the establishment of the PMSIR, no participants have withdrawn, 61% have logged into the PMSIR to update their data in the 12 months. Data has been extremely helpful for parents when they communicate with their physicians. This information has also proved useful to researchers, as a number of research projects and collaborations are the direct result of the PMSIR. In fact, the Phelan-McDermid Syndrome Foundation was awarded a contract with the Patient-Centered Outcomes Research Institute (PCORI) to expand upon the functionality of the PMSIR. The PCORI project will establish a PMS data network (PMS_DN) in partnership with Harvard Medical School's Center for Biomedical Informatics.

11:20 **167.003** Creating an Interactive National Registry for ASD in China

X. Zou[1], H. Guo[2], X. Wang[3], B. Chen[4] and P. H. Lipkin[5], (1)Pediatrics, Child Developmental & Behavioral Center, The 3rd Affiliated Hospital of Sun Yat-sen University (SYSU), Guangzhou, MD, (2)China Women's Development Foundation(CWDF), Beijing, China, (3)School of Mathematics & Computational Science, Sun Yat-sen University, Guangzhou, China, (4)Child Developmental & Behavioral Center (CDBC), The 3rd Affiliated Hospital of Sun Yat-sen University (SYSU), Guangzhou, China, (5)Pediatrics/Neurology and Developmental Medicine, Kennedy Krieger Institute/Johns Hopkins School of Medicine, Baltimore, MD

Background:
National awareness of ASD in China has increased. However, resources for diagnosis and intervention are limited, with huge regional imbalances. Economically strong cities have good access to clinics for diagnosis and resourceful information, while under-diagnosis of ASD is ubiquitous in remote areas. Hence, there is poorly reliable data of ASD prevalence in mainland China today. Additionally, the lack of standard process for clinical data collection and the difficulty in recruitment for clinical trials are both major barriers to ASD research. Establishing a nationwide web-based registry for ASD in China will allow information from multiple participants to be collected in one system, and allow participants to be matched with research trials based on eligibility. Furthermore, the registry will collect longitudinal data, in a meaningful and systematic way, to provide valuable information for further understanding ASD natural outcomes and intervention effectiveness. A parent-centered registry system has been modeled on the Interactive Autism Network and designed with parents, clinicians, researchers, and Chinese advocacy organizations. Its mission is to share knowledge and accelerate ASD research domestically and internationally.

Objectives:
By linking families, clinicians, researchers, and advocates, this project aims to:
1. Describe demographic and phenotype data for ASD in China.
2. Address research questions of critical interest to scientists and families, by establishing the largest ASD registry for domestic and international studies.
3. Facilitate internet-based distance education and skill-training of families and professionals for intervention.

4. Create a nationwide unified longitudinal dataset for treatment and follow-up.
Methods:
The ASD registry in China is online in design with user-friendly and secure data input interfaces, consent processing, and standardized workflow for data entry both within medical facilities and by ASD individuals and families. The design will allow medical facilities to use their local Electronic Health Record System for patients' information. Special algorithms will be embedded to evaluate inte- and intra-questionnaire validity and sampling tests will be performed to validate ASD diagnosis. Target population matching services will be provided to researchers according to collaborative projects' needs.
Results:
Here we will report on stakeholder engagement, which will be a vital measure of the success of the registry. Parents will assist in the creation of an online community platform for resource sharing and mutual support amongst families, and between families/professionals. Clinicians will participate in creation of protocol, e.g. the design of the clinic data entry process, and development of baseline and longitudinal datasets. They will also help families by sharing knowledge and evidence-based research findings. Researchers will develop individual study protocols, and later participate in matching potential target populations, recruitment outreach and workflow automation. Participation of advocacy organizations has also been crucial also and includes fundraising and awareness activities. These organizations play an important role for ASD acceptance in the community, provide special education and training opportunities, and can help with policy proposals, dissemination of research results, and identification of family needs generated from our registry data.
Conclusions:
Developing an ASD registry in China has required well-integrated participation of all stakeholders in the community to promote engagement and ensure success.

11:45 **167.004** National Stakeholder Consultation for a National Registry for Autism and Related Neurodevelopmental Disorders

G. Leader[1], J. O'Reilly[2], A. M. M. Daniels[3], A. Shih[4] and L. Gallagher[5], (1)Psychology, National University of Ireland Galway, Galway, Ireland, (2)Trinity College Dublin, Dublin, Ireland, (3)Science, Autism Speaks, New York, NY, (4)Autism Speaks, New York, NY, (5)Department of Psychiatry, Trinity College Dublin, Dublin, Ireland

Background:
Autism Spectrum Disorders (ASD) and related Neurodevelopmental Disorders (NDD) are chronic conditions requiring accurate information concerning the needs of individuals and families for resource and service planning and to support research. Ireland lacks an effective health information system concerning the health, educational and social needs for ASD. A National Intellectual Disability Database (NIDD) explicitly excludes diagnosis and is not universally appropriate in ASD. Therefore there is a need for an ASD/ NDD registry to support research and health service planning. Additionally a national, standardised repository of biological specimens for a range of conditions to support biomedical research has been proposed nationally. A linked ASD registry/ biorepository could broadly support health services and biomedical research. We undertook a national stakeholder consultation to determine the factors that might influence engagement and to determine an appropriate model for the registry/ biorepository.
Objectives:
The overarching objective was to engage stakeholders in the community including individuals, families, service providers and government agencies. Specifically to 1/ develop and pilot a questionnaire regarding need and utility of a registry/ biobank 2/ convene town hall meetings for qualitative feedback 3/ engage with government agencies responsible for commissioning of services and 4/ seek feedback from stakeholder and technical advisory groups to further inform on the model.
Methods:
Meetings with a stakeholder group and government officials were convened to seek opinion on the development/ model of the registry. A survey was developed and piloted at a conference for families and professionals in June 2013 in NUIG. Four town hall meetings were convened and qualitative feedback obtained. The survey was launched online and targeted through social medical, advocacy groups and professionals mailing lists. A technical advisory provided feedback regarding engagement with stakeholders and government agencies and the proposed model.
Results:
The online survey elicited 724 respondents, the majority from parents (72.1%) with a smaller number of individuals with ASD (4.3%) and professionals (14.3%). There was overwhelming support for the development of a registry (93%). Responses suggested that the focus should be health, education and social care service development. Point of diagnosis was identified as an optimal time to put data into the registry but identified that lack of time could be a potential barrier. Concerning the biobank, 84% were supportive and 77% thought they would contribute samples. Concerns were expressed about data privacy, confidentiality and inappropriate access to biosamples (e.g. police or insurance companies). Qualitative themes emerging included a sense of urgency and timeliness for the initiative but also a minority feared that data could be used to deprive people of services or to 'cure' autism.
Conclusions:
The ASD community in Ireland overwhelmingly supported the development of a registry/ biobank. Feedback indicated that a parent driven/ researcher led initiative might be the most appropriate

model. The next phase of the initiative will be a pilot registry and biobank in a defined geographical region.

Panel Session
168 - Investigating Multiple Components of Language Development in the Same Children: The Uconn Early Language Study
10:30 AM - 12:30 PM - Grand Ballroom D

Panel Chair: Letitia Naigles, *University of Connecticut, Storrs, CT*

Studies of language in children with ASD usually target just one linguistic component (e.g., pragmatics, maternal interaction, grammar, word learning, expressive/receptive language, joint attention, gesture); however, actual language development/use involves all of these simultaneously. The UCONN Early Language Study includes a unique dataset in which multiple components of language were assessed at multiple visits over a 2-year span, in >30 children with ASD plus >30 TD children who were matched on language at study onset. This panel presents four different analyses of this dataset, carried out by different researchers focusing on different language components in the same children, revealing how language components interact during development. Included are (1) analyses of the children's gestures during mother-child play sessions early in the study, and which gestures predict speech and language abilities 2 years later; (2) reports on the general lexical and grammatical growth rates of the children's speech over time, and how these rates are influenced by—and reciprocally influence—the mothers' speech; (3) analyses of the children's verb development, comparing emergence of e.g., action, mental, and social verbs; (4) data on the children's comprehension of words and grammar, especially considering how early comprehension abilities impact later language use. Cross-paper integration will be highlighted.

10:30 **168.001** The Role of Gestures in Early Language Development in Children with ASD

A. Goodwin[1], S. Goldin-Meadow[2], D. A. Fein[3] and L. Naigles[4], (1)Waisman Center, University of Wisconsin, Madison, WI, (2)University of Chicago, Chicago, IL, (3)Psychology, University of Connecticut, Storrs, CT, (4)University of Connecticut, Storrs, CT

Background:
Gestures play an important role in language development. For example, word-gesture combinations have been shown to precede word-word combinations in both typically-developing (TD) children and children with early brain injury (Özçalışkan, Levine & Goldin-Meadow, 2013). However, gesturing is known to be impaired in children with ASD (de Marchena & Eigsti, 2010). Nevertheless, language development is heterogeneous in children with ASD. Some children with ASD may use gesture to facilitate later language, while others do not.
Objectives:
This study investigates whether young children with ASD differ from language-matched TD children in gesture use, and how early gestures relate to later language development.
Methods:
Sixteen children with ASD (M age = 32.67 months) were divided into high-verbal (HV) and low-verbal (LV) groups based on Mullen expressive-language scores. Sixteen TD children (M age = 23.52 months) were matched on language level and also divided into two groups. Children were visited every four months across a two-year period. Mother-child interactions were video-recorded at each visit and coded for gesture at visit 1 and children's speech (i.e., word types & MLU) at visits 1-6. Gestures were assigned codes indicating whether they: *reinforce-speech, add-meaning-to-speech, disambiguate-speech, emphasize-speech*, serve as a *functional-act,* or occur with *no-speech.* Counts and ratios were calculated for each type. HV- and LV-ASD group means were compared to means of the TD language-matches, and relationships between early gesture and later speech were investigated for the ASD groups.
Results:
The HV-ASD group produced significantly fewer total gestures (M=20.75) than their language-matched TD peers (M=44.25; $F(1)$=7.722, p=.015). They also had lower proportions of total utterances (M=.084), words (M=.053), and communicative acts (M=.080) that were accompanied by gestures than the TD children (Ms>.097; Fs > 4.75, ps < .047). The LV-ASD group did not produce significantly fewer gestures than their LV-TD language-matches (Ms=10.13 & 18.63, respectively; p=.065*);* these groups differed significantly only in *no-speech* gestures (Ms=5.88 & 14.88, respectively; $F(1)$=6.787, p=.031). Language measures at visits 2-6 were regressed on gesture measures from visit 1, after controlling for word types & MLU at visit 1. For the HV-ASD group, children who produced more *add-meaning-to-speech* gestures and a higher ratio of *disambiguate-speech* gestures produced more word types at later visits than children who produced fewer of these gestures (ΔR^2=.357, p=.049 and ΔR^2=.258, p=.011, respectively). Children who produced more *disambiguate-speech* gestures had higher MLUs at visit 4 (ΔR^2=.158, p=.037). No gesture measures predicted later language in the LV-ASD group.
Conclusions:
 LV-ASD and LV-TD children produced similarly few gestures. HV-ASD children produced significantly fewer gestures than their HV-TD language-matches, suggesting that HV children with ASD may not

rely on gesture to bootstrap early language to the same extent as TD children. However, some gesturing of the HV-ASD children positively predicted their later language levels. The LV-ASD group did not show the same effects. These findings contribute to the large body of research demonstrating relationships between language and gesture, while showing that not all children with ASD show the same pattern as found in typical development.

11:00 **168.002** Language Development in Context: A Longitudinal Study of Typically-Developing Children and Children with ASD

R. Fusaroli[1], E. Weed[2], D. A. Fein[3] and L. Naigles[4], (1)Center of functionally Integrative Neuroscience, Aarhus University Hospital, Aarhus, Denmark, (2)Aarhus University, Aarhus, Denmark, (3)Psychology, University of Connecticut, Storrs, CT, (4)University of Connecticut, Storrs, CT

Background: Children with Autism Spectrum Disorder (ASD) often display distinctive language development trajectories (Tek et al., 2013). Because language-learning is a social endeavor, these trajectories could be partially grounded in the dynamics that characterize the children's social and linguistic interactions (Waurlamont et al., 2014).
Objectives:
We investigate language development trajectories and interpersonal linguistic adaptation over time in a longitudinal corpus of parent-child interactions.
Methods:
Participants included 66 children, 33 with ASD (MA=33 months at visit 1) and 33 TD (MA=20 months at visit 1), matched on expressive language at Visit 1. Parent-child dyads engaged in 30 minutes of semi-structured naturalistic interaction at 6 visits, collected at 4 month intervals. We first quantified amount (number of word tokens), and complexity (number of word types) of the participants' lexical behavior over time. Longitudinal adaptation was defined as the amount of variance a child's/parent's behavior at visit N explained in the parent's/child's behavior at visit N+L (baselined for her/his behavior at visit N), where L expressed an increasing distance between visits. We used mixed-effects growth curve models. The models included Mullen (Mullen 1995) and ADOS (Gotham 2009) scores as fixed factors.
Results:
Our models described the developmental trajectories combining linear and quadratic trends (0.50 < $R2m$ < 0.62, p<0.0001). For all measures we found main effects of time (linear β: -160, -39; quadratic: 22.92, 5.32), group (β: 332, 100.16), severity (β: -27, -8) and Mullen (β: -6, -1.6). Time significantly interacts with Mullen scores (linear β: 7.4, 1.92; quadratic β: -0.84, -0.2). Children with ASD showed shallower trajectories; higher Mullen scores were associated with higher intercepts and steeper trajectories, and higher ADOS scores were associated with lower intercepts.
Our models described longitudinal adaptation between consecutive visits for the number of word types and tokens (0.37 < $R2m$ < 0.76, p<0.0001). Children adapted to parents (β: 0.04), but ADOS and Mullen scores modulated this. High ADOS scores implied less adaptation (β: -8, -2.3), as did low Mullen scores (β: 0.7, 2). Parents adapted to children (β: 0.15, 0.2) with no significant impact of group, ADOS, Mullen scores or age. Increasing the lag between visit (e.g. trying to predict the child's behavior after 2 visits) decreased effect sizes and significance, with no statistical impact with a lag above 3 visits.
Conclusions:
We investigated a model in which children and parents might mutually influence each other's linguistic behavior over time, and asked whether this mechanism differed in children with ASD and their parents. Our results suggest that a quantifiable feedback loop between parents and children does exist in language development, and that this feedback loop is affected by the severity of autistic traits. This mutual adaptation mechanism appears to be in place in interactions between parents and children with ASD, though less strongly than in interactions with TD children. This may partially account for the shallower, but still present linguistic trajectories observed in children with ASD. Future work will assess more contingent dynamics of lexical and syntactic alignment and their role in language development.

11:30 **168.003** Growth Trajectories of Longitudinal Naturalistic Verb Use in ASD: Verb Category Matters

J. Parish-Morris[1], D. A. Fein[2] and L. Naigles[3], (1)Children's Hospital of Philadelphia, Philadelphia, PA, (2)Psychology, University of Connecticut, Storrs, CT, (3)University of Connecticut, Storrs, CT

Background:
Language is an important source of clinical heterogeneity in autism spectrum disorder (ASD), and delays in this area often motivate parents to seek their first evaluations. Although most children with ASD acquire at least some vocabulary as measured by parent report and standardized tests, language use in naturalistic settings remains minimally understood. Moreover, verb use is particularly understudied: Children with ASD may not demonstrate an overall verb deficit according to traditional parent report measures and standardized tests, but certain types of verbs may be selectively avoided (e.g., mental) or relied on (e.g., action) in actual language use.
Objectives:
Compare patterns of growth in action verbs, general all-purpose (GAP) verbs, and mental verbs in a naturalistic, longitudinal study of typically developing (TD) toddlers and toddlers with ASD.

Methods:
Thirty-three toddlers with ASD were matched to 35 TD toddlers on Expressive and Receptive Language abilities at visit 1 of 6. Children with ASD were classified as high verbal ability (HV; N=14) or low verbal ability (LV; N=18) at visit 6. Language produced by parents and children during six 30-minute semi-structured home-based play sessions (4 months apart) was recorded and transcribed in CHAT format. Verbs produced by children were categorized as action (e.g., *run, dance*), GAP (e.g., *give, want*), mental (e.g., *think, know*). Linear mixed models compared growth trajectories of total verb vocabulary, as well as action, GAP, and mental verbs as raw scores and proportions of total vocabulary in the three groups. Planned comparisons assessed group differences at each time point.
Results:
Growth analyses of total verb vocabulary (tokens and types) showed main effects of visit, group, and group by visit, TD=HV>LV, all $ps<.05$. Action verbs (raw types and tokens) showed a similar pattern, TD=HV>LV, all $ps<.01$. In contrast, growth trajectories of action verb proportions (types and tokens) did not differ by group or by group over time, all $ps=n.s$ (Figure 1). Growth patterns for GAP verbs (raw types and tokens) were similar to action verbs, TD=HV>LV, all $ps<.05$. Trajectories of growth in proportions of GAP verbs revealed a distinct pattern of group effects; TD=HV<LV, with LV greater than either TD or HV (Figure 2). Raw growth in mental verbs and proportion of types/tokens that were mental verbs was highly variable in the HV and LV ASD groups, TD>HV>LV.
Conclusions:
This pattern of results suggests that children with ASD can be meaningfully stratified into low- or high-verbal groups, and that patterns of naturalistic verb use differ by language ability and verb subtype. Action verbs are most robust to language delays, with similar growth in all groups relative to total verb vocabulary. In contrast, LV children, but not HV or TD children, may rely more on GAP verbs than specific semantically rich verbs. Mental verb growth trajectories differed in both the HV and LV groups relative to TD, largely by due to increased variability in children with ASD. These findings extend prior research into a new context (naturalistic) and design (longitudinal), and specify fine-grained patterns of verb use in children with ASD.

12:00 **168.004** Form Is Easy, Meaning Is Hard: What Language Comprehension Reveals about Language in Autism

L. Naigles[1] and D. A. Fein[2], (1)University of Connecticut, Storrs, CT, (2)Psychology, University of Connecticut, Storrs, CT

Background:
Children with ASD demonstrate consistent delays in the onset of language development; many also show slower growth rates in expressive language (1,8). However, given their social impairments, their comprehension of language has been more difficult to ascertain because participation on conventional receptive language tasks can be challenging (2). New methods, such as Intermodal Preferential Looking (IPL), show promise for illuminating language comprehension in children with ASD. We have used IPL to investigate comprehension of several aspects of grammar, and several word learning strategies, in a longitudinal study of children with ASD (5).
Objectives:
We bring together findings from 6 IPL studies of language comprehension and discuss what they reveal about the strengths and weaknesses of early development in ASD.
Methods:
Children were assessed every four months for a total of 6 visits. At the onset of the study, 17 children with ASD (*MA*=33 months) and 18 TD control children (*MA*=20 months) were matched on CDI vocabulary production scores (M-TD=118.7 words, M-ASD=94.7 words). Children viewed IPL tasks at each visit (see Table 1); two assessed word learning (NounBias: Do children map novel words onto objects rather than actions; ShapeBias: Do children extend novel words to objects of the same shape), three assessed grammatical comprehension (WordOrder: Do children understand sentences in SVO order; Wh-questions: After children are shown 'hitting' events (e.g., an apple hitting a flower), do they understand that 'What did the apple hit?' refers to the flower whereas "What hit the flower?" refers to the apple; Aspect: Do children understand that –*ing* is used for ongoing events and –*ed* for completed events. The final video assessed children's ability to use transitive frames to learn causative verbs (Syntactic Bootstrapping). Children's eye movements were coded off-line. For all tasks, children should look longer and more quickly to the matching screen during the test trials compared with the control trials. Production measures were also obtained, from parent-child play sessions at each visit.
Results: The grammatical tasks yielded similar findings in TD and ASD groups: The children with ASD showed early consistent comprehension of SVO word order, and reliable but developmentally-delayed comprehension of wh-questions (3,6). Both structures were observed in children's comprehension earlier than in production. Good comprehension of the '-ing/-ed' aspectual contrast was observed, even among low-verbal children (9). Performance correlated with joint attention skills, although initial language levels accounted for more variance. The lexical tasks yielded mixed findings: In both groups, novel words presented in isolation were mapped onto objects rather than actions; moreover, novel verbs in transitive sentences were consistently mapped onto causative over noncausative actions (4,6,7). However, one word learning task revealed serious impairments in the ASD group, who never demonstrated a consistent Shape Bias (7).
Conclusions:

Whereas grammatical comprehension was relatively robust in the ASD group, one word learning strategy was found to be significantly impaired. Making semantic generalizations, especially those requiring attention to global visual properties, seems more challenging than making syntactic generalizations. Social factors played only a small role in explaining variance in comprehension performance.

Panel Session
169 - You Want Me to Eat What? Novel Treatment Approaches for Food Selectivity and Feeding Problems in Children with Autism Spectrum Disorder
10:30 AM - 12:30 PM - Grand Salon

Panel Chair: Emily Kuschner, *Children's Hospital of Philadelphia, Philadelphia, PA*

Food selectivity and feeding problems are highly prevalent in children with ASD, yet few empirically supported interventions are available. Behavioral interventions are widely used in clinical feeding programs and show promise in preliminary studies; however, these time-intensive treatments are generally limited to inpatient or day treatment settings and have not been rigorously examined via randomized clinical trials. This symposium will present current efforts in the field aimed at establishing evidence-based treatments for the heterogeneous array of food selectivity and feeding problems in ASD. Three novel treatments at different stages of rigorous intervention development and evaluation will be presented: Autism MEAL Plan, Parent Training Program for Feeding Problems, and the BUFFET Program. These programs aim to bring feeding treatments to an outpatient setting and incorporate novel treatment components, including greater parental involvement, closer collaboration across disciplines (behavior specialists and nutrition experts), utilization of a group therapy model, and cognitive behavioral strategies tailored for older and cognitively higher functioning individuals. A final presentation will discuss co-occurring factors (i.e., obesity and physical activity) that may be key mediators or moderators to treatment response and merit consideration for integration into feeding treatment programs.

10:30 **169.001** The Autism Meal Plan: A Parent-Training Curriculum to Manage Eating Aversions and Low Intake Among Children with ASD

T. L. Burrell[1] and W. G. Sharp[2], *(1)Research, Marcus Autism Center, Atlanta, GA, (2)Pediatric Feeding Disorders Program, Marcus Autism Center, Atlanta, GA*

Background:
Children with autism spectrum disorder (ASD) are approximately five times more likely to develop feeding problems than are their typically developing peers, and these problems can lead to medical conditions, including vitamin and mineral deficiencies, poor bone growth, and obesity. Hence, there is a need to identify and disseminate evidence-based treatment of feeding problems associated with ASD. Behavioral intervention can be effective when delivered by trained therapists in highly structured settings. Parent Training (PT) may make it possible to disseminate behavioral intervention more broadly, and group-based interventions offer a novel, time-limited and cost effective approach to PT. Although group-based PT has been successfully applied to other prevalent childhood concerns, few studies have evaluated the use of parents as the principal agent of change to address feeding concerns in the ASD population.
Objectives:
Because past research has focused solely on individual treatment protocols for feeding problems in ASD, it is unknown whether standardized, group-based PT is efficacious. The current pilot study sought to fill this gap by developing and evaluating a group-based PT, the Autism MEAL Plan.
Methods:
In the first randomized clinical trial (RCT) ever conducted on a feeding intervention in ASD, we examined the feasibility and acceptability of the intervention and study protocol (e.g., recruitment and retention of participants, assessment procedures). In addition, we explored efficacy in changing feeding behaviors. Participants were 19 parents of children with ASD, age 3-8 years (n = 10 in the treatment group, n = 9 in the waitlist control).
Results:
Eighty three percent of sessions were attended by at least one caregiver with both the mother and father attending at least 3 sessions for four of the families in the treatment group. A post-treatment questionnaire on social validity indicated high program satisfaction, with parents perceiving the program as effective. Additionally, caregivers reported less stress following the intervention (d = 1.1).
Conclusions:
A manualized, behaviorally-based parent training program that can be easily adopted by therapists and caregivers of children with ASD is needed to promote rapid dissemination into the community. In our pilot RCT of the Autism Meal Plan, we obtained evidence of high social validity and reductions in parenting stress following intervention. These findings suggest that the intervention may provide an economical, feasible, and acceptable service delivery model for feeding problems in ASD. In addition, the findings provide important guidance for larger-scale efficacy trials.

11:00 **169.002** Parent Training for Feeding Problems in Young Children with Autism Spectrum Disorder

C. Johnson[1], T. Smith[2] and S. L. Hyman[3], (1)University of Pittsburgh, Pittsburgh, PA, (2)601 Elmwood Ave, Box 671, University of Rochester, Rochester, NY, (3)Department of Pediatrics and Clinical and Translational Science Institute, University of Rochester School of Medicine, Rochester, NY

Background:
Preliminary evidence suggests that behavioral interventions can reduce feeding problems in young children with autism spectrum disorder (ASD). These interventions have primarily been delivered in highly specialized settings (inpatient or day treatment centers that have feeding experts on staff) with little parental involvement or attention to nutrition. Moreover, randomized clinical trials of these interventions are currently unavailable.
Objectives:
The primary goal of this two-site project (University of Florida and University of Rochester) was to develop and then pilot an 11-session behavioral parent training program for feeding problems (PT-F) in children with ASD. PT-F is innovative in that it is time-limited, takes place in an outpatient setting with ongoing parent engagement, and involves an interdisciplinary collaboration of behavior specialists and nutrition experts.
Methods:
We conducted an initial case series of 14 children with ASD (11 males), mean age = 4.86 years. Each PT-F session was 60 to 90 minutes in duration, delivered 1:1 with the primary caregiver by a trained, masters- or doctoral-level therapist. Children's presenting problems included feeding selectivity (93%), parent-reported nutrition concerns (79%), family stress at mealtime (64%), and disruptive mealtime behavior (57%). We rated therapists' fidelity to the PT-F manual and parents' adherence to PT-F activities. The primary outcome measure was the Brief Autism Mealtime Behavior Inventory (BAMBI). Secondary outcome measures included the Irritability and Hyperactivity scales of the Aberrant Behavior Checklist (ABC) and the Parenting Stress Index (PSI). All outcome measures were administered at baseline and Week 16.
Results:
Therapist fidelity and parent adherence to PT-F were high. Children showed statistically significant reductions on the BAMBI (effect size [ES] = 1.50), ABC-Irritability (ES = 0.62), and ABC-Hyperactivity (ES = 0.75). Parents showed a statistically significant reduction on the PSI (ES = 0.45).
Conclusions:
Our initial evaluation of PT-F yielded promising results. We are currently conducting a pilot randomized clinical trial to evaluate the feasibility of implementing this intervention and our study protocol across sites.

11:30 **169.003** The Buffet Program: A Cognitive Behavior Therapy Approach to Food Selectivity in School Age Children with ASD

E. S. Kuschner[1], A. de Marchena[2], B. Maddox[3], H. Morton[3] and J. Worley[3], (1)Children's Hospital of Philadelphia, Philadelphia, PA, (2)Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (3)The Children's Hospital of Philadelphia, Philadelphia, PA

Background:
Behavioral treatments for food selectivity can be effective in children with ASD; however, evidence-supported treatment does not exist for cognitively higher functioning, school age children with ASD. Research indicates that higher-level cortical processes may drive food selectivity in children and adolescents with ASD rather than low-level taste detection impairments, suggesting that food selectivity could be malleable to cognitive behavior therapy (CBT).
Objectives:
The goal of this novel, proof-of-concept study was to create the Building Up Food Flexibility and Exposure Treatment (BUFFET) Program, a parent-supported, group-based CBT to increase food flexibility and food repertoire. The program integrates components of behavioral principles for food exposure with elements from two evidence-based CBTs for anxiety (*Facing Your Fears)* and flexibility (*Unstuck and On Target!)* in children with ASD.
Methods:
A preliminary feasibility and efficacy study was conducted with 11 food selective males with ASD (mean age=9.9 yrs, range 8.5-11.9; mean FSIQ=109, range 91-132) and their parent(s). The BUFFET Program was administered across 14 weekly, 90-minute sessions; children were assigned to one of three groups. The program provides seven weeks of skill building (e.g., coping strategy identification, cognitive restructuring of "Food Foe Thoughts" into "Food Friend Thoughts", food dimensionality psychoeducation), followed by seven weeks of exposure practice (termed "BUFFET Building").
Results:
Preliminary data from the first completed treatment group (*n*=4) suggest promising acceptability and satisfaction (Client Satisfaction Questionnaire ratings range 3.5-4.0 on a 4-pt scale; 83-100% attendance rate). Child "willingness to eat" ratings improved from baseline to outcome assessments; relative to baseline, children indicated at outcome that they would refuse fewer foods if asked to eat them (mean change=16%; range 4-30%), and that they were willing to eat more foods (mean change=8%; range 3-31%). (Note: accepted and refused foods were not necessarily the same.) In

addition, on average children spontaeously tried and ate at least a bite of 19/29 foods presented during weekly BUFFET snack time. During the seven weeks of BUFFET Building (i.e., exposure) practice, children averaged 17 BUFFET Building sessions (completing ~2-3 group or home practice sessions per week), completed hierarchies for an average of 9 food goals (range 3-16), and moved at least 2 foods from the "NO" or "MAYBE" category into the "YES" category. Parents also reported generalization of the skills learned during BUFFET; children spontaneously ate new foods in the "YES" category in their daily lives within the final weeks of group. Outcome data are not yet available for the remaining two groups (*n*=7) as they are currently ongoing. Acceptability remains high, as evidenced by no dropouts and continued regular attendance by all group members.
Conclusions:
Preliminary data suggest feasibility and acceptability of the BUFFET Program intervention. Initial efficacy analyses, within a multiple baseline design model, will be completed when the remaining two pilot groups complete their treatment course in November/December 2014. A pilot randomized clinical trial will be the next step to evaluating efficacy of the program in the context of a waitlist control or comparison treatment design.

12:00 **169.004** Obesity As a Modifiable Risk Factor in the Treatment of Feeding Problems in Children with ASD

L. Bandini, *Pediatrics, University of Massachusetts Medical School/Eunice Kennedy Shriver Center and Boston University, Boston, MA*

Background:
Many risk factors for obesity in children with ASD are likely the same as for typically developing children, especially within the context of today's obesogenic environment. However, by virtue of their distinct needs and challenges, children with ASD may be more susceptible to the risk factors experienced by the general population and may also be vulnerable to unique risk factors. For example, food selectivity, psychopharmacological treatment, disordered sleep, and challenges to engaging in adequate levels of physical activity may be associated with the development of obesity in this population. This talk summarizes the extant literature on the prevalence of obesity in children with ASD and the putative obesity risk factors that this population may experience.
Objectives:
To review the data on the prevalence of obesity in children with ASD and established and putative risk factors associated with obesity.
Methods:
Data presented will derive from large national datasets, convenience samples, and other studies that have provided objective data on weight status and potential risk factors for obesity in children with ASD.
Results:
Evidence from observational studies and nationally representative surveys suggest that children with ASD have a prevalence of obesity at least as high as that seen in typically developing (TD) children. Research has documented that atypical antipsychotic medication presents a clear risk for weight gain in this population. Although limited, evidence suggests that children with ASD are less active than typically developing children and encounter more barriers to participate in physical activity than TD children. Very limited data exist on the association between dietary patterns and weight status in children with ASD.
Conclusions:
Obesity and its associated sequelae pose significant threats to independent living, self-care, quality of life, and long-term health outcomes for individuals with ASD, and thus should be targets for intervention.

Poster Session
170 - Animal Models
11:30 AM - 1:30 PM - Imperial Ballroom

1   **170.001** A Monoclonal Brain-Reactive Antibody Leads to ASD-like Phenotype in Male Mice

L. Brimberg[1], S. Mader[2], V. Jeganathan[3], P. T. Huerta[4], R. Berlin[5], P. K. Gregersen[6], B. T. Volpe[5] and B. Diamond[7], *(1)Center fro Autoimmune and Musculoskeletal Disease, The Feinstein Institute for Medical Research, Manhasset, NY, (2)Center fro Autoimmune and Musculoskeletal Disease, Feinstein Institute for medical Reaserch, Manhasset, NY, (3)Center for Autoimmune and Musculoskeletal Diseases, The Feinstein Institute for Medical Research, Manhasset, NY, (4)Laboratory of Immune and Neuronal Networks, Feinstein Institute for medical Reaserch, Manhasset, NY, (5)Functional Neuroanatomy, Feinstein Institute for medical Reaserch, Manhasset, NY, (6)Center for Genomics and Human Genetics, Feinstein Institute for Medical Research, Manhasset, NY, (7)Center for Autoimmune and Musculoskeletal Diseases, The Feinstein Institute For Medical Research, Manhasset, NY*

Background: Maternal brain-reactive antibodies have been associated with increased risk for Autism Spectrum Disorders (ASD) in the offspring. These antibodies can affect the fetal brain before it

develops a competent blood brain barrier that prevents exposure to antibody. Approximately 10% of women with a child with ASD have brain-reactive antibodies, while these antibodies are present in 2% only of unselected women of child bearing age.

Objectives: We generated brain-reactive monoclonal antibodies (Mabs) from mothers of a child with ASD who harbored a positive serology in order to study their antigenic specificities and to determine which antibodies contribute to ASD pathogenesis

Methods: Memory (CD27+) B cells from the blood of women of a child with ASD previously shown to have brain-reactive antibodies were incubated with fetal human brain homogenate that had been labeled with biotin. B cells bound to fetal human brain antigens were isolated using EasySep Biotin selection kit (StemCells technologies). Single CD27+ B cells are then sorted into PCR plates and immunoglobulin heavy and light chain variable region genes were amplified by PCR and expressed in HEK 293 cells. Antigenic specificity of brain-reactive Mabs was studied using a human protein array and a cell based assay. The C6 Mab was injected into pregnant mice at E13.5. Effects of in-utero exposure on brain and behavior were analyzed during embryonic stage and in adulthood.

Results: One brain-reactive Mab, C6, targets two proteins in the potassium channel complex, a subunit of potassium channel (KCNAB2) and Caspr2; both have been previously linked to ASD. When C6 was administrated to pregnant mice on day E13.5 male but not female fetal brain showed thinning of the cortical plate and fewer mitotic cells (PH3 staining) at E15.5 compared to control embryos of mice injected with a non-brain reactive Mab. When pregnancies were allowed to reach full term, male but not female mice exposed in-utero to C6 displayed increased stereotypic behavior in the marble burying test, spent less time near a fellow mouse in the social preference test and showed impaired spatial flexibility memory in the clock maze test. Consistent with the latter observation, we found decreased dendrites and spines in the hippocampus of these mice.

Conclusions: We show in a mouse model that in-utero exposure to a monoclonal anti-brain reactive antibody isolated from a mother of an ASD child induces neurodevelopmental deffects in the offspring that can be observed already during the embryonic stage. This work demonstrates that maternal anti-brain antibodies lead to in-vivo brain and behavior alterations. Identifying more pathogenic brain-reactive Mabs can yield additional disease mechanism.

2   **170.002** Anterior Cerebellum Purkinje Cells-Restricted Expression of Mutant DISC1 Produces Neurobehavioral Abnormalities Relevant to Autism Spectrum Disorders

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)Department of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, Baltimore, MD, (2)Division of System Neurobiology and Functional Neurochemistry, P.K.Anokhin Research Institute of Normal Physiology, Moscow, Russia, (3)Department 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: Here, 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. 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 no changes in excitability and R_{input} of PC in mutant DISC1 mice. Evaluation of potential synaptic alterations is in progress. 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.

3   **170.003** Bidirectional Changes in UBE3A Gene Dosage Reciprocally Regulate Aggression in Mouse Models of Angelman Syndrome and Idic15

M. P. Anderson[1,2,3,4], D. Stoppel[5] and Y. Nong[5], (1)Pathology/Neurology, Harvard Medical School/Beth Israel Deaconess Medical Center, Boston, MA, (2)Pathology, Boston Children's Hospital, Boston, MA, (3)Autism BrainNET, Boston, MA, (4)Children's Hospital Boston Intellectual and Developmental Disabilities Research Center, Boston, MA, (5)Harvard Medical School/Beth Israel

Deaconess Medical Center, Boston, MA

Background: Reciprocal changes in UBE3A gene dosage cause two neurodevelopmental disorders. Maternally inherited deletions of UBE3A cause Angelman syndrome, characterized by intellectual disability, motor defects, seizures, and a pathognomonic increased social interest. Whereas maternally inherited triplications of UBE3A as in Idic15 Autism underlie the decreased sociability and increased repetitive restrictive behaviors seen in this genetic condition. Increased male aggression is a common comorbidity in the neurodevelopmental disorders but is not widely studied in mouse models.
Objectives: To explore whether Ube3a gene dosage regulates aggression-type behaviors.
Methods: We compared wild-type mice with mice carrying either two extra copies of Ube3a transgene (Ube3a-2x) that model Idic15 or mice with maternal Ube3a knockout (Ube3a-mKO) in the resident intruder paradigm.
Results: Aggression was increased in Ube3a-2x and decreased in Ube3a-mKO when compared to wild-type mice. Using additional mouse genetics techniques, we further mapped the aggression trait to a specific brain circuitry.
Conclusions: The findings establish that disturbances in Ube3a gene dosage reciprocally regulate aggression behavior in two mouse models of human developmental disorders and identify specific molecular and cellular defects that could underlie the behavioral problem.

4   **170.004** Decreased Akt/mTOR Pathway Is Associated with Reduced Excitatory Synaptic Marker PSD-95 and Autistic-like Behavior in Valproic Acid-Exposed Mice

*C. Nicolini[1], V. Aksenov[2], E. Rosa[1] and **M. Fahnestock**[1,2], (1)Psychiatry & Behavioural Neurosciences, McMaster University, Hamilton, ON, Canada, (2)Biology, McMaster University, Hamilton, ON, Canada*

Background: The molecular mechanisms underlying autistic behaviors remain to be elucidated. Mutations in Autism Spectrum Disorder (ASD)-linked genes encode molecules regulating dendritic spine formation, function and plasticity and de-regulate the Akt/mTOR pathway which controls protein synthesis at dendritic spines. Previously, we demonstrated reduced TrkB/Akt/mTOR signaling via p70 S6 kinase/eIF4B in human idiopathic autism. We also determined that this down-regulation was associated with decreased excitatory synaptic marker PSD-95 in patients with idiopathic autism, suggesting that these molecular changes might have adverse consequences for excitatory synapses and contribute to autistic behavior.
Objectives: In the current study, we aimed to investigate whether maternal exposure to the anticonvulsant valproic acid (VPA), which has been associated with autism-like phenotypes in both humans and rodents, affects TrkB, mTOR and their downstream effectors including PSD-95.
Methods: Pregnant CD1 mice received a single intraperitoneal injection of 500mg/kg VPA on gestational day 12, while controls were injected with saline. Dams were weaned on postnatal day (PND) 21, and offspring's behavior and somatosensory function were evaluated on PND29-30 in tests of nest-seeking, negative geotaxis and social interaction preference. Litters were then sacrificed and brain tissue harvested on PND30. Protein expression of TrkB, mTOR, p70S6K and PSD-95 were measured by Western blotting in the temporal/parietal neocortices of 14 VPA-exposed mice and 11 saline controls.
Results: Offspring of VPA-injected mothers had significantly decreased TrkB, mTOR, p70S6K and PSD-95 protein compared to controls. VPA-exposed mice exhibited autistic-like behavior in tests of social interaction preference, nest-seeking and negative geotaxis.
Conclusions: Our molecular results demonstrate that, similarly to human idiopathic autism, offspring of VPA-treated mothers had significantly decreased TrkB, mTOR, p70S6K and PSD-95, supporting the hypothesis that defective TrkB and mTOR via p70S6K may have adverse consequences for excitatory synapses and contribute to autistic behavior. Indeed, we determined that down-regulation of these molecules was associated with deficits in somatosensory function and social approach behaviors in VPA-exposed mice compared to saline controls. In conclusion, our findings show that the use of valproic acid in mice induces autistic-like behavior and successfully models the molecular changes we observe in human idiopathic autism, supporting the hypothesis that defective TrkB/mTOR signaling contributes to autistic traits.

5   **170.005** Deletion of Pten in Oxytocinergic Cells Leads to Social Behavioral Deficits and Decreased Oxytocinergic Cell Number

A. E. Clipperton-Allen, *Y. Chen and D. T. Page, Neuroscience, The Scripps Research Institute, Scripps Florida, Jupiter, FL*

Background: Mutations in *Phosphatase and tensin homolog* (*PTEN*), which encodes a negative regulator of the PI3K-Akt-mTOR pathway, are more common in the subset of ASD patients who show macrocephaly (enlarged head circumference). We have previously shown that a mouse model of *Pten* germline haploinsufficiency (*Pten*^{+/-}) exhibits ASD-relevant behavioral deficits, with social impairment in both sexes, and male repetitive behavior, mood and anxiety phenotypes. These deficits are consistent with those seen in *oxytocin* (*Oxt*) or *oxytocin receptor* (*Oxtr*) knockout mice, suggesting that *Pten*^{+/-} may affect behavior through this system. Oxytocin has been shown to mediate social behavior, mood, and anxiety, and Oxt neurons project to brain areas relevant to social behavior and

ASD. Further, *OXTR* is an ASD risk factor, and individuals with ASD have shown decreased levels of circulating Oxt. We have also found that $Pten^{+/-}$ mice have less Oxt immunoreactivity and plasma Oxt than $Pten^{+/+}$ littermates.

Objectives: We planned to assess whether *Pten* plays a cell autonomous role in behavior by altering the developmental trajectory of Oxt neurons, leading to dysregulation of behaviors relevant to ASD and comorbid disorders. We predict that hyperactive mTOR signaling, as caused by *Pten* mutations, leads to increased apoptosis in Oxt neurons and subsequent deficits in behavior relevant to ASD and comorbid disorders (e.g., mood, anxiety).

Methods: We tested male and female mice with *Pten* haploinsufficiency ($Oxt\text{-}Cre^{+/-}$; $Pten^{loxP/+}$) or deletion ($Oxt\text{-}Cre^{+/-}$; $Pten^{loxP/loxP}$) in Oxt neurons, and $Oxt\text{-}Cre^{-/-}$ controls, on ASD-relevant behaviors (social behavior: social approach, social recognition; repetitive, stereotyped behavior: marble burying) and assays related to ASD comorbidities (mood disorders: tail suspension test; anxiety disorders: dark-light emergence, open field test). We are also characterizing Oxt neurons in the paraventricular nucleus of the hypothalamus and the supraoptic nucleus using immunohistochemistry during development and in adulthood.

Results: We found that $Oxt\text{-}Cre^{+/-}$; $Pten^{loxP/loxP}$ mice showed deficits in social behavior, with females failing to prefer a social stimulus, and males showing a decreased preference for the social stimulus, as well as decreased dishabituation in the habituation/dishabituation test of social recognition. Male $Oxt\text{-}Cre^{+/-}$; $Pten^{loxP/loxP}$ mice showed decreased anxiety on the open field and increased depression-like behavior. Thus, $Oxt\text{-}Cre^{+/-}$; $Pten^{loxP/loxP}$ mice appear to recapitulate many of the behavioral phenotypes observed in $Pten^{+/-}$ mice. Histological analyses are currently underway to determine the neuroanatomical consequences of this mutation and how it may induce the observed behavioral abnormalities.

Conclusions: The observation of similar phenotypes in $Oxt\text{-}Cre^{+/-}$; $Pten^{loxP/loxP}$ and $Pten^{+/-}$ mice suggests that decreased *Pten* in Oxt neurons is a contributing factor in the social, mood, and anxiety behavioral phenotypes shown in *Pten*-deficient mice.

6 **170.006** Developmental, Behavioral, and Neurobiological Consequences of Maternal Allergic Asthma: A Mouse Model in Support of Clinical Findings

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Background: Over the past 3 decades, there have been analogous increases in the incidence of both asthma and autism spectrum disorders (ASD), raising the question of whether these two conditions share common links. Recent population-based studies of expecting mothers who later had a child with ASD identified a unique profile of immune markers that mirrored the immune profile of an allergic asthma phenotype. These data suggest that maternal allergic asthma (MAA) may be an under-examined environmental factor influencing brain and behavior development. Previous work on the role of the maternal immune system has focused on pathogen-induced (i.e. viral or bacterial) immune insults which represent only one arm of the immune response. However, rates of viral and bacterial infection are low compared to the rising rate of ASD and other neurodevelopmental disorders, suggesting that maternal infection cannot account for all cases. Conversely, asthma and allergy represent a separate branch of the immune system and rises in allergy/asthma in the US parallel rises in ASD.

Objectives: Develop an animal model to test the causal link between maternal allergic asthma and offspring brain and behavior development.

Methods: Mothers were sensitized to ovalbumin (OVA) by injection with emulsification of OVA and $(Al)OH_3$ prior to pregnancy then repeatedly exposed to either aerosolized OVA or vehicle during gestation. Offspring were assessed for changes in ASD-relevant developmental, behavioral and neurobiological measures.

Results: Both male and female mice born to mothers exposed to aerosolized OVA during gestation exhibited altered developmental trajectories in weight and length, decreased sociability, and increased marble burying behavior. Moreover, offspring of OVA-exposed mothers were observed to have increased serotonin transporter protein levels in the cortex.

Conclusions: Behavioral and neurobiological alterations can be elicited following early fetal priming with maternal allergic asthma. These data provide support that maternal allergic asthma may, in some cases, be a contributing factor to neurodevelopmental disorders including ASD.

7 **170.007** Effects of Acute N-Acetylcysteine Administration on Striatal Glutamate Concentrations and Behaviour in C57BL/6J Adult Mice

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Background: N-acetylcysteine (NAC) shows promise for the treatment of a number of psychiatric conditions such as schizophrenia and autism spectrum disorder (ASD) (Dean et. al. 2011), however its mode of action is not well understood. In addition to antioxidant and anti-inflammatory properties, NAC is thought to modulate brain excitatory transmission by stimulating the cystine-glutamate antiporter on astrocytes. This increases glutamate concentration in the extrasynaptic space, which activates presynaptic metabotropic glutamatergic receptors mGluR2/3, resulting in the inhibition of the synaptic release of glutamate (Moran et. al. 2005).

Objectives: To investigate the acute effects of NAC on striatal glutamate concentrations and its effects on behaviours known to depend upon excitatory transmission in striatal networks, namely open-field activity (a measure of anxiety) and prepulse inhibition of the startle response (PPI; an operational measure of sensorimotor gating).

Methods: Two cohorts of C57BL/6J adult mice received an intraperitoneal injection of either 150mg/kg NAC (injection volume approximately 100 µL) or vehicle (saline), 110 to 180 minutes before testing. In Cohort I, concentrations of glutamate in the left striatum were quantified using 7 Tesla *in vivo* proton magnetic resonance spectroscopy ([1H]MRS). In Cohort II, activity over a period of 10 minutes was measured in a standard open field apparatus. PPI was assessed in a startle chamber for mice where the startle response to auditory stimuli was recorded.

Results: As expected, NAC induced a decrease in creatine normalised striatal glutamate concentrations in both male and female animals ($F(1)=5.54$, $p=0.026$). This reduction in glutamate was time-dependent, as shown by a main effect of time post-dose ($F(1)=7.90$, $p=0.009$) (See figure). Time post-dose was negatively correlated with glutamate concentrations in the NAC-treated group (Pearson $r=-0.657$, $p=0.008$), but not in the control group. However, contrary to expectation, NAC treated females were significantly more anxious than controls, as indicated by less time spent in the central zone of the open field ($F(1)=6.870$, $p=0.016$), and less frequent entries in the centre ($F(1)=6.630$, $p=0.018$). NAC also impaired PPI in females ($F(1)=5.290$, $p=0.032$), but NAC treatment had no significant effect on anxiety and PPI in male animals.

Conclusions: The striatal glutamate decrease caused by NAC is analogous to our recent findings of lower striatal glutamate in adult men with ASD compared with healthy controls (Horder et. al. 2013). However, although the dose of NAC used was sufficient to lower glutamate concentrations in both sexes, only females were sensitive to its behavioural consequences. In female mice, NAC disrupted behaviours known to be impaired in neurodevelopmental disorders such as ASD or schizophrenia. Thus there is a paradox; NAC has been suggested to have clinical benefit in conditions like ASD, but we find that in this animal system, it causes biochemical and behavioural effects similar to the pathological condition.

8   **170.008** Estrogen Receptor Beta Signaling and Transglutaminase 2 in Sex Specific ASD-like Behavior in Mice

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Background: Autism Spectrum Disorders (ASD) are a heterogeneous set of disorders affecting 1 in 68 children in America and approximately 1% of the population worldwide. ASD is approximately 5 times more common in males than in females, suggesting the possible protective role of female sex hormone, estrogen in this disorder. Our recently published study, for the first time, found decreased expression of estrogen receptor β (ERβ) in the prefrontal cortex of male ASD subjects (Crider et al., 2014). ERβ plays an important role in neuroprotection and cognitive
functions suggesting that deficits ERβ signaling could contribute to the more prevalence of ASD phenotype seen in males. To further investigate the mechanism(s) connecting ERβ signaling and ASD pathophysiology, we investigated the role of transglutaminase 2 (TG2)
in mediating ERβ signaling in ASD. TG2 is a calcium-dependent enzyme that plays an important role in the posttranslational modification of proteins. At the cellular level, endoplasmic reticulum (ER) stress, which has been implicated in ASD, is shown to induce TG2 activity. Moreover, TG2 has an estrogen response element (ERE), further implicating its role in estrogen signaling.

Objectives: Our long term goal is to understand the role of TG2 in mediating ERβ signaling in ASD. This study could provide a better understanding of gender differences in and novel treatment options for ASD.

Methods: Human postmortem prefrontal cortex samples from ASD/Autism and control subjects were obtained from NICHD. Animal experiments were performed in C57BL/6 mice overexpressing Transglutaminase 2 and littermate controls. ER stress was induced by tunicamycin treatment in male mice. Protein levels were measured by western blotting. mRNA levels were measured by RT-PCR.Behavioral measures in mice included open field, light/dark test, tail suspension test, forced swim test, social interaction test, grooming, and marble bury test.

Results: We found significant increases in TG2 mRNA and protein levels in the frontal cortex of ASD subjects. In vivo, ER stress by tunicamycin treatment induced ASD-like phenotype in marble bury test, social interaction and open field tests in mice. TG2 overexpression resulted in ASD-like phenotype in male mice. To further examine the role of ERβ in ASD-like behavior, male mice were treated with PHTPP, an ERβ antagonist. Mice treated with PHTPP showed significant changes in social

interaction test, marble bury test and grooming behavior (indicating ASD-like phenotype) with no changes in open field, TST, FST orlight/dark test. Additional studies using TG2
inhibitor (Cysteamine) and ERβ agonist (ERB-041) support the role of TG2 in gender-specific changes in ASD-like behavior in mice.
Conclusions: The data from this study provide initial evidence on the mechanism of ERβ in protecting females from ER-stress-induced ASD-like behavior in mice. ERβand TG2 could be potential targets to reverse the ASD-like phenotype in males. In this regard, ERβ agonists are already known to improve brain plasticity and memory in animals (without effects on sexual behavior).

9 **170.009** Impaired Decision Making in Mice Lacking Met Receptor in the Cerebral Cortex

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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 cortex at rostral levels in transgenic mice expressing a kinase-dead Met in the *Emx1* lineage.
Objectives: Our anatomical studies reported an abnormal expansion in frontal cortical areas in adult mice lacking *Met* in the cerebral cortex. We have previously demonstrated that the prefrontal cortical regions are crucial for decision making, including reversal learning and set-shifting, two behaviors in the core behavioral domains of cognitive rigidity. We tested whether decreased Met expression impaired cognition.
Methods: We performed a battery of behavioral tests to assess motor, sensory, emotional, social and cognitive behaviors in *Met-Emx* and wildtype male and female adult mice.
Results: The *Met-Emx* mice demonstrated normal gross motor function and anxiety levels similar to the wildtype littermates. However, mutant *Met* mice were impaired in the three chamber social interaction test. Loss of Met allele(s) significantly affected completion of the rule learning and cognitive flexibility on the reversal and set-shifting tasks.
Conclusions: Mice lacking Met signaling, similar to the loss of Met function found in individuals with the *MET* susceptibility alleles for ASD, demonstrate parallel behavioral profiles. The *Met-Emx* mice showed deficits in two core domains of ASD, social interaction and restrictive behaviors/cognitive rigidity.

10 **170.010** Increased Proinflammatory Cytokines Associated with Increased Abnormal Behaviors in a Non-Human Primate Model of Maternal Immune Activation

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Background: Infection during pregnancy has been associated with an increased risk of having an offspring later diagnosed with an autism spectrum disorder (ASD). Infection during pregnancy can lead to activation of the maternal immune system and this activation of the immune system is thought to result in behavioral changes in the offspring. Most maternal immune activation (MIA) studies to date have been in rodents and usually involve the use of lipopolysaccharide (LPS) or Polyinosinic:polycytidylic acid (poly IC). Studies have shown that MIA results in behavioral changes in the offspring including reduced and altered ultrasonic vocalizations, reduced socialability and increased repetitive behaviors. Furthermore, alterations in offspring immune systems have also been identified in these models such as decreases in regulatory T cell populations, increased production of Il-6 and IL-17 from T cellsand increased production of IL-12p40 from macrophages. However, since neurodevelopmental disorders are based on behavioral changes, a non-human primate model could shed more light due to their closer relationship to humans.
Objectives: To further investigate behavioral and immune abnormalities in a non human primate model of maternal immune activation.
Methods: Twenty-one pregnant rhesus macaques were placed into four treatment groups: first trimester poly IC, first trimester Saline, second trimester poly IC and second trimester saline. Animals were given three injections over the course of 72 hours with either poly IC, a double stranded RNA analog, used to induce an immune response in the absence of an infection or saline as a control. Injections were given either near the end of the first trimester or near the end of the second trimester depending on the treatment group of the animal. Over the next four years offspring from the treatment animals underwent several behavioral analysis and had blood collected at the end of

their second and forth years. Plasma cytokine levels and supernatants from stimulated peripheral blood mononuclear cells (PBMC) were measured using a multiplex assay.

Results: Animals injected with poly IC had offspring who demonstrated increased stereotyped behaviors. In addition to these differences in behaviors offspring also showed persistent elevated production of inflammatory cytokines under multiple conditions including: G-CSF, IL-1β, IL-2, IL-4, IL-8, IL-12p40 and MCP-1. Many of these cytokines positively correlated with increased self directed behavior including G-CSF, IL-1β, IL-4 and IL-12p40 while IL-1β and IL-8 negatively correlated with whole body stereotyped behaviors.

Conclusions: MIA increases the risk for offspring to exhibit an altered behavior phenotype. In addition, MIA affects the immune profile of the offspring. Neuro-immune interactions are increasingly associated with neurodevelopmental disorders. By further studying these interactions we can better our understanding of how these two systems work together in typical development and in neurodevelopmental disorders.

11 **170.011** Loss of MeCP2 in the Rat Uniquely Models Regression, Impaired Sociability, and Transcriptional Deficits of Rett Syndrome

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Background: Mouse models of the transcriptional modulator Methyl-CpG-Binding Protein 2 (MeCP2) have advanced our understanding of Rett syndrome (RTT). RTT is a 'prototypical' neurodevelopmental disorder with many clinical features overlapping with other IDD/ASD whose pathogenesis may be similar. Therapeutic interventions for RTT may therefore have broader applications. However, the reliance on the laboratory mouse may present challenges in translating findings from the bench to the clinic, and the need to identify outcome measures in well-chosen animal models is critical for preclinical trials.

Objectives: To identify disease-relevant neurobehavioral deficits that can be uniquely modeled in a rat model of Rett syndrome, and to compare transcriptional changes in MeCP2 rodent models and human Rett brain tissue.

Methods: Male *Mecp2*[-/y] and female *Mecp2*^{-/+} rats and their respective wild-type littermate controls were evaluated for anxiety-like behavior, motor function, sensorimotor gating and cognition at juvenile timepoints. Psychomotor regression and tests for sociability were performed with juvenile female *Mecp2*^{-/+} rats and wild-type littermate animals. RNA sequencing studies were conducted to examine the hypothalamic transcription profiles of male *Mecp2*[-/y] rats and wild-type littermate animals. Gene expression alterations were compared with previously published data to identify both common and unique transcriptional changes among MeCP2 rodent models. The predictive validity of common and unique transcriptional changes of MeCP2 rodents was assessed in human brain tissue from RTT and control individuals.

Results: A novel *Mecp2* rat model displays psychomotor regression of a learned skill and impairments in juvenile play, two behavioral deficits that are unique to the rat model and that are highly relevant to RTT. In addition, the strategy of analyzing the loss of *Mecp2* in both mouse and rat may result in higher predictive validity with respect to transcriptional changes in human RTT brain.

Conclusions: These data underscore the similarities and differences caused by the loss of MeCP2 among divergent rodent species which may have important implications for the treatment of individuals with disease-causing *MECP2* mutations. Taken together, these findings demonstrate that the *Mecp2* rat model is a complementary tool with unique features for the study of RTT and highlight the potential benefit of cross-species analyses in identifying potential disease-relevant preclinical outcome measures.

12 **170.012** N-3 Polyunsaturated Fatty Acid Supplementation Prevents Adult Brain Biochemistry and Behavioral Changes Elicited By Prenatal Exposure to Maternal Inflammation

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Background:
Maternal immune activation (MIA) model precipitates a brain and behavioural phenotype which mirrors that observed in autism and related neurodevelopmental conditions. However, whether MIA also causes in-vivo differences in brain metabolites of exposed offspring similar to those reported in individuals with neurodevelopmental disorders; and whether such differences can be prevented is not yet known. Therefore, in this study we tested the hypothesis that there are metabolite differences, and specifically differences in N-acetyl aspartate (NAA), in the anterior cingulate cortex in offspring exposed to MIA model. However, small animal MRS does not yet permit reliable measurement of γ-aminobutyric acid (GABA). Hence we used western blot to quantify levels of GAD_{67} in the prefrontal cortex and striatum of this model and the effects of dietary supplementation on this marker. Last, we examined possible functional consequences of *n-3* PUFA supplementation in a range of behavioural paradigms known to be altered in the adult MIA model, namely: prepulse inhibition of startle (PPI); the elevated plus maze; open field activity and response to amphetamine.
Objectives:
To test whether *n-3* polyunsaturated fatty acid supplementation prevents adult brain biochemistry and behavioral changes elicited by prenatal exposure to maternal inflammation.
Methods:
We used a standard mouse MIA model generated using the viral analogue PolyI:C (POL) or saline control (SAL) administered to pregnant mice on gestation day 9. The resulting offspring were weaned and sexed at the postnatal day 35. Mice were then randomly divided and fed diets enriched with *n-3* polyunsaturated fatty acids (*n-3* PUFAs) or the control diet (with greater proportion of *n-6* polyunsaturated fatty acids, *n-6* PUFAs) until the end of the study. Non-invasive proton magnetic resonance spectroscopy (1H MRS) measures were also acquired from the majority of these animals (n6-SAL=10, n6-POL=7, n3-SAL=6, n3-POL=8) to quantify metabolic alterations in brain. Male offspring (n6-SAL=13, n6-POL=9, n3-SAL=8, n3-POL=8) were used in the behavioral tests and GAD_{67} western blot analysis.
Results:
NAA/Cr was significantly increased in adult mice exposed to prenatal PolyI:C challenge; *n-3* PUFA supplementation from weaning suppressed this elevation. mIns/Cr was significantly decreased in the PolyI:C exposed offspring and *n-3* PUFA appeared to attenuate this alteration, though this did not reach statistical significance post-hoc. In addition, *n-3* PUFA appears to attenuate deficits in prepulse inhibition and anxiety behavior in the immune-challenged offspring. This was accompanied by differences in GAD_{67} – an increase in prefrontal cortex and decrease in dorsal and ventral striatum in mice exposed to MIA. These same animals had behavioural deficits, including impaired PPI, greater anxiety in the plus maze and sensitivity to amphetamine challenge. *n-3* PUFA supplementation from weaning attenuated all these differences in the POL group.
Conclusions:
These experiments provide preliminary experimental evidence for a potential benefit of *n-3* PUFA in some aspects of Neurodevelopmental disorders. However, further study of the molecular mechanisms operating in *n-3* PUFA effects is warranted and this may open new avenues for prevention in neurodevelopmental psychiatric disorders.

13   **170.013** Neuropathology of Maternal Immune Activation in a Nonhuman Primate Model

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Background:
Activation of the maternal immune system during pregnancy increases the risk of offspring developing neurodevelopmental disorders including autism spectrum disorder (ASD). Rodent models have played a critical role in establishing maternal immune activation (MIA) as a causal factor for altered brain and behavior development in offspring. Findings include aberrant neuron morphology in the medial pre-frontal cortex and decreased parvalbumin expression in the ventral hippocampus (Li et al., 2014; Giovanoli et al., 2014). We have recently extended the model to a species more closely related to humans by demonstrating that rhesus monkeys *(Macaca mulatta)* prenatally exposed to MIA also develop aberrant behaviors relevant to the core symptomatology of ASD (Bauman et al., 2014).
Objectives:
The goal of this study was to comprehensively characterize markers of brain pathology and potential aberrant immune response in MIA-treated and control offspring, including neuronal dendritic arborization, spine density, cell morphology, and immunohistochemistry.
Methods:
Tissue was processed from 8 animals (4 MIA-treated, 4 control). Blocks of frontal cortex were first stained using the Golgi-Cox method to evaluate dendritic morphology. 150μm coronal sections were cut on a sliding microtome and mounted. The morphology of pyramidal cells in layer III of the

dorsolateral pre-frontal cortex (BA46) cortex was recorded and analyzed using Neurolucida software. 10 neurons per case were traced in their entirety (length and branching of apical and basal dendrites and spine density were measured). In addition, a more in-depth analysis of the apical dendrite was completed for 30 neurons/case by quantifying diameter, spine density and number of branches in a 30μm section located 100±10μm from the soma. For the initial immunohistochemical studies, we qualitatively and quantitatively characterized parvalbumin positive neurons in the hippocampal formation. 30μm thick sections were processed with DAB visualization (Parvalbumin primary antibody 1:5000, Swant, Switzerland).

Results:
While no significant group differences were found from the initial 10 neurons, significant differences were detected in the more in depth analysis of apical dendrite morphology. Compared to controls, apical dendrites of MIA-treated offspring were smaller in diameter (2.28μm vs. 2.76μm; Z=2.31, P<0.05) and had a greater number of oblique dendrites (4.74 vs. 3.53; Z=2.14, P<0.05). Preliminary analyses did not indicate a difference in parvalbumin positive cells in the hippocampus in MIA-treated offspring relative to controls.

Conclusions:
This study provides the first evidence that prenatal exposure to maternal immune activation alters dendritic morphology in a nonhuman primate model. Given our rapidly growing knowledge of the complex interplay between the immune and central nervous systems this may have profound implications for revealing the underlying neuropathology of neurodevelopmental disorders such as ASD.

14 **170.014** Norepinephrine Fiber Innervation Is Increased in the Amygdala of the Engrailed-2 (En2) Knock out Mouse Model of Neurodevelopmental Disorders

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Background:
Autism spectrum disorder (ASD) is a pervasive neurodevelopmental disorder characterized by impaired social interactions and communication and repetitive/restricted behaviors and interests. Other symptoms may include abnormalities in mood and fear responses. The neural patterning transcription factor Engrailed-2 (En2) is involved in the development of the embryonic mid-hindbrain region, where monoamine neurons emerge, and has been associated with ASD. While our previous studies indicate En2 knock out (KO) mice exhibit abnormal norepinephrine (NE) systems in the forebrain associated with deficits in social interactions, fear conditioning and depression-related tasks (Brielmaier et al, 2012, 2014), nothing is known about fiber innervation of limbic systems that may contribute to the behavioral phenotype.

Objectives:
To characterize NE fiber innervation into ventral limbic systems using biochemical and anatomical approaches.

Methods:
In postnatal day 60-70 wild type (WT) and KO mice (N=4-6/genotype), we used an antibody against the norepinephrine transporter (NET) to define the levels of proteins in dissected tissue homogenates using western blotting and the numbers of NET-containing fibers in tissue sections using immunohistochemistry. Western analysis was also performed for total protein levels of tyrosine hydroxylase (TH), the rate-limiting enzyme for NE biosynthesis.

Results:
En2 KO mice exhibited a 1.7-fold increase in total NET protein levels in the amygdala compared to WT controls (p<0.02). Furthermore, TH protein levels were increased 1.5-fold (p<0.0017), suggesting that monoamine systems were dysregulated in ventral forebrain. In parallel, NET fiber counts within the basolateral amygdala were also increased, exhibiting a 2.6-fold elevation (p<0.004), though other amygdala subnuclei displayed region-specific changes. Preliminary data also suggest increased fiber innervation in the paraventricular nucleus of the hypothalamus as well, while fiber assessments in the prefrontal cortex, nucleus accumbens, and bed nucleus of the striatum terminalis are ongoing.

Conclusions:
These observations indicate that NE fiber innervation into limbic systems may be dysregulated in this neurodevelopmental model in ways that may contribute to abnormalities in depression-related tasks (forced swim; tail suspension), fear conditioning and social interactions. These studies highlight the unexpected and complex effects of altering the levels of hindbrain gene expression on forebrain growth and development that depend on monoamine neuron projections from the brainstem. These studies may provide insight into neurobiological mechanisms that disturb long distance connectivity between brain regions that impact how the brain develops as well as maintain ongoing functional networks relevant to behavioral phenotypes. We expect that our definition of altered long distance connectivity will lay a foundation to examine the impact on functional activities in neural systems that mediate neurodevelopmental disabilities.

References: Brielmaier et al., 2012, PLoS One, 7(7):e40914. Epub 2012 Jul 19, 2012
                Brielmaier et al., 2014, Genes, Brain and Behavior, 2014 13:286-298.

15 **170.015** Pharmacological Treatment of Repetitive Behavior in the Context of Development

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Background: Repetitive behavior is a diagnostic criterion of Autism Spectrum Disorder that presents is a variety of ways, including motor stereotypy, insistence on sameness, and circumscribed interests. Our work utilizes mouse models of repetitive behavior in order to elucidate the neuropathology that mediates the behavioral disorder and to find novel drug targets for treatment. These models include the inbred C58 mouse (*Mus*) and the outbred deer mouse (*Peromyscus*). These models share a robust repetitive behavior phenotype that includes hindlimb jumping and backward somersaulting. Data from both of these models have revealed reduced activation of the indirect basal ganglia pathway. We have created a drug cocktail that specifically targets a heteromeric receptor complex found only on indirect basal ganglia pathway neurons of the striatum, made up of a dopamine D2 receptor antagonist, an adenosine A2a agonist, and a glutamate mGluR5 positive allosteric modulator. We have shown previously that acute and chronic administrations of this drug cocktail reduce repetitive behavior in both adult C58 mice and adult deer mice, whereas single or double drug combinations do not.

Objectives: To test the efficacy of the drug cocktail to reduce repetitive behavior in young mice, we administered subcutaneous injections of the drug cocktail each day for 13 days in two cohorts of mice. One cohort began treatment the day following weaning (PND 22); the other cohort began treatment during adolescence (PND 42). An additional objective was to determine whether early and repeated drug treatment could alter the developmental trajectory of the repetitive behavior and to confirm that early drug exposure had no adverse consequences on body weight.

Methods: Experiment 1: Deer mice were administered either vehicle (peanut oil) or the triple drug cocktail each morning for 13 days starting on PND 22. The drug cocktail was made up of L-421,626 (D2 antagonist) at 5 mg/kg, CGS21680 (A2a agonist) at 0.3 mg/kg, and CDPPB (mGluR5 positive allosteric modulator) at 15 mg/kg. Mice were tested for their repetitive behavior on PNDs 22, 25, 28, 31, 34, 42, 49, 56, and 63. Experiment 2: Deer mice were administered either vehicle or the triple drug cocktail each morning for 13 days starting on PND 42. Mice were tested for their repetitive behavior on PNDs 42, 45, 48, 51, 54, 56, and 63.

Results: Experiment 1: The triple drug cocktail significantly and selectively reduced repetitive behavior on each of the testing days during the 13 day repeated drug treatment phase. In addition, a continued reduction in repetitive behavior was seen in the previously-treated group for up to 21 days following discontinuation. Experiment 2: The triple drug cocktail significantly reduced repetitive behavior in the adolescent mice during the 13 day treatment phase. This effect, unfortunately, did not last beyond the repeated drug treatment phase. Body weights were not different between groups for either experiment.

Conclusions: We can successfully and selectively treat repetitive behavior in young mice with our triple drug cocktail without adverse change in body weight. Very early drug treatment can also change the trajectory of repetitive behavior development.

16 **170.016** Pten Mutations Alter Brain Growth Trajectory and Allocation of Cell Types through Elevated Beta-Catenin Signaling

Y. Chen, W. C. Huang, J. Sejourne, A. E. Clipperton-Allen and D. T. Page, *Neuroscience, The Scripps Research Institute, Scripps Florida, Jupiter, FL*

Background: The gene *PTEN* encodes a canonical negative regulator of the PI3K-Akt-mTOR pathway. Mutations in *PTEN* are reported in approximately 7-22% of individuals with ASD and macrocephaly. Extreme variations in head circumference are associated with *de novo* mutations in both *PTEN* (macrocephaly) and components of the Wnt-β-Catenin pathway (micro- and macrocephaly) in individuals with ASD. Importantly, both Pten and β-Catenin regulate tissue growth and cell number via signaling through Akt and GSK-3β. We have previously reported that adult *Pten* germline haploinsufficient ($Pten^{+/-}$) mice show both brain overgrowth and social behavioral deficits relevant to ASD.

Objectives: Using *Pten* haploinsufficient mice, we address three related questions: 1) What is the trajectory of brain overgrowth? 2) Is the overgrowth caused by uniform scaling across cell types, or are some cell populations differentially impacted? 3) What is the genetic network in which *Pten* acts to influence brain growth? We hypothesized that *Pten* haploinsufficiency alters brain growth trajectory and scaling of neuronal and glial populations through elevated β-Catenin signaling.

Methods: We measured brain mass and applied the isotropic fractionator technique to estimate cell density and total cell number based on isolation of nuclei from brains of newborn and adult mice. To confirm findings using this approach, we applied immunohistochemical analyses. β-Catenin activity was assessed using a reporter mouse line.

Results: We found that $Pten^{+/-}$ brains were heavier than brains of wild type littermates at birth and in adulthood. Total cell number was elevated in the cerebral cortex of $Pten^{+/-}$ mice, without a corresponding change in cell density. The ratio of NeuN (neuronal marker) positive cells was significantly higher in $Pten^{+/-}$ than wild type cortex at birth, but lower than wild type in adulthood. Immunohistochemistry confirmed the presence of excess glia in the cortex of adult $Pten^{+/-}$ mice.

Elevated β-Catenin signaling was observed in the cortex of newborn *Pten*^{+/-} mice and haploinsufficiency for *β-Catenin* rescued cortex overgrowth in adulthood by suppressing the number of non-neuronal cells.

Conclusions: This work expands the characterization of *Pten* haploinsufficient mice. Our discovery that *Pten* haploinsufficiency leads to a non-uniform magnitude of brain overgrowth and scaling of neuronal and glial cell populations across developmental stages has implications for the identification of biomarkers and mechanisms of pathophysiology in ASD. In addition, our finding suggests that β-Catenin acts in a common network with Pten to regulate brain growth via control of cell number, and that this network may be a point of vulnerability and a target for therapeutic intervention for the subset of individuals with ASD and macrocephaly.

17 **170.017** Regulation of Seizure Susceptibility in Shank3 Deficiency

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Background: Although a strong co-morbidity exists clinically between epilepsy and autism spectrum disorder (ASD), the cause of this co-morbidity is unknown. Several studies in rodent models with autism-related mutations suggest that specific defects in the molecular mechanisms that regulate excitability in both epilepsy and autism may be shared and control the severity of the seizures. The alterations in the magnitude of induction may provide a reliable measure of the severity of seizure activity and help to clarify the subtypes of seizures in ASD, but systematic analysis of differentially induced seizure susceptibility of animals with mutations in autism-related genes has not been investigated. Approximately 2% of severely affected children with ASD have deletions or point mutations in the *SHANK3* gene, which results in Phelan-McDermid syndrome (PMS). SHANK3 is a scaffolding protein that forms the core of the postsynaptic density in glutamate synapses. Seizures have been reported in up to 30% of PMS patients and can present as febrile or afebrile generalized tonic–clonic, focal, and absence seizures.

Objectives: Our aim was to investigate how the autism-related mutation in Shank3 in rodents affects the seizure sensitivity, and to identify the underlying signaling mechanism/s in the regulation of differentially induced seizure susceptibility by Shank3.

Methods: Seizure threshold differences was assessed in Shank3-deficient mouse and rat models using a GABA antagonist (pentilenetetrazol, PTZ), a glutamatergic agonist (kainic acid), electrical stimulation, sound, or hyperthermia to induce seizures. Extracellular and whole-cell recordings of pyramidal cells in hippocampal slices before or during application of relevant seizure induction protocols were used to identify if excitatory and inhibitory transmission is affected differentially with different seizure induction protocols.

Results: Reduced Shank3 levels dramatically affect seizure susceptibility induced by PTZ but not kainic acid or sound. PTZ-induced seizure threshold is significantly increased in Shank3 deficient mice, as well as in Shank3-deficient rats with a similar mutation. Electrophysiological recordings of spontaneous postsynaptic potentials revealed that GABAergic transmission is reduced in Shank3-deficient mice. Additionally, after application of another seizure induction condition, high temperature, to hippocampal slices, hyperthermia-induced synaptic depression is reduced in Shank3-deficient mice.

Conclusions: Our results show that Shank3 deficiency may regulate the inhibitory/excitatory balance and modify the risk for seizures differentially with different induction protocols. Differences in the response to seizure-induction protocols may be due to changes in different molecular targets or differential modulation of overlapping molecular pathways. Ongoing experiments using electrical stimulation and hyperthermia as additional seizure induction protocols will build a more complete model to understand the seizure susceptibility in animal models of PMS. Identification of underlying mechanisms will also help for the development of therapies that are more effective in susceptible individuals by interfering with the processes underlying epilepsy.

18 **170.018** Striking Differences in the Neuroanatomical Phenotype of the Neuroligin3 R451C Knock-in and the Neurexin1± Knock-out

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Background: Neurexin and neuroligins are synaptic cell adhesion genes that have been independently associated with autism (Jamain et al., 2003; Kim et al., 2008). Neurexins are found on the pre-synaptic side and they bind to neuroligin on the post synaptic side. It is thought that alterations in either neuroligins or neurexins could alter the excitatory/inhibitory balance and possibly cause the autistic symptoms (Etherton et al., 2009, 2011).

Objectives: To compare and contrast the volumetric differences of the NL3 R451C knock-in (NL3 KI) mouse with the neurexin1α (NRXN1α) knock-out.

Methods: In total, 48 fixed mouse brains were examined. Sixteen of which were NL3 KI, 8 wild-type (WT, B6/129F2) and 8 NL3 KI. The other 32 were NRXN1α, 10 WT (B6/SV129), 13 NRXN1α (+/-), and 9 NRXN1α (-/-). The NL3 KI mice were 15 weeks and the NRXN1α mice were 11-13 weeks old.

MRI Acquisition – A multi-channel 7.0 Tesla MRI scanner was used to acquire images of the brain. To acquire images for an anatomical analysis, a T2-weighted, 3-D fast spin-echo sequence was used. This sequence yielded an image with 56 µm isotropic voxels (3D pixel) ~12 h (Lerch et al. 2011). *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 62 different regions in both groups (Dorr et al. 2008). Multiple comparisons were controlled for using the False Discovery Rate (FDR) (Genovese et al., 2002).

Results: Fourteen significant regional differences were found in both the NL3 KI and the NRXN1α (-/-), but the differences were in opposing directions, with the regions in the NL3 KI smaller, and in the NRXN1α larger. Several large white matter structures were affected indicative of structural connectivity differences between groups. One of the largest differences in the NL3 KI is the 12% decrease in the hippocampus, and this is seen clearly in Figure 1. Overall the hippocampus was not affected in the NRXN1α model, although it was larger (+3%, FDR of 16%) and there were a few voxel-wise increases found (Figure 1E). In addition to the neuroanatomical differences in the hippocampus, the electrophysiology is quite different (Etherton et al., 2009, 2011), with the NL3 KI showing an enhancement of excitatory synaptic transmission, and the NRXN1α showing a reduction in spontaneous excitatory transmission. Differences are also found behaviourally between the two models, with NL3 KI mice showing social deficits that are not seen in the NRXN1α.

Conclusions: One might hypothesize due to their close connection that the neuroanatomical phenotype of the NL3 KI and NRXN1α model may be similar, but they are quite different. It is clear that multiple factors can lead to an autistic phenotype and therefore care must be taken in assessing genetic manipulations involving similar genes or genetic pathways.

19   **170.019** Unusual Adult Reciprocal Social Interactions, Ultrasonic Vocalizations, Self-Grooming, Seizure Activity and EEG Gamma-Power in Shank3B Knockout Mice: Replications and New Discoveries

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Background: Translocation and breakpoint mutations in *SHANK3* have been implicated in autism spectrum disorder (ASD). Shank3 is a synaptic scaffolding protein, localized in the postsynaptic density. Mutant mouse models have been generated to evaluate the biological and behavioral consequences of *Shank3* gene mutations, including targeted mutations in the ankyrin (*Shank3A*), PDZ (*Shank3B*) or Homer binding domains within the *Shank3* gene (Bozdagi et al., 2010; Peca et al., 2011; Bangash et al., 2011; Wang et al., 2011; Kouser et al., 2013).

Objectives: The present experiments in *Shank3B* mice were designed to (a) evaluate replicability of published phenotypes; (b) evaluate novel behavioral and physiological phenotypes of high relevance to ASD. The longer-term objective is to select mouse models with robust ASD-relevant phenotypes for discovery of pharmacological interventions for the symptoms of ASD. Our investigations of *Shank3B* knockout mice are a component of the Autism Speaks Preclinical Autism Consortium on Therapeutics (PACT).

Methods: Social and repetitive behavioral assays were conducted as previously described (Silverman et al., 2010, 2012). An analysis of male–female reciprocal social interactions and ultrasonic vocalizations was conducted in male subjects paired with freely moving unfamiliar estrus C57BL/6J females, within a sound attenuating chamber.   Videos were scored by investigators uninformed of genotypes, using Noldus Observer software, as previously described (Yang et al., 2012). A sensitive ultrasonic Avisoft Bioacoustics microphone collected audiofiles, which were later quantified with SAS-LAB software. Physiological parameters of EEG and core body temperature were recorded using wireless telemetry transmitters, implanted into 7-week-old male *Shank3B* null and wildtype subject mice. Data were collected for 8 days in a 12 hour light/12 hour dark cycle followed by 8 days of a 24 hour dark cycle. Animals were then administered pentylenetetrazole (PTZ; 40 mg/kg, i.p.). EEG seizures, gamma oscillations and circadian rhythms were analyzed using automated algorithms.

Results: Adult male-female social interactions were lower in *Shank3B* null mutants than wildtype littermates on several key social parameters. Fewer ultrasonic vocalizations were emitted during the session. Self-grooming was higher in the null mutants than in their wildtype littermates, in both males and females, in our standard assay, replicating and extending the original report (Peca et al., 2012). *Shank3B* null mutant males exhibited more frequent and longer spontaneous seizures during the dark cycle and increased gamma activity (30-80 Hz) in the light phase. Upon PTZ-treatment, the *Shank3B* null mutants showed a significantly reduced number of myoclonic jerks.

Conclusions: We confirmed the robustness of elevated self-grooming in *Shank3B* null mutant mice. We discovered reduced ultrasonic vocalizations and reciprocal social interactions by adult male *Shank3B* null mutant mice. We also show that *Shank3B* null mutant males have increased spontaneous seizures during night, and protection against PTZ-induced seizures during day, which may be related to increased gamma EEG power. These results suggest that *Shank3B* null mutants have a reliable behavioral phenotype that is reflective of deficits in core symptom domains of ASD. Moreover, our neurophysiological analyses point to EEG abnormalities that may represent quantitative, translational

biological markers of pathophysiology associated with mutations in the *Shank3* gene.

20   **170.020** Zebrafish mbd5 Loss of Function Mutation Affect Embryonic Neuron Differentiation and Maturation

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Background: The prevalence of Autism spectrum disorders is growing rapidly within last decades with the etiology remains largely unknown. A newly identified member of methylated DNA binding domain protein family MBD5 has attracted substantial attentions recently, due to its causer role in 2q23.1 microdeletion syndrome. Patients with *MBD5* haploid insufficiency display complex clinical symptoms including infantile ASD, EE, and craniofacial abnormalities. *Mbd5* conditional knockout mouse die in preweaning stage, while heterozygous mutation mimicry features of 2q23.1 microdeletion syndrome, suggesting MBD5 might play critical role in nervous system during early embryonic developmental stage.
Objectives: To further dissect the roles of MBD5 in nervous development and maturation, and the correlations between MBD5 mutations with neurological disorders like ASD.
Methods: We choose Zebrafish as the animal model. Fish *mbd5* expression was knocked down via injecting morpholino oligo affecting either ATG or RNA splicing. The development and morphology of fish embryo was closely monitored after injection. The expression of marker genes involved in neuron development and maturation was determined via whole amount in situ hybridization, qPCR and western blot. Fish behaviors were recorded and analyzed via Zebrafish Lab system.
Results:
Knock down of fish *mbd5* cause significant embryonic development delay, lethality, and morphological abnormalities in brain and cardiac vesicle that can be alleviated by co-injecting *mbd5* cDNA constructs. Preliminary evidence indicated that *mbd5* mutation disrupted the expression of critical genes regulating neuron maturation probably through affecting DNA methylation.
Conclusions: Disrupt *mbd5* expression in Zebrafish cause embryonic development delay and lethality, which is consistent with the mouse model, suggesting the role of MBD5 in embryo development is conserved across species. The neuronal disorders caused by MBD5 insufficiency probably due to the misexpression of critical genes involved neuron differentiation and maturation, a mechanism depend on DNA methylation.

21   **170.021** • Maternal Immune Activation in Mice: A Longitudinal Analysis in the C57 Strain

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Background: Potential environmental risk factors for autism spectrum disorders (ASD) include viral/bacterial infection and rodent models of maternal immune activations have been developed and widely used also in preclinical studies to test treatment effectiveness.
Objectives: The present study investigated short- and long-term neurobehavioural effects of administration of immune factors during gestation to mimic a maternal viral infection.
Methods: Polyinosinic-polycytidylic acid (Poly I:C), a synthetic analog of double-stranded RNA to mimic a viral infection, was injected into pregnant C57BL6/j dams on gestational day 12.5. Neonatal behavioural responses (ultrasonic vocalizations and spontaneous motor patterns) were measured on postnatal days 4, 7 and 10; at adulthood sociability in the three-chamber test, exploration in an open field test and marble burying behaviour were assessed. The experimental design includes 10/12 litters in each treatment group and data were analysed considering the litter-effect.
Results: Neonatal vocalizations were altered in Poly I:C pups: a reduction in vocalization rate was evident on pnd 10, with males more affected than females. As for spontaneous motor responses, Poly I:C male pups show an hyperlocomotor profile, with higher levels of pivoting/locomotion throughout the ages considered. An altered locomotor profile was still evident in adult Poly I:C male at adulthood, with lack of the expected habituation and less anxious profiles evident in the last part of a one-hour open field test; in Poly I:C males also increased stereotyped rearing responses were evident. In the three-chamber sociability test, Poly I:C treated mice (both sexes) show an increased sniffing response of the cage not containing the social stimulus, whereas a reduced response to novelty was evident in Poly I:C males.
Conclusions: Prenatal immune activation induces neonatal behavioural alterations in both vocal and motor domains that are more evident in males. The behavioural effects at adulthood appear more robust in explorative/stereotyped motor domains, more limited in the social competences, as measured in the three-chamber test, suggesting a more cautious use of these mice as a full model of ASD.

Poster Session
171 - Brain Structure
11:30 AM - 1:30 PM - Imperial Ballroom

171.022 Activation Likelihood Estimation Guided Investigation into the Anatomy of the Social Brain in Autism

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Background: Impairment in social communication is a hallmark feature of autism spectrum disorder (ASD) (DSM-V). Functional and anatomical alterations found in a set of brain areas, called the "social brain" may underlie these deficits in autism. These regions include: the temporal-parietal junction (TPJ), precuneus, superior temporal sulcus (STS), anterior cingulate cortex (ACC), fusiform gyrus (FG), and medial and inferior aspects of the pre-frontal cortex (MPFC, IFG) (Ashwin et al., 2007; Blakemore, 2008; Frith, 2001; Hadjikhani et al., 2007; Pelfrey et al., 2011). However, heterogeneity in ASD, variability among fMRI tasks, and differences in participant age have made the identification of a social brain signature of autism challenging.
Objectives: The goal of this study is to characterize the functional differences in the social brain in individuals with ASD using activation likelihood estimation (ALE), and to use these results to examine the neuroanatomy of social brain in this population.
Methods: Statistically significant foci of brain activity from 50 fMRI studies comparing individuals with autism to TD controls on 16 different types of social cognition paradigms (e.g., face processing, theory-of-mind, emotion processing) were entered into GingerALETM using a cluster-level threshold of p < .05. This included 675 individuals with ASD and 695 typically developing (TD) controls (mean age range 9-33). A mask of the results was created using the ALE results, which then was mapped to the pial surface of an average brain template using structural MRI from 115 individuals (55 ASD and 60 TD) using FreesurferTM's bbregister, and performed cluster-level analyses on group differences in brain volume, surface area, and thickness in each of these ROIs.
Results: *ALE* - Statistically significant clusters in the cortex included the right fusiform/lateral occipital gyrus ($k = 17480mm^3$), IFG ($k = 16760mm^3$), middle and transverse temporal gyrus ($k = 11736mm^3$), and precuneus ($k = 880mm^3$), and left fusiform/middle occipital gyrus ($k = 15608mm^3$), STS/MTG ($k = 7552mm^3$; $k = 1104mm^3$), insula ($k = 5264mm^3$), MPFC ($k = 2480mm^3$), IFG ($k = 4408mm^3$), and postcentral gyrus ($k = 2112mm^3$). *Morphometry* - Decreased cortical surface area was found in the left STS/STG in our ASD participants relative to intracranial surface area (ICSA) ($k = 204.05mm^2$), and age relative to ICSA ($k = 135.98mm^2$), with additional decrease in the right insula relative to ICSA ($k = 65.7mm^2$). Increases in the fusiform and the IFG in ASD were found as a function of mean cortical thickness ($k = 65.51mm^2$) and age ($k = 64.57mm^2$).
Conclusions: Our meta-analysis of social cognition studies highlights a network of brain regions that are part of the social brain. Anatomical mapping of these regions suggest a subsection of regions to be significantly altered in ASD. Some of these regions, STS and fusiform, have been previously proposed as potential neuroendophenotypes of autism (Kaiser et al., 2010; Spencer et al., 2011). Age-related effects suggest that age and total-brain measures are important when considering cortical morphology. In addition, our findings suggest social brain alterations in ASD at functional and anatomical levels reflecting the complexity of the disorder.

171.023 Age Related Differences in White Matter Diffusion Measures in Autism Spectrum Disorder

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Background: It is well established that autism spectrum disorder (ASD) is accompanied by developmental differences in brain anatomy and connectivity. However, the neural systems underlying ASD are complex and remain poorly understood. White matter differences in ASD have been widely studied with Diffusion Tensor Imaging (DTI) but results are heterogeneous and vary across the age range of study participants. In order to characterize the neurodevelopmental trajectory of white-matter maturation, it is thus necessary to examine a broader age range of individuals with ASD and typically developing controls, and to dissect potential age x group interactions.
Objectives: The objectives of the present study were (1) to investigate the neurodevelopmental trajectory of white-matter maturation in a broad age range of individuals with ASD and typically developing controls, and (2) to examine age x group interactions.
Methods: We employed a spatially unbiased probabilistic Tract-Based Spatial Statistics (TBSS) approach and a region-of-interest analysis to examine age-related differences in white-matter connectivity in a sample of 41 individuals with ASD, and 41 matched controls between 7-17 years of age. DTI data was acquired for all participants, and pre-processed using FSL software.

Results: We found significant age-related difference between the ASD and control group in a spatially distributed network of brain regions using the voxel-wise approach, and the region-of-interest analysis. In these regions, measures of fractional anisotropy (FA) significantly increased with age in both groups. However, the age-related increase in FA was significantly larger within the ASD group relative to controls. Furthermore, we found that measures of radial diffusivity (RD) significantly decreased with age in both groups, and that the decrease in RD was stronger in the ASD group relative to controls. We also investigated between-group differences in lateralization of FA, and report FA values in the post-central gyrus to be significantly more left lateralized in ASD. Last, we examined the relationship between DTI measures and symptom severities in the ASD group. Here we found significant correlations between FA values and restricted and repetitive behaviour as measured by the ADOS in several large-scale white-matter fiber tracts in the brain.

Conclusions: Taken together, our findings suggest that individuals with ASD have an atypical trajectory of white matter maturation relative to controls. Future histological validation and longitudinal analyses are required to further characterize the extent, time course and aetiology of these differences.

24   **171.024** Age-Related Decline in Neuron Number in the Amygdala in ASD

N. Barger[1], **M. V. Vargas**[2] and C. M. Schumann[1], (1)Psychiatry and Behavioral Sciences, UC Davis MIND Institute, Sacramento, CA, (2)UC Davis MIND Institute, Sacramento, CA

Background: The amygdala undergoes aberrant development and function across the lifespan in most individuals with an autism spectrum disorder (ASD). Given its role in mediating social and emotional appraisal and response, it has long been the focus of research on ASD pathophysiology. From MRI studies, we know that the amygdala is increased in size in the majority of children with ASD, however this size difference does not persist into adulthood. In contrast, in histological analyses, we have previously found that neuron numbers in the amygdala are reduced in adults that had ASD during life. Reduced neuron numbers were most evident in the lateral nucleus, a major input region for sensory and cognitive information into the amygdala. However, the cellular neuropathology underlying aberrant amygdala development from childhood to adulthood remains relatively unexplored in ASD.

Objectives: Given previous findings of decreased neuron numbers in adults with autism, this study sought to determine if there are age-related changes in the number of neurons in the amygdala of typical and ASD brains. Because the amygdala is structurally and connectively heterogeneous and not all of its nuclei evidence reduced neuron number in adults, we used stereological methods to quantify age-related cellular variation in four individual amygdaloid nuclei: the lateral, basal, accessory basal, and central nuclei.

Methods: The optical fractionator technique was used to estimate neuron number in four amygdala nuclei (lateral, basal, accessory basal, and central) on Nissl-stained coronal sections of ASD and typical control postmortem brains ranging from 2-44 years of age. To assess age-related variation, linear regressions of neuron number and age were performed for each nucleus for each diagnostic group.

Results: In controls, there was no significant relationship of age and neuron number in any of the nuclei analyzed ($p > 0.05$). In contrast, in the ASD cases, lateral ($p = 0.02$) and central ($p = 0.03$) nucleus neuron numbers showed significant negative linear relationships with age. No significant trends were observed in the other amygdala nuclei ($p > 0.20$) in the ASD cases.

Conclusions: Our findings indicate that neurons in the amygdala may be undergoing developmental decline in ASD cases, compared to typically developing individuals. Furthermore, they suggest that the neuropathology of the amygdala observed in adults with ASD may be the product of events occurring throughout the post-natal time period of development. Assessing autistic neuropathology across age groups can help to better characterize potential developmental mechanisms underlying significant variation in the brains of adults with ASD as well as to identify sensitive neurodevelopmental periods to better inform treatment programs

25   **171.025** Altered Hippocampal-Cortical Gray-Matter Structural Covariance in Males with Autism Spectrum Disorder

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Background: Inter-regional covariation of brain structural volumetry has been suggested to reflect systemic neurodevelopmental architectural processes. In individuals with autism spectrum disorder (ASD), several pathophysiological brain structural abnormalities have been reported to be involved across various regions. In particular, aberrant morphometry of the hippocampus, despite mixed results, may be implicated in specific memory patterns in ASD. How brain systems structurally covary with the hippocampus in ASD remains unclear.

Objectives: We investigated the patterns of hippocampal morphometry relating to various structural indices across cortical regions in ASD and typically developing (TD) individuals. We hypothesized that to the extent that aberrant hippocampal structure captures systemic neurodevelopmental disorders

in ASD, positive associations should be observed across various cortical areas. By contrast, in TD, hippocampal structure should be less associated with the morphometry of other cortical regions. Methods: Structural MRI imaging data (3 Tesla system) of 117 males with ASD (aged 14.6 ± 4.4 years) and 108 TD males (aged 15.0 ± 5.9 years), with age ranging from 7 to 30 years were acquired. Surface-based morphometry analysis was implemented using Freesurfer ver. 5.2.0, which parcellated gray matter into cortical areas (based on the Desikan-Kiliany atlas) and hippocampus for each participant. Partial correlations, controlling for age, intelligence and intracranial volume, were undertaken to assess the significance and differences in volumetric covariance between the bilateral hippocampus and the ipsilateral cortical regions, respectively, among ASD and TD males. All the correlation results were corrected for multiple comparisons using False-Discovery Rate (q < 0.05). Results: In the TD group, the volume of the right hippocampus was positively correlated with that of all the major right-hemispheric cortical regions, including frontal, temporal, parietal, occipital, and cingulate cortices; and there were less extensively positive associations between the volume of left hippocampus and the left hemispheric frontal, parietal, occipital, and cingulate cortices. In the ASD group, right hippocampal volume was positively correlated with the volume of the right lingual gyrus, middle temporal gyrus, pars opercularis, parahippocampus, and posterior cingulate cortex; the left hippocampal volume was only structurally covaried with the medial orbital frontal gyrus. Conclusions: In general, hippocampal-cortical structural correlations were more widespread and positive in the TD group, while this covaried relationship was reduced in the ASD group. Our findings point to a systemic pattern of neuropathological gray matter development across various brain regions in individuals with ASD that is distinct from more homogeneously inter-regional morphometric co-variations in TD individuals. The functional significance of aberrant hippocampal-cortical structural correlations in ASD warrants further investigation.

26   **171.026**   An Investigation of the Microstructural Organisation of the Fronto-Parietal Branches of the Superior Longitudinal Fasciculus Using Constrained Spherical Deconvolution Based Tractography in Autism Spectrum Disorders

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Background:
Constrained spherical deconvolution (CSD) tractography can facilitate fiber tracking through complex neural regions and generate robust tract reconstructions which cannot be achieved using the diffusion tensor model. Primate and post-mortem research has established that the superior longitudinal fasciculus (SLF) is a white matter tract largely composed of three fronto-parietal longitudinal pathways, the SLF I, II and III. It has been suggested that the SLF I sub-serves the dorsal attention network (DAN), the SLF III sub-serves the ventral attention network (VAN) and the SLF II facilitates communication between these networks. The branches of the SLF have never been isolated in an ASD population. Investigating each distinct branch is important for understanding the neural correlates of attention dysfunction in ASD. As the process of attention is lateralised, evaluating the symmetry of the SLF is also crucial for understanding impaired attention in ASD.
Objectives:
The main objective of this research is to use constrained spherical deconvolution (CSD) based tractography to isolate the bilateral SLF I, II and III and investigate diffusion measures of fractional ansiotropy (FA) and the Westin measures of linear and planar diffusion coefficients (CL and CP). The study will also evaluate the symmetry of the SLF I, II and III.
Methods:
High angular resolution diffusion imaging (HARDI) data (61 directions, b-value = 1500 s/mm^2) was acquired for 45 cases and 45 controls. Preprocessing was completed using ExploreDTI software (http://www.ExploreDTI.com). Data quality checks were performed and subject motion and eddy current induced geometric distortions were corrected for in one interpolation step to minimise blurring effects. The B-matrix rotation was also performed to maintain orientation of the data. The tensor model was applied to the data using robust estimation of tensors by outlier rejection (RESTORE) method. CSD tractography was then performed and the SLF I, II and III were isolated (see Figure 1). FA, CL and CP measures were extracted and independent t-tests were completed. All statistical analyses were Bonferroni corrected at a significance level of p < 0.05/3 = 0.0166
Results:
In the left SLF I, the ASD group showed greater CL (F (1, 88) = 9.204, p = 0.003) and a strong trend towards greater FA (F (1, 88) = 5.772, p = 0.018) relative to the control group. In the right SLF II, the ASD group also showed greater FA (F (1, 88) = 7.221, p = 0.009) and greater CL (F (1, 88) = 7.862, p = 0.006) than controls. In the SLF II, the ASD group had significantly greater right lateralisation of FA (F (1, 88) = 8.792, p = 0.004) and borderline significance in CL (F (1, 88) = 5.899, p = 0.017) in comparison to the control group.
Conclusions:
Abnormal structural connectivity of the SLF I, II and III was described thus further substantiating the theory of disrupted cortical connectivity in ASD. The branches of the SLF have been associated with the dorsal and ventral attention networks thus it is reasonable to suggest that aberrant structural connectivity may underpin attentional deficits in ASD.

27   **171.027**   Anomalous Anatomical Connectivity Networks in Children with High Functioning Autism Spectrum Disorder

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Background: Altered cortico-cortico connectivity has been implicated in the neurobiological basis of autism spectrum disorder (ASD). Several lines of evidence indicate that ASD may be associated with underconnectivity between distant cortical regions, and a corresponding over-abundance of local connections. Graph Theory (GT) methods applied to structural connectivity networks derived from diffusion tensor imaging (DTI) may help directly address this hypothesis. GT is a branch of mathematics and computer science that has recently been adapted to neuroimaging studies of whole-brain connectivity. The two principal measures that can be derived from GT are the clustering coefficient (CC) and the characteristic path length (CPL). The CPL is generally taken to be a measure of long-range connectivity, while CC is a measure of local inter-connectivity, averaged over the whole brain. Clinical group differences as well as correlations with behavior have been observed in these network measures for a variety of psychiatric disorders [Bullmore 2009].
Objectives: 1) To examine whether the anatomical connectivity networks of children with ASD differ from Typically Developing (TD) children in their overall topological properties, using DTI tractography. 2) To assess the hypothesis that ASD is associated with long-range underconnectivity and an overabundance of short-range connections. 3) To examine whether graph theory metrics correlate with core ASD symptoms.
Methods: DTI was acquired in 35 Children with High-Functioning ASD (HF-ASD), and 35 TD controls, aged 9-14 years. The groups were matched on age, sex, IQ and handedness. After preprocessing with CATNAP and eddy-current correction, cortical regions were parcellated using a semi-automated atlas-based procedure. Each subject's FA and B0 images were transformed to the JHU-ICBM template using multi-channel Large Deformation Diffeometric Morphic Mapping (LDDMM). The ROI labels from the JHU-ICBM atlas [Mori 2008] were then back-projected onto each subjects' standard-space images. Fiber-tracking was then initiated in each cortical label, using FACT as implemented in CAMINO. The number of streamlines connecting each cortical region to each other cortical region was taken as a measure of connectivity between cortical regions. GT measures were computed using the Brain Connectivity Toolbox [Rubinov 2010].
Results: The mean CC over all nodes was significantly higher in children with HF-ASD (p=0.0007, Wilcoxon rank-sum) than in TD children, indicating a greater degree of local interconnectivity in children with HF-ASD. There were no significant group differences in the mean CPL. In the HF-ASD group, CC was found to be positively correlated with the stereotyped and restricted interests subscore of the ADOS (p=0.0332 r=0.361), and CPL was negatively correlated with the stereotyped and restricted interests score (p=0.0478 r=-0.336), and the ADOS total score (p=0.0341 r=-0.130).
Conclusions: The anatomical connectivity networks of children with HF-ASD show increased short-range connectivity compared to TD children. The findings also demonstrate that graph-theoretic properties of full-brain cortico-cortico anatomical networks correlate to measures of symptom severity in children with HF-ASD.

28   **171.028**   Atypical Cortical Gyrification but Not Autism Spectrum Disorder Diagnosis Predicts Differences in White-Matter Wiring

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Background: Evidence suggests that Autism Spectrum Disorder (ASD) is accompanied by neurodevelopmental differences in brain structure and connectivity. More specifically, it is thought that the brain in ASD is over-connected locally, and under-connected globally (Belmonte et al., 2004). While evidence for global under-connectivity is growing (Koshino et al., 2008; Pugliese et al., 2009), there is currently a lack of neuroimaging studies examining *in vivo* proxy measures for local grey-matter wiring (Ecker et al., 2013). Furthermore, it is currently unknown how proxy measures of grey-matter connectivity relate to differences in white-matter wiring in ASD.
Objectives: Here, we therefore examined (1) vertex-wise differences in local gyrification (Schaer et al., 2008) as a proxy measure for atypical microstructural grey-matter connectivity between individuals with ASD and controls, and (2) established the relationship between atypical local gyrification and local differences in white-matter connections.
Methods: Structural MRI and DTI data was collected on 51 well-characterized male adults with an ADI-R confirmed diagnosis of ASD (mean age 26+7 years, FSIQ 112+13), and 49 matched typically developing male controls (mean age 28+6 years, FSIQ 115+10). Surface reconstructions for all participants were performed using FreeSurfer software on the basis of high-resolution T_1-weighted inversion recovery images. Between-group differences in local gyrification index (LGI) were examined using a GLM on the vertex level. The individual's structural MRI data (both surfaces and volumes) were subsequently co-registered with the DTI data in order to create regions-of-interest for automated fibre tracking using the surface-based clusters of significant between-group differences in LGI.

Between-group differences in diffusion measures were then examined for tracts originating or terminating in the ROI. Last, we established the relationship between variations in LGI and diffusion measures within and between groups.

Results: Individuals with ASD had significantly increased local gyrification in a large left-hemisphere cluster centered on the central sulcus, including the primary and pre-motor cortex and the primary somatosensory cortex (t_{max} = 3.33, $n_{vertices}$ = 8996, $p_{cluster}$ = 0.039) relative to controls. Within the cluster of between-group differences in LGI, individuals with ASD also had a significant increase in axial diffusivity (diffusivity along axons), particularly in short intra-regional U-shaped fibers. Last, we found that the degree of axial diffusivity of tracts within the surface-based ROI was predominantly correlated with the degree of cortical folding, rather than diagnostic category.

Conclusions: Our study demonstrates that the degree of cortical gyrification of the outer grey-matter surface of the brain is regionally enhanced in individuals with ASD, and that grey-matter differences - but not diagnostic status (i.e. having a diagnosis of ASD) - significantly predicted the white-matter connectivity of these regions. Thus, white-matter differences in ASD should not be interpreted in isolation (i.e. without consideration of grey-matter differences) and may be secondary to an abnormal development of grey-matter.

29 **171.029** Atypically Rightward Cortical Asymmetry in Both Children and Male Adults with Autism

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Background:
One potential contributing neuroanatomical substrate for the functional characteristics of autism spectrum conditions (henceforth 'autism') is atypical cerebral asymmetry. Individuals with autism exhibit deficits in left hemisphere-specialized functions such as language, communication and motor control/praxis whilst appearing relatively unaffected in right hemisphere-specialized functions such as visuospatial abilities.

Objectives:
To investigate in two independent samples of individuals with autism whether (1) atypical structural asymmetry is present in regions integral to language, motor and visuospatial processing and (2) this relates to autistic characteristics and language, sensorimotor and visuospatial functioning.

Methods:
Sample 1 comprised 84 right-handed, high-functioning adult males with autism and 84 neurotypical males aged 18-43 years. Autistic symptoms were assessed by the ADI-R and ADOS. Language was assessed by the Non-Word-Repetition task, the word generativity F-A-S task and verbal IQ, motor performance by the Purdue PegBoard Test and visuospatial abilities by the Embedded Figures Task. Sample 2 comprised 47 right-handed, high-functioning children with autism (8girls; 39boys) and 87 neurotypical children (61boys; 26girls) aged 8-12 years. Autistic symptoms were assessed by the ADI-R, ADOS and SRS. Motor performance was assessed by the Physical and Neurological Examination for Subtle Signs.

The two samples were analysed separately using SPM8. Simulated T1-weighted IR images generated from DESPOT1 MRI scans at 3T (sample1) and T1- MPRAGE scans at 3T (sample2) were flipped, segmented and registered to separate symmetrical DARTEL templates. Laterality indices of grey matter volumes were defined as: 2*[(right–left)/(right+left)]. Two analyses of volumetric asymmetry were conducted: (1) a voxel-wise ROI analysis within three functionally defined regions of interest; (2) a follow-up whole brain volumetric analysis. Functional ROIs were generated using the online database NeuroSynth by deriving meta-analytic co-activation patterns for regions functionally related to language, motor and visuospatial functions.

Results:
Voxel-wise analysis of volumetric asymmetry within the language ROI revealed significant reductions from typical leftward asymmetry in both adults with autism (cluster-level FDR-corrected q=0.021) and children with autism (cluster-level FDR-corrected q=0.010). There were no significant deviation from typical asymmetry for the motor and visuospatial ROI in either sample. The voxel-wise whole brain analyses revealed reductions in leftward asymmetry in perisylvian temporal and parietal regions and posterior ventrolateral frontal cortex in both adults (cluster-level q=0.01) and children with autism (cluster1: q=0.035; cluster2: q= 0.002; cluster3: q<0.001; cluster4; q=0.026). Correlations with symptom severity or cognitive-behavioural performance measures were not significant in either group.

Conclusions:

Atypical cerebral asymmetry is present in both children and adults with autism and is most pronounced in posterior regions related to language processing. Future studies should examine behavioural correlations with such cerebral asymmetry. Given that cerebral asymmetries are very subtle at the neuroanatomical level, future studies should take into account lateralization at a functional level to fully reveal the nature of atypical lateralization in autism. Finally, given the postulated role of prenatal sex hormones in creating cerebral laterality, and the recent finding of elevated prenatal sex steroids in autism, this mechanism should be explored in cohorts where fetal steroids, measures of autistic traits, and MRI data are available.

30 **171.030** Brain Volumes Associated with High Levels of Aggression in ASD

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Background: Some level of aggression is present in around half of children and adolescents diagnosed with autism spectrum disorders (ASD). Comorbid aggression in autism causes additional family stress including increased isolation, parental exhaustion, safety concerns, and financial strain. Previous neuroimaging research has suggested structural abnormalities in ASD in prefrontal and medial temporal regions of the brain. Similar structures have also been implicated in aggressive and hyperactive behavior in non-autism samples. The definition of narrower behavioral phenotypes will be useful in elucidating brain networks that are more specific to autism subtypes. However, we know of no studies investigating the potential association of aggression with atypical brain development in ASD.
Objectives: We analyzed associations between MRI-based volumetric measurements and behavioral reports of aggression in ASD. We hypothesized that aggression would predict abnormal growth, relative to matched controls, in prefrontal and medial temporal regions of the brain.
Methods: We used data from the Utah Autism Research Project, described in Allen-Brady et al. (2010). Fifty-eight ASD participants (ages 3-36) were compared with 33 neurotypical controls matched for IQ and age. We conducted whole-brain analyses of structural MRI data. The ASD aggression group was defined using a score of >17 on the *Irritability* subscale of the Aberrant Behavior Checklist (ABC). Statistical analyses consisted of general linear models with brain measures as dependent variables predicted by group (low aggression controls, low aggression ASD, and high aggression ASD) while controlling for age and intracranial volume.
Results: Various frontal regions emerged as significant areas associated with increased aggression in ASD. The high aggression ASD group had decreased white matter volume in total frontal lobe bilaterally. Additionally they had increased gray matter volumes in left frontal pole and right mOFC. In addition to frontal areas, the high aggression ASD group had decreased white matter in the right temporal pole. An unexpected decrease in brainstem volume was also observed for the high-aggression group.
Conclusions: Consistent with morphological studies of ASD as well as studies of aggression, these data suggest abnormal neural organization in the frontal and temporal regions for ASD individuals with comorbid aggression. The decrease in key white matter volumes suggest a possible disruption in the neural network of the brain leading to increased aggression. Decreased brainstem volume may indicate the contribution of a low-level regulatory system contribution to impulse control difficulties associated with aggression.

31 **171.031** Co-Occurring Anxiety Disorders Are Uniquely Associated with Decreased Amygdala Volume in ASD

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Background: Although deficits in amygdala function have long been associated with autism spectrum disorder (ASD), findings of abnormal amygdala structure have been less consistent. The most recent data indicate that amygdala undergoes early overgrowth in ASD followed by attenuated growth (i.e., comparable to controls) beginning in early adolescence. However, research to date has largely failed to consider the influence of co-occurring anxiety disorders, which affect more than 40% of the ASD population and are associated with abnormal amygdala volume (including findings of both increased and decreased size). Individuals with ASD and co-occurring anxiety may have a unique trajectory of amygdala development that has been consistently overlooked.
Objectives: This study tests the hypothesis that individuals with ASD and co-occurring anxiety show abnormal amygdala structure (as indexed by amygdala volume).
Methods: 53 participants with ASD and 37 typically developing controls (TDCs; mean age = 12 years for both groups) underwent extensive diagnostic assessment and MRI scanning. ASD was assessed

using the Autism Diagnostic Observation Schedule and either the Autism Diagnostic Interview-Revised or DSM-driven parental interview. The presence or absence of an anxiety disorder was established using the Anxiety Disorder Interview Schedule. All participants completed a high-resolution T1-weighted structural MRI scan. ASD participants were categorized based on the presence or absence of a DSM anxiety disorder. The resulting three final groups (ASD+Anxiety [n = 28], ASD-Anxiety [n =25], and TDC [n = 37]) were matched on age and intellectual ability (measured via the Differential Abilities Scale - II). The ASD+Anxiety and ASD-Anxiety groups were matched on core ASD symptoms (measured via the Social Communication Questionnaire). Amygdala volumes were estimated using the FSL program FIRST, then manually inspected (data for two participants were discarded at this stage due to poor segmentations). Group differences in amygdala volume were estimated via a general linear model including total brain volume as a covariate.

Results: When covarying brain volume, the ASD+Anxiety group showed decreased right amygdala volume compared to the TDC and ASD-Anxiety groups (p-values of .035 and .003, respectively). The ASD-Anxiety and TDC groups did not differ in right amygdala size, nor were any group differences found in left amygdala volume. Although not predicted a priori, the ASD+Anxiety group also showed increased brain volume relative to the TDC group (p = .056), but not to the ASD-Anxiety group.

Conclusions: Individuals with ASD and co-occurring anxiety show a distinct amygdala abnormality that is not shared by individuals with ASD but non-clinical levels of anxiety. The present finding of decreased amygdala volume in ASD and anxiety is novel and consistent with some previous studies of anxiety disorders. On the other hand, findings of comparable amygdala volume between the ASD group without anxiety and the TDC group are consistent with previous studies showing null effects of amygdala volume in early adolescence. Brain volume results indicate that this relative decrease may need to be interpreted in the context of broader patterns of abnormal brain development that are unique to individuals with ASD and anxiety.

32   **171.032**   Correlations Between Depression and Anxiety Scores and Subcortical Regional Volumes in Autism Spectrum Disorder

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Background:
Comorbid conditions such as depression and anxiety (including obsessive-compulsive disorder (OCD)) are common among individuals with Autism Spectrum Disorder (ASD) with prevalence estimates of around 31% and 42% respectively (Joshi et al. 2013; Gjevik et al. 2011). Certain biological pathways, including subcortical brain regions, have previously been linked to anxiety and depression as well as to core symptoms of ASD (Ecker et al. 2012). Whether the biological pathways mediating symptoms of anxiety and/or depression in individuals with ASD resemble the pathways in non-ASD individuals is currently unknown. The identification of biological mechanisms mediating similar symptoms across a range of disorders is essential given the need to understand common vs distinct disease pathways.

Objectives:
The objective of this study was therefore to examine the neuroanatomical associates of depression and anxiety in individuals with ASD and typically developing controls. Specifically, we focussed on subcortical brain regions.

Methods:
We included 112 right-handed males (67) and females (45) with ASD (mean age 26 years, mean FSIQ 110), and 126 typically developing healthy (73 males and 53 females; mean age 28 years, mean FSIC 117). High-resolution structural T_1-weighted MRI images were acquired for all participants. The FreeSurfer image analysis suite was used for data pre-processing and automatic segmentation of subcortical regions, including amygdala, hippocampus, putamen, caudate, thalamus, pallidum and accumbens area. Between-group differences in volumes of individual subcortical regions were examined via a generalized linear model, controlling for total brain volume. Furthermore, we examined the relationship between subcortical volumetric measures and the severity of anxiety and depressive symptoms as measured by the Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI) and the Obsessive-Compulsive Inventory - Revised (OCI-R).

Results:
Individuals with ASD had a significantly increased volume of the right caudate ($F (14, 220) = 4.9$, $p = 0.03$), the left putamen ($F (14, 220) = 6.2$, $p = 0.01$), the total putamen ($F (14, 220) = 5.1$, $p = 0.02$), and the left nucleus accumbens ($F (14, 220) = 5.7$, $p = 0.02$). Also there were significant interactions between diagnosis and BAI scores in volume of the left thalamus ($F (14, 211) = 3.9$, $p = 0.05$) and right thalamus ($F (14, 211) = 5.8$, $p = 0.02$), and the left putamen ($F (14, 211) = 4.1$, $p = 0.04$) and right putamen ($F (14, 211) = 5.0$, $p = 0.03$). In right thalamus there was also a significant interaction between diagnosis and OCI-R scores ($F (14, 211) = 8.6$, $p = 0.004$).

Conclusions:
To our knowledge, this is the first study to provide proof of concept that biological differences in brain development may underpin *both* core symptoms of ASD and the severity of commonly co-occuring mental health symptoms.

171.033 Different Patterns of Cortical Brain Alterations in Preschool-Aged Boys with Autism Spectrum Disorder with and without Intellectual Disability

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Background: Autism spectrum disorder (ASD) is a heterogeneous condition, with varying behavioral presentations and comorbidities. Multiple etiologies and neural phenotypes likely exist. An estimated 30% of children diagnosed with ASD have comorbid intellectual disability (ID). Little is known, however, about how the neuroanatomical profiles differ between children with ASD with and without comorbid ID.

Objectives: We utilized multivariate pattern analyses to compare regional cortical gray matter measurements in preschool-aged boys divided into three groups: (1) ASD and comorbid ID (ASD+ID), (2) ASD without ID (ASD), and (3) age-matched typical developing (TD) controls.

Methods: Structural MRIs were acquired in 105 boys (28 ASD, 27 ASD+ID, 50 TD) with a mean age of 36.2 months. Cortical gray matter was parcellated into 34 gyral regions per hemisphere using Freesurfer (v5.1.0). Measurements included surface area, cortical thickness, and volume for each cortical region. Cognitive testing was carried out at two time points, one at study entry and again two years later (mean 65.9 months) using the Mullen Scales of Early Development. Development Quotient (DQ) scores were calculated at both time points, and a cutoff of 70 was used to determine ASD+ID and ASD groups. Only participants with stable DQ scores across both time points were included in this study. We utilized cross-validated linear support vector machine (SVM) analyses, controlling for total cerebral volume, to classify ASD+ID vs TD, ASD vs TD, and ASD+ID vs ASD. Left and right hemispheres were analyzed separately. Preprocessing included normalization across features. Recursive feature elimination was utilized to identify features with the greatest contribution to classifications. Result includes: (1) performance (accuracy, sensitivity, specificity) (2) weights of regions that contribute to each classification, and (3) comparison of features across three classification groupings.

Results: Classification accuracies were significant for all three comparisons. Left cortical volumes had the best discriminability for both ASD groups relative to TD, and there was significant overlap in the pattern of brain regions, particularly in the frontal and temporal lobes (e.g. temporal pole, medial orbitofrontal cortex, frontal pole, pars triangularis, caudal middle frontal gyrus, and pars orbitalis). There were, however, an additional 15 regions identified in the ASD+ID vs TD comparison diffusely distributed the entire brain. In contrast, there was only one region (entorhinal cortex) that was unique to the ASD vs TD comparison. Classification performance for discriminating between the two ASD subgroups (ASD+ID vs ASD) was also high. While cortical thickness did not achieve high accuracy in discriminating both ASD groups from TD, right cortical thickness had the highest discriminability for ASD +ID vs. ASD.

Conclusions: Children with ASD with and without comorbid ID have overlapping, but different neural phenotypes. Children with ASD+ID have a more diffuse pattern of alterations relative to TD controls. A better characterization of unique patterns of brain alterations in different subgroups of children with ASD may lead to more specific, targeted intervention strategies.

171.034 Group Differences in Head Motion May Confound Anatomical Connectivity Findings from DWI

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Background: Common findings in diffusion-weighted imaging (DWI) studies of children and adolescents with autism spectrum disorder (ASD) include reduced fractional anisotropy (FA), increased mean diffusivity (MD), and increased radial diffusivity (RD) of white matter tracts. Such effects have been reported by multiple groups particularly in frontal and temporal lobes and in the major association fasciculi. However, recent studies suggest that head motion may alter diffusion measures and result in spurious findings of group differences (Ling et al. 2012, Koldewyn et al. 2014, Yendiki et al. 2013), calling these results into question.

Objectives: To determine whether careful matching for head motion in DWI would alter findings of group differences in children and adolescents with ASD.

Methods: Diffusion weighted MRI was collected from 54 ASD and 44 typically developing (TD) participants ages 7-17 years. In a multi-stage process, groups were matched at increasing levels of stringency based on qualitative and/or quantitative assessment of head motion. Qualitative assessment included visual inspection for (i) slice-wise signal dropout (ii) image noise and (iii) shifts of head placement between acquisition of diffusion volumes (sensitization directions). Quantitative assessment included four motion measures (average inter-volume translation, average rotation, proportion of slices affected by signal dropout, severity of signal dropout) as described by Yendiki et al. (2013). At each matching stage, groups were compared on FA, MD, RD, and AD (axial diffusivity) using two approaches: Tract Based Spatial statistics (TBSS) and probabilistic tractography.

Results: When quality screening was not applied (n_{ASD}=54, n_{TD}=44) the ASD (compared to the TD) group showed higher RD diffusely throughout the right cerebral hemisphere, with modest effect sizes (Cohen's d≈.27) and no other significant differences. We then excluded participants with *any* visible

artifacts in the raw DWI images (stringent quality group: $n_{ASD}=30$, $n_{TD}=30$), after which no significant differences were found between groups on any diffusion measures. However, assessment of quantitative measures of motion showed residual differences in average motion between groups. When these carefully screened groups were *further* matched on the four quantitative measures of motion ($n_{ASD}=27$, $n_{TD}=22$), significantly higher RD was found in the right forceps major and splenium of the ASD group, with large effect sizes ($d≈.83$).

In preliminary analyses, we also performed probabilistic tractography on white matter projection paths, specifically the cortico-spinal tract and striato-frontal pathways, detecting significant group differences for cortico-spinal (AD) and striato-motor (MD, RD) tracts in full samples, but no significant group differences in stringently quality-controlled and matched groups.

Conclusions: Our results are partially consistent with those reported by Koldewyn et al. (2014), suggesting that group differences in head motion can have substantial effects on DWI findings. However, in contrast to this earlier study, we found that optimal group matching re-instated some between-group findings not seen in less tightly matched, but stringently quality-controlled data. These differences may reflect a subtle interplay between data quality, matching, and reduced statistical power in more selective subsamples. Given inadequate motion procedures in many previous DWI studies of ASD, the existing literature may have to be revisited with caution.

35 **171.035** Immunophenotype of Activated Astrocytes Associated with Brain-Region-Specific Neuronal Migration Abnormalities in Idiopathic Autism and Autism Caused By Chromosome 15q11.2-q13 Duplications

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Background: The majority of postmortem brain studies in autism are focused on neuron pathology as a direct cause of functional abnormalities. However, recent studies reveal that neurogenesis, neuron migration, cortical lamination, and synaptogenesis are regulated by astrocytes (Barres et al. 2008). Neuropathological studies of subjects diagnosed with autism demonstrate almost all neuronal abnormalities (Wegiel et al. 2012, Casanova et al. 2002, Hutsler and Zhang, 2010) known to be regulated by astrocytes. Immunocytochemical studies demonstrating reactive astrocytosis in the cerebral cortex and white matter (Vargas et al, 2005) and western blots demonstrating increased GFAP levels in the cerebral cortex and cerebellum of autistic brains (Laurence and Fatemi, 2005) may be associated with neuronal alterations. Based on our preliminary studies, we hypothesized that in autism, abnormal neuronal migrations, including ectopic and heterotopic neurons, and focal microdysplasia, are associated with the enhanced focal proliferation of astrocytes with an immature immunophenotype (strong expression of FMRP and minimal GFAP expression).

Objectives: 1. To demonstrate that the pattern of astrocytosis in autism is not random but brain region specific and enhanced in regions enriched in heterotopic neurons and microdysplastic areas. 2. To verify the hypothesis that the neuronal developmental abnormalities are associated with a similar pattern of astrocytosis regardless of autism etiology.

Methods: One formalin-fixed brain hemisphere from each of 7 subjects with idiopathic autism, 7 with dup15/autism 5 to 39-years of age, and 7 age-matched control subjects was dehydrated, embedded in polyethylene glycol (PEG) and cut into serial hemispheric 50-µm-thick sections. Global mapping and characterization of astrocyte immunophenotype was performed by the application of antibodies detecting glial fibrillary acidic protein (GFAP; pAb G9269) and mouse mAb MMS-5231 (BioLegend, Dedham, MA) which recognizes the 340-355 aa region of human FMRP (LaFauci et al. 2013) and labels cytoplasmic and nuclear FMRP in neurons, including subcortical ectopic or heterotopic neurons, as well as astrocytes typical for the early postnatal period of life.

Results: In contrast to the reported decrease/loss of astrocyte FMRP shortly after birth, hemispheric sections immunostained with mAb 6B8 revealed prominent FMRP immunoreactivity in astrocytes in several brain areas in subjects diagnosed with idiopathic autism and dup(15)/autism. The most common and prominent astrocytosis was found in the border between the cerebral cortex and white matter, and in the cortical molecular layer, both enriched in ectopic neurons. Clusters of FMRP+ astrocytes were detected in the deep layers of the cerebral cortex, in cerebellar white matter and cortex, as well as in the amygdala and thalamus. Strong FMRP immunolabeling was detected in astrocytes in the ventricular subependymal zone and adjacent white matter, as well as in the glia limitans both in control and autistic subjects. Double staining revealed that the majority of subcortical and cortical FMRP+ astrocytes expressed only traces of GFAP and resembled early postnatal phenotype.

Conclusions: This postmortem study demonstrates that FMRP+ astrocytosis is associated with cerebral and cerebellar neuronal developmental abnormalities in autistic subjects of unknown and known etiology. FMRP immunostaining reveals new properties and function of astrocytes in the brain of subjects with autism.

36 **171.036** Impaired White Matter Integrity in Unaffected Siblings of Probands with Autism Spcectrum

Disorders

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Background:
Increased head circumstances were noted between probands with autism spectrum disorders (ASD) and their unaffected siblings. Siblings, like their probands, revealed significantly reduced amygdala volume, as well as aberrant white matter integrity in the frontal, parietal and temporal lobes on structural MRI. However, considering the heterogeneity of ASD brains, using the whole tract to compare between siblings and controls may under-estimate the difference between siblings and controls.
Objectives:
This study aimed to investigate white matter integrity between unaffected siblings of ASD probands by using a segment-based analysis, and examined the clinical correlates.
Methods:
Forty unaffected siblings of probands with ASD (mean age 15.5±5.9 yrs; male n=29, 72.5%) were recruited with thirty-nine age-, sex-matched typically developing controls (14.7±6.3 yrs; male n=26, 66.7%). Using a clustering method for the diffusion spectrum images, we searched for the largest segment of each tract with the largest difference compared to controls.
Results:
Compared to matched controls, unaffected siblings showed reduced mean generalized fraction anisotropy (mGFA) on nine tracts, including bilateral frontal-aslent tracts, right superior longitudinal tract 2, right CST toe, frontostriatal tracts (left ventrolateral, right ventrolateral), thalamic radiation (left ventral, right dorsal), corpus callosum (splenium) and increased mGFA of precuneus. Among the ten tracts, reduced right SLF2 was associated with more stereotyped behaviors and overall social responsiveness deficits in the siblings. Besides, impaired frontostriatal tracts, thalamic radiation and splenium were associated with higher agitated, destructive behaviors, internalizing and externalizing symptoms. Moreover, several tracts in siblings were associated visual memory deficits, spatial working memory, and planning deficits.
Conclusions:
The unaffected siblings of ASD probands showed aberrant white matter integrity which were correlated with clinical autistic traits and executive dysfunction. The abnormal tract integrity could serve as a potential endophenotype for ASD research.

37   **171.037** Influence of Speech Onset Delay on Cortical Gyrification in Adolescent and Young Adults with Autism Spectrum Disorders

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Background: Autism spectrum disorders (ASD) particularities in cortical organization are not restricted to early childhood. For instance, gyrification, defined as the ratio of the inner to the outer cortical contour, locally differs between ASD and typically developing adolescents and young adults (Libero et al., 2014; Schaer et al., 2013; Wallace et al., 2013). Wallace *et al.* (2013) have reported gyrification increases in association cortices in ASD together with a discrepancy in the association between vocabulary scores and gyrification. Others have also found frontal gyrification increases in autism but not Asperger (Jou et al., 2010). This difference might be underlined by diverging language development, as symptomatic and structural heterogeneity in autism is believed to arise from increased neuro-plasticity that could target either speech or perceptual brain regions (Mottron et al., 2014).
Objectives: To examine whether the categorization of ASD individuals according to the presence or the absence of a speech onset delay can account for gyrification variability in ASD, especially in the perceptual association cortices.
Methods: High-resolution anatomical magnetic resonance imaging T1-weighted scans were obtained from 41 typically-developing young adults (5 females) and 61 individuals with ASD (7 females). ASD Subjects were divided according to the report of a Speech Onset Delay during childhood (SOD group, N=31) or not (NoSOD group, N=30) regardless of their DSM IV subgrouping (autistic or Asperger). The three groups were matched on age (14-38, mean≈22), FSIQ (66-131, mean≈104) and handedness. Following the 3-D methodology by Schaer *et al.* (2008), accurate measurements of local Gyrification Indexes (IGI) were computed using FreeSurfer. Age influences were modeled separately for each

group. Group*age interaction and main effect of group on local gyrification were explored. Clusters of significant differences are reported at p=.01 but were not corrected for multiple comparisons.
Results: Both ASD groups showed areas of higher lGI compared to controls: right anterior cingulate and precuneus (SOD) as well as several clusters in bilateral medial and orbito-frontal cortex, right precuneus, superior frontal and temporal cortices (noSOD). Differences between the ASD groups and controls in relation to age were observed, in orbito-frontal, superior frontal, middle temporal, anterior cingulate and mainly in the right precuneus, where the unfolding rate was lower in controls compared to both the SOD and noSOD groups. Gyrification was higher in the noSOD versus the SOD group in some frontal and temporal clusters, in bilateral occipital cortices and in a larger region encompassing parts of the right inferior parietal and occipital lobes. This perceptual region overlaps with the most extended cluster showing age-related folding differences, i.e. where gyrification decreased faster in the noSOD than in the SOD group.
Conclusions: While some regions of increased gyrification in ASD correspond to recent results, those involving frontal and cingulate cortices, together with differences between ASD subgroups based on language acquisition in age-related changes, represent new findings. Evidencing the relevance of gyrification measures in ASD structural studies, this work, by detecting differences in parieto-occipital perceptual associative regions between ASD subgroups also highlights the importance of considering speech onset categorization in autism research.

38   **171.038** Intrainsular White Matter Connectivity and Sensory Profiles in Children with and without Autism Spectrum Disorder

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Background: Individuals with autism spectrum disorder (ASD) have impairments in social responsiveness as well as altered responsiveness to sensory stimuli. While the relationship between these symptoms is not known, the insula is a region of interest given its involvement in processing both sensory and social stimuli (Craig, 2011). The functional anatomy of the insula follows an anterior-posterior gradient, with various sensory representations along the length of the axis including social/affective touch in the most posterior region (Olausson et al., 2002) and oral sensory stimuli more anteriorly. The most anterior region of the insula functions as a salience detector, evaluating sensory stimuli for affective relevance and acting as a hub to link salient stimuli to large scale neural networks for attention (Menon and Uddin, 2010) . White matter connections between regions of the insula may therefore serve as a pathway for the emotional processing of sensory stimuli, and may be particularly relevant for understanding the link between sensory and social responsiveness in ASD. Because of its importance for social development and its representation in the insula, the present study focused on the sense of touch.
Objectives: We sought to explore properties of white matter connectivity between the anterior and posterior insula and their associations with sensory profiles including measures of responsiveness to social touch in children with and without ASD.
Methods: 24 children with ASD and 20 children with typical development completed MRI scans and their parents completed questionnaires about sensory behaviors. Anterior and posterior insular seeds were defined using a parcellation generated on a standard template (Farb et al., 2013). Probabilistic tractography was used to generate white matter tracts between the seeds. Fractional anisotropy (FA) and tract volumes normalized for total brain volume were calculated for each subject. Independent samples t-tests were conducted to explore group differences in FA and tract volume, and correlations were used to assess relations between tract characteristics and sensory profiles.
Results: FA and relative tract volumes were both decreased in the ASD group compared to the typically developing group (FA: t (52)=-2.186, p=.033, volume: t(53)=-2.241, p=.029). Within the ASD group, decreased intrainsular FA was associated with aberrant response to social sensory stimuli across sensory modalities (r=-.531, p=.008). Decreased tract volume was associated with aberrant response to social touch (r=-.433, p=.034) and tactile hyporesponsiveness (r=-.417, p=.04). Increased tract volume was associated with unusual sensory interest in touch (r=.441, p=.03). There were no significant associations between FA or volume and sensory profiles within the TD group alone.
Conclusions: We noted differences in the intrainsular white matter microstructure between individuals with and without ASD. These results suggest smaller and less organized tracts connecting the posterior sensory insular cortex to the anterior salience detector in individuals with ASD, and this disorganization is associated with altered responsiveness to social sensory stimuli, particularly touch. This suggests that individuals with ASD may ascribe less salience to social touch stimuli, which may impact social function, given the primacy of touch in early social development.

39   **171.039** Longitudinal Cortical Thickness Development in Relation to Changes in SRS Scores over Time in Autism

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Background: The relationship between brain development, clinical heterogeneity and outcome in autism is unknown. Our group previously described widespread abnormalities in longitudinal cortical thickness age-related changes in autism compared to a typically developing sample. Here we expand on these initial findings and examine brain growth associated with changes in clinical characteristics within our autism sample.

Objectives: To identify regional differences in longitudinal cortical thickness age-related changes in autism participants whose autism traits decrease over time vs. increase over time, as measured by the Social Responsiveness Scale (SRS).

Methods: Freesurfer-derived cortical thickness measurements were examined in 73 males with autism (age 3-36 at first MRI scan) scanned up to three times, on average every 2.5 years. SRS scores obtained at the initial scan and a follow-up timepoint were compared, resulting in a slope estimate for each participant. Participants were classified as having autism traits that "decreased" vs. "increased" over time if their slopes fell outside of one standard deviation of a typically developing comparison sample. Mixed effects models were used to compare longitudinal cortical thickness changes between the autism subgroups.

Results: Individuals whose SRS Total Score or autism traits decreased over time (n=18) had a greater rate of cortical thinning in the right lateral orbitofrontal, middle temporal, insular cortex, and left parahippocampal and left precuneus cortex. Those whose autism traits increased over time (n=20) showed a greater rate of cortical thinning in the right rostral anterior cingulate cortex, left bank of the superior temporal sulcus and temporal pole. A decrease in SRS Autistic Mannerisms over time (n=34) was associated with reduced cortical thinning in the cingulate (bilateral rostral anterior, right caudal anterior and isthmus), right fusiform, left bank of the superior temporal sulcus and temporal pole.

Conclusions: Our findings suggest regional differences in cortical thickness age-related changes may be associated with improvement or worsening of autism symptomatology in late neurodevelopment. Cortical thickness of the middle temporal and bilateral cingulate regions overlap with those identified in a genetic analysis of candidate genes for autistic traits in a typically developing sample (Hedrick et al 2012). Interestingly, only one region identified in our current analysis was also described as atypically developing in a group level analysis of our larger autism sample vs. our typically developing group (Zielinski et al. 2014). These findings highlight the importance of examining clinical heterogeneity within autism samples and accounting for changes in autism traits over time when measuring brain-based biomarkers.

40   **171.040** Maturational Differences in Auditory Event-Related Potentials According to Presence Versus Absence of Language Impairment in Children with Autism Spectrum Disorder

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Background: Age-related maturation in sound processing has previously been examined in children by evaluating auditory event-related potentials (AEPs) in response to a single tone using intra-class correlation (ICC). Using this approach, it has been shown that children who have a language impairment but are otherwise typically developing (specific language impairment) have immature AEPs that resemble younger children with typical development. This suggests that maturational delay in auditory cortical processing may contribute to language impairment. Less is known about language impairment in autism spectrum disorder (ASD). Many children with ASD have an oral language impairment, and some have argued that the etiology of language impairment in ASD overlaps with specific language impairment. Few studies have focused on auditory processing in children with ASD, and no study to date has explored the use of ICC to evaluate auditory cortical maturation in children with ASD who have impaired language (ASD-LI) or normal language (ASD-LN).

Objectives: 1) To evaluate the maturation of AEP waveforms of children with ASD-LN and ASD-LI compared to normative waveforms of children with typical development; 2) to compare AEP maturational differences between ASD-LN and ASD-LI.

Methods: Eighty-four children aged 7-11 years (typical development: N=67, ASD-LI: N=7, ASD-LN: N=10) 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 while the child watched a silent movie. Children in the groups with typical development and ASD-LN had standard scores ≥ 85 on the *CELF–4*, while those with ASD-LI scored < 85 (greater than 1 *SD* below the mean). Children with typical development were separated into four groups according to age, and a normative grand averaged AEP waveform was generated for each age: 7, 8, 9, 10 years (N=15, 16, 22, 14, respectively). The individual waveforms of each child with ASD-LI and ASD-LN were compared to each of these four normative waveforms at three frontal electrodes (F3, Fz, F4) and an ICC was

calculated for each comparison. Since higher ICCs indicate a better resemblance of two waveforms, each electrode was assigned an age-equivalent based on the comparison that yielded the highest ICC. The average age-equivalents of the three frontal electrodes between the groups with ASD-LI and ASD-LN were compared using independent t-tests.

Results: Children with ASD-LI and ASD-LN did not significantly differ in chronological age (mean age = 9.1 and 9.0 years, respectively), but did significantly differ in language ability (mean standard score = 70 and 99). In terms of AEP maturity, the ICC-estimated age-equivalents of the waveforms of children with ALI were significantly lower than for those with ASD-LN (mean age-equivalent = 7.4 years and 8.4 years, respectively, $t(15)=2.71$ $p<.05$).

Conclusions: Results revealed that AEP waveforms in children with ASD-LI were less mature than those with ASD-LN. Such immaturity was not related to chronological age, but rather to language ability. This suggests that, as previously reported for specific language impairment, language impairment in ASD may be related to delayed neural maturation of auditory processing.

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41 **171.041** Microstructural Covariance of White Matter in Autism Spectrum Disorder

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Background: Brain imaging findings in children with autism spectrum disorder (ASD) suggest this condition is associated with altered white matter microstructure, which may lead to atypical brain "connectivity" (for a review, see Travers et al., 2012). Nevertheless, there is substantial heterogeneity in the behavioral phenotype of ASD, and it is unclear whether individuals with ASD have atypicalities of white matter microstructure that are localized to specific tracts. To assess this, one may examine how different white matter tracts relate to each other in typically developing (TD) individuals and then compare these patterns to those found in ASD. If white matter microstructural abnormalities are localized to specific tracts in ASD, then there will be atypicalities in the microstructural properties of these tracts in ASD than in typical development. Understanding specific white matter network "signatures" at group and individual levels may help us better determine meaningful classifications within the autism spectrum.

Objectives: We examined the extent to which the underlying white matter microstructure, as measured by diffusion tensor imaging (DTI), of each white matter tract related to that of each other white matter tract. We then compared the correlation matrix of diffusion coefficients of the ASD group to that of the TD group to determine the degree of similarity of the white matter tracts between each group.

Methods: *MRI Acquisition*: Participants for this study consisted of 100 males with ASD and 57 age-matched TD males between 3 and 39 years of age. DTI data were acquired from each participant, images were corrected for distortion and head motion and maps of fractional anisotropy (FA), mean diffusivity (MD), and radial diffusivity (RD) were calculated; only FA was used herein. *Analysis:* Mean FA from 48 major white matter tracts, as defined by the JHU ICBM-DTI-81 template, were extracted from each individual dataset. To examine the covariance of the microstructure of these white matter tracts between ASD and TD individuals, a matrix of the correlation between each of the 48 white matter tracts was generated for the ASD group and the TD group, separately. Box's M-test was then used to examine whether these matrices were significantly different.

Results: A gravitational plot of the organization of white matter microstructure of ASD and TD groups is depicted in Fig. 1. The correlation matrix of the ASD group was found to be significantly more widespread than the correlation matrix of the TD group ($p = .027$).

Conclusions: Our results suggest that, at the group level, individuals with ASD have significantly less uniform white matter microstructure across multiple tracts of the brain compared to individuals with typical development. This suggests the possibility of more tract-specific white matter microstructure atypicalities in ASD. Future analyses will examine this white matter microstructural covariance at the individual level to determine possible biology-derived subgroups in ASD.

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42 **171.042** Neuroanatomical Abnormalities Are Shared By Males with Autism and Their Unaffected Brothers

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Background: Autism is a highly heritable neurodevelopmental disorder, yet the search for genes with a definitive role in its etiology has remained elusive. Deconstructing the disorder with endophenotypic approach, where the variance is thought to be associated with a fewer number of genes, should boost the statistical power of molecular genetic studies and clarify the pathophysiology of autism.

Objectives: We aimed to test for neuroanatomical endophenotypes in a group of males with autism, their unaffected brothers, and typically developing control (TDC) males.

Methods: The 94 participants (aged 9-19 years) consist of 20 males with autism (mean age, 13.3 ±

2.5 years; mean full-scale IQ, 103.8 ± 17.8), 20 unaffected brothers (mean age, 14.4 ± 3.1 years; mean full-scale IQ, 112.0 ± 10.4), and 54 TDC males (mean age, 12.8 ± 2.6 years; mean full-scale IQ, 112.5 ± 11.6) received clinical and neuropsychological assessments and undertook structural magnetic resonance imaging scans. Voxel-based morphometry using DARTEL approach was performed to obtain regional gray and white matter volumes. General linear analyses of the volumes of brain regions, adjusting for age, full-scale IQ and tissue specific volume, were used to compare the three groups. Conjunction analysis for global differences was done at a cluster level (clusters surviving familywise error p<0.05, with cluster-forming threshold at p < 0.005).

Results: There were no differences in global gray matter, white matter, and total brain volumes among three groups. We found abnormal neuroanatomy in gray matter volume in the mid-cingulate cortex, precentral cortex, alongside rolandic operculum, and white matter volume in the bilateral superior corona radiata and hippocampus portion of the cingulum bundle were shared between males with autism and their unaffected brothers as compared to the TDC males.

Conclusions: The present study had limitations of relatively small sample size and caveat of generalization to other subgroups on the autism spectrum conditions. Nonetheless, our findings suggest that atypical neuroanatomy in the brain regions related to motor, language, and memory processing may be an endophenotypic marker for autism. Functional implications for these shared neuroanatomical abnormality warrants further investigation.

43 **171.043** Probing the Neural Circuits Underlying the Social Brain Using Diffusion Tractography and Graph Theory

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Background: Recent functional imaging, lesion and neurophysiological studies have identified a group of functionally associated brain areas as the neural basis for social cognition, which are commonly referred to as the social brain. While social deficits are the hallmark of autism spectral disorders (ASD)(Ditcher, 2012), work on systematically mapping the underlying networks connecting these brain regions and studying the topological characteristics of the networks is lacking.

Objectives: The objectives of the current study are to dissect the aforementioned anatomical network using diffusion tractography and to probe its structural architecture using graph theory methods.

Methods: *Subjects:* 20 healthy right-handed human subjects (age: 39.3±11.9 yrs, 10 females) were included in the analyses. *MRI data acquisition:* MRI data were obtained using a 3T Siemens Trio Tim scanner. The imaging parameters for T1w and diffusion MRI can be found in our previous work(Li, 2013). *Social brain network reconstruction:* As no single task can concurrently activate all brain regions underlying social processing, we chose our nodes based on the collated coordinates of activated brain areas in previous task fMRI studies(Overwalle, 2009)**.** The fusiform face area (FFA), the superior temporal sulcus (STS), the inferior parietal lobe (IPL) and premotor cortex (PMC), the temporoparietal junction (TPJ), precuneus (PC), ventromedial prefrontal cortex (vmPFC) and amygdala (AMG) were included in the analyses. Spherical regions-of-interest (ROIs) centered at each coordinate were generated, projected onto a surface-based template in FreeSurfer, and then transformed to each individual's space. We used probabilistic diffusion tractography, implemented in FSL, to track the anatomical connections among the sixteen social brain ROIs. After the connections between each ROI pair were derived, the thresholded tract volumes were employed as an index of connectivity strength between seed ROI pairs(Li, 2012). In graph theoretic analyses, we used four complementary measures to indicate whether a node plays a central role in a network (also called hub)(Li, 2013). Nodes that were ranked in the top percentile in the majority of the four centrality measures were identified as putative hubs in the network. Results:

Results: The spatial trajectories of the pathways mapped using diffusion tractography were consistent with those identified using invasive tracer methods in monkeys. Based on the four centrality measures, the most frequently occurring putative hub under varying thresholds was the left AMG, followed by the right PC and right AMG.

Conclusions: We mapped the anatomical connections among sixteen social brain areas using diffusion probabilistic tractography and then analyzed the structural architecture of the network using graph theory methods. We identified bilateral AMG and the right PC as the most frequently identified hubs. Our AMG findings are consistent with electrophysiological, lesion, and functional imaging studies demonstrating the critical role of the amygdala in social perception and cognition. Our network approach may provide a new avenue for examining function and dysfunction among the social brain network in ASD.

44 **171.044** Repetitive Behavior Symptoms Associated with Hippocampus and Amygdala Volumes in ASD

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Background: Although restricted and repetitive behaviors and interests (RRBI) are hallmark signs of autism spectrum disorders, the underlying neural mechanisms have received little attention in the

literature. Recent behavioral research (e.g., Wigham et al., 2014; Rodgers et al., 2012) has suggested strong links between repetitive behaviors and symptoms of anxiety that are quite frequent in ASD samples. In typical populations, symptoms of anxiety are known to arise in part from atypical function of the medial temporal lobe (MTL) including amygdala and hippocampus. We therefore investigated whether MRI-obtained volumes of these structures may relate to anxiety and RRBI symptoms in ASD adults.

Objectives: We hypothesized three-way associations between structural volumes of the hippocampus and amygdala with behavioral measures of RRBI and anxiety in our ASD sample more than in controls.

Methods: Young adults (ages 18-30) diagnosed with autism spectrum disorders (ASD, n =21) and age- and IQ-matched healthy college students (n = 20) completed MRI scans after completing a series of dimensional autism and emotion regulation surveys administered via internet-based software. Structural volumes of the hippocampus were obtained using hand-tracing by expert raters and additional ratings using established Freesurfer protocols. Amygdala volumes were obtained from Freesurfer.

Results: Hippocampus and amygdala volumes were not significantly correlated with either age or Full Scale IQ. In line with our previous work, the specific anxiety measure of *intolerance of uncertainty* was significantly correlated in the ASD with the *Mannerisms* subscale of the Social Responsiveness Scale-2nd Edition (SRS-2); general trait measures of anxiety (the STAI-Trait and Beck Anxiety Inventory) were not. In the ASD group, both right and left hippocampus volumes (using both estimating methods) as well as amygdala volumes were significantly, positively correlated with the SRS-2 *Mannerisms*scale, but not with any anxiety measures. In contrast, the control group showed significant negative associations between trait anxiety and both left amygdala and left hippocampus.

Conclusions: The heterogeneity of autism spectrum disorders is challenging to match to brain-based measures, but narrower phenotypes may provide a useful platform for analysis. Here we show differential associations between brain volume of critical MTL structures with repetitive behaviors in ASD and trait anxiety in controls. Future research using both functional and other structural (e.g., DTI) methods may elucidate differences in these networks that aid understanding of etiology and targeted strategies for intervention.

45   **171.045** Structural Connectivity Between Orbitofrontal Cortex and Amygdala and Its Association with Socio-Emotional Skills in Autism Spectrum Disorder

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Background: Individuals with Autism Spectrum Disorder (ASD) have social and communication deficits, demonstrate restricted and repetitive behavior, and show difficulties with emotion regulation.

Objectives: The goal of this investigation is to increase our understanding of the neural correlates of social skills and emotional regulation in children and adolescents with ASD. We particularly focused on the uncinate fasciculus since this white matter tract connects the amygdala with the orbito-frontal cortex which are involved in socio-emotional processing.

Methods: The association between white matter integrity in the left and right uncinate fasciculus and social skills and emotion regulation was examined in 18 high functioning individuals with ASD and 18 group-matched typically developing (TD) controls using Diffusion Tensor Imaging. To test specificity of the associations between white matter integrity and socio-emotional skills, the relationship between the uncinate fasciculus and restricted and repetitive behaviors was examined as well. Emotion regulation, social skills, and repetitive behaviors were assessed using parent-report measures.

Results: Compared to TD individuals, individuals with ASD had lower fractional anisotropy in the left uncinate, but not in the right uncinate. Group moderated the association between left uncinate and socio-emotional skills, indicating that within the ASD group, white matter integrity was associated with socio-emotional skills. Further analyses revealed that individuals with ASD with lower white matter integrity had increased social deficits and increased difficulties regulating emotions. There was no association between white matter integrity in the left and right uncinate and restricted and repetitive behaviors.

Conclusions: This study provides preliminary evidence that the left uncinate may play a critical role in social skills and emotion regulation in individuals with ASD. Additional investigations are needed to examine these relationships in a larger sample size that includes lower functioning individuals.

46   **171.046** Temporal Lobe over-Connectivity Differentiates Autism Spectrum Disorder from Other Neurodevelopmental Disorders in Toddlers: A Hardi Diffusion MRI Study

E. Conti[1,2], J. Mitra[3], S. Calderoni[2], G. Cioni[1,2], S. Mazzotti[2], F. Muratori[1,2], S. Rose[4], K. K. Shen[4] and A. Guzzetta[1,2], (1)Developmental Neuroscience, University of Pisa, Pisa, Italy, (2)Stella Maris Scientific Institute, Pisa, Italy, (3)Digital Productivity Flagship, The Australian eHealth Research Centre, CSIRO, Herston, Australia, (4)The Australian eHealth Research Centre, CSIRO, Brisbane, Australia

Background: One of the greatest priorities for clinicians dealing with autism spectrum disorder (ASD) is the need for early predictive biomarkers, allowing for a prompt specific intervention apt to improve

long-term outcome. Advanced connectivity studies are emerging in the literature reporting a disrupted connectivity in toddlers with ASD, detectable even before the full phenotypic expression of the disease. Most of these studies however, compare ASD and typically developing subjects, thus providing little information on the specificity of the abnormalities detected as to other neurodevelopmental disorders (NDD). To our knowledge, only one recent study explored brain structural differences between toddlers presenting with ASD and NDD, through a voxel-based approach. It mainly showed increased volumes of grey and white matter within the temporal lobes and higher fractional anisotropy in the corpus callosum, posterior cingulate cortex, and limbic lobes.
Objectives: We performed a whole-brain tractography study in toddlers from two clinical groups, ASD and other NDDs, matched for age and gender, to identify the networks showing significantly different connectivity.
Methods: As part of an ongoing prospective project, we enrolled all children referred to our tertiary care centre for neurodevelopmental disorder from January 2012. Subjects were included if they i) received a clinical diagnosis of Neurodevelopmental Disorder, ii) were aged under 36 months, iii) had no neurometabolic or genetic syndromes and iv) performed a brain MRI. A total of 59 subjects with NDD fulfilled our inclusion criteria. The cohort was further divided into two groups, based on clinical assessment: ASD (n=39; mean age=27 months) and NO-ASD (n=20; mean age=30 months).
Brain MRI was performed on a 1.5T GE scanner. High angular resolution diffusion imaging (HARDI) scans were acquired using 31 diffusion weighted images (b value = 1000 s x mm^-2). Image post-processing consisted of cortical parcellation of the T1 images into 90 regions excluding the cerebellum. Whole brain probabilistic tractography was done using the Anatomically Constrained Tractography (ACT) framework of MRtrix. Further, SIFT was used to reduce bias over longer streamlines. Network connectivity matrices of size 90x90 were built that encoded the number of streamlines connecting each pair of cortical regions. Network Based Statistics (NBS) was finally applied on the connectivity matrices to evaluate the network differences between the ASD and DD groups.
Results: The network differences revealed over-connectivity (higher number of streamlines) in the ASD group with a significance of p<0.05. Two main networks were identified, both centered on the superior temporal gyrus, one in the left hemisphere (5 nodes and 4 edges) and the other in the right hemisphere (3 nodes and 3 edges). No networks showed significant over-connectivity in the DD group.
Conclusions: This is the first tractography study comparing toddlers with ASD and other NDDs. We report a trend in over-connectivity in toddlers presenting with ASD, particularly in networks involving the temporal lobes, known to be crucial for social-skills development. This extends previous findings from voxel-based analysis showing increased volumes in comparable regions. Further studies are needed to confirm our findings and to clarify their translational significance.

47 **171.047** The 16p11.2 Locus Modulates Brain Structures Common to Autism, Schizophrenia and Obesity

A. M. Maillard[1], A. Ruef[2], F. Pizzagalli[3], E. Migliavacca[4], L. Hippolyte[3], S. Adaszewski[3], J. Dukart[3], C. Ferrari[3], P. Conus[3], K. Männik[4], M. Zazhytska[4], V. Siffredi[3], P. Maeder[3], Z. Kutalik[3], F. Kherif[3], N. Hadjikhani[5,6,7], J. Beckmann[3], A. Reymond[8], B. Draganski[3,9] and S. Jacquemont[1], (1)Service of Medical Genetics, Lausanne University Hospital, Lausanne, Switzerland, (2)LREN - Département des neurosciences cliniques, Lausanne University Hospital, Lausanne, Switzerland, (3)Lausanne University Hospital, Lausanne, Switzerland, (4)University of Lausanne, Lausanne, Switzerland, (5)Massachussetts General Hospital, Charlestown, MA, (6)Brain Mind Institute, EPFL, Lausanne, Switzerland, (7)University of Gothenburg, Gothenburg, Sweden, (8)Center for Integrative Genomics, University of Lausanne, Lausanne, Switzerland, (9)Max Plank Institute, Leipzig, Germany

Background: Anatomical structures and mechanisms linking genes to neuropsychiatric disorders are not deciphered. Reciprocal copy number variants at the 16p11.2 BP4-BP5 locus offer a unique opportunity to study intermediate phenotypes in carriers at high risk for autism spectrum disorder (ASD) or schizophrenia (SZ).
Objectives: The aim of this study is to investigate variation in brain anatomy in 16p11.2 deletion and duplication carriers.
Methods: We acquired T1 - and diffusion-weighted images. Analysis was performed using voxel-based statistical methods in SPM8
Results: Beyond gene dosage effects on global cortical surface, grey and white matter volumes, we show that the number of genomic copies is negatively correlated to grey matter volume and white matter tissue properties in cortico-subcortical regions implicated in reward, language and social cognition. Despite the near absence of ASD or SZ diagnoses in our 16p11.2 cohort, the pattern of brain anatomy changes in carriers spatially overlaps with the well-established structural abnormalities in ASD and SZ. Using measures of peripheral mRNA levels, we confirm our genomic copy number findings.
Conclusions: This study identifies an intermediate phenotype under gene dosage influence in 16p11.2 carriers. This combined molecular, neuroimaging and clinical approach, applied to larger datasets, will help interpret the relative contributions of genes to neuropsychiatric conditions by measuring their effect on local brain anatomy.

48 **171.048** The Effect of Demographic and Clinical Features on the Volume of Corpus Callosum in Preschoolers with Autism Spectrum Disorder: A Case-Control Study

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Background:
A growing body of literature has identified size reduction of the corpus callosum (CC), in subjects with autism spectrum disorders (ASD). The CC volume also appears to be inversely related to autism severity and to intelligence quotient (IQ). However, to date very few studies have been conducted on preschool-age ASD children.
Objectives:
to compare the volume of CC and its sub-regions between preschoolers with ASD and controls subjects (CON) and to examine their relationship to demographic and clinical variables (gender, age, non-verbal IQ –NVIQ-, expressive non-echolalic language, emotional and behavioral problems, and autism severity).
Methods:
CC volume of 40 preschoolers with ASD (20 M and 20 F; mean age: 49 ± 12 months; mean NVIQ: 73 ±22) and 40 gender, age, and NVIQ-matched CON subjects (20 males –M- and 20 females –F-; mean age: 49 ± 14 months; mean NVIQ: 73 ± 23) were quantified with an automated parcellation approach using FreeSurfer software (http://surfer.nmr.mgh.harvard.edu/) on MRI images. Clinical parameters were assessed using standardized tests, such as Leiter International Performance Scale-Revised, or Griffiths Mental Development Scale for intelligence quotient, Autism Diagnostic Observation Schedule-Generic (ADOS-G) for autism severity, consensus group about productive language abilities in ASD children (Tager-Flusberg et al., 2009) for level of expressive non-echolalic language, Child Behaviour CheckList 1½-5 (CBCL 1½-5) for emotional and behavioral problems.
Results:
no significant volumetric differences in CC total volume between ASD and CON were found when Total Brain Volume (TBV) was used as a covariate (p=0.15). Analogously, absence of CC volumetric differences was evident when boys and girls with ASD were compared to their matched controls (M: p=0.57; F: p=0.53). By further subdividing the CC into five anatomically discrete portions (anterior, mid-anterior, central, mid-posterior and posterior), no statistically significant differences in volumes of CC subregions between ASD patients and CON were detected, considering TBV as covariate. CC total volume was positively correlated with age in CON (p=0.009), but not in ASD subjects. Moreover, CC total volume were negatively correlated with ADOS-G total score (p= 0.018), and with ADOS-G Language and Communication-subscores (p=0.017), whereas no association between CC volume and other variables (NVIQ, language, emotional and behavioral problems) was detected.
Conclusions: In agreement with some, but not all, of the studies on CC volume in ASD subjects, we didn't find CC volumetric differences between ASD preschoolers and carefully matched controls. The absence of positive correlation between CC volume and age in ASD patients confirms the atypical growth trajectory widely reported in these young children, whereas the indirect relationship between CC volume and ADOS-G scores suggests the involvement of the CC in core ASD symptoms.

49 **171.049** White Matter Integrity Associated with Symptoms of Co-Occurring Mood and Anxiety Disorder in Autism Spectrum Disorder: A Tract-Based Spatial Statistics and Tractography Analysis

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Background: Adults with autism spectrum disorder (ASD) have a very high risk of experiencing mood and anxiety disorders. These symptoms can cause significant impairment to quality of life and place a high burden on family and carers. To inform better preventative and treatment strategies, it is important to examine the neurobiological basis of mood and anxiety disorders within people with ASD.
Objectives: To examine brain white matter (WM) tract integrity associated with symptoms of mood and anxiety disorder in adults with ASD.
Methods: We examined WM tract integrity using diffusion tensor imaging (DTI). We recruited 50 adults with ASD and 59 healthy controls who were assessed by gold standard self-report screening tools for symptoms of mood and anxiety disorders. The analysis consisted of whole-brain tract-based spatial statistics (TBSS) and atlas based tractography of the extended limbic pathways (uncinate fasciculus, cingulum, fornix, inferior longitudinal fasciculus (ILF) and inferior fronto-occipital fasciculus (IFOF)) and

subregions of the corpus callosum (CC). We compared DTI measures (number of streamlines, fractional anisotropy, mean diffusivity and perpendicular diffusivity) between the ASD cases and the controls and correlated them with clinical symptom severity.

Results: Our TBSS results demonstrated that ASD cases had significantly lower fractional anisotropy in a number of regions including; the CC, the uncinate fasciculus, cingulum and IFOF. We also observed higher mean diffusivity in the genu of the CC, IFOF and superior longitudinal fasciculus. Although there were no significant correlations with mood and anxiety symptoms in the TBSS analysis, the tractography analysis revealed significant correlations with these symptoms, particularly in the anterior regions of the CC, the left cingulum, uncinate fasciculus and ILF and the right IFOF.

Conclusions: To our knowledge, this is the first DTI study correlating co-occurring symptoms in adults with ASD. We demonstrate that many of the same WM regions that differ between ASD and controls are also associated with mood and anxiety symptoms within people with an ASD. This suggests a limbic system-related common aetiological pathway for mood/anxiety disorders and ASD. We also found preliminary evidence that the WM underlying symptoms of co-occurring conditions may be different in ASD. Further investigation is needed to relate these differences to differences in treatment response.

50 **171.050** Widespread White Matter Diffusivity Changes in Autism: A Tract Based Statistical Analysis of Diffusion Tensor Imaging Study

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Background: Characterizing the features of white matter structural connectivity is of central importance in autism brain science. Many studies have shown differences in white matter between children with autism spectrum disorders (ASD) and children with typical development (TD). Diffusion tensor imaging (DTI) techniques can be used to quantify white matter integrity in vivo in terms of fractional anisotropy (FA) and mean, axial and radial diffusivity (MD, RD, AD). Here we applied tract-based spatial statistics (TBSS) to compare children with autism spectrum disorders (ASD) and children with typical development (TD) regarding the orientation, coherence and magnitude of their white matter tracts. We hypothesized that tissue pathophysiology documented in autism, particularly neuroinflammation, would lead to lower FA and greater diffusivity in ASD

Objectives: To characterize white matter microstructure as part of an ongoing multimodal investigation of the relationships among structural, functional and pathophysiological features of brain in autism.

Methods: Magnetic resonance volumetric and diffusion tensor imaging were performed on 50 males, 23 ASD (10.43y± 1.77, NVIQ 99.77±17.11), 27 TD (9.94y± 2.49, NVIQ 113.34±16.59). ASD diagnosis was ascertained using ADOS and clinical assessment. DTI metrics (FA, MD, AD, RD) were generated by FSL (FMRIB Software Library V5.0.6), and then aligned and projected onto the mean FA skeleton which represents the centers of all the tracts. Between group voxelwise statistical analysis was applied to the resultant data. To test for (Group X Age) interaction we performed GLM analysis using age as a covariate

Results: Our results revealed significantly increased right and left hemispheric white matter MD and RD in the ASD group as compared to the TD group in the anterior thalamic radiation, cortico-spinal tract, forceps major, inferior fronto-occipital fasciculus, inferior and superior longitudinal fasciculus (as well as the temporal part of the superior longitudinal fasciculus), the uncinate fasciculus, cingulate gyrus and the hippocampal cingulum. AD was significantly higher in the ASD group only in the left hemispheric white matter in the anterior thalamic radiation, cortico-spinal tract, inferior fronto-occipital fasciculus, inferior and superior longitudinal fasciculus as well as the temporal part of the superior longitudinal fascicules and the uncinate fasciculus. There was no significant difference between the groups regarding FA. When we added age as covariate using GLM, we found that MD, AD and RD retained significance in the above-mentioned tracts, and that FA was did not achieve significance

Conclusions: Our findings suggest widely distributed differences between ASD and TD in the white matter fiber tracts with many fiber tracts involved. Such differences may be related to specific genetic or functional vulnerability of these tracts, but the distribution of this increased diffusivity appears more consistent with a downstream effect of a more widespread abnormality in the brain that may involve both the axons and the tissue milieu around the tract fibers, including the extracellular matrix, which could impact diffusivity measures. Follow-up multimodal analyses are planned to assess the correlation of these changes with measures of functional connectivity in the same subjects.

**Poster Session
172 - Brain Function**
11:30 AM - 1:30 PM - Imperial Ballroom

51   **172.051**   A Proton 7T MR Spectroscopy Study of ASD: Altered Creatine Levels

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Background: Magnetic Resonance Spectroscopy (MRS) can be a useful method to study pathophysiological changes in ASD. Several studies have reported reductions in NAA, Cr, Cho and GABA in many brain regions of individuals with ASD, suggesting abnormalities in the excitatory and inhibitory balance in the brain, as well as neuronal and glial densities. However, depending on factors like participant age and brain region, these results tend to vary. Moreover, the vast majority of these studies have been carried out on 3T and 1.5T MRI scanners. Higher magnetic fields can help increase the signal-to-noise ratio and help resolve some of the overlapping peaks of the metabolites
Objectives: The goal of our study was to look at metabolite levels in an area of primary visual cortex (VC) representing BA17, as well as medial prefrontal cortex (PFC), representing BA32, using 7T MRS. We were mainly interested in group differences in the following metabolites: NAA, Cr, Cho, GABA and Glu.
Methods: We scanned 8 ASD individuals and 6 typically developing (TD) individuals matched for age, gender and IQ, at the Oxford Centre for functional MRI of the Brain (FMRIB). Both the VC and PFC MRS voxels were placed in a region that centres on the midsaggital plane. For the VC, we placed the MRS voxel in a region that includes the anterior part of the calcarine sulcus. For PFC, we included the region anterior to the cingulated gyrus that represents BA32. We collected data using a semi-LASER sequence, and used LCModel to fit our spectra.
Results: We found that Cr levels were significantly increased in VC compared to PFC for both groups ($p < 0.05$), and that Cr levels were significantly increased in PFC for ASD compared to TD individuals ($p < 0.05$). When we controlled for age differences, we found no regional differences, but the group difference remained. There were no other group differences. NAA values were significantly higher in PFC than in VC. The other metabolites showed no regional differences.
Conclusions: Elevated Cr levels may be related to abnormal glial function in the medial PFC, which is consistent with some of our postmortem work in other brain regions. Our preliminary results also suggest that altered markers of neuronal metabolism may not always be detected using MRS. Further work will involve trying to correlate measures from spectroscopy with diffusion data and MEG data collected from these same individuals.

52   **172.052**   Abnormal MEG Gamma Oscillations Induced By Visual Motion in Children with ASD

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Background: A large body of evidence suggests that alternation of the balance between neural excitation and inhibition (E/I balance) in direction of excitation is an important factor leading to development of autism spectrum disorders (ASD). When present in visual cortex, the altered E/I balance may account for visual perceptual abnormalities frequently reported in ASD. The high-frequency (gamma) oscillations are crucially dependent on functioning of fast-spiking, parvalbumin-positive GABAergic inhibitory interneurons and may appear valuable correlates of the altered E/I balance. The frequency of the visual gamma oscillations reflects kinetics of inhibitory processes in neural networks and according to the animal studies is modulated by properties of visual stimulation, e.g. by velocity of visual motion. The velocity-related changes in gamma frequency may provide valuable information about inhibitory processes in visual cortex in children with ASD.
Objectives: We aimed to study whether the modulation of gamma oscillations frequency by velocity of visual motion is altered in children with ASD as compared to the typically developing control children. We also investigated whether such alternations, if present, are related to performance of a visual orientation discrimination task that is particularly sensitive to neural inhibitory function.
Methods: We studied 27 boys with ASD (IQ>60) aged 8-15 years and 27 age-matched typically developing (TD) boys using whole head Magnetoencephalography (MEG). Participants watched high-contrast annual gratings moving with different speeds while performing a simple detection task. The gamma individual peak frequency (IPF) was identified for each participant and for each stimulus velocity at the occipital MEG sensor with the greatest gamma response amplitude. After the MEG session the oblique grating orientation discrimination threshold has been measured in 13 ASD and 18 TD participants in a psychophysical experiment.
Results: Gamma frequency significantly increased with stimulus velocity in both TD and ASD participants. The difference in gamma IPF between the fastest and slowest stimulus velocity (i.e. gamma *dynamic range*) was significantly smaller in the ASD then in the TD group, suggesting impaired velocity-related modulation of inhibitory processes in visual cortical areas. Both the gamma IPF to the fast moving stimuli and the gamma dynamic range correlated positively with IQ, but did not correlate with the autism quotient. In the ASD, but not in the TD children the broader dynamic range of gamma frequency predicted better capacity for discrimination of oblique grating orientation.
Conclusions: The narrow dynamic range of gamma oscillations frequency in children with ASD suggests abnormally slow kinetics of neural inhibition in visual cortex under high functional load. This

physiological abnormality may affect basic visual processes in children with ASD.

53 **172.053** Age-Associated Changes in Functional Networks in ASD: Is There a Shift from Overconnectivity in Childhood to Underconnectivity in Young Adulthood?

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Background:
It has recently been suggested that developmental changes in network connectivity may explain seemingly inconsistent findings of functional over- vs. underconnectivity in ASD. A recent review (Uddin et. al. 2013) of intrinsic functional connectivity (iFC) studies in ASD suggests that there might be an age-related shift from increased connectivity in children with ASD to reduced connectivity in adolescents and young adults with the disorder.
Objectives:
This study aims to empirically test this notion in a large sample of individuals with ASD and typically developing (TD) controls, utilizing the Autism Brain Imaging Data Exchange (ABIDE) dataset.
Methods:
Utilizing a low-motion subset of the ABIDE resting-state fMRI data (94 individuals with ASD and 94 TD participants; ages 7-34 years; head motion <0.2mm), within-network iFC for three commonly observed networks (Default Mode, Mirror Neuron, and Language) was assessed. Following standard preprocessing procedures (slice-time and motion correction; co-registration and standardization to the MNI space; application of the bandpass filter and spatial smoothing; removal of nuisance regressors including motion, white matter, ventricular and global signals, and their derivatives), canonical regions of interest (ROIs) for each network were identified based on previous reports. Using average time series extracted from each ROI, whole-brain correlation maps were created, cluster corrected ($p<1^{-7}$) and Fisher-transformed to z'. For each network node (used as seed), the mean z' was extracted from all other nodes of the respective network to determine the within-network functional connectivity. The relationship between these scores and age was examined within each group with linear and polynomial (quadratic) models, to determine the change in connectivity across age.
Results:
For none of the three networks, a significant effect of age on iFC was found. Although age-related slopes were slightly more positive in the ASD than in the TD group for each network, none of these interaction effects approached significance.
Conclusions:
Our findings suggest that effects of individual variability (and other sources of variability that may be hard to control in multisite datasets) may dominate more subtle age-related changes in within-network iFC between ages 7 and 34 years. Specifically, no evidence supporting a crossover from overconnectivity in childhood to underconnectivity in adolescence or adulthood could be detected in ASD.

54 **172.054** Altered Neural Responses to Familiar and Unfamiliar Speech in Six-Week Old Infants at High Risk for ASD

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Background: Based on prenatal exposure to speech, newborns already show a preference for their native language (e.g., Mehler et al, 1988). Infants' native language preference (or lack thereof) can thus provide an index of their attention to, and uptake of, the input that is available to them. A growing number of studies have demonstrated that fMRI during natural sleep can successfully be used to map neural responses to speech in infancy (e.g., Dehaene-Lambertz et al., 2010; Redcay & Courchesne, 2008b), with reliable activity in fronto-temporal language areas reported as early as 2 days after birth (Perani et al., 2011). Notably, altered activity during speech processing has also been observed in toddlers with autism spectrum disorders (ASD) who underwent fMRI during natural asleep (Redcay & Courchesne, 2008; Eyler et al., 2012).
Objectives: Here we examine the neural circuitry subserving language processing in 6-week-old infants at high (HR) and low risk (LR) for ASD in order to identify patterns of brain activity that may predict altered trajectories of language development, as well as an ASD diagnosis, well before overt delays in language acquisition and ASD symtomatology can be observed.
Methods: fMRI was conducted during natural sleep. Stimuli were speech samples produced by different female native speakers of English and Japanese (8 segments for each language). Both English and Japanese stimuli were previously used in behavioral studies in LR infants (Sundara et al, 2008) and were matched for duration, intensity, peak amplitude, pitch, and pitch range. According to a traditional block-design, the alternating English and Japanese speech segments (18s each) were interspersed with periods of silence (12s each). Preprocessing (including motion scrubbing) and statistical analyses were conducted in FSL except for registration to a neonate template implemented in AFNI. Regression analyses were conducted using language measures collected at 9 (MacArthur-

Bates Communicative Development Inventories; CDI) and 12 (Mullen Scales of Early Learning; MSEL) months of age.

Results: Robust activity in bilateral language areas was detected in both groups for both English and Japanese segments (vs. baseline), with LR infants showing overall stronger activity than HR infants. Both groups showed differential activation patterns for English vs. Japanese. However, these patterns differed between the two groups. LR infants showed significantly greater responses to Japanese than English in temporal language regions, as well as in parietal attentional areas, suggestive of a novelty bias. In contrast, HR infants showed no significantly different activity for Japanese and English in canonical language areas, showing instead greater activity in subcortical regions for English vs. Japanese. Neural responses to speech at 6-weeks of age predicted CDI and MSEL language scores at 9 and 12 months of age, respectively.

Conclusions: These data suggest that natural sleep fMRI is well suited to probe the extent to which infants have already learned the prosodic contour of their native language. Furthermore, these findings suggest that early patterns of brain activity in response to familiar and unfamiliar speech are predictive of subsequent language development and may thus provide an early biomarker of future risk for ASD.

55   **172.055** Altered Resting State Functional Network Topology Across Neurological Conditions: A Comparison of Autism Spectrum Disorder with Phenylketonuria and Traumatic Brain Injury

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Background: It has been previously suggested that functional connectivity (FC), as measured by functional magnetic resonance imaging (fMRI), is altered in individuals with ASD, but the nature of this aberration has not been clearly delineated. Additionally, altered FC patterns in ASD have not been explored widely in the context of other neurological conditions with symptomatology distinct from ASD.

Objectives: In the present study, we used graph theoretical analysis to examine resting state FC data from a large sample of participants in hopes of gaining additional insight into how the topological properties of functional networks differ based on factors such as diagnosis and age. In addition to individuals with ASD and typically developing individuals (TD), we examined individuals with phenylketonuria (PKU), a metabolic disorder with cognitive symptoms, and individuals with traumatic brain injury (TBI).

Methods: Resting state fMRI data was collected from 61 individuals with ASD (mean age=15.4), 12 individuals with PKU (mean age=23.6), 18 individuals with TBI (mean age=39.4), and a comparison group of 61 TD individuals (mean age=15.4). The ASD and TD groups were also split into age subgroups via median split. Following data pre-processing and anatomical parcellation into 90 cortical and subcortical regions of interest, partial correlation matrices were generated and thresholded at consistent network sparsity. Topological properties were then compared between diagnostic groups and age subgroups via two- and one-way ANOVAs.

Results: Statistical analysis revealed that the ASD group demonstrated reduced local network organization (decreased local network efficiency and likelihood of short-range connections, $p < .05$ in both instances) that accompanied a bias toward greater global network organization (increased global network efficiency and likelihood of long-range connections, $p < .05$ in both instances), as compared to the TD group. There were no significant interactions between diagnosis and age groups. The PKU and TBI groups demonstrated a bias toward local network organization (increased local network efficiency and likelihood of short-range connections, $p < .001$ in both instances) with reduced global network organization (decreased global network efficiency and likelihood of long-range connections, $p < .001$ in both instances), in comparison to the TD group. In subsequent analyses, 13 functional subnetworks were identified using a community detection algorithm and compared between groups for topology. In particular, as compared to the TD group, the ASD group demonstrated reduced network density within a subnetwork containing temporal cortical regions ($p < .01$). The PKU group showed reduced FC in subnetworks containing frontoparietal and orbitofrontal regions, as compared to the TD group ($p < .01$). Lastly, the TBI group displayed widespread reduced network efficiency and FC in 10 of the 13 subnetworks ($p < .01$ in all instances).

Conclusions: The results of the present study indicate alterations in functional network and subnetwork topology in ASD. In addition, ASD seems to differ from other neurological conditions in its bias toward global over local network organization. Future studies are needed to explore how these findings contrast with other FC findings in ASD, as well as characterize network alterations within the context of symptom severity.

56   **172.056** An Integration of fMRI Neural Effects of Oxytocin in Children with ASD: Insights from Three Paradigms of Social Processing

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Background: **Discoveries regarding the impact of acutely modulating the neuropeptide oxytocin (OT) have led to exciting avenues for translational research efforts in autism spectrum disorders (ASD). Novel reports on the neural mechanism involved in intranasal administration of OT to adults with ASD highlight OT's positive impact on key nodes of "the social brain" such as the amygdala and the medial prefrontal cortex (mPFC). Considering the early onset of ASD and the young age of diagnosis and treatment and considering the positive impact acute manipulation of OT has had on various social behaviors, such as emotion recognition and theory of mind, it is crucial to achieve a crystalized understanding of the neural mechanism underlying OT administration in children and adolescents with ASD.**
Objectives: **Using several fMRI paradigms that assess different modalities of social processing, we aimed to pinpoint the neural mechanism underlying a single OT administration in children with ASD. We further aimed to identify neural networks and connectivity measures that are associated with OT's impact compared to placebo. We expected neural effects of OT administration to be apparent in key nodes of the social brain, such as the amygdala, the posterior superior temporal sulcus and the mPFC. We also expected OT to enhance activation in neural circuits that process reward and motivation such as the striatum.**
Methods: **Seventeen children with ASD (ages 7-18) received acute administration of OT in this placebo-controlled study of changes in brain activity and behavior. Forty-five minutes following OT administration, an fMRI scan ensued in which three fMRI paradigms for social processing were presented: Reading the Mind in the Eyes, Biologicl Motion and Affective Voices. fMRI data was analyzed to assess the neural impact of OT.**
Results: **Results from brain function analysis of a mentalization task indicate that OT increased activity in the striatum, the middle frontal gyrus, the medial prefrontal cortex, the right orbitofrontal cortex, and the left superior temporal sulcus. In the striatum, nucleus accumbens, the left posterior superior temporal sulcus, and the left premotor cortex, oxytocin increased activity during social judgments and decreased activity during non-social judgments. All of these regions have previously been implicated in their involvement in social perception and cognition, mentalizing abilities, and theory of mind. In both the mentalization and the biological motion task, we show that OT can enhance connectivity between striatal regions and frontal cortical regionscebo, an effect that may underlie the processing of the rewarding value of social-emotional stimuli. Finally, we also show that for affective voice processing OT enhances saliency by increasing activity in the left superior frontal gyrus, middle temporal gyrus, cuneus, cerebellar lobule VI, the right inferior frontal gyrus and the right caudate.**
Conclusions: **These results provide essential and critical steps in the integrative understanding of the neural mechanism underlying a single administration of intranasal OT has in youth with ASD. We believe this will advance translational progress in support of more effective treatments for core social deficits in ASD.**

57   **172.057**   An fMRI Exploration of Atypical Multisensory Perception in Autism Spectrum Disorders

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Background: Multisensory perception plays an integral role in early cognitive, perceptual, language, and social development. Relevant to the current study, temporal synchrony is one of the first properties used by infants to integrate their sensory experiences (Lewkowicz, 1999).
Sensory atypicalities may be core deficits of individuals with autism spectrum disorders (ASD) and contribute to downstream perceptual and social-cognitive consequences, including hyper- and hypo-sensitivities, poor eye contact, poor imitation skills, repetitive self-stimulatory behavior, and difficulties with social and communication abilities (Bertone, et al., 2005). Abnormalities in the integration of sensory information may underlie these sensory atypicalities (Iarocci & McDonal, 2006). In individuals with ASD, these multisensory perception difficulties may be limited to, or most apparent for, linguistic-based stimuli (Bebko et al., 2006). However, previous studies have not specified whether the ostensibly linguistic-specific deficit observed in ASD is actually due to the linguistic nature of the stimuli, or to the social nature of the stimuli that is inherent in audiovisual presentations of a person talking.
The posterior superior temporal sulcus (pSTS) appears to be critical for the temporal integration of audiovisual stimuli (Calvert, 2001). In addition to its central role in multisensory temporal processes, studies have shown anatomical (Levitt, 2003) and functional (Pelphrey, 2008) abnormalities within the pSTS of participants with ASD.
Objectives: The present objective was to explore the neurological basis of deficits in multisensory integration in individuals with ASD. Importantly, the current study delineated linguistic and social processing using three distinct categories of stimuli: social-linguistic, social-nonlinguistic, and nonsocial-nonlinguistic stimuli. Further, temporal variations of the stimuli were presented (synchronous vs. asynchronous). The current study identified neurological regions of interest that

demonstrated multisensory enhancement, including the pSTS, to compare multisensory integration between individuals with and without ASD across all content and synchrony conditions.

Methods: Fifteen participants with ASD were matched on chronological age and full sale IQ to 18 participants without ASD (comparison group). All participants were between 18-29 years of age and had average to above average IQ. Participants underwent an fMRI scan while viewing the stimuli videos with concurrent eye-tracking to ensure that participants attended to the stimuli.

Results: Preliminary results indicate that for the comparison group, peak activation in the pSTS is reduced for temporally synchronous relative to temporally asynchronous audiovisual presentations across all content conditions. However for participants with ASD, this reduced activation for the temporally synchronous conditions was only equivalent to the comparison group for the nonsocial-nonlinguisitc and social-nonlinguistic conditions. The ASD group showed less reduction in activation relative the comparison group in the social-linguistic condition.

Conclusions: If the preliminary results hold, this would indicate that atypical neural processing in the pSTS might underlie the linguistic-specific multisensory perception impairment in ASD. The reduced activation to all synchronous stimuli may reflect increased processing efficiency associated with multisensory binding. Thus, individuals with ASD do not display the same increased processing efficiency for linguistic information, which may result in downstream impairments, including socio-communication and language deficits.

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58   **172.058** Atypical Generalization of Learning in Adolescents with Autism Spectrum Disorders: An fMRI Study of Transitive Inference

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Background:
Individuals with autism spectrum disorder (ASD) exhibit impairments in generalizing learning, which profoundly affect their adaptive functioning. However, little is known about the neurobiology of these deficits.
Objectives:
To use a new child-friendly paradigm and task-based functional magnetic resonance (fMRI) to illuminate cognitive and neural mechanisms underlying generalization impairments in ASD.
Methods:
21 high functioning adolescents with ASD aged 12-18 years, and 23 gender, IQ, and age-matched adolescents with typical development (TYP) were recruited (Mean = 14.9 years). They completed a Transitive Inference (TI) task with training on a stimulus hierarchy in which A>B>C>D>E>F during rapid event-related fMRI. There were 2 Training Sessions including stimulus and feedback phases, followed by a "Big Game" with testing on generalization to novel pairs BD, BE, AF. Whole-brain univariate, region of interest, and functional connectivity analyses were performed. Based on our prior behavioral study of TI (Solomon, Frank, Smith, Ly, & Carter, 2011), we hypothesized that individuals with ASD would use a conjunctive learning approach reliant on the hippocampus; whereas TYP would use an associative learning strategy reliant on the striatum and prefrontal cortex (PFC).
Results:
Between group differences in accuracy in Training Sessions 1 and 2 were examined using linear mixed models. Tests of fixed effects showed a main effect of Session ($F(1,45) = 42.2$, $p<.001$); a main effect of pair ($F(4, 271) = 18.7$, $p < .001$), and a Session x pair interaction ($F(4,271) = 18.5$, $p < .001$), suggesting the both groups used associative learning by Session 2. Consistent with hypotheses, during the stimulus phase of Training, whole brain analyses using ANOVA showed that TYP demonstrated greater recruitment of left dorsolateral PFC (BA 9 [-30, 20, 40]) than ASD. Contrary to hypotheses, during the feedback phase of Training, both groups showed comparable recruitment in the caudate bilaterally [-18, -10, 31], [18, 17, 19]. During the Big Game, TYP showed greater recruitment of left posterior cingulate cortex [BA 31; -6, -16, 49]. In the ASD group, functional connectivity between the hippocampus and the caudate, and the caudate and the left dorsolateral PFC during training were significantly associated with Big Game performance [(r = .61, p = .004) and (r = .67, p = .001), respectively]. TYP showed significantly greater functional connectivity between the BA 31 seed and regions of the PFC including right BA 10 [27, 53, 19], right BA 11 [45, 47, -8], and left BA 47 [-33, 32, -5], [-42, 29, -11] and [-45, 29, -2].
Conclusions:
While ASD engaged the hippocampus to some extent, they also showed strong relationships between indices of associative learning and task performance. TYP engaged a more extensive network reminiscent of one used for general reasoning and mature math problem solving. While effective, learning in those with ASD may be less flexible due to their failure to reliably engage prefrontal and default mode brain regions involved in attention regulation. Changing this balance offers a potential avenue for treatment.

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59   **172.059** Auditory Event-Related Potentials As a Function of Clinical Sensory Subtype in Autism Spectrum Disorder

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Background:
Clinical sensory features are reported in many children with Autism Spectrum Disorder (ASD) and present as sensory hyper-reactivity (e.g. covering ears to loud or unexpected sounds), sensory hypo-reactivity (e.g. failure to orient to name or react to painful stimuli), and/or unusual sensory interests or behaviors (e.g. rocking, compulsive touching and noise-making). Distinct clinical sensory subtypes have been identified in ASD resulting in a two-factor behavioral theory positing that sensory features are characterized by impairment in sensory reactivity *and/or* multisensory integration (Lane et al 2014). Research in this area, however, is hindered by a lack of rigorously developed clinical protocols to accurately identify and characterize sensory features. Clinical practice relies on parent or proxy-report measures and clinician impression to identify sensory features. While more precise electrophysiological and imaging measures have been used to quantify neural sensory impairment in ASD (Marco, Hinkley, Hill & Nagarajan, 2011), there are limited reports of the correspondence between clinically observed sensory features and neural deviations.
Objectives:
The broad aim of this study was to gather preliminary neural evidence to support a two-factor behavioural theory of sensory features in ASD. We used measures derived from auditory event-related potentials (ERP) to examine variations in neural profiles in children with ASD as a function of clinical sensory subtype.
Methods:
Participants for the study were children aged 6-10 years with a diagnosis of ASD (n=19) and typically developing same-aged peers (TYP; n=30). Participants in the study completed a clinical protocol that assessed sensory features (via administration of the Short Sensory Profile (SSP)), autism symptoms and hearing function, and an ERP protocol assessing auditory (phoneme) novelty detection in an oddball paradigm. Classification of participants' clinical sensory differences into sensory subtypes was made using scores from the SSP using an algorithm derived by Lane et al, (2014). ERP data was collected on an EGI GES 300 system utilizing a HydroCel 128 channel sensor net. A number of procedures were implemented to improve children's compliance with the ERP experiment and to retain maximum data for analysis. Subsequently, our findings include data from individuals with a variety of functional abilities. We analysed data across all channels and by distinct regions of interest.
Results:
Participants exhibiting sensory subtypes associated with sensory reactivity displayed heightened responses to the onset of novel auditory stimuli (p=0.009) and a sustained, elevated response during later auditory processing (p=0.05). Further, our findings suggest that classification of children with ASD using clinical sensory subtype reveals auditory response differences that are not apparent when grouping children by diagnostic classification alone.
Conclusions:
The results of our study suggest that auditory event-related potentials in an oddball paradigm discriminate between individuals with clinically significant sensory reactivity, multisensory integration impairments and those who are sensory adaptive. Our study provides preliminary neural evidence validating a two-factor behavioral theory of sensory features in ASD.

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60   **172.060**   Auditory Evoked Electrophysiological Response Component "M100" Is Delayed in 16p11.2 Deletion but Not Duplication Carriers

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Background:
Copy number variants in the BP4-BP5 16p11.2 have been associated with cognitive and behavioral anomalies, in many cases reaching diagnostic criteria for autism spectrum disorder (ASD). On the other hand, idiopathic ASD patients have been shown to have a neurophysiologic correlate in latency delays of auditory evoked responses measured using electrophysiological techniques such as magnetoencephalography, (MEG). The neurobiological basis of such latency delays has been speculatively attributed to both white matter conduction deficits and deficiencies in synaptic transmission. However, the underlying genetic etiology has not been explored.
Objectives:
To explore the genetic etiology of neurophysiological responses, namely auditory evoked neuromagnetic response components in child carriers of 16p11.2 deletion and duplication compared to age-matched controls, as part of the Simons VIP project.
Methods: 140 child participants were recruited. After elimination of 25 cases (for incidentally determined drug use/atypical MRI findings) cohorts of 43 carriers of the 16p11.2 deletion, 23 carriers of the 16p11.2 duplication and 49 controls remained. Neuromagnetic recording was performed using 275-channel biomagnetometers during binaural auditory stimulation with sinusoidal stimuli of 300ms duration and frequencies of 200Hz-1000Hz. Auditory evoked responses were modeled in bilateral auditory cortex after artifact elimination and M100 responses were characterized for each

hemisphere and condition as that evoked response peak, with appropriate magnetic field topography, occurring after an M50 component and within a latency range of 80-185ms (wide range reflecting the age-distribution). Linear mixed modeling was performed with Subject/Site as random effects and Case, Stimulus and Hemisphere as fixed effects. Age was considered a covariate in all analyses.

Results: Evaluable data were obtained from the majority of the 16p11.2 deletion carriers (37/43) and neurotypical controls (42/49), but fewer of the 16p11.2 duplication carriers (14/23). In this cohort, age did not differ (deletions: 11.4+/-2.6yrs, duplications: 12.1+/-2.8yrs; neurotypical 12.8+/-2.6yrs). Considering M100 latency analysis there was a significant main effect ($p<0.05$) of Case with 16p11.2 deletion carriers (149+/-3ms) exhibiting a 23ms delay compared to controls (126+/-3ms). Duplication carriers showed no significant difference from neurotypical controls (although trended to a 6ms decrease in latency (118+/-5ms)). This effect persisted across stimulus conditions and hemisphere. Within the subpopulation of carriers meeting ASD diagnostic criteria, there was an additional non-significant M100 delay of 5ms (deletions, N=11).

Conclusions: Significant M100 delay in 16p11.2 deletions compared to controls suggests a genetic etiology for the neurophysiological observation independent of clinical diagnosis. Absence of an analogous delay in duplication carriers points to the specificity of this change, with genetics contributing equally or more than clinical diagnosis to the latency delay. In fact a slight facilitation of the M100 response in 16p11.2 duplication carriers might be further explored as a candidate indicator of a gene dosage effect. The non-significant but additional delay associated with ASD diagnosis suggests that 16p11.2 deletion is not the sole basis for M100 delays, while the delays associated with 16p11.2 in the absence of meeting diagnostic ASD criteria suggest either a non-specificity of the neurophysiologic finding, or sensitivity to sub-clinical neuronal dysfunction, that may be further explored in the broader autism phenotype.

61   **172.061** Auditory Stream Segregation in Verbal and Minimally Verbal Adolescents with Autism Spectrum Disorder

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Background: Impairment in the use of language in social interactions is a hallmark feature of autism spectrum disorder (ASD). In severe cases, children with ASD are minimally verbal. However, research on the minimally verbal ASD population has been very limited. There have been no studies of auditory perception and processing in this population that may help explain their very limited language. Previous studies have shown that auditory stream segregation, the ability to segregate sounds produced by distinct sources, is impaired in Asperger's Syndrome and high-functioning ASD, however none included minimally verbal participants.

Objectives: Our goal was to compare auditory stream segregation ability in verbal and minimally verbal adolescents with ASD and age-matched controls.

Methods: Participants included adolescents in three groups: 1) typical development, 2) verbal ASD, 3) minimally verbal ASD. ASD was diagnosed using ADI-R and ADOS and all the participants were assessed on a range of measures. In the experiment, participants watched a silent movie of their choice while passively listening to a traditional oddball stream, either in isolation (oddball condition) or in the presence of an interfering stream. Interfering streams were either spectrally distant from (segregated condition) or close to the oddball stream (integrated condition). In the oddball stream, the deviant stimuli differed from the standards only in intensity. The interfering streams were engineered so that the deviants were not unexpected if the two streams were heard as perceptually integrated. The event-related potentials (ERP) in response to the deviants were extracted and analyzed. Resting state EEG was also recorded for 10 seconds both at the beginning and the end of each block in the experiment.

Results: The P1-N1 amplitude in the oddball condition was similar across groups. Although significant group differences were present for integrated and segregated conditions, the main effect of group was not significant. We also computed the inter-trial coherence (ITC) of the ERP to measure the phase consistency across trials. No group difference in ITC was observed in the oddball condition. However, in the segregated condition, the ITC was significantly lower in the minimally verbal group than the other two groups. In addition, the power of the resting state EEG between 2 to 20 Hz was significantly higher in the minimally verbal ASD group than the other two groups. Lastly, the phase-locking value (PLV), a measure of how strongly the ERP phase locked to the input envelope, was similar across all groups, suggesting that the temporal encoding is largely intact in the ASD groups.

Conclusions: These results demonstrate the feasibility of using EEG to measure stream segregation in a minimally verbal ASD population. The results of the ITC indicate that the cortical response to deviant sounds in the minimally verbal ASD group is normal in simple acoustical environments. However, when multiple sound streams were present simultaneously, this cortical response was substantially degraded only in the minimally verbal ASD group. This degradation was not due to impairment in the temporal encoding fidelity, but rather reflecting a deficit in auditory stream segregation ability, and an elevation of the resting state EEG power.

62   **172.062** Autonomic Nervous System Function in Response to Social Judgment in Adolescents with and without Autism Spectrum Disorder

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Background: Autism Spectrum Disorder (ASD) is a heterogeneous neurodevelopmental disorder characterized by deficits in reciprocal social behavior. However, it is unclear if deficits in social behavior are primarily due to disinterest in social stimuli, or to elevated stress response to social information or events. The autonomic nervous system helps to facilitate salience detection, approach, and avoidance behavior in response to sensory information, including social stimuli. Research in our lab has shown enhanced responsivity to social stress and variable biobehavioral profiles in children with ASD. Previous work with children with ASD has also demonstrated alterations in autonomic regulation, including respiratory sinus arrhythmia (RSA), a measure of vagal control over heart rate fluctuation. The majority of prior work has focused on children with ASD, but adolescents with ASD have been understudied. The adolescent period may be of particular interest to the study of ASD, as this developmental epoch is associated with increased salience of social judgment in typically developing (TD) populations.

Objectives: In this study, we employed the Trier Social Stress Test (TSST) to study RSA response to social judgment in ASD compared to TD adolescents.

Methods: Participants with ASD or TD ages 12-17 underwent a modified version of the TSST as part of a larger study of stress and social behavior. In this modified version, one of the raters was replaced with an age-matched peer. At arrival and during the TSST, vagal tone and cardiac output were measured using MindWare, a mobile unit that measures real-time cardiac and respiration data. The TSST included four 5-minute periods: preparation, speech, mental subtraction, and debriefing. Heart rate data was cleaned and RSA was calculated using the MindWare software suite. RSA data was log-transformed to correct for skewness of the data. We performed repeated measures ANOVA to determine group differences in RSA at baseline and during each 5-minute portion of the TSST. We included pubertal status, as assessed by the Physical Development Scale, as a covariate in our model. Additional *post hoc* t-tests were performed to assess for group differences at each time point.

Results: There was a significant effect of diagnosis on RSA values (p=0.03), with *post hoc* analyses suggesting significant differences in RSA between groups during the speech (p=0.027), mental subtraction (p=0.001), and debriefing (p=0.013) portions of the task. TD participants showed higher mean RSA values than ASD participants, with no significant differences in baseline RSA. There were no significant effects of pubertal status or interaction effects with diagnosis.

Conclusions: Our findings indicated differences in autonomic arousal in ASD adolescents compared to TD peers. TD peers overall showed elevated RSA during the TSST compared to baseline RSA, suggesting engagement of the ANS in preparation for the stress challenge. Meanwhile, the ASD group overall did not show such engagement of the ANS, and in fact showed a significantly decreased RSA compared to baseline, suggesting a poorly regulated vagal tone. These findings suggest that autonomic dysregulation may contribute to social behavior deficits in ASD.

63   **172.063**   Behavioral, but Not Neural Differences in Face Recognition in Adults and Elderly with Autism

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Background:
Perceptual closure refers to the ability to form a global and coherent perceptual representation on the basis of few details. A classical example is provided by two-tone (black and white) images of human faces (Mooney faces). In a Mooney image, the local features become too ambiguous to be recognized individually, and must be disambiguated based on their context within a global configuration. Mooney faces have been used to investigate various aspects of intact and impaired face processing (the ability to recognize a person from their facial appearance). Given that autism is typically associated with a detail-oriented visual processing style and social deficits, the neural mechanisms underlying perceptual closure may be different in patients with autism spectrum disorders (ASD).

Objectives:
Examine the neural mechanisms underlying perceptual closure in face processing in adults and elderly with ASD.

Methods:
Using 3T event-related fMRI we measured BOLD-signal changes in 50 subjects with and 49 without ASD (30-74yrs) to investigate how the brain forms perceptual decisions about complex visual forms. We showed 100 upright Mooney faces and 100 visually similar non-face images for 200ms in a random sequence. To identify closure-related activity contrasts of correctly identified faces minus non-faces were computed. Post-scanning tests included a self-paced shortened version of the same perceptual closure task to examine the overall ability to recognize face stimuli.

Results:
Behavior
Preliminary data suggest that participants with ASD showed significant reduced detection-rates for faces (M=71% vs 77%; Mann-Whittney-U=.027), but not for non-faces (M=85% vs 86%; Mann-Whittney-U=.85). People with ASD were slower on both conditions, irrespective of accuracy (all

p's<.02). Performance on the self-paced task outside the scanner was similar between groups (p's>.62), with higher accuracy rates for non-faces than for faces in both groups (p's<.001). In addition, controls were faster in the face-condition with correct responses (p=.01), but there were no reaction time differences for the other conditions.

fMRI

There were no differences in neural responses between the groups for faces>non-faces or the inverse contrast (irrespective of accuracy). In the combined sample, the fMRI data showed increased activation for faces relative to non-faces in the bilateral fusiform face area (FFA), inferior frontal gyri, parietal lobule, amygdala-hippocampal complex and right angular gyrus and left anterior cingulum (FWE-corrected: p<.05; >10 contiguous voxels).

No age-related effects were found for behavioral and neuroimaging data.

Conclusions:

The behavioral data suggest that face recognition is more dependent on holistic processing than non-face recognition in both groups. This finding is further strengthened by the significant difference in detection rates in the self-paced task. The fMRI data showed typical responses in the FFA and inferior frontal gyri and are consistent with other recent studies demonstrating similar activation patterns for faces compared to non-faces in ASD. Overall, these findings suggest a specific face recognition deficit in adults and elderly with ASD independent of age, despite similar brain recruitment.

64   **172.064** Beta-Adrenergic Antagonism Modulates Default Mode Network Coherence in Autism Spectrum Disorder

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Background: Altered functional connectivity (FC) and network coherence is implicated in autism spectrum disorder (ASD) with the majority of studies suggesting local hyper-connectivity and long distance hypo-connectivity. *Beta*-adrenergic antagonism, such as the use of propranolol, benefits social and communication domains in ASD and performance benefits on language tasks following propranolol administration have been associated with increased FC. These cognitive and behavioral benefits following propranolol administration may be due to pharmacological effects on network coherence improving cognitive processing.

Objectives: We propose that the cognitive and behavioral benefits from propranolol may be partially mediated by changes in network coherence in the brain, which is especially relevant for ASD given the known alterations in FC. Resting-state fMRI data was acquired to assess drug-related changes in network coherence.

Methods: Participants attended three counterbalanced sessions separated by at least 24 hours in which propranolol, nadolol, a peripheral beta-adrenergic antagonist, or placebo were administered in a double-blinded manner. Utilizing a graph theoretical approach, we assessed the effects of *beta*-adrenergic antagonism on resting state network coherence in individuals with ASD compared to unaffected individuals, with particular emphasis on the default mode network (DMN). DMN regions (ROIs) were also segregated into subnetworks using the Louvain algorithm for community detection. This process was repeated for 1000 iterations to determine the most representative functional network structure.

Results: Regardless of diagnosis, *beta*-adrenergic antagonism decreased FC and network efficiency in the dorsal medial prefrontal cortex (dMPFC) subnetwork of the DMN and increased connectivity and network efficiency in the medial temporal lobe (MTL) subnetwork. However, these alterations in network coherence appeared to be due to diagnostic group specific effects on functional organization. ROIs comprising the dMPFC subnetwork decreased co-occurrence in the ASD group but increased co-occurrence in the control group; whereas ROIs comprising the MTL subnetwork increased lateralized co-occurrence in the ASD group but decreased lateralized co-occurrence in the control group. Furthermore, network coherence and functional organization effects were primarily not seen with nadolol, a peripheral *beta*-adrenegic antagonist that does not cross the blood-brain barrier, suggesting these findings were not due to peripheral cardiovascular effects on the BOLD signal.

Conclusions: Our findings suggest that *beta*-adrenergic antagonism may be able to up- or down-regulate specific subnetworks in the brain and differentially affect functional organization of the DMN in individuals with ASD as compared to controls. Network coherence and functional organization in the brain modulates information processing. *Beta*-adrenergic effects on network coherence altering information processing may underlie the previously reported propranolol-mediated benefits to the social and language domains in ASD.

65   **172.065** Biomarkers for Psychosis Risk Prediction

ABSTRACT WITHDRAWN

Background: Although neurodevelopmental processes figure prominently in the etiology of psychosis, onset of overt symptoms typically does not occur until late adolescence or early adulthood. It is particularly critical to identify early (pre-onset) biomarkers of psychotic illness, given that overt diagnosis may be a late manifestation of the underlying disease processes. As such, there is intense interest in enhancing methods for early detection, which may ultimately lead to prevention strategies.

Objectives: Here I will present new findings regarding neurobiological risk factors predictive of conversion to psychosis, and their implications for potential pathophysiologic mechanisms. Potential convergence with biomarkers relevant to autism spectrum disorders (ASD) will be highlighted.

Methods: Longitudinal studies of putative neuroimaging and blood-based biomarkers were conducted in both clinically and genetically defined at-risk cohorts. The North American Prodrome Longitudinal Study (NAPLS) is a prospective longitudinal investigation of ~275 youth at clinical high risk (CHR) for psychosis, defined by the presence of moderate to severe attenuated positive symptoms. Neuroimaging and blood assays were conducted over a 2-year follow-up period, during which clinical outcomes were monitored. Gene expression and neuroimaging findings indexing psychosis risk in a highly penetrant genetic subtype of psychosis (i.e., patients with 22q11.2 microdeletions; 22q11DS) will also be presented.

Results: Findings indicate that CHR subjects who converted to psychosis showed a steeper rate of gray matter loss in prefrontal cortical regions, as well as greater ventricular expansion, relative to non-converting CHR subjects and healthy controls. Differential tissue loss was predicted by an aggregate measure of pro-inflammatory cytokines in plasma. Parallel structural neuroanatomic findings in 22q11DS patients indicated that cortical thickness in the medial prefrontal cortex uniquely predicted psychotic symptoms. Further, gene expression studies in this cohort indicated highly significant overlap between a module of co-expressed genes associated with psychosis in 22q11DS and transcriptional changes in an idiopathic schizophrenia cohort.

Conclusions: Structural neuroanatomic changes precede the onset of overt psychotic symptoms; convergent findings from clinical and genetic high risk cohorts implicate prefrontal cortical changes in symptom onset. Further, findings implicate neuroinflammatory processes in psychosis etiology, possibly by activating synaptic pruning processes, leading to observed gray matter tissue loss. Given the long-hypothesized role of neuroinflammatory factors in the etiology of autism, these findings suggest a possible point of etiologic overlap. Future work to determine temporal precedence of peripheral blood and brain biomarkers of psychosis is warranted. Relevance to risk prediction in ASD is highlighted throughout this presentation.

66 **172.066** Biomarkers of Outcome with Intervention in Toddlers at Risk for ASD

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by core impairments in social communication skills. While behavioral intervention is the mainstay of treatment, the heterogeneity of the disorder precludes a "one size fits all" treatment approach and, in turn, makes it challenging to predict individual responses to treatment. Efforts have been made in genetics, electrophysiology (event related and resting state), and neuroimaging to quantify biomarkers that may inform treatment targets and outcomes in children with ASD.

Objectives: We focus on electrophysiological (EEG) biomarkers and review studies that have sought to characterize clinically meaningful (1) subgroups within the autism spectrum and (2) change with development and/or intervention, using event related and resting state EEG. We then present early data from a behavioral intervention study of toddlers, ages 12-24 months, who are showing early signs of social communication deficits (HR=high risk for ASD). EEG defined domains at baseline and after treatment include face processing, learning from social engagement and resting state oscillations.

Methods: Toddlers ages 12-24 months who are showing signs of social communication impairment, as quantified by a battery of clinical assessments including the Mullen Scales of Early Learning, Early Social Communication Scales (ESCS), and the Autism Diagnostic Observation Schedule-Toddler Version (ADOS-T), are being enrolled in a behavioral intervention study targeting joint attention and engagement (JASPER: Joint Attention Symbolic Play Engagement Regulation). At baseline and then at the end of the two-month intervention, children are studied with comprehensive behavioral measures and EEG measures of: familiar vs. unfamiliar faces, object processing after social engagement, and resting state (video of soap bubbles). EEG measures were chosen based on the putative developmental targets of the JASPER intervention, namely joint attention, engagement and behavior regulation.

Results: There was tremendous heterogeneity in resting state EEG power in the at-risk group, particularly in gamma and theta power. EEG power in both frequency bands did not correlate with language or cognitive ability but did relate to overall social engagement at baseline. On the other hand, there was consistent evidence of differentiation of familiar and unfamiliar faces, as quantified by a larger Nc and N290 amplitude to stranger compared to caregiver. Additionally, data quality was much improved at the second visit, quantified by percent good trials in event related paradigms, and

in the amount of physiological artifact in resting state.

Conclusions: These findings suggest that processing of familiar and unfamiliar faces may not be as useful of a stratification marker as resting state oscillations in infants and toddlers with ASD symptoms. Moreover, the difference in data quality after treatment may reflect improved behavior due to intervention (ie. treatment effect on the clinical status of child) or simply a desensitization effect from repeat testing, both of which have to be considered when identifying quantifiable markers of change with intervention. We place these early results in the context of our overall discussion about choice of biomarkers in defining treatment outcomes in ASD.

67 **172.067** Brain Chemistry in Adults with Autism Spectrum Disorder

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Background:
Clinical research suggests that core ASD symptoms may be milder in adulthood than during early development. An extant theory posits that behavioral improvements with age may be a result of maturation and the stabilization of disease processes. However, very little is known about the biochemical integrity of grey and white matter in adults with ASD, how these measures change with age, and how such indices of brain health are associated with the presentation of autism symptoms.
Objectives:
1)   Determine whether abnormalities in white matter and grey matter are present in adults with ASD.
2)   Determine whether aberrant developmental trajectories are present in brain metabolites in ASD using a cross-sectional approach.
3)   Determine whether grey matter and white matter integrity are associated with ASD symptomotology measured with the Autism Diagnostic Observation Schedule.
Methods:
MRI (T1-weighted 3DMPRAGE and magnetic resonance spectroscopic imaging (MRSI; TE=19ms) data were acquired on a 3T Philips Achieva scanner for 18 adults with ASD and 22 age and IQ-matched typically developing controls (TD)[mean age: ASD=24.7(4.8), TD=24.2(3.8); mean FSIQ: ASD=114.1(9.7), TD=111.8(12.5)]. LCModel with water referencing and partial volume correction was used to obtain chemical estimates. T1-weighted images were segmented into gray matter, white matter, and cerebrospinal fluid compartments and coregistered with the spectroscopic images for computation of compartmental chemical concentrations.
Results:
MANOVAs for both compartments were conducted with diagnosis and age as independent variables, and with five metabolite concentrations as the dependent variables [choline (CHO), creatine (CRE), n-acetyl aspartate (NAA), myoinositol (INS), glutamate+glutamine (GLX)]. The grey matter analysis did not show a significant multivariate effect for the five metabolites in relation to diagnosis (ASD versus TD: p=.107), age (p=.057) or the age by diagnosis interaction (p=.094). The white matter analysis showed a significant multivariate effect for the five metabolites as a group in relation to diagnosis (ASD versus TD: Roy's largest root = .556, $F(6,30)$=2.781, p=.029) and the age of the participant (Roy's largest root = .593, $F(6,30)$=2.965, p=.021). In addition, the interaction between age and diagnosis was significant (Roy's largest root = .545, $F(6,30)$=2.727, p=.031). Follow-up univariate analyses of the metabolite concentrations in white matter indicated the interaction was significant for CHO ($F(1,35)$=5.758, p=.022) and INS ($F(1,35)$=7.975, p=.008), reflecting that for both CHO and INS, metabolite concentrations are increasing with age in the TD group but not in the ASD group.
 Univariate analyses of the main effect of group also indicated that the ASD group had significantly higher levels of CHO ($F(1,35)$=5.854, p=.021) and INS ($F(1,35)$=8.780, p=.005), evaluated at age 24.4 years.
Within the ASD group, individual differences in social dysfunction were correlated with CHO (r = .572, p = .013) and GLX (r = .497, p= .036), indicating that greater symptom severity was associated with higher metabolite levels in white matter.
Conclusions: Adults with ASD appear to have white matter abnormalities characterized by elevated metabolite levels and an atypical developmental trajectory of metabolites associated with glial proliferation and membrane breakdown, inflammation, and demyelination. Concomitant changes in grey matter do not appear to be present.

68 **172.068** Brain Connectivity during a High-Level Visual Perceptual Task in Young ASD Children: A MEG Investigation

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Background: Enhanced local connectivity in autism has been mostly demonstrated through resting-state fMRI studies (Keown et al, 2013, Supekar et al, 2013). However, task-related connectivity is fairly

low in these regions (Liu et al, 2011; De Ramus et al, 2014). Coherence of electrophysiological signal between pairs of regions is another method to assess task-related connectivity (Kikuchi et al 2013, Kenet 2014). Among the frequency bands that can be investigated by MEG, gamma-frequency oscillations between neural networks are believed to represent ongoing cognitive processes during the perception of visual patterns.

Objectives: We sought to investigate local, task-related connectivity associated with the performance of a mental rotation task in young ASD children of typical intelligence.

Methods: MEG data were acquired during a mental rotation task (modified version of The Purdue Spatial Visualization Tests: Visualization of Rotations) with a custom child-sized MEG system, which facilitates the measurement of brain activities in young children. Recordings were obtained with a 151-channel SQUID (Superconducting Quantum Interference Device), whole-head coaxial gradiometer MEG system for children (PQ 1151R; Yokogawa/KIT, Kanazawa, Japan). Coherence values were examined in the following two bands: gamma-1 (31.0 – 58.0 Hz) and gamma- 2 (62.0 – 80.0 Hz). Eighteen ASD children (age: 83.9 months [59 - 111], mean IQ 105 [77 - 145]) were included in this study. They were diagnosed with childhood autism (n = 13), atypical autism (n = 4) or Asperger's syndrome (n = 1) according to the Diagnostic Interview for Social and Communication (DISCO) criteria. Parents consented to their child's participation in the study and had full knowledge of the nature of the research. Written informed consent was obtained prior to enrolment in the study. The Ethics Committee of Kanazawa University Hospital approved the methods and procedures, all of which were in accordance with the Declaration of Helsinki.

Results: Autistic children performed the mental rotation task faster than the control group (see behavioral results in Kikuchi et al, joint communication). There was a negative correlation (Pearson) between task performance and coherence in the gamma-1 band in several intra-hemispheric pairs of regions (the centro-occipital and front-parietal networks in the right hemisphere, and the temporo-parietal and temporo-central networks in the left hemisphere; $P < 0.0025$) and in the gamma-2 band in one intra-hemispheric region (the centro-frontal network in the left hemisphere; $P < 0.0025$).

Conclusions: In contrast with the findings of most fMRI resting states studies, our results reveal low connectivity between associative visual regions and the parietal lobe during the performance of high level visual tasks in autistic children. This atypical low connectivity may contribute to the strong performance of these children in visual tasks. The results of this independent method confirm those obtained by task-related fMRI showing low connectivity between the inferior temporal area and the parietal and occipital areas during the detection of locations in high-level visual tasks. How and why these neurophysiological correlates favor exceptional behavioral performance in such tasks remains to be investigated.

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69   **172.069**   Brain and Behavioral Responses to a Flanker Task Differ for Children with Autism Spectrum Disorders

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Background: Executive control – the ability to manage complex or conflicting information in the service of a goal – is often impaired among children with autism spectrum disorders (ASD). The ability to inhibit conflicting information is specifically impaired relative to other aspects of inhibition (Christ et al., 2007). A developmentally appropriate flanker task, the Child Attention Network Test (Child ANT), has been used for measuring event-related potential (ERP) responses to conflict monitoring (i.e., the N2) and evaluating conflicting stimuli (i.e., the P3).

Objectives: To investigate ERPs and behavioral responses of children with and without ASD during the Child ANT task and their relation to executive control.

Methods: Twenty-three seizure-free children with ASD and 34 typically developing (TD) children between the ages of 7-11 years participated. All had IQ > 85 and there were no group differences on verbal, performance, or full scale IQ, age or gender. Diagnosis was confirmed with the ADOS, ADI-R, and DSM-5 criteria. The Behavior Rating Inventory of Executive Function (BRIEF)-Parent Report was obtained as a behavioral correlate of broad executive control skills. Electrophysiological responses were recorded during the Child ANT. Mean amplitude was examined at the P100 (Oz), N2 (Fz), and P3 (Pz). Accuracy and reaction time were also collected.

Results: Overall, accuracy was lower in the incongruent condition, $F(1,53)=24.73$, $p<.001$, and in the group with ASD, $F(1,53)=5.00$, $p=.03$. Reaction time was slower for incongruent trials, $F(1,53)=40.39$, $p<.001$, and a group x condition interaction was detected, $F(1,53)=3.95$, $p=.05$. In terms of ERP response, a significant group by condition interaction was detected at the P100, $F(1,55)=4.63$, $p=.04$, suggesting groups perceived and attended to basic visual information in the task differently. For the N2, mean amplitude differed by condition, $F(1,55)=10.33$, $p=.002$, and group, $F(1,55)=6.89$, $p=.01$. No significant effects were found for the P3. Difference scores (I-C) were calculated for the P1, N2 and P3. Within the TD group, the P1 correlated with accuracy, $r(27)= .51$, $p=.007$; N2 correlated with better Parent BRIEF global executive composite scores (GEC), $r(28)= -57$, $p =.002$, metacognition (MI), $r(28)= -.56$, $p=.002$, and behavioral regulation (BRI), $r(28)= -.43$, $p=.02$; and, P3 correlated with better BRIEF GEC, $r(28)= .45$, $p=.017$, and MI, $r(28)= .48$, $p=.01$. No correlations were found in the ASD group. Results of time frequency analysis will also be reported.

Conclusions: Consistent with recent work, our results suggest that children with ASD have reduced accuracy and speed on a task measuring the ability to inhibit conflicting information, whereas typical

children showed the expected pattern of responses. Children with ASD processed visual information differently across conditions and showed less efficient processing overall as shown by increased P1 and N2 mean amplitudes, respectively. This, along with the lack of behavioral correlations on the BRIEF, potentially suggests a compensatory network for executive control in ASD. Further investigations using a broader region of interest and time frequency analysis are underway to better understand neural responses during the task.

70   **172.070** Changes in Functional Brain Network and White Matter Connectivity Underlying Language Comprehension in Children with Autism after a Reading Intervention

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Background: With the rising prevalence in autism spectrum disorders (ASD), there is a growing need for improved understanding of the neurobiology of this disorder in order to develop targeted interventions. Behavioral studies have reported that high-functioning children with ASD struggle with different aspects of oral and reading comprehension, including pragmatics, semantics, and phonological processes (Williams et al., 2008), while their decoding and word identification skills remain intact (Nation et al., 2006; Norbury & Nation, 2011). Neuroimaging research has demonstrated alterations in synchronization of brain areas underlying language comprehension, including semantics and integration of social information, (Groen et al., 2010), lexical over thematic processing (Just et al., 2004), and pragmatics and syntax (Groen et al., 2008).
Objectives: This functional magnetic resonance imaging (fMRI) study investigates the changes in the integrity of the reading network in the brain in children with ASD as a result of a 10-week (200 hours) visualizing language intervention. This is investigated at three levels: 1) a language comprehension task; 2) task-free resting state; and 3) white matter connectivity.
Methods: We used fMRI and diffusion tensor imaging (DTI) fiber tractography to investigate our questions. A word-similarities task (e.g., *orange, apple, mango, table*. Is the fourth word similar to the other three?) and resting state scan were presented while children underwent fMRI. 32 children with ASD (ages 8-13 years) were scanned twice, with 17 children receiving the intervention between scans (ASD-EXP), and 15 wait-list control children (ASD-WLC). In addition, 27 typically-developing (TD) children were scanned once. Data were acquired from a Siemens 3.0T Allegra head-only scanner.
Results: The main results of this study involve changes in function and structure of the reading network in ASD-EXP participants. These results are: (1) in word-similarities task, the ASD-EXP group of children showed increased activation in the right middle occipital gyrus and lingual gyrus pre- to post-imaging session; In addition, when compared to ASD-WLC participants, the ASD-EXP group showed greater activation in both language regions (e.g., Wernicke's area) and frontal regions (e.g., MPFC) post-intervention (p<0.001, cluster corrected); (2) Resting state functional connectivity results showed increased connectivity post-intervention in the ASD-EXP group between Broca's area and supramarginal gyrus and between Wernicke's area and left-lateralized language regions. Additionally, correlation of functional connectivity and improvement in reading comprehension in the ASD-EXP group revealed greater connectivity in both Broca's and Wernicke's area; Lastly, (3) DTI data showed that after intervention, the ASD-EXP group demonstrated increased fractional anisotropy (FA) in the right arcuate fasciculus and thalamic radiation.
Conclusions: We found that strengthening of functional connectivity of frontal and posterior language regions, as well as increased white matter integrity, was positively correlated with behavioral improvement in reading comprehension. Overall, this study provides multiple sources of evidence (task-based fMRI, resting state fMRI, and DTI) showing improvement in the brain circuitry underlying language processing in children with ASD after reading intervention. The findings of this study emphasize the importance of targeted interventions for children with ASD, and are encouraging for future studies to continue to assess intervention-related changes in brain circuitry.

71   **172.071** Conscious and Nonconscious Emotional Processing and Level of Autistic Traits

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Background:
Difficulty with emotion perception is a core feature of autism spectrum disorder (ASD) that is associated with the broader phenotype. Emotion processing is subserved by complex, densely connected yet separable cortical and subcortical brain systems. Conscious processing is a complex process involving multiple systems, whereas the subcortical visual processing pathway is hypothesized to be a simpler, rapid system. Most investigations of face processing deficits in ASD have focused on cortical pathways, such as the fusiform gyrus and superior temporal sulcus. More recently, evidence from neuroimaging studies implicates subcortical circuitry in the neuropathology of ASD. However, few studies have been replicated, and temporal characteristics of this subcortical route remain unexplored.
Objectives:

The current study explored the neural underpinnings of conscious and nonconscious perceptions of affect in typically developing individuals with varying levels of autistic-like traits (measured with the Autism Quotient (AQ)). We investigated the relationship between autistic-like traits and face processing efficiency as measured with event-related potentials (ERPs). The temporal sensitivity of this neuroimaging technique enabled relative reliance upon cortical versus subcortical routes of perception.

Methods:
We utilized ERPs (the P100, N170, and P300) to measure differences in face processing for emotional faces that were presented (a) either too quickly to reach conscious awareness (16 ms) or (b) slowly enough to be consciously observed (200 ms). Data were collected from 36 typically developing adults (M = 22.51 years, SD = 1.72, 13 females).

Results:
All individuals (regardless of AQ score) evidenced increased P100 ($p < .01$) and P300 ($p = .01$) for non-conscious versus consciously presented faces. Individuals with high AQ scores evidenced delayed early ERP components related to faces (P100, N170). Specifically, individuals with high AQ scores had delayed P100 component to subliminally presented faces ($p = .006$), as well as to neutral faces, particularly in the right hemisphere ($p = .019$), and delayed N170 to neutral faces ($p = .002$).

Conclusions:
Non-consciously perceived emotional faces elicited enhanced neural responses regardless of AQ score. Furthermore, higher levels of autistic traits were associated with inefficient face perception (i.e., longer latency to face-sensitive ERP components). This delay parallels processing delays observed in ASD. These data suggest that inefficient social perception is present in individuals with sub-clinical levels of social impairment and is observed in both cortical and subcortical pathways.

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72 **172.072** Dissociating Neural Response to Gaze Cues in ASD and Schizophrenia Using Simulated Face-to-Face Interaction

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Background:
Deficits in maintaining and interpreting social gaze are hallmark features of autism spectrum disorder (ASD). Individuals with ASD show reduced attention to direct gaze, attenuated sensitivity to gaze changes, and less use of gaze cues to facilitate facial communication. Atypical gaze processing is not unique to ASD and is evident in other disorders, including schizophrenia. It is unknown whether specific abnormalities in gaze processing differ by diagnostic category, or whether they are general indicators of social dysfunction across neurodevelopmental disorders.

The N170 is a negative-going event-related potential (ERP) that is recorded over occipitotemporal scalp and indexes the earliest stages of face processing. It is sensitive to point of gaze on the face and is atypical in both ASD and schizophrenia. In addition, N170 variability is associated with empathy, social competence, anxiety, and withdrawal across clinical populations. Previous studies of N170 response to gaze-related cues are limited by their use of static faces, which have questionable ecological validity. This study utilizes 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 schizophrenia.

Objectives:
This study aimed to (i) evaluate N170 response to direct and averted gaze in adults with ASD, schizophrenia, and typical development to determine between-group differences in neural processes associated with face decoding and (ii) examine transdiagnostic associations between neural response and social difficulties.

Methods:
Participants included 7 adults with ASD, 8 with SCZ, and 7 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 N170 was extracted from electrodes over right occipitotemporal scalp. Participants completed the Social Responsiveness Scale (SRS) and the Broader Autism Phenotype Questionnaire (BAPQ). Between-group differences were examined with repeated measures ANOVAs; transdiagnostic associations between neural response to gaze shift and self-report of social difficulties were explored with bivariate correlations.

Results:
Between-group analyses revealed no main effects of group or gaze direction, and no group by gaze direction interaction for N170 amplitude (Fig.1). Instead, across groups, N170 amplitude was significantly negatively correlated with social aloofness (BAPQ) and social motivation (SRS) (Fig.2). N170 latency, however, showed between-group differences: there was a main effect of group, driven by a significant latency delay in schizophrenia relative to both ASD and controls (Fig.1). There was no main effect of gaze direction or group by gaze direction interaction for N170 latency.

Conclusions:
Results revealed that efficiency of face-decoding neural mechanisms during simulated face-to-face

interactions differentiates ASD from other disorders characterized by social dysfunction. In contrast, strength of these mechanisms relates to social competency transdiagnostically, rather than varying by diagnostic category. These findings support a dimensional approach to understanding gaze processing differences in ASD and related disorders.

73 **172.073** Distributed Hypoconnectivity As a Neural Endophenotype of Autism

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Background:
Endophenotypes are quantifiable, heritable and state-independent markers of psychiatric disorders (Gottesman and Gould, 2003). Endophenotypes of autism should reliably quantify genetic effects of the disorder and may play an important future role in prevention, diagnosis and treatment. Identification of endophenotypes in autism has, however, thus far been limited; studies have either reported behavioral endophenotypes, or described changes in task-evoked activations localized to specific brain regions. Such reports of localized changes have been difficult to replicate, in part due to heterogeneous age and gender samples between studies (Müller et al, 2011).
A promising candidate endophenotype of autism is whole-brain hypoconnectivity, which has been reported to varying extents in autism populations, and may underlie the clinical manifestations of the disorder (Di Martino et al, 2014). Problematically, reports of hypoconnectivity have been variable and inconsistent, which may again reflect group heterogeneity, calling for further investigation with well-defined, well-matched groups.
Objectives:
Here we examined whole-brain functional-MRI connectivity from a large sibling-pair neuroimaging dataset during 3 tasks and 1 no-task condition, to investigate whether hypoconnectivity constitutes an endophenotype for autism. We aimed to explore global differences alongside specific networks consistently abnormal in autism, such as the default mode network (DMN).
Methods:
fMRI was performed for 53 subjects with high-functioning autism, 44 unaffected siblings of people with autism ("siblings"), and 40 controls during rest, an embedded figures and an emotional face processing task, and the 'Reading the Mind in the Eyes' task. Following preprocessing, functional connectivity in each of the 4 conditions was established as the correlation between the average time series of each pair of 264 regions of interest (Power et al, 2011). To maximise the homogeneity of participant groups for our analysis, we selected age- and IQ-matched groups of 14 males with ASD (mean age: 15.05), 14 siblings (mean age: 15.03) and 14 controls (mean age: 15.1) using an unbiased algorithm (van Casteren et al, 2007). We computed the relative DMN connectivity as the strength of connections within vs. outside the DMN, and additionally used the Network-Based Statistic (Zalesky et al, 2010) to look for specific network differences.
 Results:
Group differences in the average strength of correlations between regions appeared in *all* conditions, though these did not reach significance in the 'Eyes' task. During both other cognitive task-conditions and during resting state, a significant endophenotype effect occurred in which siblings exhibited stronger average network connectivity than autistic participants and weaker connectivity than controls. This effect was non-focal in the embedded figures task but left-lateralised in the emotional faces task, involving anterior and posterior cingulate regions. Preliminary analysis identified the same endophenotype in the DMN during resting state.
Conclusions:
We found significant reductions in cortical connectivity during rest and two different cognitive tasks. In each condition, adolescents with autism displayed weaker connectivity than did siblings; these, in turn, exhibited weaker connectivity than controls. These findings corroborate earlier reports of hypoconnectivity in autism in a replicable well-matched sample, finding these to be distributed and non-focal, and further our understanding of the broader autistic phenotype.

74 **172.074** Dynamic Systems Imaging in Adolescents with ASD of Lower and Higher Cognitive Ability

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Background:
Abnormal connectivity is a key component of the neural basis of ASD. Current evidence suggests that both under-connectivity and over-connectivity may be characteristic of the autism phenotype. Less is known about dynamic changes in the timing of network configurations in ASD and the integrity of large-scale physiologic systems in individuals with ASD of lower cognitive ability (LCA).
Objectives:
1)   Characterize and compare network dynamics and standard connectivity in LCA and higher

cognitive ability (HCA) adolescents with ASD.
2)   Investigate the impact of light sedation on network dynamics and the limitations/potential of this methodology.
3)   Investigate the relationship between network dynamics and autism severity.
Methods:
Three resting state fMRI scans were collected on 13-15 year olds; a subset of participants were scanned under propofol sedation. To address the role of cognitive functioning, we ran three contrasts with groups matched on age and IQ: HCA vs typically developing (TD), HCA awake (non-sedated) vs HCA sedation, and LCA vs developmentally delayed (DD) (all sedated). Participants scanned while alert were instructed to close their eyes. Scans were preprocessed using a standard approach. We performed a novel dynamic analysis as follows. We selected MNI coordinates identified in the literature as nodes in the default mode network (DMN), dorsal attention network (DAN), fronto-parietal task control network (FPTC), and "salience" network (SAL). For each coordinate we extracted the signal from a 10mm sphere. These timecourses were submitted to an exploratory factor analysis in a structural equation modeling framework to identify factors (networks) with identical structure in each contrast separately. The individual scores for each network for each subject were used as regressors in a voxelwise univariate general linear model (GLM) in FSL. This allowed us to compare the time-varying expression of networks across groups with respect to each other (i.e., as correlations of expression) and with respect to other un-seeded networks (via GLM).
Results:
Sedation affected both cortical dynamics and functional connectivity. The contrast between awake and sedated individuals with ASD showed higher correlations (suggesting poorer independence) between the attention networks and lower correlations between the SAL and the DAN in sedated compared to awake individuals. Dynamic connectivity analyses showed predominantly higher correlations in HFA compared to TD in networks involved in attention and introspection. Further, the correlation between the DAN and FPTC is correlated with ADOS symptom severity ($r(4)=.933$, $p=.006$) and is higher in all HFA participants than controls. No group differences in dynamics were observed between the LCA group and the DD group, although in the GLM analyses, LCA showed higher connectivity in occipital, cingulate, and frontal regions and lower connectivity in the temporal lobes and thalamus (see Figure 2).
Conclusions: Large-scale brain system alterations are observable in individuals with ASD with both higher and lower cognitive abilities. Dynamic connectivity approaches are highly sensitive to diagnostic status and individual differences in autism severity. However, they may be less sensitive for identifying abnormal network dynamics when participants are scanned under sedation, because sedation itself appears to lower differentiation of networks and reduce network expression.

75   **172.075** EEG Coherence: A Potential Predictive Neonatal Biomarker for Identification of Autism Risk and Prediction of Severity in 30 Month Olds

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Background: Early biomarkers of autism spectrum disorders (ASDs) are being sought in order to improve early identification and treatment and developmental outcome for those at risk of developing an ASD. EEG biomarkers have been studied in high-risk infants down to 6 months of age and power and coherence differences between low- and high-risk infants from 12 months of age have been shown (Tierney 2012, Righi 2014). Eye fixation has also been shown to decline from 2 to 6 months of age in infants that go on to develop ASDs (Jones 2013), long before the emergence of the classic behavioral triad: social and communication impairment with repetitive/stereotyped behaviors.
Objectives: We sought to study EEG long-distance connectivity in the newborn period as measured by inter-hemispheric EEG coherence to determine if this biomarker might serve to identify infants at risk of autism and predict the severity of autistic features at outcome.
Methods: Thirteen pregnant women who were mothers of at least one child with an ADOS +/- ADI-R confirmed clinical diagnosis of autism spectrum disorder (ASD) were recruited and followed through delivery. Their newborn infant (InfSib), at high risk of autism by virtue of being a sibling of the autistic proband, was followed prospectively from birth to 30+ months of age. Appropriate institutional approvals and consents were obtained. In the newborn period, ~ 42 weeks gestational age, high-density sleep EEG was collected in the InfSib. Neonatal sleep EEG coherence in the high risk InfSib was compared to a low risk age-matched normative data set (CHIME controls). InfSib developmental outcome measures at ~30 months of age, including the Pervasive Developmental Disorder-Behavorial Index (PDD-BI), were collected and analyzed for correlation with newborn sleep EEG coherence.
Results: Twelve of the 13 recruited mothers gave birth to live infants. Eleven had adequate neonatal sleep record at 42 for analysis and nine have outcome data at ~30 months. As a group, the CHIME controls showed coherence in active and quiet sleep in frequencies below 10 Hz with the highest coherence in the *delta* band, whereas coherence was significantly lower in the same frequencies in the high risk InfSibs group (p<0.01 at 2 Hz). Further, behavioral outcome in the InfSibs based on the Autism Severity Composite of the PDD-BI showed a strong negative correlation with the *beta* band EEG coherence measured in the neonatal period (r-value: - 0.77, p=0.02 at 26 Hz).

Conclusions: Long distance connectivity in the newborn period as measured by inter-hemispheric EEG coherence is a promising biomarker for identifying neonates at increased risk of developing an ASD. Further, our data suggest that decreased functional connectivity in the neonatal period may predict severity of autistic behaviors in two year olds. Sleeping EEG coherence in the newborn period should be further explored as a potential biomarker of autism risk and severity and may offer insight into the neurobiology and ontology of autism spectrum and related disorders.

76   **172.076** EEG Connectivity in Infants at High Risk for Autism

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Background: It has been previously reported that structural and functional brain connectivity in individuals with autism spectrum disorders (ASD) is atypical and that the extent and directions of the abnormality may vary with age. However, to date, no measures of functional connectivity measured within the first 2 years have specifically associated with a later ASD diagnosis.

Objectives: In the present study we analysed functional brain connectivity in 14-month-old infants at high and low familial risk for ASD using electroencephalography (EEG). We aimed to investigate if abnormal EEG connectivity during infancy predicts later ASD outcome.

Methods: EEG was recorded while infants attended to videos. We focused on the infant alpha band, because it is 1) intimately related to attention processes; 2) less prone to variations in infant's cognitive and emotional engagement than the theta rhythm; and 3) less likely to be contaminated by cranial muscle artefacts then the EEG oscillations of higher frequencies. Alpha connectivity was assessed using debiased weighted phase lag index (dbWPLI) – a recently developed method that is robust to volume conduction effect. Infant's behaviour during EEG session (looking, motion, affect, etc) was recorded and coded off-line. At 36 months the high-risk infants were assessed for symptoms of ASD.

Results: In all experimental groups the functional connectivity peaked in the alpha frequency range (7-8 Hz). As a group, high-risk infants who were later diagnosed with ASD demonstrated elevated phase-lagged alpha-range connectivity as compared to both low-risk infants, and to high-risk infants who did not go on to ASD. Hyper-connectivity was most prominent over frontal and central areas. The degree of hyper-connectivity at 14 months correlated with the severity of restricted and repetitive behaviours in participants with ASD at 3 years. As the group differences in functional connectivity may reflect differences in behaviour during the EEG session, we conducted detailed analysis of infant's behaviour during EEG recording. No group differences were observed in attentiveness to the movies, amount of gross body movements, or amount of time when participants demonstrated negative/positive affect. Further, no group differences in absolute or relative alpha spectral power were found.

Conclusions: At least some infants later diagnosed with ASD demonstrate functional hyper-connectivity in the alpha frequency range. This hyper-connectivity cannot be accounted for by inter-individual differences in behaviour during EEG session or by inter-individual differences in EEG spectral power, but seems to constitute an important feature of the early neurophysiological phenotype.

77   **172.077** Effect of Familiarity on Reward Anticipation in Children with and without Autism Spectrum Disorders

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Background: Previous research on the reward system in autism spectrum disorders (ASD) suggests that children with ASD anticipate and process social rewards differently than typically developing (TD) children—but has focused on the reward value of unfamiliar face stimuli. Children with ASD process faces differently than their TD peers. Previous research has focused on face processing of unfamiliar faces, but less is known about how children with ASD process familiar faces. The current study investigated how children with ASD anticipate rewards accompanied by familiar versus unfamiliar faces.

Objectives: The aim of the current study was to utilize electrophysiology to investigate the effect of familiarity on reward anticipation in response to faces versus non-faces in children with and without ASD. While previous studies have investigated the effects of familiarity on face processing, none have directly explored how the neural reward system is affected by familiarity in ASD. Specifically, we wanted to investigate reward anticipation for familiar versus unfamiliar faces, and scrambled versions of those images.

Methods: The stimulus preceding negativity (SPN) of the event-related potential (ERP) was utilized to measure reward anticipation. Participants were 6- to 10-year-olds with ($N = 14$) and without ($N = 14$) ASD. Children were presented with rewards accompanied by incidental face or non-face stimuli that were either familiar (caregivers) or unfamiliar. All non-face stimuli were composed of scrambled face elements in the shape of arrows, controlling for visual properties.

Results: No significant differences between familiar versus unfamiliar faces were found for either

group. When collapsing across familiarity, TD children showed larger reward anticipation to face versus non-face stimuli, whereas children with ASD did not show differential responses to these stimulus types. Magnitude of reward anticipation to faces was significantly correlated with behavioral measures of social impairment in the ASD group.

Conclusions: The findings do not provide evidence for differential reward anticipation for familiar versus unfamiliar face stimuli in children with or without ASD. These findings replicate previous work suggesting that TD children anticipate rewards accompanied by social stimuli more than rewards accompanied by non-social stimuli. The results do not support the idea that familiarity normalizes reward anticipation in children with ASD. Our findings also suggest that magnitude of reward anticipation to faces is correlated with levels of social impairment for children with ASD.

78 **172.078** Effective Connectivity of Mirror System Brain Areas in Autism Spectrum Disorder

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Background:
Autism Spectrum Disorders (ASD) are characterized by difficulties with facial mimicry, imitation, and the understanding of mental and emotional states in others. It has been suggested that deficits in relating to the intentions and emotions of other people are associated with reduced functioning of the human mirror neuron system (MNS). In previous studies, reduced activation in brain areas related to the MNS (in particular in the inferior frontal gyrus, IFG) during imitation and observation of actions has been taken as evidence for such a mirror system deficit in ASD. However, more recent activation based fMRI results are increasingly inconclusive with regard to the mirror system deficit hypothesis of autism. Several studies report either comparable activation in the MNS or even hyperactivation. Differential connectivity patterns in the core areas of the MNS (i.e. the superior temporal sulcus (STS), inferior parietal cortex (IPC) and IFG) may better characterize impaired and spared functionality of the MNS in autism and reconcile conflicting findings.
Objectives:
We investigated functional connectivity patterns during observation and imitation of facial expressions in mirror system areas.
Methods:
Eighteen adolescents and young adult patients with ASD and 18 matched controls were scanned with fMRI during imitation and observation of facial expressions of emotion. Brain imaging data were analyzed with SPM8, using a flexible factorial ANOVA model. Using DCM8, effective connectivity patterns of the MNS network were investigated. Bayesian model selection was used to determine the optimal model for each group, reflecting modulatory influences of task conditions (such as imitation and stimulus properties) within the network.
Results:
Both groups showed comparable magnitudes of brain activation in core areas of the MNS (e.g. STS, IPC, IFG) in response to facial stimuli (imitation and observation). However, different functional network architectures emerged with respect to the modulatory influences of the instruction to imitate. In particular, controls showed significant functional connectivity in the connections between STS->IPC->IFG, as well as in a direct STS->IFG connection, whereas patients with ASD showed functional connectivity only in the STS->IPC->IFG pathway.
Conclusions:
Our findings are in accordance with the EP-M theory of autism that predicts intact functioning in the STS->IPC->IFG pathway (reflecting largely intact goal-directed emulation and planning [EP] of imitative actions), but reduced connectivity in the direct STS->IFG pathway (reflecting reduced direct facial mimicry [M]) for autism. Furthermore, these results highlight the importance of functional connectivity analyses to elucidate characteristics of brain network functioning and its disturbance in autism.

79 **172.079** Effects of a Novel Behavioral Intervention for Irritability in Autism on Neural Circuitry of Emotion Regulation

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Background: Approximately 50 percent of children with autism spectrum disorder (ASD) exhibit irritability and disruptive behaviors such as tantrums, noncompliance, and aggression. If present in childhood, aggression tends to persist into adulthood and contribute to disability over and above the core autism symptoms. The atypical antipsychotics risperidone and aripiprazole are approved for aggression in ASD but they are associated with weight gain and other adverse effects. Parent training and applied behavioral analysis interventions for aggression in autism have been studied in young children but not in adolescents with high-functioning ASD.
Objectives: The objectives of this study were to test whether behavioral intervention for irritability in

autism would engage neural targets within the circuitry of emotion regulation. Methods: Based on our work on cognitive-behavioral therapy and parent management training for disruptive behavior, we developed a new intervention, comprehensive behavior therapy for irritability and aggression (BTIA) for adolescents with autism. We piloted BTIA with eight adolescents with ASD and high levels of aggressive behavior.

Results: Subjects included seven boys and one girl with ASD, mean age=14.3+1.4 and mean IQ=94.6+12.8. Six subjects were receiving medication (aripiprazole, citalopram, quetiapine, atomoxitine, and sertraline) that had been stable for at least six weeks prior to initiating BTIA and remained stable during the study. Participants showed a significant reduction in aggressive behavior with a 12-point change in the mean ABC irritability score from baseline to endpoint (paired samples t=10.6, p<0.01). *The 12-point reduction in the ABC irritability score is a clinically meaningful change and it is similar to the mean improvement in the RUPP trial of risperidone (Research Units on Psychopharmacological Interventions in Autism Network, 2002).* We also collected fMRI data during the frustration-induction GoNoGo task before and after treatment in four of eight children who participated in the CBT pilot. Regions-of-Interest analysis of the fMRI data was conducted using the independently-defined ROIs that were modulated by the task in an earlier study (Perlman and Pelphrey, 2010). There was an increase of activation in the right ventrolateral PFC in the recovery from frustration versus winning contrast from pre- to post-treatment. There were also increased levels of activation from pre- to post-treatment in the dorsal ACC, dorsomedial PFC, and right inferior frontal gyrus, and decreased activation in the right amygdala. The magnitude of the effects of BTIA on the levels of BOLD activation calculated as the Cohen's d effect size for the difference in post- to pre-treatment activation divided by the pooled standard deviation ranged from 0.64 to 1.1, indicating moderate to large effect sizes.

Conclusions: These results demonstrate that the BTIA can engage the neural circuitry of emotion regulation in children with ASD complicated by irritable and aggressive behavior. Larger, randomized controls studies are needed to confirm these findings.

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80   **172.080**   Electrophysiological Endophenotypes in Autism: A Family Study

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Background: Attempts to categorize genetic/behavioral components of ASD reveal diverse causal mechanisms, leading to diagnostic heterogeneity. One promising avenue of research is the identification of endophenotypes of ASD. The error-related negativity (ERN), a scalp-recorded event-related potential that represents performance monitoring processes, may qualify as an endophenotype of ASD. However, previous research is mixed, with some studies pointing to a reduced-amplitude ERN in ASD relative to neurotypical controls and other studies revealing minimal or no group differences.

Objectives: We examined the ERN as an endophenotype of ASD by determining whether ERN amplitude and behavioral (error rates, reaction times [RT]) differences were present in first-degree relatives of ASD probands. We compared electrophysiological and behavioral data in male ASD probands and each proband's father, mother, and one non-ASD male sibling relative to control youth and their parents. We hypothesized that youth with ASD would display reduced-amplitude ERN and impaired behavioral modification. We also hypothesized that higher presence of ASD characteristics in first-degree relatives would be associated with reduced EEG and behavioral activation.

Methods: We collected data from 19 ASD probands, 53 first-degree relatives, and 75 control youth and parents during a modified Eriksen flanker task. One-way ANOVAs were used to examine group differences in ASD symptoms. Group (ASD, ASD Sibling, Control Youth, ASD Mothers, ASD Fathers, Control Mothers, Control Fathers) x Accuracy (Error, Correct) repeated-measures ANOVAs were used to examine group differences.

Results: Levels of autism symptomology significantly differed between youth groups. ASD probands displayed significantly higher levels of symptomology relative to controls and siblings (ts < 9.14, ps > 0.001) but siblings and control youth did not significantly differ on measures of autism symptomology (ts < 0.77, ps > .44). Fathers of ASD probands displayed significantly greater autism symptomology relative to control fathers (t = 2.33, p = 0.03) but group differences were not present among mothers ($|ts|$ < 1.30, ps > .20). Repeated measures ANOVAs on ERN amplitude revealed a significant main effect of Accuracy (F = 161.96, p < 0.001) but no significant main effects or interactions with Group ($|Fs|$ < 1.82, ps > .10). Significant main effects of Accuracy were observed for error rates (F = 430.91, p < 0.001) and RTs (F = 739.99, p < 0.001). For error rates, the interaction with Group was not significant (F = .47, p = 0.83) but the main effect of Group was significant (F = 7.74, p < 0.001). For RTs, the Accuracy x Group interaction (F = 9.59, p < 0.001) and main effect of Group were significant (F = 1.22, p = 0.30). However, there were no significant differences between youth or parent groups for error rates or RTs ($|Fs|$ < 1.07, ps > .35).

Conclusions: Although groups differed on measures of autism symptomology, no group differences were present for electrophysiological or behavioral data. These findings suggest that autism may not be consistently associated with reduced performance monitoring and that the ERN may not qualify as an endophenotype for ASD. Given the heterogeneity of previous studies, replication is warranted.

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81   **172.081**   Emotion Attribution from Dynamic Faces: Bold Differences Pre- and Post- Decision in ASDs

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Background:
Atypical emotion attribution from facial expressions in Autism Spectrum Disorder (ASD) has been widely reported. However, to our knowledge, previous studies have not disentangled neural activation pre- and post-emotion attribution in ASD. To address this limitation, a novel dynamic facial expressions paradigm (DFEP) was developed to elucidate the neural processes engaged pre- and post-attribution of emotion from developing naturalistic facial expressions.
Objectives:
Determine if there are differences in neural activation pre- and/or post-attribution of emotion in individuals with ASD compared to typically developing individuals.
Methods:
Twenty subjects with ASD and 15 matched typical developed (TD) controls (8-18yrs) watched 10s displays of dynamic faces inside an MRI scanner. Subjects pressed a button once they "were sure" that the face, which started with a neutral expression, was expressing happiness, sadness or remaining neutral. Subjects completed 2 runs, each containing 16 blocks of each emotion.
Using the time-to-decision, subject-specific design files that split each display into a pre- and post-decision phase (DP) were created, giving a 2 (group) by 3 (emotion) by 2(DP) design. BOLD signal was compared using a 2x3x2 random effects ANCOVA, with age and verbal IQ entered as covariates to control for potentially confounding effects. Main effects and interactions were thresholded at $p < 0.005$, corrected for multiple comparisons using cluster size threshold estimation.
Results:
We found a main effect of Group in the Post-Central Gyrus (PCG), with BOLD activity being higher in the ASD than the TD group. Social Responsivity Scale (SRS; Constantino 2000) score significantly predicted activity in this region during the Sad emotions pre-decision in the ASD, but not the TD group. A Group x DP interaction was found in the Caudate, driven by increased activation post- relative to pre-decision in the TD group, but not in the ASD group. A Group x Emotion interaction was found in the Supra-Marginal Gyrus (SMG): the TD group had decreased activation for Neutral relative to Sad faces, but the ASD group showed decreased activation for Sad relative to Happy faces. Finally, there was a complex 3-way interaction in the left Middle Frontal Gyrus (MFG), driven by differences between the groups and emotions in the post-DP.
Conclusions:
The DFEP shows the ASD group had significantly greater PCG activation than the TD group across all emotions and DPs, which correlated with autistic symptoms before the emotion attribution decision for sad faces. Only the TD group demonstrated increased caudate activation post- relative to pre-decision, supporting reduced activation from social stimuli in reward areas of the brain in individuals with ASD. The SMG showed decreased activation for Neutral relative to Sad faces in the TD group, but decreased activation for Sad relative to Happy faces in ASD subjects, suggesting SMG engagement may subserve processing of different emotions in the ASD and TD groups. The left MFG activation differences between the ASD and TD Groups across emotions in the post-DP suggests that this area, which is involved in emotion attribution and empathy, is atypically activated after the attribution of emotion in individuals with ASD.

82   **172.082** Epigenetic and Neural Correlates of the Broad Autism Phenotype
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Background: Oxytocin plays an important role in social and affiliative behaviors, leading to questions of the hormone's involvement in autism spectrum disorders. Attempts to pinpoint single nucleotide polymorphisms (SNPs) of the oxytocin receptor gene (*OXTR*) involved in autism have identified potential risk alleles; however these results are inconsistent (LoParo & Waldman, 2014). The current research addresses limitations of the SNP approach by considering a novel epigenetic modification of *OXTR*, DNA methylation, that impacts the expression of the gene (Kusui et al., 2001) without changing its underlying structure.
Critically, *OXTR* methylation is variable in the population and preserved in both peripheral blood and neural tissue (Gregory, Connelly et al., 2009). Previous work by our group demonstrated that higher *OXTR* methylation is associated with autism (Gregory, Connelly et al., 2009) and variability in *OXTR* methylation is associated with neural systems supporting social perception. (Puglia, Morris & Connelly, submitted). The current work extends these findings by examining the relationship between *OXTR* methylation, neural correlates of social perception, and the broad autism phenotype (BAP). The BAP is considered a wider continuation of the autism spectrum that extends to the general population and consists of milder, but qualitatively similar traits as those understood to be defining features of autism (Piven, et al., 1997). Our approach combines functional neuroimaging and epigenetic methods allowing us to explore a wider range of phenotypic variability and provide a shift away from traditional, categorical distinctions when studying genetic contributions to social cognitive abilities.
Objectives: To establish relationships between BAP traits, *OXTR* methylation, and neural activity during social perception.

Methods: Forty-three neurotypical adults (21 males) aged 18-25 provided a blood sample for assessment of *OXTR* methylation, participated in a passive-viewing biological motion perception fMRI task, and completed the Autism Spectrum Quotient Questionnaire (AQ, Baron-Cohen et al., 2001). fMRI blocks consisted of point-light walkers displaying biological (BIO) or random (RAND) motion. BOLD activity for the BIO>RAND contrast was modeled with AQ score as a regressor, whole-brain cluster corrected p<0.01. Additional analysis included sex as a nuisance variable.

Results: A methylation by sex interaction approached significance, revealing a negative association between methylation and AQ score for males (b=-0.20) and a positive association for females (b=0.23, p=0.063). There was a significant positive main effect of AQ score on BIO>RAND activity within ventromedial prefrontal cortex, dorsal anterior cingulate gyrus, left middle temporal gyrus, left supramarginal gyrus, and left angular gyrus. Analysis with sex as a nuisance variable revealed a significant positive main effect of AQ score within ventromedial prefrontal cortex, frontal pole and left middle temporal gyrus.

Conclusions: Expanding upon earlier work showing a relationship between *OXTR* methylation and autism, we reveal that *OXTR* methylation is differentially associated with the occurrence of BAP traits across sexes. Furthermore, we find significant increased neural activity associated with increased BAP traits occurring in regions supporting mentalizing. The over-recruitment of theory-of-mind regions during a simple social perception task for individuals with more BAP traits may reflect a compensatory mechanism associated with increased effort to interpret the biological motion.

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83   **172.083** Evaluation of Mismatch Negativity As Biomarker for Language Impairment in Autism Spectrum Disorder

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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 6-10 with ASD+LI, ASD-LI and typically developing controls (TD) during a passive auditory oddball experiment presenting pure tones, speech sounds and complex non-speech sounds. During the recording children were instructed to watch a movie and ignore the sounds.

Results: Individuals with ASD+LI demonstrated MMN latency differences in response to all sounds compared to those with ASD-LI and TD controls. We propose that decreased MMN latency is associated with LI in ASD and propose that it is a sensitive and specific predictor of LI in individuals already diagnosed with autism.

Conclusions: It has been proposed in the literature that decreased MMN latency is associated with immature white matter pathways in the brain and inefficiencies in auditory stimulus transmission may play a role in language impairment in autism. If future research reveals that the MMN latency differences predict future ASD+LI diagnosis in infants and young children, MMN could be used as an early biomarker of LI impairment in ASD. Early identification of ASD language impairment (LI) in at risk children is critical for ensuring that these children get access to early intervention.

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84   **172.084** Eye Gaze and ERP Correlates of Emotion Processing Across Adults with ASD and Schizophrenia

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Background: Both Autism Spectrum Disorder (ASD) and schizophrenia (SZ) are characterized by difficulty with social cognition. In particular, emotion processing is a notable weakness across ASD and SZ, with both groups displaying deficits in emotion recognition and theory of mind. Eye-tracking (ET) studies reveal atypical gaze patterns to emotional faces in ASD and SZ, while event-related potential (ERP) experiments also suggest common dysfunction in neural systems subserving facial emotion processing. In line with the Research Domain Criteria (RDoC) initiative, the current study is the first to co-register ET and ERP methodologies for the study of emotion processing across multiple

neurodevelopmental disorders.

Objectives: Using ERPs, eye-tracking, and behavioral data, the current study aimed to (i) identify overlap in emotion-specific brain responses and gaze patterns across ASD, SZ, and typical development (TD), (ii) characterize ASD-specific electrophysiological and behavioral markers of atypical emotion processing, and (iii) identify relationships between behavioral measures of social functioning and biological indices of emotion processing.

Methods: EEG was recorded from 7 adults with ASD, 8 with SZ, and 10 with TD using a 128-electrode Hydrocel Geodesic Sensor net. ET was recorded simultaneously with an Eyelink-1000 remote eye tracker. Participants viewed a crosshair followed by an emotion-neutral face. Contingent upon participants' fixation to the eye region, the face changed to display a happy or fearful expression. ERPs were segmented to the presentation of the emotional face. To investigate the earliest stages of emotion processing, N170 amplitude and latency were extracted from occipitotemporal electrodes. ET data were collected to quantify gaze patterns to the eye and mouth regions. Behavioral and self-report measures of emotion processing and social cognition were collected, including the Reading the Mind in the Eyes Test (RMET), Broader Autism Phenotype Questionnaire (BAPQ), and Social Responsiveness Scale (SRS).

Results: Analyses revealed no significant between-group differences in N170 amplitude or gaze toward the eyes of emotional faces. However, across all participants, more robust N170 response to emotional faces correlated with better emotion recognition (RMET), all rs<-.500, ps=.015. Results examining time spent looking to the mouth revealed a main effect of emotion ($F(1,24)=4.531$, p=.045) and a group by emotion interaction ($F(2,24)=3.463$, p=.049). Whereas individuals with SZ and TD directed their gaze toward the mouth more when viewing happy compared to fearful faces, the ASD group showed the opposite pattern (i.e., more mouth-looking to fearful faces). Across happy and fearful faces, more time looking to the eyes correlated with lower autistic symptomatology (BAPQ) and higher social responsiveness (SRS), all rs<-.413, ps<.045.

Conclusions: This study assessed electrophysiological and behavioral markers of atypical emotion processing across ASD, SZ, and TD. Neural indices of face decoding were associated with emotion recognition abilities across groups, while preferential gaze to the eyes of emotional faces was associated with measures of social cognition. Individuals with ASD were characterized from those with SZ and TD by increased gaze toward the mouth to fearful than happy faces. Thus, in addition to identifying biomarkers of social dysfunction across diagnostic groups, the current study also identifies ASD-specific markers of emotion processing.

85 **172.085** Eye Movement Abnormalities in Individuals with ASD and Their Unaffected Biological Parents

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Background: Eye movement studies provide a precisely quantifiable and translational method for studying sensorimotor impairments in autism spectrum disorder (ASD), and could provide insights into its pathophysiological mechanisms. Individuals with ASD show reduced accuracy of both rapid, saccadic eye movements and sustained smooth pursuit eye movements. Additionally, we have identified reduced accuracy of saccades and smooth pursuit eye movements in unaffected first-degree relatives of individuals with ASD. Oculomotor abnormalities thus represent promising intermediate phenotypes, or biological alterations intermediate between genes and overt clinical manifestations that are expressed in both affected individuals and their unaffected first-degree biological relatives. The extent to which oculomotor abnormalities in ASD are familial has yet to be determined.

Objectives: To examine saccadic and smooth pursuit eye movements in individuals with ASD and their unaffected parents, and determine the extent to which eye movement deficits co-segregate within families.

Methods: Forty-five family trios (proband with ASD, biological mother, biological father) and 81 age-, IQ- and gender-matched controls (39 proband controls, 42 parent controls) completed eye movement testing. Participants with ASD were between ages 5-22 years and had a Performance IQ > 70. Individuals >55 years of age were excluded to limit variable age-related effects on motor functioning. All participants completed 60 trials of a visually-guided saccade task during which they made saccades to peripheral targets that appeared unpredictably but with equal probability at 12 or 24 deg to the left or right of center. The accuracy and latency of each saccade were examined. Participants also completed 40 trials of a smooth pursuit eye movement task during which they tracked targets moving leftward or rightward from center at 4, 8, 16, 24, or 32 deg per second. To determine smooth pursuit accuracy, we computed the velocity of pursuit eye movements relative to the target velocity.

Results: Individuals with ASD showed reduced accuracy of both saccadic and smooth pursuit eye movements. We will report results for the following ongoing analyses of our family data: 1) comparisons of saccade and smooth pursuit accuracy between our 90 unaffected biological parents of individuals with ASD and 50 matched parent controls; and 2) the interrelationship between oculomotor accuracy across probands and their unaffected parents. We also will test the association between eye movement abnormalities and broader autism phenotypic characteristics in parents as measured by the Broader Autism Phenotype Questionnaire (BAP-Q).

Conclusions: Our results indicate that saccadic and smooth pursuit eye movements are reduced in

accuracy in ASD. We have previously shown that these deficits may be present in unaffected first-degree relatives, but the familiality of these deficits has not been directly assessed. In this study, we will report the extent to which saccadic and smooth pursuit eye movement abnormalities are present in unaffected biological mothers and fathers of individuals with ASD, and whether these deficits co-segregate in different families. To the extent that these deficits are present in families, our results may help establish oculomotor deficits as biological intermediate phenotypes associated with ASD useful for identifying pathophysiological mechanisms and resolving heterogeneity in this disorder.

86   **172.086**   Face Processing in Infants Demonstrating Early Signs of ASD

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Background:
With earlier detection methods and known benefits of early intervention in Autism Spectrum Disorders (ASD), there is increasing demand for objective measures of risk for ASD and, in turn, of response to intervention. Processing of socially salient information, such as faces, has been studied as a means to understand social cognition in children showing early signs of ASD (Klin, 2003). In children with ASD and in infants at familial risk for ASD, EEG studies have revealed atypical face processing when compared to children without social communication delays (Dawson, 2002).
Objectives:
We investigated 12-24 month old children at high-risk (HR) for developing ASD based on evidence of early social communication delays, before they began an early behavioral intervention program (JASPER: Joint attention symbolic play engagement regulation; Kasari). We asked whether EEG correlates of face processing differentiated this group from a cohort of typically developing (TD) children and whether there was heterogeneity in face processing that may serve as a useful intermediate phenotype for predicting response to intervention. We focused on familiarity processing because the intervention is parent-mediated and targets joint attention.
Methods:
A cohort of 15 HR infants and 7 age-matched TD children (mean age = 19 months) were presented with images of their caregiver and a stranger in a randomized order while EEG was recorded using 128-channel sensor caps (Electrical Geodesics, Inc.). Data were artifact detected, interpolated, and averaged before analysis, with data rejected for insufficient number of trials, leaving 10 HR and 5 TD children with data for analysis. Repeated measures ANOVA was performed for group (HR, TD), condition (caregiver, stranger) and region (right, left) for face sensitive EEG components, with focus on the Nc (negative component) based on the age range being studied.
Results:
The HR group scored significantly lower than the TD group on the Mullen Scales of Early Learning developmental quotient (DQ) and verbal DQ sub-scores. All children in the HR group scored in the at-risk range on the Autism Diagnostic Observation Schedule-Toddler Version (ADOS-T). There was a significant condition effect across groups for Nc mean amplitude, with a greater response to the stranger condition (stranger: -10.01 mV; caregiver: -6.91 mV; p<0.01). This effect did not differ between groups, such that HR and TD children both showed a larger response to the stranger condition. There were no correlations between differentiation of conditions (Nc mean amplitude difference) and Mullen subscores or ADOS-T scores in the HR group.
Conclusions:
Despite evidence of delays in social communication skills, infants at HR for ASD demonstrated typical neural responses to faces. Within this small cohort, it seems that face processing may not be the most sensitive biomarker of risk for ASD. However, there still may be individual differences in face processing and overall attention to faces that relate to baseline joint attention skills or that may predict response to an intervention that targets eye contact and attention to social cues. Continued data collection will facilitate analysis of individual and subgroup differences that may inform predictors of outcome in this cohort.

87   **172.087**   Face-Selective Activation in Orbitofrontal Cortex Correlates with Social-Motivation in the Broader Autism Phenotype

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Background:
Face processing abilities are supported by a distributed network of regions that includes a "core" network important for processing perceptual properties of faces, as well as an "extended" network of regions that includes nodes supporting higher level aspects of face processing such as personal significance, social memory, and motivational relevance.   The perceptual nodes have received a great deal of attention, but the extended network is somewhat understudied, particularly with regard to face processing deficits in autism spectrum disorder. One node of the extended network is the orbitofrontal cortex (OFC), which has been implicated in processing face emotion and/or facial beauty. Outside of the face processing literature, the OFC has been broadly implicated in value

computations in both decision-making and response to biological and personal value (e.g. food, money). Thus, the question remains as to whether the OFC encodes a category-specific social-communicative value that is distinct from other object categories. Furthermore, there is currently no evidence of a relationship between individual differences in social-communicative skills and activation of the OFC in response to faces.

Objectives:
To characterize category-selectivity and brain-behavioral correlates in the OFC in response to various categories of objects in a cohort of 20 healthy college age adults using fMRI (10 female; mean age=24).

Methods:
In an fMRI study, we used a block design in which 4 categories of objects were presented, including faces, scenes, clocks, and highly palatable food. Image acquisition of the OFC was optimized using a 30-degree angle slice acquisition and post-processing correction of geometric distortion using gradient field maps. Prior to the imaging session, participants also completed the Broader Autism Phenotype Questionnaire (BAP-Q) and the Cambridge Face Memory Test (CFMT).

Results:
Regions of interest were computed based on the AAL atlas, including medial and lateral OFC subregions (mOFC; lOFC), as well as bilateral amygdala and bilateral nucleus accumbens (Nacc). Results revealed face-selective responses in the mOFC and amygdala and reward-general (faces & food greater than other object categories) responses in lOFC and Nacc (See Figure 1). In addition, face-selective responses in the mOFC appear to be behaviorally relevant, as responsiveness to faces in this region inversely correlated with the aloof subscale of the broader autism phenotype (BAP-Q), which indexes a lack of interest or enjoyment in social interactions (Figure 2A). The relationship between mOFC response to faces and the BAP-Q aloof subscale was distinct from face-memory abilities (CFMT) that were correlated with activation in the right fusiform gyrus (Figure 2B).

Conclusions:
These findings suggest that regions of the OFC may be selective for social stimuli and that the function of this region in the extended face network may be linked to social motivation related to the autism phenotype. The mOFC response is distinct from face perception responses in the fusiform gyrus, suggesting a distinct function of this region in social motivation, rather than perceptual aspects of face processing. These results indicate that future studies of the development of OFC face patches and their integrity in individuals with ASD is warranted.

88   **172.088** Facial Processing in Low-Functioning Individuals with Autism: An N170 Event-Related Potential Study

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Background: Abnormalities in the neural processing of faces have been previously documented in high-functioning individuals with autism (HFA). In EEG studies of normal controls (NC), the N170 event-related potential (ERP) shows a larger amplitude for faces relative to objects, and a delayed latency for inverted faces relative to upright faces. Previous work with HFAs has also demonstrated increased N170 amplitude for faces relative to objects; however, the delay in N170 latency for inverted faces relative to upright faces was not observed. The processing of faces in low-functioning individuals (LFA) with autism might also be altered but has previously not been explored. Abnormal development of the fusiform gyrus in autism may underlie patterns of weak central coherence, specifically the tendency towards feature-based rather than configural face processing. This processing style means that individuals with autism have less experience processing faces holistically, which may be reflected in atypical N170 effects. Atypical face processing could contribute to abnormal social development in ASD; therefore this is an important aspect of cognition to study in this population. To our knowledge, this study is the first to examine facial processing in LFAs using ERPs.

Objectives: The current study characterizes and contrasts facial processing in LFAs, HFAs, and NCs. Specifically, this study evaluates the response of the N170 ERP component to faces vs. inverted faces vs. non-facial stimuli (houses) in order to compare differences between the three groups.

Methods: Participants were LFAs, HFAs, and NCs. Stimuli consisted of gray-scale digital images of upright faces, inverted faces, houses, and filler items (furniture), which served as targets. While EEG data was recorded, images were presented for 500ms each, with an inter-stimulus interval of 500-1000ms. To maintain attention, participants were instructed to respond only to the targets; participants unable to make a behavioral response were asked to passively watch.

Results: For both NCs and HFAs, we found increased N170 amplitude in response to upright faces and inverted faces compared to houses. For both groups, we found a greater negative amplitude and a delay in N170 latency for inverted faces relative to upright faces. For LFAs, we found no N170 amplitude difference between the three conditions in the typical time window. However, in the later window of 200-250 ms, we observed a greater negativity to upright faces, and a greater positivity to inverted faces, relative to houses.

Conclusions: Overall, we replicated previous finding in normal controls, showing a typical processing delay for inverted faces relative to upright faces. For high-functioning individuals with autism, we also found a delay in N170 latency for inverted faces relative to upright faces, contradicting previous

findings showing no such delay for this group. For the low-functioning individuals with autism, the lack of amplitude difference between conditions in the canonical N170 time window may suggest that they are not differentially processing the images. Later differences observed in the 200-250ms time window may be indicative of delayed N170 effects; however, patterns across the conditions in this time window still differ from those observed for NCs and HFAs.

89 **172.089** Facial Response to Visual Stimuli: Using Pupil Response As an Indicator for Phenotype in ASD

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Background: Recent studies have indicated advances in the search for an autism phenotype (Bernier, et al., 2014). fMRI data shed light on underlying neuroanatomical differences in the ASD brain, such as amygdala overgrowth (Amaral, Schumann, & Nordahl, 2008), interconnectivity of brain regions (Cassanova, 2007), and a three-phase brain growth model of neuroanatomical changes from early post-natal development, persisting to late adolescence/early adulthood (Courchesne, Campbell, & Solso, 2011). Although there is much to be gained from brain imaging data, the use of less invasive physiological measures from a clinical standpoint may be pursued to decrease age of diagnosis, confirm behavioral characteristics in the diagnostic process, and support better understanding of underlying neurologic function in terms of expression of phenotype. Preliminary research suggests baseline pupil dilation is markedly different in individuals with autism when compared to individuals without autism (Martineau, et al., 2011), and differences in performance on transient pupil reflex tests have been documented (Fan, Miles, Takahasi, & Yao, 2009). Pupillometry is a viable measure of the autonomic nervous system (ANS) in a variety of neurologic disorders, including ASD (Daluwatte, et al., 2013). The pupil reflex test, a tool used to identify increased cerebrospinal fluid pressure, a characteristic observed on fMRI in ASD (Shen, et.al., 2013), holds promise for diagnosis. Commonly observed characteristics of the visual system in ASD include visual acuity within normal limits, but difficulty with eye gaze and photosensitivity, indicative of possible cranial nerve damage and oculomotor palsy.
Objectives: a) confirm use of the pupil reflex test to identify adolescents with ASD; b) determine whether a potential phenotype for ASD, marked by pupil response differences, is present in late adolescence for a given ASD subtype; c) determine whether these differences can be observed on a basic neurological exam testing cranial nerves II and III.
Methods: Utilizing eye-tracking software, this study examined differences in function of the sympathetic and parasympathetic nervous systems in 12 adolescents with ASD and 12 typically developing adolescents (TD) analyzing measures of pupil dilation/constriction, measures of cranial nerves underlying the pupillary reflex in response to pen light and swinging flashlight tests, and measures of ocular motility (optokinetic nystagmus).
Results: The use of the pupil reflex test positively predicted participants' inclusion in the ASD group, demonstrating a decrease in latency of pupil constriction in response to light, as well as a decrease in latency of response and tracking, on tests of nystagmus, when compared to the TD group.
Conclusions: These findings hold promise for the use of pupil response as a potential biomarker for ASD, much like the use of PERRLA to describe neurologic function post-stroke, post-traumatic brain injury, or in the presence of a neurodegenerative disorder. Results further confirm this measure for use with a specific subtype of ASD later in development, confirming a persistence of ANS dysfunction later in life. Follow-up clinical testing may prove beneficial to further confirm these findings as a viable clinical tool for pediatricians, neurologists, and other health-care personnel diagnosing ASD, and to contribute to the existing body of knowledge related to eye-tracking and potential subtyping of ASD.

90 **172.090** Functional Lateralization of the Cerebral Cortex in 16p11.2 Deletion and Duplication Carriers

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Background: Deletion or duplication of the ~600 kb BP4-BP5 interval at 16p11.2 is associated with a wide range of cognitive deficits and neuropsychiatric disorders, including autism spectrum disorders (ASD), language delay, and intellectual disability. These associated behavioral phenotypes can also relate to atypical functional lateralization of the cerebral cortex. Deletion and duplication carriers have widespread differences in gray and white matter volume. They also differ in the white matter microstructure.
Objectives: Given the association between the 16p11.2 copy number variant (CNV) and ASD, and language or intellectual deficits, we investigated how functional asymmetry of the cerebral cortex is affected in CNV carriers and how it relates to IQ and language ability.
Methods: Two cohorts of CNV carriers (children with deletions: n = 26, 8 – 16 years old; adults with duplications: n = 23, 18 – 62 years old) were compared to two samples of age-matched controls

(children: n = 45; adults: n = 58). The preprocessing of the resting-state BOLD images and calculation of the mean left and right laterality indices followed the pipeline outlined in Liu et al. (2009). An independent sample of 100 healthy individuals was used to determine highly lateralized functional connections in the cerebral cortex. These left- and right-lateralized connections were used to calculate mean left and right laterality indices for each participant, respectively.
Results: The deletion carriers were less left- and right-lateralized than age-matched controls, although after controlling for age, sex, handedness, imaging site, and micromovements, only the right-lateralized differences remained significant (left: t = -1.75, p = 0.09; right: t = 2.44, p = 0.02). Group differences were not found in the adult duplication participants (left: t = 0.08, p = 0.93; right: t = 0.31, p = 0.76). Across all children, full scale IQ and language ability were positively correlated with the degree of left lateralization (IQ: b = 0.005, p = 0.004; language: b = 0.003, p = 0.05), although after controlling for the group effects only full scale IQ's relationship with left lateralization remained (IQ: b = 0.004, p = 0.03; language: b = 0.002, p = 0.34). In other words, as left lateralization increased in the children, IQ increased. A relationship was not found between full scale IQ and right lateralization (b = 0.0008, p = 0.59) or language ability and right lateralization (b = 0.0007, p = 0.62) in the children samples. Also, there was no relationship found between lateralization and full scale IQ (left: b = 0.002, p = 0.39; right: b = -0.003, p = 0.09) in the adult samples.
Conclusions: Functional lateralization of the cerebral cortex is affected when a single copy of the 16p11.2 CNV is present but not when three copies are present. The pattern of decreased lateralization matches previously reported findings in ASD. Group differences in laterality overlap with IQ and language ability, with the relationship between IQ and lateralization in the left hemisphere remaining even after accounting for group differences.

91 **172.091** GABA(A) Receptors in Autism - a Multicenter Positron Emission Tomography Study

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Background: GABA (gamma-amino-butyric-acid) is the primary inhibitory neurotransmitter in the human brain. It has been proposed, on the basis of animal, genetic and post-mortem evidence, that the symptoms of autism spectrum disorders (ASDs) are associated with deficient GABA neurotransmission, possibly including reduced expression of GABA(A) receptors. These receptors are also a major focus of drug discovery (and recent Fast Fail initiatives in the USA). We recently **(Mendez et al. 2013)** reported preliminary evidence of reduced GABA(A) alpha5 binding *in vivo* in adults with an ASD. However, this requires replication. Moreover it is unknown whether any putative differences in GABA(A) are generalised to all receptor subtypes, or specific to alpha5.
Objectives: We conducted the first large study to investigate GABA(A) receptor density in adults with 'high functioning' ASD, using Positron Emission Tomography (PET). In this multicenter study, part of the EU-AIMS consortium, we carried out two linked experiments to provide complementary information about GABA(A). In one, we used the tracer [11C]flumazenil for quantification of total GABA(A) receptors; and in the other, we used [11C]Ro154513 as this tracer allows the selective quantification of GABA(A) alpha1 and alpha5 subtypes. Together, these two tracers provide a comprehensive analysis of GABA(A) density..
Methods: In the [11C]flumazenil experiment, 15 adults with ASD were compared to a control group of 8 healthy volunteers matched for age, sex, and IQ. Regional binding potential (BP_{ND}) to the GABA(A) receptor was examined. Quantitative analysis of PET images used a simplified reference tissue model with the pons as reference region, as standard for this tracer **(Klumpers et al. 2008)**.
In the [11C]Ro154513 experiment, 10 adults with ASD were compared to 7 healthy controls matched for age, sex, and IQ. [11C]Ro154513 V_T was calculated on the basis of an arterial input function and GABA(A) alpha1 and alpha5 receptor binding was estimated using a spectral decomposition of the activity time course **(Myers et al. 2012).**
Across both studies, inclusion criteria included: age 18-50; medically fit; free of psychotropic medication at the time of the study; IQ > 70; no history of epilepsy or other neurological illness. All ASD volunteers were diagnosed by using DSM-V criteria and verified by ADOS and, where possible, ADI. None of the volunteers in the [11C]flumazenil experiment took part in the [11C]Ro154513 experiment.
Results: In the [11C]flumazenil experiment, we found no evidence of differences in binding potential in any brain region (all p>0.22). Similarly using [11C]Ro154513, we found no significant differences in

whole-brain estimates of either GABA(A) alpha1 (p=0.44) or alpha5 (p=0.49) subtype receptors in adults with ASD, nor were there significant regional differences in any brain area.

Conclusions: This is the largest PET study of GABA(A) in ASD to date. Nonetheless our initial results are inconsistent with the hypothesis that GABA(A) receptor abnormalities are present across the ASD spectrum in adults with normal intellectual ability. However, reductions in GABA(A) receptors may exist in children **(Mori et al. 2011)**, or in other ASD subgroups. We also cannot rule out differences in GABA(A) receptor *function*.

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92   **172.092**   Granger Causality Estimation of Brain Connectivity in Autism Spectrum Disorders

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Background:

Disruption in interregional functional and anatomical connectivity has been at the center of neurobiological accounts of autism spectrum disorder (ASD) (Just et al., 2012; Maximo, Cadena, & Kana, 2014). While insights from these models are valuable, functional connectivity does not provide the time-lagged causality and directionality of connectivity. Effective connectivity, however, provides information about the influence one system exerts over another in a given experimental context (Büchel and Friston, 2000). Only a few previous fMRI studies have utilized effective connectivity to understand the neural mechanisms in ASD (Deshpande et al., 2013; Shen et al., 2012; Shih et al., 2010; Wicker et al., 2008).

Objectives:

The main objective of this fMRI study was to examine effective connectivity differences underlying self-other processing in individuals with ASD using Granger causality method.

Methods:

Eighteen high-functioning adolescents and adults with ASD and 18 age-and-IQ-matched typically developing control (TD) adults participated in this study. Participants made "yes" or "no" judgments about whether an adjective, presented visually, described them (*self*) or their favorite teacher (*other*). The data were collected using a 3T MRI scanner. Mean time series was extracted from 5 different regions of interest (ROIs) for all participants: left inferior parietal lobule (LIPL), left medial prefrontal cortex (LMPFC), supplementary motor area (SMA), and the pars opercularis (LIFO) and pars triangularis (LIFT) aspects of the left inferior frontal gyrus (LIFG). The extracted time series were normalized and the hemodynamic response de-convolved using a cubature Kalman filter (Havliceck et al., 2011) to get the underlying neuronal responses, which were put into the multivariate autoregressive model (Deshpande et al., 2010). Connectivity matrices were obtained and FDR corrected *t*-tests were performed to determine group differences.

Results:

For *self* condition, ASD participants showed weaker effective connectivity than TD from LIFT to LIPL and to LMPFC, from LIFO to LIPL and LMPFC, and from LIPL to LIFT (all $p < 0.05$ corrected). For *other* condition, ASD participants showed weaker effective connectivity from LIFO to LIPL and to MPFC. Effective connectivity during *self* condition was stronger for ASD than TD from LIPL to LIFO and to MPFC, and from MPFC to all other regions; LIFT; LIPL (all $p < 0.05$ corrected) . For *other* condition, effective connectivity in ASD was stronger for LIPL to LIFO, and bidirectionally between LIPL and LMPFC.

Conclusions:

Overall, this study found strong causal information transfer among three brain areas, LIFG, MPFC, and IPL, with most of the weaker connections of ASD originating from LIFG to IPL or MPFC. The MPFC has been associated with theory-of-mind and thoughts about others (Ebner et al., 2011), and the LIFG and LIPL have been found to have a role in self-other processing (Decety and Somerville, 2003; Kelley et al., 2002). Overall, the findings of this study underscore altered patterns of information flow in participants with ASD during social cognition (Deshpande et al., 2013) and supplement functional connectivity findings in ASD.

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93   **172.093**   Hemispheric Differences in Language Processing in Autism Spectrum Disorders: A Meta-Analysis of Neuroimaging Studies

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Background: Language and communication impairments are a hallmark feature of autism spectrum disorders (ASD). These impairments have been attributed to brain abnormalities at anatomical as well as functional levels. Abnormal asymmetry of the language association cortex (Herbert et al., 2005) and right lateralization of the functional language network (Redcay & Courchesne, 2008; Kana & Wadsworth, 2012) have been reported in ASD. Other findings include altered connectivity of the brain areas underlying language processing (Williams et al., 2013), and an over-reliance on visual cortices (Kana et al., 2006) to aid language comprehension in autism. However, a comprehensive

characterization of the functional language networks in individuals with ASD, which could aid diagnosis and design of intervention, has been lacking.

Objectives: The aim of the present study was to quantify common and consistent patterns of neural activity differences associated with language processing in ASD as compared to typically developing control (TD) participants across a large number of neuroimaging studies of language.

Methods: This preliminary analysis utilized activation likelihood estimation (ALE) meta-analytic approach to examine 20 previously published fMRI studies of language processing in ASD (N=311) and TD (N=307) participants. Statistically significant brain activation foci from these studies at within-group level (ASD, TD), and at between-group level (ASD>TD, TD>ASD) were subjected to quantitative voxel-based meta-analysis using ALE in *GingerALE* and the results are reported at a cluster-level correction of p<0.05 and a cluster forming FDR correction of p<0.05. The tasks included addressed semantic processing, sentence comprehension, processing figurative language, and speech production.

Results: The main results of this study include: 1) ASD participants had significantly reduced brain activity (ALE values), relative to TD, in core language areas, such as the left middle/superior temporal gyri (LMTG/LSTG) and the left inferior frontal gyrus (LIFG); 2) Reduced activity in ASD in medial regions, such as the left medial prefrontal cortex (LMPFC) and the anterior cingulate cortex (ACC); and 3) Greater activity in ASD than TD participants in the right hemisphere homologues of language areas, such as the right inferior frontal gyrus (RIFG) and the right superior temporal gyrus (RSTG) as well as in the cerebellum and the posterior cingulate cortex (PCC).

Conclusions: Findings of this study point to altered patterns of neural recruitment in individuals with ASD while engaged in language processing. An important finding is the hemispheric difference, with ASD participants relying more on the right hemisphere language areas, which has been correlated with poorer language functioning (Dawson et al., 1986; Coffey et al., 2008). This could reflect task difficulty and spill-over processing (Just et al., 1996). We also found reduced recruitment of left hemisphere language areas in ASD participants, suggesting less refined resources and approach to language comprehension (e.g., Harris et al., 2006). Furthermore, reduced activity in MPFC may suggest weak coherence in text comprehension in ASD (Mason and Just, 2006). Although preliminary, the findings of our study provide a cross-section of the functional integrity of the "language brain" in ASD. Further analyses of the data by including more studies are in progress.

94 **172.094** How Do Children with and without Autism Perceive the Passage of Time?: fMRI Reveals Differences in Neural Systems Recruited for Time Perception

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Background: Identifying the relative function of the primordial interval timing system (in the milliseconds to minutes range) is arguably important in those affected with autism; pathophysiological differences are beginning to be revealed (not only in autism, but related psychological conditions; e.g., schizophrenia, ADHD), and autistic interval timing differences have been found to correspond to certain diagnostic behavioral tendencies. It is generally found that individuals with autism tend to be less precise and more variable when timing relatively longer stimulus durations (e.g., over ~3+ seconds; compared to unaffected individuals). The timing of supra-second durations is well known to recruit cortico-striatal timing mechanisms in adults, but as yet how the autistic brain 'keeps time' is unknown.

Objectives: To-date, there are no existing fMRI studies of interval timing in typical childhood, or in those children affected with autism. In our fMRI study, children (aged 8-13 years) with and without a diagnosis of autism completed a temporal ordinal comparison (time perception) procedure inside the magnet using supra-second durations ranging from 1-11-s.

Methods: During each trial in the temporal ordinal comparison procedure, a pair of stimulus durations (comprising a standard, S; and comparison, C) are presented in quick succession, and children were asked to judge whether C was 'shorter' or 'longer' than S. There were two versions of the task in which S was either (consistently) 2.2-s or 8.2-s. In both versions, the six C durations were shorter and longer incremental deviants of S (+/-12, 24, 36%). Our a-priori ROI mask included regions typically recruited during adult time perception tasks: the supplementary motor area; the middle frontal and pre-frontal, superior and inferior parietal, and middle and superior temporal gyri; sub-lobar regions (e.g., striatum, thalamus, insula) and cerebellum.

Results: Data revealing group patterns and differences in neural activation during both S and C durations will be presented across our ROI. One particularly interesting group difference we observed corresponds to the apparent over-engagement of striatal timing mechanisms when those with autism are timing relatively shorter S and C durations—for instance unlike unaffected children, they revealed striatal activity during the 2.2-s but not 8.2-s standard duration; and tended to recruit the striatum across the comparison durations in the 2.2-s version of the task (ranging between 1-3-s).

Conclusions: Children with autism show different patterns of activity in several brain regions known to be involved in temporal processing (compared to unaffected children), particularly cortico-striatal systems which are recruited (or 'engaged') at shorter durations than appears typical. This pattern suggests affected individuals may experience a subjective lengthening of relatively short durations, and/or, a proclivity to engage beat-based timing mechanisms.

95 **172.095** Investigating the Neural Mechanisms Underpinning Theory of Mind Processes in ASD

Using a Reinforcement Learning Framework

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Background:
One of the cardinal and unique features of Autism (ASD) is their difficulty in understanding the mental states of others (Theory of Mind; ToM). Despite numerous behavioural and neuroimaging investigations, it is as yet unclear why individuals with ASD tend to struggle with this task. It has been suggested that the computational and neural mechanisms that underpin ToM may be similar to those that underpin first-person Reinforcement Learning (RL), i.e. unexpected decision-making outcomes (false beliefs) constitute prediction errors (PE) that activate neurons in regions such as the Middle Cingulate Cortex (MCC; Apps et al., 2013). Here, we present a novel paradigm for investigating ToM processes in ASD that is amenable to computational modeling and neuroimaging.
Objectives:
To investigate neural mechanisms underpinning ToM processes in ASD using a RL framework.
Methods:
Fifteen ASD and twenty age and IQ matched control subjects participated in this study. Figure 1 shows the experimental paradigm. Trials began with the presentation of 2 white doors with the Agent ("Player 1", "Player 2", or "Computer") printed underneath. "Player 1" meant the subject in the scanner picked one of the two doors. "Player 2" or "Computer" meant the subject in the scanner watched a door being selected by either an individual they met outside, or a computer. Once a door was chosen it would change to red or green; a red door indicated the player would probably not win money this trial, a green door indicated the player would probably win a euro. This contingency was true for 66% of trials (True Belief trials: TB). The remaining 34% of trials were False Belief trials (FB) where the contingency was reversed, i.e. no money behind a green door, or a euro behind a red door. Regardless of which agent was playing, the subject in the scanner always received privileged information in the lower left corner of the screen telling them what the real outcome of the trial would be. At this point the subject could determine if themselves, the other player, or the computer held a TB or FB. Subjects in the scanner would press a button immediately after the privileged information to indicate if this was a TB or FB trial.
Results:
Total accuracy ($F_{(1,33)}=15.894, p<0.001$) and FB accuracy ($F_{(1,33)}=15.84, p<0.001$) were significantly poorer in ASD individuals compared to controls. However, only FB trials showed a significant Group*Agent interaction ($F_{(2,66)}=6.095, p<0.005$). This is driven by significantly poorer accuracy in ASD for third person and computer FB trials compared to their own FB trials (Figure 2A). There were no differences between Agents in the control group. Using fMRI we localized these Group*Agent interactions to MCC and left Heschl's Gyrus (OP 4, Figure 2B).
Conclusions:
Using a RL framework we provide strong evidence that a deficit in social PEs (PEs about other people) may underlie problems with ToM tasks. This is consistent with Apps et al (2013) who proposed that disruption to the gyrus of the MCC would lead to specific deficits in social cognition, as seen in ASD.

96   **172.096** Local Brain Connectivity Across the Lifespan in Autism Spectrum Disorder and Typical Development

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Background:
        Autism spectrum disorders are characterized by abnormal brain connectivity (Kana et al., 2005), with some evidence for short-range overconnectivity and long-range underconnectivity (Courchesne & Pierce, 2004). Regional homogeneity (ReHo) is an analytic approach that can be applied to resting-state fMRI data to measure short-range (local) functional connectivity within a discrete region of the brain (Zang et al., 2004). There are few studies that have examined local connectivity in ASD using ReHo (e.g., Paakki et al., 2010), and none have examined whether local connectivity changes with age in ASD, nor whether these changes parallel those observed in typical development.
Objectives:
        We aimed to characterize the developmental changes in ReHo across children, adolescents, and adults with high-functioning autism (HFA) and a typically developing (TD) group. We further aimed to characterize relationships between local connectivity and symptom severity in the HFA group.
Methods:
        Data from the Autism Brain Imaging Data Exchange (Di Martino et al., 2014) contributed by NYU was used. Data were stratified into Child (< 11 years, $n=36$), Adolescent (11-18 years, $n=40$), and Adult (≥18 years, $n=30$) groups. The HFA and TD participants were matched within age group on IQ, mean framewise displacement (Power et al., 2012), and gender. After pre-processing the data using DPARSF-A (Yan & Zeng, 2010), ReHo values were calculated for every voxel within an eroded brain mask to remove invalid data at the brain edges. ReHo was calculated by computing Kendall's coefficient of concordance for one voxel and the surrounding 26 voxels (Kendall & Gibbons, 1990).

Global mean ReHo was calculated by computing the mean ReHo for the entire brain for each subject. Differences in ReHo between HFA and TD groups within each age group were assessed with an independent samples *t*-test using SPM8. A linear regression model was used to assess the relationship between global mean ReHo and social communication questionnaire values (Berument et al., 1999), using mean framewise displacement as a covariate.

Results:

Patterns of both increases and decreases in ReHo were observed in comparisons across all age groups. The TD group showed consistently higher ReHo in the occipital and cerebellar regions compared with HFA across all age groups. When comparing the effect of diagnosis and age group on global mean ReHo measures, there was a significant interaction of diagnosis and age group, $F(2,100)=3.39$, $p=.038$, partial $\eta^2=.064$. Global mean ReHo values were higher for TD ($M=.435$, $SD=.03$) than HFA ($M=.419$, $SD=.03$) in children, but this did not reach significance, $t(34)=-1.72$, $p=.095$. Global mean ReHo values were similar between diagnostic groups in adolescents and adults. Global mean ReHo values positively predicted SCQ total score in children and adolescents with HFA, $t(50)=2.15$, $p=.039$, $\beta=.45$.

Conclusions:

Contrary to the short-range overconnectivity hypothesis, children with HFA demonstrated lower ReHo across the brain compared with TD children. Global mean ReHo was similar between HFA and TD groups across adolescence and adulthood, supporting a "normalization" of brain connectivity in adulthood (Tyzka et al., 2013). Individual differences in regional homogeneity, indicative of short-range overconnectivity, may drive poor social communication in autism.

97 **172.097** Longitudinal Changes in M100 Latency in Children with ASD and Neurotypical Controls

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Background:
One of the more replicated electrophysiological signatures of ASD is the auditory M100 latency delay of ~10ms in children with ASD, as compared to typically developing age matched controls. This electrophysiological observation has great potential as a biological marker (biomarker), exhibiting a plausible putative biological underpinning in the correlation between thalamocortical white matter microstructure and M100 latencies. Children with ASD do not demonstrate the typical maturation of white matter microstructure and relation of this white matter microstructure to function. As such, M100 latency delays may be due to altered maturation or decoupling of structure to function relationships. Previous studies utilizing cross-sectional design have suggested a similar maturation rate of 3 ms/year for children with ASD and typically developing controls, although inter-individual variability is high (perhaps reflecting phenotypic heterogeneity).

Objectives:
The purpose of this study was to obtain longitudinal (3yr follow-up) M100 latency data to assess cortical response maturation *within-subjects* in contrast to previous cross-sectional data.

Methods:
Utilizing a longitudinal design with an inter-scan interval of 3-5 years (aged 6-9 yrs old at first scan), both typically developing and children with ASD passively listen to simple sinusoidal tones (200, 300, 500 & 1000 Hz,130 tones/frequency; 45dB, 300ms, 10 ms ramps, binaurally) while ensemble neuronal responses were recorded with whole head MEG. Artifact rejection and source modeling was performed using BESA. A linear mixed model with condition as a fixed effect was used to predict a stimulus independent M100 was generated for left and right hemisphere. The rate of maturation was derived in two separate ways: 1) using group level regression of data, and comparing the slope of the TD and ASD cohorts fits; 2) determination of individual subject maturation rates, and comparing these at the group level.

Results:
Maturation derived either through group level regression or via individual maturation rates appear consistent with prior cross-sectional findings, with maturation rates being ~ 2ms/year for both TD and ASD. However; right hemisphere responses differed depending on which method of calculation was used. For maturation rates derived from individual subjects rates, ASD demonstrated a greater rate of maturation (5.3ms/year) than TD (1.8 ms/year) (p<0.01). Group-level regression failed to replicate such findings, with only qualitatively greater maturation rates in ASD (4.29ms/year) than TD (1.4 ms/year) (p=0.16).

Conclusions:
Aberrant M100 maturation in the right hemisphere of children with ASD may account for latency alterations observed across ages, though results derived from individual subject maturation rates suggest that a convergence of latencies may occur in adulthood. The relationship of this within-subject maturation to within-subject white matter maturation has yet to be analyzed, however; previous studies suggest this is also perturbed in ASD. To determine if the discordance derived findings from individual based maturation rates and previous studies is actual more subjects are needed.

98 **172.098** MMN and Glutamatergic E-I Imbalance in Children and Adults with ASD and Phelan-

Mcdermid Syndrome

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Background:
The discovery of effective treatments in ASD has been a challenge because of the phenotypic, aetiological and genetic heterogeneity of the disorder, and the poorly understood underlying pathophysiology(ies). Recently, identification of monogenic forms of ASD offers novel opportunities for the understanding of pathophysiological mechanisms. ASD is caused by a haplo-insufficiency of SHANK3 (Phelan-McDermid Syndrome (PMS) in approximately 1% of cases. Individuals with PMS present with different degrees of Intellectual Disability (ID), motor problems and 50-80% have autistic symptoms. SHANK3 is a scaffold protein of the postsynaptic density of glutamatergic synapses. This suggests that SHANK3 deficiency may impact glutamatergic function (Excitatory-Inhibitory imbalance), and cortical network function Here we explore abnormalities in mismatch negativity, which relies on NDMDAR signalling, and has shown to underpin sensory processing abnormalities, as a potential biological risk marker.
Objectives:
(1) To comprehensively characterise children and adults with PMS in terms of ASD symptoms, neuropsychiatric comorbidities and IQ.
(2) To compare differences in MMN as assessed using an auditory oddball task in children and adults with PMS, ASD and typical development.
Methods:
Because of severe to profound intellectual disabilities associated with PMS, methods have been adapted to account for the low comprehension skills and often lack of speech of the participants. In particular, participants' autistic symptoms are assessed using gold standard assessments (i.e. ADOS), parental interviews (i.e. ADI-R), and parental completion of questionnaires (i.e. Repetitive Behaviour Scale, Short Sensory profile, etc.). Intellectual ability is measured using the Mullen Scales of Early Learning (for younger and more intellectually impaired participants), or the British Picture Vocabulary Scales and Raven's Colour Progressive Matrices (for more able participants). Mismatch Negativity (MMN) is assessed using an auditory oddball task). MMN is a well-established method in evoked-potential research in which an unpredictable change in a repetitive sound sequence elicits the mismatch negativity (MMN) response. It is said to be associated with pre-attentive cognitive operations in audition.
Results:
The study is currently on-going. EEG and clinical data from 5 PMS participants, 11 typically developing children and 16 children with ASD have already been collected. By May 2015, data from at least 10 PMS vs 20 idiopathic ASD individuals will be presented and discussed.
Conclusions:
Comprehensive multi-level characterisation of children harbouring SHANK3 deficits may help to identify common vs. distinct (biochemical, brain imaging) biomarkers related to synaptic defects and their link to behavioural and clinical abnormalities in ASD.

99 **172.099** Measures of Signal Complexity in Resting-State EEG Recordings from Young Children with ASD

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Background:
Multiscale sample entropy (MSE), a measure of signal complexity, is a promising biomarker of both autism spectrum disorder (ASD) diagnosis (Ghanbari et al., 2013) and ASD risk (Bosl et al., 2011), yet few studies have characterized its trajectory in either typical development (TD) or in ASD. Furthermore, relationships between alternative measures of signal complexity and MSE remain uncharacterized in either population. We have introduced frequency variance (FV), a surrogate measure of phase resetting and metastable dynamics, as an alternative measure of signal complexity for comparison with MSE. Metastability is a mechanism underlying the synchronization of neuronal assemblies serving as substrates for cognitive states (Werner 2007) and thus may relate to the cognitive inflexibility observed in ASD.

Objectives:
In this cross-sectional study, we sought to correlate FV and MSE with age in cohorts of ASD and TD children ages 2–6. We also examined the relationship between FV and MSE within each cohort to judge the extent to which FV and MSE measure different aspects of signal complexity.
Methods:
Age matched children with ASD (n = 23, age = 55 ± 9.0 months) and TD controls (n = 34, age = 55 ± 12 months) were recruited through the UCLA Center for Autism Research and Treatment (CART). EEG was recorded while children watched a video of soap bubbles for 2 minutes. After artifact rejection, recordings were bandpass filtered in the beta-gamma range (12 – 48 Hz), as these frequencies carry phase resets, captured by FV, in spontaneous EEG (Freeman et al., 2003). A brain-related signal from an independent component analysis (ICA) was selected for further analysis. FV was computed as the variance of the time derivative of the analytic phase calculated by the Hilbert transform. MSE was computed for 20 time scales following Ahmed and Mandic (2011).
Results:
While FV was negatively correlated with age in TD (r = -0.38, p = 0.026), no correlation was found between FV and age in ASD, nor was any correlation found between MSE and age in either cohort. In the ASD cohort, a strong negative correlation exists between MSE at short time scales and FV (r = -0.72, p = 0.00013) whereas, in TD, MSE correlation with FV was instead observed at small time scales corresponding mostly to beta oscillations (r = -0.56, p = 0.00062).
Conclusions:
In TD children, FV exhibits a stronger correlation with age than MSE and, therefore, may serve as a more promising biomarker of typical development. This correlation was not observed in the ASD cohort, possibly because this biomarker does not appear in children with delayed language or social communication. Relationships between FV and MSE in each cohort suggest that (1) frequency components within the beta-gamma bands of EEG signals from TD children exhibit greater signal power at high frequencies than is the case in ASD children and (2) MSE and the reciprocal of FV both quantify similar aspects of signal complexity.

100 **172.100** Mirror Neuron System Response to Action Simulation in Children with Autism

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Background: While deficits in the ability to imitate have been reported widely in individuals with autism spectrum disorders (ASD) (Williams et al., 2004), not all forms of imitation are equally impaired (Hobson & Hobson, 2008). At the neural level, dysfunction of the mirror neuron system (MNS) has been proposed to explain imitation deficits in autism (e.g., Williams et al., 2001; Dapretto et al., 2006). However, several recent studies have criticized this view finding evidence for robust activation and modulation of activation in MNS in ASD individuals (Dinstein et al., 2010). Previous research indicates that action simulation may provide an important resource for developing a better understanding of MNS functioning in ASD by allowing analysis of the functioning of this system independent of motor production (Wadsworth & Kana, 2011).
Objectives: To examine the role of MNS in mediating action simulation (mental imitation of an action) in children and adolescents with ASD.
Methods: Fourteen high-functioning children and adolescents with ASD (8-17 years old) and 15 age and IQ-matched typically developing (TD) controls participated in this functional MRI study. Participants watched 20 cartoon images, developed by Heilman and colleagues (Mozaz et al., 2006), of people performing everyday actions (10 transitive actions, 10 intransitive actions) but with the hands missing. Participants were asked to identify which hand orientation (of three answer choices presented) would best fill in the gap.
Results: The main results of this study are: 1) Action simulation elicited robust activity in the MNS in ASD and TD participants; 2) Significantly reduced activity in ASD participants, relative to TD, while simulating transitive actions in right inferior parietal lobule (RIPL) and increased activity in right middle temporal cortex for intransitive actions (p<0.005, k = 80 contiguous 2mm^3 voxels); 3) Significantly increased percent signal change (psc) was found in ASD participants in the left inferior frontal gyrus (LIFG) and regions related to motor planning and control (right precentral and postcentral gyrus, right cerebellum) during action simulation (p<0.05); 4) PSC in the LIFG was negatively correlated with scores on a measure of visual-motor integration (r = -0.53, p<0.05); and 5) No significant group differences on performance accuracy, but longer reaction time in ASD during action simulation.
Conclusions: Overall, participants with ASD showed intact performance in action simulation, and we did not find any evidence for a global MNS dysfunction in these participants. However, when transitive actions were simulated, ASD children showed reduced RIPL activity. This may be associated with limited processing of object affordances necessary for designing an appropriate motor plan (Maranesi et al., 2014) and also may be associated with less mirror neuron activity (Williams et al., 2006). In addition, ASD participants showed increased activation of the LIFG, potentially related to increased task difficulty (Martineau et al., 2010). Thus, it is possible that altered MNS response in ASD may be manifested only in complex action simulation. More research, manipulating task demand and contexts, is needed to generate a consensus on the role of MNS in ASD symptomatology.

101 **172.101** Modulation of Simon Interference Inhibition Processing By Serotonin in Autism: A Pharmacologic Functional MRI Study with Acute Tryptophan Depletion

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Background:
Stereotyped and repetitive behaviours constitute one domain of the classical triad of symptoms characterizing Autism Spectrum Disorder (ASD). Neurocognitive theories suggest that these symptoms may be related to deficits of interference-inhibitory control. In typically developing brain, inhibitory control tasks are mediated by the serotonergic (5-HT) system; e.g. reducing 5-HT by Acute Trypthophan Depletion (ATD) has been shown to modulate brain activation in the neurocognitive networks underlying inhibition processing in healthy controls (Rubia 2005). Individuals with ASD, however, show (i) atypical brain activation when performing tasks requiring cognitive interference inhibition (Schmitz 2006), and (ii) abnormalities in the 5-HT system (Zafierio 2009). However, direct evidence linking atypical 5-HT system to impaired inhibitory control in ASD remains is missing.
Objectives:
Here, we therefore examined the role of the 5-HT system in the neuroprocessing of interference-inhibition in people with ASD and neurotypical controls using pharmacologic functional Magnetic Resonance Imaging (pfMRI) involving ATD. We firstly established differences in the neurocognitive networks underlying interference-inhibition between individuals with ASD and controls. Secondly, we investigated whether modulation of the 5-HT neurotransmitter system by ATD differentially affected brain activity and task performance in the ASD and control groups.
Methods:
14 adult males (age 37(16-57); FSIQ IQ 115) with an ADI-R confirmed diagnosis of ASD, and 14 matched controls were scanned on two separate occasions using a double-blind randomized, cross-over design on a 1.5T MRI scanner at the IoPPN, London. On one visit, a placebo (SHAM) amino acid drink was consumed. During the other visit, a Tryptophan depleted amino acid drink was consumed. At both occasions, fMRI scanning was performed using the EF Simon cognitive-interference inhibition task (ref). Order or active vs sham drink was randomized. Blood Oxygenation Level Dependent (BOLD) signal data were analyzed with the non-parametric image analysis software XBAM (www.brainmap.co.uk). To investigate the differential effect of tryptophan depletion on Simon inhibition processing, we performed 2 Group (Control, ASD) X 2 tryptophan status (SHAM, ATD) factorial designed ANOVA interactions.
Results:
There was a > 70% blood tryptophan reduction after consumption of the depletion drink in both groups. There were no differences in the performance of the task in either group. However, relative to controls, people with ASD showed an atypical pattern of brain activation. We found significant interactions between SHAM/ATD conditions and diagnostic groups in right medial frontal and left superior temporal gyri. In these regions, the interactions were an indication of a pattern of 'normalization', where ATD decreased the BOLD signal for the controls and enhancing the signal response for individuals with ASD.
Conclusions:
Attenuation of 5-HT levels in the brain of individuals with ASD by ATD leads to 'normalization' of the neural networks involved in inhibition tasks relative to controls. These results suggest that 5-HT dysfunction in ASD may partially explain altered brain activity during inhibition tasks relative to healthy controls. If correct, this implies that the *reducing* brain 5-HT may be a novel theraputic approach in some individuals for autistic symptoms underpinned by abnormal inhibitory control.

102 **172.102** Neural Response to Biological Motion in Males and Females with ASD

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Background:
Females are diagnosed with ASD less frequently than males (at a 1:4 ratio). For this reason, most published research either excludes females or is underpowered to analyze sex differences. Consequently, the behavioral and neural characteristics of ASD in females are poorly understood**.** Prior research has established that hemodynamic markers of biological motion perception are attenuated in individuals with ASD, and females with ASD show more attenuated electrophysiological markers of face processing, the N170, than males with ASD or typically developing controls. However, the early time course of biological motion perception in females with ASD remains unstudied.
Objectives:
A four-site network was created to recruit sufficient numbers of females with ASD to allow for comparisons across sex and diagnostic groups. This approach allows us to assess the temporal neural dynamics of biological motion processing in girls with ASD towards the end of elucidating the neural and behavioral phenotype of females with ASD.
Methods:

Preliminary data from 13 TD (6 female) and 19 ASD (9 female) children between the ages of 8 and 17 observed biological motion (point light displays of walking humans) or non-biological motion (scrambled motion) while EEG was recorded at 500hz from a 128 channel Geodesic Sensor net. Mean amplitude of the N170 to biological and non-biological motion was measured at lateralized occipitotemporal recording sites.

Results:
Results from our preliminary sample identify differences between diagnostic status and sex on neural response to biological and non-biological motion. Overall there was a significant interaction between hemisphere, condition, and diagnoses [F= 4.65, p=.04]. These results show that differences between biological and non-biological motion were most apparent in the right hemisphere. Within the right hemisphere there was a significant interaction between condition and diagnosis [F=9.67, p=.004] such that TD individuals exhibited more negative N170s to biological versus non-biological motion. A marginal interaction between condition, diagnosis, and sex [F=3.49, p=.072] indicated that ASD females exhibited a less negative N170 to biological motion relative to non-biological motion, while ASD males displayed the opposite pattern. In contrast, all TD individuals exhibited more negative N170s to biological motion. Group differences were attributable to differences between TD and ASD females. Separate repeated measures ANOVAs by sex revealed significant condition by diagnoses interactions in females [F=10.04, p=.007] but not males [F=.96, p=.34].

Conclusions:
These results suggest that perception of socially relevant stimuli may be more impaired in females than in males with ASD. This finding is consistent with reports that females with ASD exhibit more severe impairments in social and communicative function. Ongoing data collection and analyses (in 40 additional subjects) will address temporal dynamics of social brain function in females with ASD, and will include age in the analyses. Additional analyses in progress will assess brain response to additional EEG components and oscillatory activity and examine relationships among neural metrics and clinical characteristics.

103 **172.103** Neural Response to Interactive Faces Is Associated with Clinical Characteristics in ASD and Typical Development

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Background: Individuals with autism spectrum disorder (ASD) tend to exhibit atypical gaze and neural responses to faces. Most studies have focused on perception of static faces, although social difficulties in ASD are most apparent in interactive contexts. The P100 and the N170 are event-related potentials that chart static facial-processing, but their connection to the clinical phenotype during reciprocal facial-processing is unknown.

Objectives: The current study investigated the relationship between neural responses to interactive faces and clinical characteristics. Using integrated eye-tracking (ET) and electroencephalography (EEG), we measured visual attention and neural response (P100, N170) to dynamic faces in ASD and typically-developing (TD) children. We sought to identify relationships between neural responses and clinical characteristics. We hypothesized that atypical facial-processing patterns would correlate with higher levels of clinical dysfunction.

Methods: Participants included school-aged children matched on age and IQ with ASD ($n = 19$) or TD ($n = 19$). EEG was recorded with a 128-channel sensor-net, and ET was recorded with an EyeLink-1000 remote camera system. In a gaze-contingent paradigm, participants viewed an arrow that cued them to look at the eyes or mouth of a face that then dynamically responded by opening either its eyes or mouth. Social function was measured using multiple standardized measures including the Multidimensional Anxiety Scale for Children (MASC), Childhood Anxiety Sensitivity Index (CASI), Vineland Adaptive Behavior Scales 2nd Edition (VABS-II), and Social Responsiveness Scale Parent Report (SRS-P).

Results: Preliminary data indicated that, when viewing reciprocal eye gaze, the TD group (but not the ASD group) exhibited significant correlations between higher levels of anxiety (MASC Total and CASI Average scores) and greater left hemisphere P100 ($r = 0.713$, $p = 0.002$) and N170 ($r = -0.619$, $p = 0.01$), respectively. In addition, only in the TD group, greater social adaptive functioning (VABS Social Standard Score) was correlated with greater left hemisphere P100 ($r = 0.658$, $p = 0.002$). Lesser impairment in cognition (SRS-P Cognition T-Score) was correlated with greater P100 in the right hemisphere for TD ($r = -0.504$, $p = 0.039$) but in the left hemisphere for ASD ($r = -0.492$, $p = 0.045$).

Conclusions: This study employed an innovative gaze-contingent paradigm to more realistically assess neural responses to simulated social interactions and their relationship with the clinical phenotype. Individuals with higher anxiety may be more vigilant in anticipating (P100) and recognizing (N170) eye contact in the TD group. In addition, greater social functioning predicted increased attention (P100) toward eyes in the TD group. The lack of these relationships in the ASD group is consistent with a lack of neural specialization in processing social information. Finally, lateralization differences may reflect different functional brain circuitry between groups. Data collection is ongoing, and analyses in progress examine visual attention in relation to brain activity and clinical characteristics in these groups and an additional group of unaffected siblings. Preliminary findings indicate potential benefits of using ET-EEG biomarkers to develop better diagnostic and treatment options.

172.104 Neural Sensitivity to Live Social Interaction Captures Developmental Variability in ASD Traits

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Background: The explicit social cognitive abilities of individuals with autism spectrum disorders (ASD) are frequently greater than corresponding abilities to navigate live social interaction (Klin et al., 2003). Understanding the behavioral and brain bases of this gap is fundamental to understanding ASD. To date, however, few neuroimaging paradigms have directly compared the processing of live versus recorded social stimuli, in part due to difficulties maintaining experimental control. Novel well-controlled neuroimaging paradigms examining specialization for live interaction will elucidate both core ASD symptoms and common comorbidities that are also most acute in live contexts (e.g., social anxiety).

Objectives: This study validated a novel approach to studying the neural correlates of processing of live versus recorded speech in children and adults and examined the relation between sensitivity to live interaction and ASD traits.

Methods: Thirty-one typical adults (13 males) and 17 typically-developing children (8 males) aged 7-13 years (mean=10.8, SD=1.6) completed a novel fMRI task in which they listened to short vignettes in two conditions: Live and Not-Live. In the Live condition, participants listened to a social partner that they believed was speaking over a live audio feed. In the Not-Live condition, participants listened to recorded speech from another speaker. Vignettes contained no references to people or social situations, and, unbeknownst to participants, Live segments were prerecorded in order to match speech characteristics and linguistic content with Not-Live speech. To match attention, participants answered a question and received feedback after each vignette. ASD traits were measured in adults with the Autism Quotient (AQ) and in children with the Social Responsiveness Scale (SRS). Children also completed the Social Anxiety Scale for Children—Revised.

Results: Children and adults rated the Live condition as feeling more live (i.e., like the speaker was talking directly to the participant) than the Not-Live condition (p<.01). For adults, greater perceived liveness for the Live condition correlated with lower AQ scores (r=-.40, p<.05). Adult whole-brain analysis comparing Live to Not-Live audio revealed increased activity in social brain regions, with greater differential dorsal medial prefrontal cortex (dMPFC) activation associated with lower ASD traits (r=-.51, p<.01). To analyze brain-behavior relations in children, regions of interest were created from adults. For children, greater activation for Live versus Not-Live stimuli in left superior temporal sulcus (STS) and temporoparietal junction (TPJ) was associated with diminished ASD traits (ps<.05), and social anxiety was positively correlated with live sensitivity in right TPJ (r=.66, p<.01).

Conclusions: This novel neuroimaging paradigm successfully captured neural differences elicited by real-time interaction in children and adults. In adults, higher ASD traits were associated with diminished neural discrimination for live versus recorded speech and with decreased ratings of perceived liveness for live, but not recorded, speech. For children, this paradigm dissociated between ASD traits (marked by decreased live specialization) and social anxiety traits (marked by increased live specialization). These findings are consistent with the hypothesis of impaired response to live interaction in ASD, perhaps reflecting diminished resonance with social partners, and indicate that interactive paradigms are an important direction for future clinical research.

172.105 Neural Signatures of Discrepant Nonverbal and Verbal IQ in Youth with ASD

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Background: Research suggests that discrepant cognitive abilities (non-verbal IQ [NVIQ] > verbal IQ [VIQ], and VIQ > NVIQ) are more common in youth with ASD than in normative samples, and the NVIQ>VIQ pattern has been found to be associated with more severe autism symptomatology. However, the neural underpinnings of discrepant cognitive abilities in youth with ASD have not yet been established. Understanding the neural basis for IQ discrepancy is important because it may inform a critical ASD endophenotype and lead to greater understanding of the biology underlying heterogeneity in the presentation of ASD.

Objectives: We sought to investigate the neural basis of discrepant cognitive abilities in youth with ASD. We used a well-validated fMRI task engaging social perception and evaluated, on a whole-brain level, the neural correlates of the (NVIQ minus VIQ) difference score, while controlling for ASD symptom severity and full-scale IQ.

Methods: Sixty-seven children and adolescents (4-17 yrs., 54 males) with high-functioning ASD participated. They passively viewed alternating blocks of point-light displays of biological versus scrambled motions in a Siemens 3T scanner. All participants were diagnosed with ASD using the Autism Diagnostic Observation Schedule (ADOS), and the final diagnosis was confirmed by expert clinical judgment. Cognitive abilities were assessed with the Differential Abilities Scales-Second Edition (DAS-II).

Results: The NVIQ/VIQ discrepancy cutoffs were determined using DAS-II normative criteria of a significant discrepancy. Participant groupings (NVIQ>VIQ, NVIQ=VIQ, VIQ>NVIQ) did not differ significantly on age, gender, full-scale IQ, ASD symptom severity (as measured by ADOS CSS score) and head motion in the scanner. Our sample showed a greater trend of individuals with NVIQ>VIQ (21%) and VIQ>NVIQ (19%) when compared to the normative criteria (15%), but this difference is not

significant, chisq(2) = 3.54, p = .17. For this reason, we did not test for group differences but treated the difference score, NVIQ minus VIQ, as a continuous variable. The (NVIQ minus VIQ) difference score was positively correlated with activation to biological versus scrambled motion in the postcentral gyrus, middle temporal gyrus, lateral occipital cortex, precuneus, inferior temporal gyrus, and fusiform gyrus, voxel-level Z > 2.326, cluster-level P < .05. Neurosynth-based functional decoding results indicate that these regions are primarily associated with visual perception, object recognition, spatial attention, and motion perception. Importantly, these neural correlates remained when controlling for ASD symptom severity and full-scale IQ score. Strikingly, ASD symptom severity was inversely correlated with the activation in the right posterior superior temporal sulcus (pSTS).
Conclusions: Our results suggest that the magnitude of a participant's NVIQ>VIQ discrepancy is associated with activity in a network of brain regions that are known to be engaged during early visual perception, object recognition, spatial attention, and general motion perception. Importantly, these neural correlates cannot be attributed to individual differences in ASD symptom severity or full-scale IQ level. Together, these results suggest that the NVIQ>VIQ discrepancy, as a feature underlying heterogeneity in the presentation of ASD, has its own neural basis that is separable from ASD core symptoms.

106 **172.106** Neural, Behavioral and Parent-Reported Indices of Executive Attention in Younger Siblings of Children with Autism

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Background:
Younger siblings of children with autism (High-risk [HR]-Siblings) are at increased risk for autism or subclinical social/cognitive deficits referred to as the Broader Autism Phenotype (BAP). Though much research has described behavioral variability exhibited by HR-siblings, little is known about neural mechanisms associated with this heterogeneity. Executive attention is the ability to monitor and resolve conflict between competing stimuli, and is related to self-regulation and social skills. Deficits in executive attention may account for the regulatory and social deficits observed in HR-Siblings.
Objectives:
This study uses a multi-measure approach (EEG, Flanker Task, parent-report) to examine executive attention in preschool-aged HR-Siblings (both affected and unaffected) and a comparison group of low-risk siblings of children without autism (LR-Siblings).
Methods:
Participants include 22 4-7 year-old younger siblings of children with an autism spectrum disorder diagnosis, 3 of whom displayed clinically-significant symptoms of autism (Affected HR-Siblings), and an age-, gender,- and sex-matched sample of 16 LR-Siblings. Participants successfully (≥40% accuracy) completed the Children's Attention Network Task (ANT; Rueda, 2004), with electroencephalograph (EEG) collected simultaneously. In this modified Flanker task children pressed a button corresponding to a central stimulus' direction. Central stimuli faced the same (congruent, CON) or opposite (incongruent, ICON) direction as flanking stimuli. CON and ICON stimulus-locked event related potentials (ERPs; N200, P300) were examined at fronto-central sites. Behavioral variables include reaction time and accuracy to CON and ICON stimuli. Parents reported on children's effortful control (Child Behavior Questionnaire, CBQ; Rothbart et al., 2001).
Results:
A series of repeated measures analyses of variance (Group [3]: Affected HR-Siblings, Unaffected HR-Siblings, LR-Siblings X Trial Type [2]: CON vs ICON) were conducted with task accuracy and reaction times (behavioral), and N200 adaptive mean amplitude at Fz (neurophysiological) as the dependent variables. Behaviorally, a main effect of trial type revealed that regardless of diagnostic group, participants made more errors $F(1,36)=32.36$, $p<.001$, and responded more slowly $F(1,36)=7.97$, $p=.008$, on incongruent compared to congruent trials. Neurophysiologically, a main effect of group emerged, $F(2, 28)=6.76$, $p=.004$, with Affected HR-Siblings exhibiting significantly less negative N200 adaptive means than LR-Siblings regardless of condition, $M_{dif}=7.54$, $p=.005$ (Figure 1). With respect to parent-reported Effortful Control, a multivariate analysis of variance revealed group differences in global levels of Effortful Control, $F(8, 46)=4.03$, $p=.001$, driven by differences in Inhibitory Control, $F(2, 26)=6.76$, $p=.004$. Affected HR-Siblings were rated highest in Inhibitory Control (Figure 2). Across the full sample, and split by group, the N200 ERP was not correlated with task performance or parental reports of effortful control.
Conclusions:
Despite a lack of differences in behavioral performance between HR- and LR-Siblings, a neurophysiological index (N200) clearly differentiated sibling groups. These impairments fell along a continuum from Affected HR-Siblings to LR-siblings, indicative of a BAP. Interestingly, Affected HR-Siblings exhibited higher Inhibitory Control than LR-Siblings. These children may be overly controlled and rigid in their thinking, which may serve as a compensatory mechanism in ANT task performance, where groups performed comparably. Subtle differences in cognitive and executive attention may index the BAP better than behavioral measures alone.

107 **172.107** Neurochemical and Neuroanatomical Changes in Children, Adolescents and Adults with Autism Spectrum Disorder

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Background: Prefrontal cortex (PFC) is associated with executive functions, social cognition, and ability to adjust behavior. These characteristics are known to be impaired in patients with autism spectrum disorder (ASD). It has also been proposed that in ASD patients the PFC has local over-connectivity and long-range underconnectivity, which may be caused by increased overall excitation due to an imbalance in the excitation/inhibition ratio (E/I). These connectivity changes impair the integration of information flow from/to several cortical and subcortical brain regions compromising PFC functions, and brain systems to which it connects. Moreover, E/I imbalance may also play a role in abnormal neurodevelopment in ASD.
Objectives: To investigate whether there is an imbalance in the E/I in the PFC of individuals with ASD, and whether cortical and subcortical volumetric differences are concomitantly present in ASD.
Methods: ASD group:25 males; 15 ± 5y.o (range:11-33); positive ADI-R and ADOS; FSIQ:93 ± 14; typically developing (TD) group:22 males; 17 ± 6y.o. (range:10-32); FSIQ:122 ± 15; (mean$\pm$SD). All TD participants were screened with Social Communication Questionnaire and Social Responsiveness Scale excluding ASD symptomatology.Data were acquired in a 3T Siemens scanner. Two MPRAGE sequences were acquired for volumetric analysis. Freesurfer 5.0 was used to obtain cortical and subcortical volumes. A 3x3x3cm^3 single-voxel located in the bilateral medial PFC was acquired using MEGA-PRESS for quantification of gamma-aminobutyric acid (GABA) (inhibition) and glutamate (excitation) ratios to N-acetylaspartate+N-Acetyl aspartylglutamic acid (NAA+NAAG). PRESS was used to obtain absolute brain metabolites concentrations: N-acetylaspartate (NAA), Choline (Cho), Inositol (Ins), and Creatine+phosphocreatine (tCr). Ratios and absolute concentrations were quantified with LCModel 6.3 1-D. Voxel tissue composition (gray matter, white matter, and cerebrospinal fluid) were measured using SPM and in-house developed software running in Matlab. Due to lack of quality 17 datasets were excluded from this particular analysis (9 ASD; 8 TD). Groups for neurochemical study were: ASD: 16 males, 15 ± 3y.o (range:12-24; FSIQ:90 ± 14; TD:14 males; 11-28 y.o., 18 ± 6y.o (range:11-28); FSIQ:124 ± 16 (mean$\pm$SD).
Results: The Glu/NAA+NAAG was increased in the ASD group (p=0.01), whereas no changes were observed in GABA/NAA+NAAG, or other main brain metabolites. Volumetric measurements revealed decreased volumes in the left amygdala and right thalamus in the ASD group (p=0.009 and p=0.025, respectively); the left thalamus showed a tendency for reduced volume (p=0.06). Furthermore, in the ASD group, decreased volumes were detected in the left hemisphere: lateral orbitofrontal cortex (p=0.01), and pars orbitalis (p=0.01); as well as in the right insula (p=0.04). Increases were found in left paracentral gyrus (p=0.03), and right rostral anterior cingulate (p=0.01).
Conclusions: Our results clearly point to an increase in E/I in ASD patients, however the relative nature of our measurements still leaves open the question on the source of such imbalance. We are acquiring unsuppressed water spectra for the absolute quantification of GABA and glutamate, which will enable us to clearly understand the direction of such imbalance. Together with the neurochemical results, anatomical changes support thalamo-cortical deficits, as well as impaired systems involved in executive function and regulation of emotional processing and communication in ASD.

108 **172.108** Neurophysiological Markers of ASD in Tuberous Sclerosis Complex

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Background: Tuberous Sclerosis complex (TSC) is an autosomal dominant disorder caused by mutations in TSC1 or TSC2 genes. TSC is often diagnosed prenatally or shortly after birth and confers a high risk of neurodevelopmental disorders, most commonly, autism spectrum disorder (ASD) and intellectual disability. Up to 80% of children with TSC will experience intellectual delay and up to 60% will meet criteria for ASD. This high comorbidity coupled with the prenatal diagnosis of TSC provides a model system to investigate pathways to ASD early in life. Currently, the causal mechanisms leading to the pathogenesis of neurodevelopmental disorders in TSC are yet to be elucidated with genetic and neurological correlates of the disorder (i.e., tubers and seizures) unable to account for the high preponderance of ASD in this clinical group. Recent evidence from both animal and human studies of TSC has pointed towards disturbances in the visual domain as a potential pathway to the development of ASD in TSC.
Objectives: To identify potential neurophysiological markers of ASD in infants with TSC by assaying low- and high-level visual processing.

Methods: The data reported form part of an ongoing multi-site, longitudinal investigation mapping the development of infants with and without TSC from 6 months through to 36 months. High-density electroencephalographic (EEG) recordings were conducted with infants with TSC and age-matched typically developing controls. Low-level visual processing was assessed using a pattern-reversal visual evoked potential (VEP) paradigm. Higher-level visual processing was assessed using a face-object paradigm. Peak amplitude and latency of the P1 was quantified in the VEP paradigm and mean amplitude of the N290 and P400 was quantified in the face-object task. ASD was assessed at 24 and 36 months with the Autism Diagnostic Observation Schedule and developmental level was assessed using the Mullen Scales of Early Learning.

Results: Preliminary findings demonstrate that children with TSC and ASD show distinct patterns of neurophysiological responding across low-level and higher-level visual processing paradigms by 24 months. In terms of low-level processing, the P1 was of higher amplitude and longer latency in TSC and ASD children compared to typically developing children (Figure 1). In terms of higher-level visual processing, children with TSC and no-ASD and typically developing children showed differential N290 and P400 amplitudes to faces versus objects; however, there was a lack of differential responding in children with TSC and ASD (Figure 2).

Conclusions: Preliminary findings suggest that children with TSC who meet criteria for ASD display distinct electrophysiological responses to visual stimuli. Specifically, these findings point towards alterations in both low-level and higher-level visual processing in infants with TSC and ASD. Disturbances in the neural processing of visual stimuli may be a contributing pathway to the high rates of ASD in TSC.

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109   **172.109** Plasticity of Brain Networks for Social Cognition in Adults with ASD

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Background: The right posterior superior temporal sulcus (pSTS) / temporo-parietal junction (TPJ) is a central node in the neural systems that support action observation, social perception, and theory of mind (ToM). Abnormal function in the right pSTS/TPJ is now a well-replicated finding in autism spectrum disorder (ASD). Moreover, the degree of dysfunction in the right pSTS/TPJ is related to the severity of social dysfunction across individuals with ASD. Together, the available evidence suggests that this region may serve as a target for interventions designed to improve social cognition in ASD.

Objectives: Adopting an experimental therapeutics approach, we employed a Virtual Reality Social Cognition Training (VR-SCT) and a well-validated fMRI paradigm to target activity/connectivity in a neural system emanating from the right pSTS/TPJ in adults with ASD.

Methods: Current participants include 5 adults (M_{age} = 20.18 years) with ASD (3 males) and 4 (M_{age} = 25.28 years) typically developing (TD) adults (2 males). In a within-subjects pre-treatment—post-treatment design, participants viewed alternating blocks of animated geometric shapes that displayed either socially-related interactions or random movements, while lying in a 3T scanner. Behaviorally, ToM was measured at baseline and post-treatment using the Frith-Happé animations. ASD diagnoses were confirmed via expert, multi-disciplinary clinical evaluation using gold-standard research instruments including the ADOS. The TD adults did not receive intervention but were scanned twice, allowing us to: 1) evaluate test-retest reliability of measures; 2) control for the passage of time; and 3) compare treatment effects to normative activation patterns. All adults with ASD received 10 sessions of VR-SCT intervention over a 5-week period (2 sessions per week). The intervention involved a highly innovative telemedicine approach and features safe, repeatable social-skill practice through VR role-playing. The use of VR computer avatars provides adults with ASD a familiar and predictable environment, reducing their anxiety and increasing confidence in social situations.

Results: On the behavioral measures, treatment of the adults with ASD, led to improvement in ToM, replicating prior results from members of our team. At the level of neural systems, the TD adults showed decreased activation in the right pSTS/TPJ region, perhaps reflecting habituation to the novel stimuli. Strikingly, adults with ASD generally exhibited increased activation in this target region of the right pSTS/TPJ, post-treatment > pre-treatment, voxel-level Z > 1.645, cluster-level P < .05. Functional connectivity analyses revealed that within the adults with ASD, there was generally increased connectivity from the right pSTS/TPJ region to the medial prefrontal cortex (MPFC), post-treatment > pre-treatment, voxel-level Z > 1.645, cluster-level P< .05.

Conclusions: While data collection is ongoing, the current results are beginning to reveal a remarkable degree of malleability in the neural systems involved in social cognition in adults with ASD. These results reflect a novel experimental therapeutics approach and offer important implications for much-needed additional research on interventions specifically targeting neural mechanisms for social information processing in adults with ASD.

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110   **172.110** Prefrontal Neurofeedback Training Approaches in Children with Autism Based on the Relative Power of EEG Rhythms Analysis

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Background:
Electroencephalographic biofeedback training (so called brainwave neurofeedback) is a treatment potentially useful for improvement of self-regulation skills in autism spectrum disorder (ASD). We proposed that prefrontal neurofeedback training will be accompanied by changes in relative power of EEG bands and ratios of individual bands (e.g. theta/beta ratio). By using the custom-made MATLAB application based on wavelet transformation, we were able to detect changes in the relative power and band ratios during the neurofeedback course.
Objectives:
The goal of the study was to detect the correlations between prefrontal neurofeedback training and the changes in relative power of EEG bands and the individual band ratios. And further to find an effective approaches for prefrontal neurofeedback training.
Methods:
The protocol used a training procedure, which according to specifications, represents wide band EEG amplitude suppression with simultaneous up-regulation of 40Hz centered gamma activity. In the first pilot study on 8 children and adolescents with ASD (~17.4 yrs) we used 12 sessions long course of prefrontal neurofeedback from AFz site, while in the second study on 18 children (~13.2 yrs) we administered 18 sessions of 25 min long prefrontal neurofeedback training. Quantitative EEG analysis (qEEG) was completed for each session of neurofeedback using a custom-made MATLAB application to determine the relative power of the individual bands (delta, theta, alpha, beta, and gamma) and their ratios within and between sessions.
Results:
Using our custom-made MATLAB application, we were able to detect changes in the relative power and band ratios during the neurofeedback, specifically linear decrease of theta/beta ratio (from 9.54±3.57 to 7.81±1.46 mean decrease being -1.72±3.40) and increase of 40 Hz centered gamma (from 73.1±4.85 to 75.39±5.27) over 18 sessions of neurofeedback in 18 children with ASD. The pilot study that used only 12 sessions showed significant qEEG changes sessions but did show only trend of progress across the 12 sessions. Also, there was found a significant reduction in Lethargy subscale of the ABC. The rating scores showed reduction (from 10.18±6.07 to 7.53±5.82), while Hyperactivity scores also showed decrease (from 16.65±13.78 to 13.29±11.97)
Conclusions:
Our experiments showed advantages of 18 sessions long weekly prefrontal neurofeedback training course in children with autism. Neurofeedback effects in the autism group were expressed in increased relative power of gamma band, decreased Theta/beta and Theta/low beta ratios. Custom-made Matlab program developed for the analysis of EEG data using wavelet analysis was useful to detect changes in EEG profiles during neurofeedback sessions.

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111   **172.111** Preserved Configural Processing in High-Functioning Adults with Autism: An EEG/ERP Study

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Background:
Typical developing adults are experts in the recognition of human faces and their expressions because they are capable of facial configural processing. Individuals with autism spectrum disorders (ASD) are impaired in face perception. This impairment has been associated in some studies to deficits in facial configural processing. Configural processing encompasses analysis of the generic position of the facial features (first-order relations), analysis of the spacing among them (second-order relations), as well as the ability to glue them in a unified face gestalt (also known as holistic processing).
Objectives:
To study the neural correlates of configural processing in adult ASD, by using a set of stimuli with distinct processing requirements (from first to second order configural and holistic processing) and to investigate behavioural and neurophysiological indicators of configural processing. Differentiation between these levels of face processing is possible by using face stimuli that lack some of the information available in photographic images, for example schematic faces lack second-order information, whereas Mooney faces lack first-order and second-order information.
Methods:
The sample consisted of 25 participants: we measured using electrode arrays of 40 channels event-related potentials (ERPs) in 9 high-functioning adults with ASD and 16 healthy controls, during a face decision task, using a comprehensive set of photographic, schematic and Mooney upright and inverted faces, and as control scrambled images. These heterogeneous set of stimuli involve differentially the various levels of configural processing (first-order, second-order and holistic). Subjects with ASD were recruited from the Neurodevelopment and Autism Unit from Child Center of Hospital Pediátrico, Centro Hospitalar Universitário de Coimbra and the Coimbra and Viseu Autism

Associations (APPDA). ASD subjects were male (mean age = 23.1 years; SD = 7.04). The diagnosis was based on the results of gold standard instruments such as parental or caregiver interview (Autism Diagnostic Interview– Revised, ADI-R) and direct structured proband assessment (Autism Diagnostic Observation Schedule, ADOS). The clinical criteria for autistic disorder were based on DSM-V. The 16 healthy controls were men (mean age = 23.4 years; SD = 5.06). Control subjects were screened for ASD with the Social Communication Questionnaire. Electrophysiological data were recorded using a NuAmps 40 Channel Quick-Cap (Compumedics, NeuroScan, USA). Analysis of variance (ANOVA) with within subjects factors face type (upright, inverted and scrambled) and hemisphere (left and right) and between subjects factor group (ASD, Controls). Significance level was set at $(\alpha)=0.05(p<0.05)$.

Results:
Behaviorally, there were no differences in performance between ASD and healthy controls. Both groups found it easier to recognize photographic and schematic faces than Mooney faces. We were able to detect that at the electrophysiological level that subjects with ASD displayed a normal configural processing related N170 inversion effect (being significant bilaterally).

Conclusions:
We conclude that the adult ASD subjects show positive electrophysiological evidence for sparing of facial configural processing, using an extended set of faces. Given that when their attention is oriented to the faces they are able to perform facial configural processing, the results do not seem to support reports of local processing biases in the ASD population.

112   **172.112**   Reciprocal Alterations of White Matter Microstructure in Carriers of Deletions Versus Duplications at the 16p11.2 Chromosomal Locus Are Associated with Cognitive and Behavioral Impairments

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Background: Copy number variants (CNVs) at the BP4-BP5 16p11.2 chromosomal locus are associated with autism, schizophrenia, and epilepsy. Individuals with 16p11.2 deletions tend toward increased body mass index (BMI) and larger head size, while individuals with the reciprocal duplications often demonstrate lower BMI and smaller head size.

Objectives: To compare white matter (WM) alterations in pediatric and adult carriers of 16p11.2 duplications and deletions using diffusion tensor imaging (DTI), and to relate these alterations to cognitive and behavioral function.

Methods: The study included 30 pediatric deletion carriers, 13 pediatric duplication carriers, 7 adult deletion carriers, 23 adult duplication carriers and matched control participants for each cohort. Nonverbal IQ (NVIQ) and social responsiveness scale (SRS) scores served as measures of cognition and social behavior, respectively. 3T structural MRI and DTI using 30 directions at b=1000 s/mm^2 were acquired and fractional anisotropy (FA), mean diffusivity (MD), radial diffusivity (RD), and axial diffusivity (AD) maps were constructed using tract-based spatial statistics (TBSS). Voxel-wise group differences of each DTI parameter were assessed for each of the four CNV carrier cohorts and their matched controls. Global and regional group differences were also assessed separately for the children and adults using analysis of variance (ANOVA). Finally, correlations of NVIQ and SRS were performed with the absolute value of z-scored DTI values in global and regional white matter.

Results: The voxel-wise TBSS results reveal extensive WM increases of FA and AD in the pediatric deletion carriers relative to their controls, whereas the pediatric duplication carriers show extensive decreases of FA and elevations of MD and RD. The adult duplication carriers similarly exhibit decreased FA and increased RD relative to their controls, but with additional extensive decreases of AD. While the adult deletion carriers do not show significant voxel-wise group differences due to lack of statistical power with only 7 carriers, they do exhibit significant elevations of AD in the association and limbic tracts from the ANOVA group analysis. Significant correlations between NVIQ and the absolute values of z-scored DTI metrics in the callosal, association, and projection tracts were found in children, with both increases and decreases of DTI metrics from control values associated with lower NVIQ. The adults showed significant correlations of NVIQ and SRS with the absolute value of z-scored DTI metrics in the callosal and limbic tracts.

Conclusions: We demonstrate widespread and opposing WM alterations in carriers of the 16p11.2 deletion versus the reciprocal duplication, consistent with the theory of gene dosage dependence. We also show associations of cognitive and behavioral impairment with deviation in either direction from the WM microstructural values of the control cohorts. The common cognitive/behavioral effects of these opposite changes in WM microstructure may help elucidate the heterogeneity in prior DTI studies of neuropsychiatric disorders that are associated with this CNV, such as autism and schizophrenia. These significant findings with modest sample sizes support the view that specific genetic variations may be more strongly associated with changes in WM microstructure than are the more mechanistically complex shared neuropsychiatric diagnoses.

113 **172.113** Reduced Prefrontal Cortical Responses and Atypical Connectivity to Join Attention in Children with Autism Spectrum Disorder (ASD): A Functional Near-Infrared Spectroscopy Study

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Background: Autism spectrum disorder (ASD) is a neuro-developmental disorder, characterized by impairments in one's capacity for joint attention. Joint attention is a process whereby two individuals share the focus of attention on the same object or event as one is following the gaze or pointing gestures of the other. This is critical for the development of social, language and cognitive abilities, so the neuroimaging studies of joint attention were crucial for understanding autism spectrum disorder deeply

Objectives: In this study, functional near-infrared spectroscopy (fNIRS) was applied to study the differences in activation and functional connectivity in the prefrontal cortex between children with autism spectrum disorder (ASD) and typically developing (TD) children.

Methods: 20 ASD and 20 TD children were recruited to perform joint and non-joint attention tasks. 8 video clips were made to arouse joint/non-joint attention experience (4 for joint attention and 4 for non-joint attention). 22 fNIRS measurement channels were located at the prefrontal cortex by using 10-20 system.

Results: Compared with TD children, children with ASD showed reduced activation and atypical functional connectivity pattern in the prefrontal cortex during joint attention. The analysis of functional connectivity showed that the prefrontal cortex of TD children exhibited a much more obvious lateralization to the left hemisphere during joint attention than non-joint attention, manifesting as reduced interhemispheric correlation in term of strength as well as correlation maps when the seed was located in the left prefrontal cortex. However, children with ASD did not show any similar pattern.

Conclusions: The atypical development of left prefrontal cortex might play an important role in social cognition defects of children with ASD.

114 **172.114** Refining EEG Biomarkers in ADHD for Diagnosis and Treatment Response Monitoring

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Background: There is marked heterogeneity in the behavioral, cognitive, and neural presentations of children diagnosed with attention-deficit/hyperactivity disorder (ADHD). This heterogeneity presents research and clinical challenges when trying to identify putative risk genes, define core deficits and recommend optimal treatment interventions for children with ADHD. Electroencephalograpy (EEG) is a strong candidate biomarker due to its high heritability and strong familial clustering, diagnostic utility, and sensitivity to treatment response. In addition, the first EEG biomarker for ADHD diagnosis was recently approved by the US Food and Drug Administration (FDA). While this diagnostic advancement may represent a milestone in general acceptance of using EEG as a quantitative assessment of brain function, further refinement of EEG biomarkers that better account for clinical heterogeneity and neurodevelopmental changes need to be developed.

Objectives: We will review the vast EEG literature in ADHD leading to the development of the FDA approved EEG biomarker as well as subsequent literature suggesting further refinement is needed. We will then present data from EEG studies of children with and without ADHD as well as EEG correlates of medication response among children with ADHD.

Methods: The sample consisted of 179 participants with ADHD and 93 non-clinical, healthy comparison children, aged 7- to 14-years old. All children received a baseline assessment consisting of semi-structured diagnostic interviews, comprehensive neurocognitive testing and EEG recording. Children with ADHD were then randomized to one of three medication conditions: d-methylphenidate, guanfacine, or their combination. Behavior, cognitive function and EEG during resting state and cognitive activation were measured at baseline and optimal dose for each medication group. Separate analyses for EEG markers that accurately identify children with ADHD diagnosis and that are associated with treatment response were conducted.

Results: First, we tested the FDA approved EEG biomarker (i.e., theta/beta ratio; THBR) for accuracy in ADHD diagnosis. The THBR did not differ significantly between children with ADHD and healthy comparison children. ADHD subtype and psychiatric comorbidities such as disruptive behavior disorders and depression have opposing and significant mediating effects on the THBR. Next, we tested multiple EEG features measured during a working memory task for association with ADHD diagnosis. This data yielded information about cortical mechanisms underlying working memory deficit and developmental course of these mechanisms in ADHD. Prediction of ADHD using multiple EEG measures was moderately high and suggested this may be a promising direction. Finally, we analyzed medication effects on EEG measures for the three medication groups and identified several markers for positive medication treatment response.

Conclusions: The data presented suggest that multivariate EEG biomarkers may be useful indices of

ADHD diagnosis, developmental course of disorder, and treatment response. The insights gained from these results may inform similar efforts in other neurodevelopmental disorders such as autism spectrum disorder (ASD).

115 **172.115** Relationship Between Neural Coherence and Social Functioning in Autism Spectrum Disorder

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Background: Autism spectrum disorders (ASD) are characterized by atypical social functioning, communication, and restricted/repetitive behaviors. With increasing prevalence (1 in 68), it is imperative to clarify etiological mechanisms and identify biomarkers underlying ASD that may lead to earlier diagnosis. Disruptions in neural synchrony may be a primary neurophysiological mechanism underlying aberrant connectivity that could contribute to the core symptoms of ASD, particularly altered social functioning.
Objectives: This study investigated relationships between neural synchrony (i.e., synchronous brain oscillations) at rest and social functioning.
Methods: Twelve ASD (Age: M = 8.9; SD= 1.0) and 13 neurotypical (NT) children (Age: M = 9.3; SD = 1.3) underwent magnetoencephalography (MEG) during resting state. Cortical activity was recorded using a 148 channel whole head MEG system (4D Neuroimaging, Magnes WH2500). Synchronization of neuronal activity was quantified by calculating coherence (0 to 1) (i.e. connectivity) between cortical sites from MEG imaged brain activations. Power spectra for activity at all active sites were calculated to quantify differences in alpha (8-14 Hz), beta (15-30 Hz), and gamma power (30-80 Hz). For each frequency, a t-test was computed to assess group differences in coherence for each pair of brain regions (N=1431). Kendall Tau correlations were computed to explore relationships between coherence and social functioning and measured by the Social Responsiveness Scale.
Results: Decreased coherence between Default Mode Network (DMN) regions (medial prefrontal, cingulate, and parietal cortices) was noted in ASD. *Alpha band*: In ASD, higher coherence between cingulate and right precentral (t = -.62, p = .006), postcentral (t = -.59, p = .008) regions was related to greater social awareness. In NT, higher coherence between right orbitofrontal regions and right (t = .50, p = .03) and left gyrus rectus (t = .47, p = .04) as well as left angular gyrus was related to overall social difficulties. For both groups, higher coherence between left caudate and other cortical regions was related to more atypical behaviors. *Gamma band*: In ASD, higher coherence between left temporo-parieto-occipital and right temporal and frontal regions, particularly orbitofrontal, was related to lower social awareness. Increased connectivity between right parietal (angular) regions and fronto-temporal regions was related to increased atypical behaviors.
Conclusions: This study aims to illuminate differences in neural synchrony and altered patterns of connectivity that could serve as a potential biomarker for ASD. Analyses indicate that enhanced alpha power and connectivity between regions of the DMN are related to higher social awareness in ASD. In both groups, increased alpha and gamma power and connectivity between orbitofrontal regions and posterior cortical regions appears to confer risk for social difficulties. Likewise, higher connectivity between the striatum and other cortical regions confers risk for atypicality. These findings suggest an emerging pattern of altered cortical connectivity in regions of the DMN that are related to aberrant social functioning and aberrant connectivity between the basal ganglia that is related to atypical behaviors; both core deficits in ASD. Finally, the results reveal the utility of MEG to quantify altered neural coherence and to detect potential biomarkers of ASD.

116 **172.116** Replicable Network-Based Diagnostic Classification of ASD in the Autism Brain Imaging Data Exchange

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Background: Autism spectrum disorders (ASDs) are characterized by alterations in and heterogeneous patterns of functional brain connectivity. This heterogeneity has presented a significant obstacle to MRI/fMRI-based diagnostic classification because most optimization algorithms assume a single, mutually exclusive distinction between control and ASD groups. As a solution, in this study we present a novel classification method based on a combination of network-based effective connectivity (structural vector autoregression; SVAR) and a high-dimensional variable selection procedure (smoothly clipped absolute deviation; SCAD) to identify subsets of connections that are robust to high-dimensional heterogeneity, and as such may have promise when applied to fMRI data in order to predict ASD diagnostic status.
Objectives: Determine the efficacy of a high-dimensional variable selection procedure (smoothly clipped absolute deviation; SCAD) in determining diagnostic status (ASD versus non-ASD) in a large, publicly available repository of resting-state data (Autism Brain Imaging Data Exchange; ABIDE), and replicate the classification procedure across 16 physical ABIDE sites.
Methods: We used resting state-fMRI data from 1,112 subjects (ASD N=539, Control N=573) across 16 geographic sites from ABIDE, to measure functional connectivity estimates among 12 regions of interest (ROIs) in the frontostriatal circuit. We incorporated all 12 ROIs into subject-level network

maps, yielding 144 directed connectivity paths per subject. Using a leave-one-out procedure, we compared predicted diagnosis from SVAR+SCAD against actual diagnosis based on (ADOS/ADI-R).
Results: Results indicated that fronto-striatal network maps contained, at the individual- and site-levels, sufficient data to accurately classify 84.6% of cases, on average, across all 16 ABIDE sites. Correlational and temporally-lagged models performed relatively poorly, whereas a model that combines instantaneous and temporally-lagged effects (structural vector autoregression; SVAR) provided a superior model fit, achieving greater than 90% accuracy for sites with less than 50 subjects.
Conclusions: Network-level information that is variably expressed as the directional connective properties of the fronto-striatal circuit can be captured by SVAR+SCAD and used to predict the diagnosis of ASD via a leave-one-out prediction algorithm. Although no significant associations between any single connectivity estimate and ASD diagnosis were observed, SVAR+SCAD captured network-level properties that are not currently incorporated into other machine-learning and prediction algorithms, which focus on a low- (or one-) dimensional distinction between groups. Replication of predictive estimates across ABIDE sites increases confidence in the utility of this method for fMRI-based classification enterprises.

117 **172.117** Resting State Functional Connectivity of Social Brain Regions in Autism Spectrum Disorder: Correlate with Social Symptom Severity in ASD

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Background: Autism spectrum disorder (ASD) is neurodevelopmental disorder characterized by qualitative deficits in social and emotional cognition (Baron-Cohen et al., 2005). Recent functional neuroimaging studies of ASD in 'social brain' predict that deficits of function in social brain regions impede social and emotional cognition in ASD. However, much work needs to be done in order to advance evidence for the social brain network in ASD because social brain is defined as the complex network of areas.
Objectives: The aims of the present research are (1) to test the hypothesis that lower intrinsic functional connectivity of social brain in ASD relative to individual with typical development (TD), using resting state functional MRI (rs-fMRI) and (2) to evaluate degree of lower intrinsic functional connectivity between social brain regions predicted symptom severity for social skill in individual with ASD.
Methods: Using the seed-based approach and functional amplitude of low frequency fluctuation (fALFF) approach (Zou et al., 2008) based on rs-fMRI, we investigated intrinsic functional connectivity of social brain in 18 young male adults with high-functioning ASD (25.6 ± 7.2 years; full scale IQ [F-IQ] = 106.8 ± 13.9) compared to 26 age-matched young male adults from the TD group (23.9 ± 3.8 years; F-IQ = 113.3 ± 9.8). We also performed logistic regression analysis between functional connectivities and social skill symptom severity using AQ score.
Results: ASD showed over 10 difference significantly lower strength of rs-FCs in the social brain seeds with right inferior frontal gyrus (IFG), left dorsal medial prefrontal cortex (dMPFC) and right amygdala (figure A). Moreover, the ASD group showed significantly lower strength of resting state functional connectivities from bilateral IFG, bilateral dMPFC, bilateral ventral medial prefrontal cortex (vMPFC), bilateral insula, bilateral middle cingulate cortex (MCC), right posterior cingulate cortex (PCC), bilateral amygdala, right fusiform gyrus (FFG), and bilateral temporal pole (figure B). In the logistic regression analysis, the strength of rs-FC among left IFG ($R^2 = 0.380$; $p < 0.05$), left dMPFC ($R^2 = 0.415$; $p < 0.05$), left insula ($R^2 = 0.345$; $p < 0.05$), right IFG ($R^2 = 0.472$; $p < 0.05$), and right amygdala ($R^2 = 0.518$; $p < 0.05$) were predictive of social skill symptom severity on ASD group.
Conclusions: We found that not only are the lower intrinsic functional connectivity of social brain regions in ASD compared to TD, but also there are difference range of function connectivities in social brain regions in dMPFC, IFG, and amygdala. In particular, our findings suggest that lower functional connectivity of IFG, dMPFC, amygdala, and insula compared to other social brain regions involved in social and emotional cognition may impair the individual with ASD to experience social interaction which needed social and emotional cognition.

118 **172.118** Sensory Processing Abnormalities, ASD Features, and Modulation of Auditory Evoked Potentials in Fragile X Syndrome

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Background: Sensory hypersensitivities are common, clinically distressing features of both Autism Spectrum Disorder (ASD) and the Fragile X Syndrome (FXS). Preclinical evidence suggests that this symptom results from synaptic hyperexcitability in sensory systems. Local circuit function in sensory networks is dependent on the dynamic balance of inhibitory/excitatory synapses in sensory cortex. Shifts in this balance modulate stimulus selectivity and sensory habituation to a repeated stimulus. These processes can be selectively examined with sensory evoked potentials.

Objectives: The objective of this study was to examine local circuit function in auditory cortex by assessing sensory habituation, sensitivity and selectivity in FXS.

Methods: Auditory evoked potential studies were completed with adolescent and adult individuals with FXS (N=17), and matched healthy controls (N=15). Event-related potentials (ERPs) were examined during a passive auditory habituation task. Habituation trials (150 total) consisted of a train of four 1000 Hz beeps separated by a 500 ms inter-stimulus interval, with an inter-trial interval of 4 sec. Dense array EEG and spatial PCA were used to capture the ERP response to each stimulus in the 4 stimulus train. Absolute ERP amplitudes as well as percent reduction in amplitude to each repeated stimulus were compared between groups.

Results: FXS patients showed reduced habituation to repeated tones reflected in a significantly decreased level of N1 reduction over trials, t(30)=2.24, p=.03. A subset of FXS patients showed "giant" N1 amplitudes (more than 2x that of healthy controls) to all four repeated stimuli. Increased negative N1 amplitude was strongly correlated with increased clinical reports of auditory processing abnormalities on the Sensory Profile (rho=-.59, p=.02) which were in turn correlated with increased endorsement of ASD features on the Social Communication Questionnaire (SCQ; rho=.66, p=.03). FXS patients also showed significantly decreased N2 ERPs to each of the stimuli in the 4 stimulus train (p's<.01). Abnormally decreased negative average N2 amplitude showed a strong correlation with increased Irritability scores on the Aberrant Behavior Checklist (rho=.75, p=.005) for FXS.

Conclusions: FXS patients show hyperexcitability of the N1 ERP response and increased impairment in sensory habituation linked to clinical reports of auditory processing abnormalities and to the presence of ASD-like traits. Abnormalities in the N2 ERP response suggest a reduction in executive function associated with extended stimulus processing, potentially reflecting a reduction in the cognitive components associated with habituation to repeated stimuli which may contribute to the increased levels of irritability seen in these individuals.

119   **172.119**   Sensory over-Responsivity and Amygdala Response to Emotional Faces in Youth with and without ASD

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Background: Sensory over-responsivity (SOR) is extremely common in individuals with ASD (Baranek et al., 2006; Ben-Sasson et al., 2007) and is now included in the DSM-V diagnostic criteria. Previous studies in our lab have shown that in children with ASD, higher SOR symptoms are associated with amygdala hyperactivation in response to mildly aversive visual, auditory, and tactile stimuli (Green et al., 2014; under review). Individuals with SOR may over-attribute salience to sensory stimuli resulting in an overactive amygdala response. Additionally, sensory stimuli may trigger an anxiety response, given the overlap between SOR and anxiety (Green & Ben-Sasson, 2010). It has also been shown that individuals with ASD have an exaggerated amygdala response to emotional faces, when directed to look at the eyes (Dalton et al., 2005). However, it is not known if the overreactive amygdala response in individuals with SOR is specific to basic sensory stimuli, or if they have more generalized amygdala hyperactivity to emotional faces, such as in individuals with ASD. We were interested in fearful faces in particular, given that children with anxiety disorders display amygdala hyperactivity to fearful faces (e.g., Thomas et al., 2001), and SOR is so highly correlated with anxiety.

Objectives: To understand if SOR symptoms are associated with amygdala hyperactivity in response to emotional faces, and to fearful faces specifically.

Methods: Participants were 20 children and adolescents with ASD and 20 matched TD controls, ages 8-16. While undergoing fMRI, participants passively observed faces displaying different emotions (fearful, happy, sad, angry, and neutral) in the scanner. We used a jittered event-related design, where faces were presented every 3 sec (for 2 sec each) according to an optimized random sequence. Parents rated children's symptoms of SOR with the Short Sensory Profile (Dunn, 1999) and with the Sensory Over-Responsivity Inventory (SensOR; McIntosh, 1999). Scores from subscales reflecting over-responsivity were standardized and combined to create a sensory composite score. Parents also rated their children's anxiety symptoms using the CBCL Anxiety subscale.

Results: FSL was used to run subject-level and group-level analyses with the following contrasts: All faces > Fixation and Fear > Neutral. Within- and between-group analyses were thresholded at Z > 1.7. Anxiety scores and SOR composite scores were included as regressors in a second group-level analysis to examine the relationship between SOR symptoms and amygdala response, while controlling for anxiety. The ASD group had greater amygdala activation in the All > Fixation condition only (whole-brain correction at p<.05); there were no group differences in the Fear > Neutral condition. SOR and anxiety scores were not correlated with amygdala response for either group in

either condition, based on a small volume correction at p<.05 within the right and left amygdalae.
Conclusions: Our findings suggest that for individuals with SOR, hyperactivity of the amygdala is not a generalized response, but is instead specific to mildly aversive sensory stimuli. Clinical implications of this finding include the possibility that for individuals with SOR, anxiety and distraction can be significantly decreased by limiting exposure to extraneous aversive environmental stimuli.

120   **172.120**   Sex Differences in Autism: A Resting-State fMRI Investigation of the Intrinsic Neural Circuitry in Males and Females

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Background: Sex is increasingly recognized as a source of heterogeneity in psychiatric neuropathophysiology. Disorders related to social functioning such as autism spectrum disorders (ASD) differ considerably in prevalence and severity between males and females. Little is known however on the neural systems underlying these sex-differential expressions.
Objectives: In light of the dysconnection model of autism linking ASD to altered brain connectivity within specific circuits, the current study aimed to examine whether (i) ASD-related alterations in intrinsic functional connectivity are similar or different in males and females with ASD; and/or (ii) whether alterations in functional connectivity fit predictions of the 'extreme male brain' theory, i.e., by reflecting neural masculinization in males and/or females with ASD.
Methods: Sex-specific differences in intrinsic functional connectivity were analyzed using a large, multicenter resting-state fMRI dataset, comprising 42 males/ 42 females with ASD and 75 male/ 75 female typical controls (TC), included in the Autism Brain Imaging Data Exchange (ABIDE) repository. Three indices of functional circuitry were examined, including (i) investigations of the functional circuitry of the posterior superior temporal sulcus, a key 'hub' in social information processing networks; (ii) exploration of the functional circuitry of the posterior cingulate cortex, a core region of the default network; and (iii) an investigation of region-to-region functional connectivity within a whole-brain parcellated network, comprising 200 regions-of-interest.
Results: Males and females showed a differential neural expression of ASD, characterized by strikingly consistent patterns of hypo-connectivity in males with ASD (blue connections in figure A), and hyper-connectivity in females with ASD (red connections in figure A). This pattern was found for all the examined connectivity indices (figure shows this pattern for region-to-region functional connectivity within the whole-brain parcellated network). Further, females with ASD generally displayed higher connectivity compared to males with ASD (blue connections in figure B), whereas typical females generally displayed lower connectivity compared to typical males (red connections in figure B). Patterns of hyper-connectivity in females with ASD therefore reflected a shift towards the (high) connectivity levels seen in typical males (neural masculinization), whereas patterns of hypo-connectivity observed in males with ASD reflected a shift towards the (low) typical feminine connectivity patterns (neural feminization) (red interaction pattern in figure C).
Conclusions: In summary, our data support the notion that ASD reflects a disorder of sexual differentiation rather than a disorder characterized by masculinization in both genders. Future work is needed to identify the underlying factors such as sex hormonal alterations that relate to and/or drive the observed neural effects and to elucidate the mechanisms by which these sex-specific neural expressions modulate the presentation of the ASD neurophenotype.

121   **172.121**   Sex Differences in Biological Motion Perception Among Youth with ASD: An fMRI Investigation

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Background: Males ($\male$) are more likely to carry a diagnosis of autism spectrum disorder (ASD) than females ($\female$), with the sex ratio estimated at ~4:1. This skewed ratio is not well understood, and research on sex-related differences in functional brain activity among individuals with ASD is particularly sparse.
Objectives: Investigation of the skewed sex ratio in ASD has previously been limited by small sample sizes of $\female_{ASD}$. To address this knowledge gap, we are oversampling $\female_{ASD}$ by recruiting from multiple sites nationwide over a five year period. Here, we report on preliminary fMRI-assessed sex differences in brain response to biological motion, among youth with ASD as well as unaffected sibling (US) and typically developing comparison groups.
Methods: Participants, aged 8-18 years ($M = 12.8$ yr), are a subsample ($N = 93$) collected during this ongoing project. Exclusion criteria included root mean squared movement $\geq$ 4mm. Group membership was as follows: $\female_{ASD}$ $n = 19$; $\male_{ASD}$ $n = 21$; $\female_{US}$ $n = 15$; $\male_{US}$ $n = 6$; $\female_{TD}$ $n = 15$; $\male_{TD}$ $n = 20$.
Participants viewed 12 interleaved blocks of point-light displays of biological motion, 6 coherent (BIO) and 6 scrambled (SCRAM). FMRI data were analyzed using tools from FSL implemented via LONI

Pipeline. At the single-subject level, the contrast of interest was BIO > SCRAM with standard motion parameters and motion outliers included as covariates. Higher-level analysis was carried out at the whole-brain level with automatic outlier deweighting; images were thresholded at $Z > 2.3$ and a cluster-corrected $p = 0.05$. Variances were calculated separately for ASD, US, and TD groups, and age was entered as a covariate. The BIO > SCRAM mean was calculated for each group; additionally, BIO > SCRAM activity for $♀_{ASD}$ was compared to $♂_{ASD}$, $♀_{US}$, and $♀_{TD}$. Sex differences within the comparison groups were also tested.

Results: Clear functional differences exist between $♂_{ASD}$ and $♀_{ASD}$ responses to biological motion stimuli, with $♀_{ASD}$ demonstrating greater activity in temporo-occipital, prefrontal, striatal, amygdalar, and neocerebellar regions than $♂_{ASD}$. $♀_{ASD}$ response to biological motion was also greater than $♀_{TD}$ in amygdala, medial prefrontal cortex, precuneus, and paracingulate. Similar to $♀_{ASD}$, $♂_{TD}$ had greater activity than $♀_{TD}$ in ventromedial prefrontal cortex and precuneus. No significant differences were found between $♀_{ASD}$ and $♀_{US}$. See figure for further detail.

Conclusions: Previously-drawn conclusions about atypicalities in social brain response among individuals with ASD may be male-specific. In particular, $♀_{ASD}$ may not show the hypoactivation in temporal regions (e.g., posterior superior temporal sulcus and temporo-parietal junction) that has been repeatedly documented in predominantly $♂_{ASD}$ samples. Further, the differences in $♂_{ASD}$ and $♀_{ASD}$ response are not completely attributable to an overlaying of typical sexually dimorphic brain responses onto this population; $♀_{ASD}$ differed from $♀_{TD}$ in ways that were highly similar to the ways in which $♂_{TD}$ differed from $♀_{TD}$. These results are highly novel, and even in their preliminary form represent one of the largest samples in which ASD-related sex differences in functional brain response have been tested.

122 **172.122** Specificity of Atypical Neural Development for Language in Infants at Risk for ASD

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Background:
Delayed language development is a characteristic feature of Autism Spectrum Disorder (ASD). An important skill that develops before children produce speech is the ability to discriminate speech sounds. Research has identified abnormal perceptual narrowing in infants at high risk for ASD (Seery 2010). However, given that multiple developmental conditions are associated with language delay, it is unknown whether these findings are specific to ASD to reflective of non-specific developmental disturbance. Sagittal craniosynostosis (SC) and deformational plagiocephaly (DP) are conditions associated with language delay and subsequent learning disability (Magge 2002). Given that SC, DP, and ASD may all affect infants early in development and exert potential impact on language development, patients with SC and DP are an appropriate clinical comparison group to investigate the specificity of atypical perceptual narrowing in ASD.

Objectives:
The present study aims to contrast the neurophysiological response to language stimuli in infants at high risk for ASD (HR-ASD) with infants with non-ASD conditions that affect auditory processing. Findings will be compared to infants at normal risk for ASD (NR).

Methods:
Four groups of infants from English-speaking families participated in the current study: 12 infants at high risk for ASD (by virtue of having an older sibling diagnosed with the disorder); 12 infants with SC; 20 infants with DP; and 24 NR infants. Participants were divided into two age groups: a) between 3-9 months and b) between 10-17 months. EEGs were recorded with a 128 channel HydroCel GSN net during auditory presentations of non-native dental /da/ and retroflex /Da/ phonemes. EEG data was analyzed to extract ERPs evoked by phonemes (P150, a positive deflection over left and right anterior scalp between 100 and 300 ms, and N450, a negative deflection over the left and right temporal scalp between 400 and 550 ms).

Results:
Preliminary analyses contrasting the peak amplitudes of ERPs in response to the dental and retroflex phonemes revealed that NR control infants between 3 and 8 months differentiated the two phonemes (mean difference= 3.56 microvolts). Analyses in progress contrast peak amplitudes across clinical groups and across developmental cohorts. We predict that at earlier ages, infants with HR-ASD, SC, and DP will demonstrate discrimination of the non-native phonemes similar to controls. However, we predict that the HR ASD, SC, and DP groups will demonstrate persistent discrimination of the non-native phoneme at later ages relative to normal-risk subjects, indicating deviant language development.

Conclusions:
Results will provide insight into the underlying processes behind abnormal neurophysiological responses to language in ASD. By contrasting the specific patterns of atypical neural development in ASD with other clinical groups, this study will provide critical information regarding the specificity of atypical development in ASD.

172.123 Transient Visual Evoked Potentials in Monogenic and Idiopathic ASD

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Background: There is a critical need to identify biomarkers of ASD that can be obtained from severely affected individuals. Visual evoked potentials (VEPs) offer a noninvasive technique to evaluate the functional integrity of visual pathways and are thought to primarily reflect the sum of excitatory and inhibitory postsynaptic potentials occurring on apical dendrites of pyramidal cells in superficial layers of the occipital cortex. The major positive and negative peaks in VEP waveforms reflect different cellular events (Creutzfeldt & Kuhnt 1973, Zemon et al 1986). The transient VEP (tVEP) waveform is well characterized with an initial peak (P0) at approximately 60 ms representing activation of the primary visual cortex from lateral geniculate nucleus (LGN) afferents (glutamatergic), a negative peak (N0) at approximately 80 ms representing excitatory (glutamatergic) postsynaptic activity, and a positive peak (P1) at approximately 100 ms reflecting inhibitory (GABAergic) activity. VEPs provide a novel method to answer questions about disease pathophysiology and may be useful as electrophysiological biomarkers reflecting neural mechanisms known to be associated with clinical disorders. Examining single-gene forms of ASD can inform our understanding of ASD more broadly. Objectives: To use tVEPs to objectively measure the integrity of multiple frequency mechanisms in children with genetically-defined ASD subtypes relative to children with idiopathic ASD and to unaffected siblings.
Methods: VEPs were obtained from children with Phelan-McDermid syndrome (PMS), Fragile X syndrome (FXS), idiopathic ASD, unaffected siblings, and typically developing (TD) controls, extracted from ongoing EEG using a single electrophysiological channel. A contrast-reversing checkerboard stimulus (100% contrast) was displayed for 60 seconds to elicit a transient VEP, which enables the examination of multiple frequency mechanisms. All participants received genetic testing to confirm diagnoses. PMS was diagnosed using chromosomal microarray or targeted sequencing, and FXS was diagnosed by analyzing the FMR1 repeat. Standardized research diagnostic instruments (ADOS-2, ADI-R) and DSM-5 criteria were used to diagnose ASD.
Results: Children with PMS displayed distinct tVEP waveforms that reflect a deficit in glutamatergic activity and lack of a high frequency response as compared to children with FXS, idiopathic ASD, unaffected siblings, and TD controls. Children in all other samples displayed the expected tVEP waveform with peaks and troughs at P0, N0, and P1. Results from a measure of magnitude squared coherence (MSC) indicated that children with PMS only showed significant responses at the lowest frequency band (6-10 Hz), while all other groups showed responses at both low and high frequencies.
Conclusions: Our results support findings from animal models which indicated glutamatergic dysregulation in PMS (Yang et al. 2012, Bozdagi et al. 2013) and the effects of *SHANK3* deficiency on AMPA, NMDA, and metabotropic glutamate receptors. Fast acting ionotropic glutamate receptors are necessary to obtain a high frequency VEP response, which is absent in the data from children with PMS. This study is the first step towards identifying neural biomarkers in children with PMS. Future studies must assess electrophysiological functioning in larger samples and in other sensory modalities (e.g., auditory) to determine whether individuals with PMS have an underlying global sensory problem.

172.124 What Do We Currently Know about Resting State EEG Biomarkers in Autism Spectrum Disorder?

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Background: Electroencephalography is a noninvasive technique that captures the underlying electrical changes in brain activity at the scalp surface. Interdisciplinary research endeavours are beginning to show promise in the development of resting state electroencephalography (rsEEG) biomarkers for the early detection of ASD. However, limited information is available about the similarities and differences between analysis methods used to date, and about the gaps in knowledge about these methods.
Objectives: Here we conducted a critical review of the current state of rsEEG biomarkers in ASD to draw attention to clinical and methodological limitations that need to be addressed in future work.
Methods: A systematic review was conducted using "resting state", "EEG", "biomarker", and "autism", contained in the title, keywords or abstracts of articles in *BioMed Central*, *PubMed*, *Scopus*, *ScienceDirect* and *IEEE Xplore* journals. Primary papers identified were used to identify secondary literature sources regarding strengths and weaknesses of identified methods.
Results: Three primary methodological papers were identified: modified multiscale entropy (MME) by Bosl et al. (2011), coherence analysis (CA) by Duffy and Als (2012), and recurrence quantification analysis (RQA) by Pistorius et al. (2013). Bosl et al. (2011) implemented a nonlinear complexity

univariate feature extraction technique able to distinguish infants at high risk for ASD and typically developing controls; a follow-up investigation incorporating the final diagnoses of each child is pending. It is anticipated that features extracted using a multivariate feature extraction technique, i.e. from all EEG channels combined, will provide information relating to the system as a whole and will enable the extraction of more informative features that would enable better group discrimination. Duffy and Als (2012) implemented univariate feature extraction of coherence features to distinguish children with and without ASD; this approach employs Fourier analysis which assumes that data are stationary and that analysis of short segments is sufficient. Long EEG segments, typically minutes in length, are required in order to obtain reliable coherence estimates. A trade-off thus exists between segment length and stationarity – the segment length must be long enough to yield good frequency resolution, but short enough to satisfy the assumption of stationarity. The RQA feature extraction methodology proposed by Pistorius et al. (2013) was the third promising method for biomarker development, as RQA can be applied in univariate or multivariate time series analysis, it can reliably analyse short segments, and can be applied to linear or nonlinear data without having to make prior assumptions regarding linearity or stationarity of data. The RQA method requires evaluation on larger-scale samples.

Conclusions: Scrutiny of the three biomarker methods reported to date suggest that, whilst binary categorical classification of ASD versus typically developing children may be possible, many other questions remain unanswered. No studies to date have examined biomarkers for ASD in relation to other neurodevelopmental disorders, for instance. It is likely that rsEEG biomarkers will be sensitive to a range of factors that require rigorous evaluation, including age, gender, eyes-open versus eyes-closed condition, or the presence of artefacts.

125   **172.125** Young Adults with ASD Have a Higher Rate of Epileptiform Eegs Than Young Children in a Clinical Sample

D. U. Menon[1] and J. B. Ewen[2], (1)Kennedy Krieger Institute, Baltimore, MD, (2)Kennedy Krieger Institute/Johns Hopkins School of Medicine, Baltimore, MD

Background: Children with autism spectrum disorders (ASD) have abnormal EEGs more commonly than does the general population, with peaks of onset under 5 years and over 10 years of age. Further, many children with ASD who do not have epilepsy do nevertheless have abnormal EEGs. The significance of these EEG abnormalities is unclear but is a topic of considerable interest due to the potential of revealing mechanistic insights about both disorders as well as potential therapeutic pathways in ASD. The incidence of epileptiform discharges (independent of clinical epilepsy) at difference ages is, however, unknown.

Objectives: In a sample of children referred for EEG, to determine whether individuals with ASD have a different prevalence of abnormal EEGs by ages.

Methods: We reviewed all clinical EEG reports from the Kennedy Krieger Institute Clinical Neurophysiology Laboratory that had the words "autism," "autistic," "Asperger," "ASD," or "PDD" in the history section. EEGs were recorded between 1984 and 2014 and included routine, extended (1-4 hours) and overnight studies. 429 subjects each contributed one EEG. EEGs were coded as normal or showing epileptiform (focal, multifocal, and generalized) or non-epileptiform abnormalities. We then stratified by age (0-5y, 6-11y, 12-14y, 15-18y, >18y), and a logistical regression compared odds of having epileptiform EEGs between the 0-5y age group and all other age groups separately.

Results: Adults >18 years of age had a far higher chance of having epileptiform discharges on EEG as compared with children aged 0-5 years (OR = 6.3; p = 0.003). No other comparison was significant.

Conclusions: The primary conclusion is that there is a higher rate of epileptiform EEG in young adults with ASD as compared with young children with ASD. Given that random sampling from the overall population of individuals was not performed, the likelihood of sampling bias must be considered in the interpretation. One possibility is that clinicians have a more accurate pre-test assessment of whether the patient has epilepsy in adults than in young children. The adults sample would then be enriched with individuals with epilepsy as compared with the younger children. Another possible explanation for the results is that the overall population prevalence of epileptiform EEGs is higher in adults than young children with ASD. Future analyses will look at the rates of clinical epilepsy in this sample, to determine to what extent epilepsy mediates the relationship between age and abnormal EEGs.

Poster Session
173 - Epidemiology
11:30 AM - 1:30 PM - Imperial Ballroom

126   **173.126** A Large-Scale Analyses of ASD Cases Using Electronic Medical Records

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Background: Electronic Medical Records (EMR) are an emerging resource for studies evaluating risk factors, diagnosis trends, co-occurring conditions and other areas of research on autism spectrum disorder (ASD). EMR holds great potential for a number of reasons, including the amount of data, the ability to integrate data of various types, and the possibility of analyzing large numbers of cases. The latter is a particularly relevant for ASD, which is characterized by both clinical and genetic heterogeneity

Objectives: Our objectives were as follows:

a) to develop a method of identifying ASD cases by combining past approaches of querying ICD codes with natural language processing of the clinical notes to provide a more accurate assessment of case status; and

b) to investigate demographic and socio-economic factors influencing the age of first ASD diagnosis and follow-up.

c) to follow the temporal evolution of diagnosis ("diagnostic shift") as extracted by the above methods.

Methods: We 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 code anywhere in their EMR from 2009-2014 that was recorded by CCHMC's Division of Developmental Disabilities and Behavioral Pediatrics (DDBP).   DDBP houses a specialized ASD diagnosis and treatment center and has a rigorous and uniform ASD assessment pipeline. We used several natural language processing (NLP) systems to confirm (or disprove) the ASD diagnosis in the clinical narrative, including the Apache clinical Text Analysis and Knowledge Extraction System (cTAKES), yTEX, and MetaMap.   We compared the accuracy of selecting cases by ICD9 code versus NLP diagnosis extraction by comparing each to a manual review of the clinical notes.   We also traced the temporal sequence of diagnoses for a given patient over multiple DDBP encounters.   Finally, we correlated our findings with the patients' demographic and socio-economic status. Data will additionally be combined with hospital –based controls, including those with developmental disabilities and neurotypical to facilitate multivariate analyses.

Results: We considered a sample of 3,878 total ASD cases through selection by ICD9 code and confirmation with NLP. The sample consisted of 3,159 male and 719 female (~ 4:1 ratio) children between the ages of 2 and 18. The racial composition was: 78.3% white, 10.6% black, 5.7% other, 2.3 % two or more races, 1.6% Asian, 1.2% unknown, 0.23 % Native Hawaiian or Indian/Alaska Native. A subsample of n=100 observations were validated by comparing ICD9 codes and NLP diagnosis extraction to a manual review of the clinical notes. As shown in Fig. 1, we see an indication of a discrepancy between the numbers of African American children in our cohort vs. the expected number of African American children based on U.S. Census data.   Certain geographical areas appear to be particularly affected.

Conclusions: Preliminary results suggest a slight racial bias with a lower representation of African American children for some, but not all geographic areas. Further multivariate analyses will control for age, IQ, gender and additional socioeconomic factors; we will additionally evaluate diagnostic trends over time.

127 **173.127** A Prospective Birth Cohort Study on the Independent and Joint Effect of Maternal Preconception Obesity/Diabetes, and Gestational Diabetes in the Development of ASD, ID and Other DD

M. Li[1], *M. D. Fallin*[1,2], *A. W. Riley*[1], *R. J. Landa*[3,4], *D. Caruso*[1], *C. Pearson*[5], *S. Kiang*[5] *and X. Wang*[1,2], *(1)Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Johns Hopkins School of Medicine, Baltimore, MD, (3)Center for Autism and Related Disorders, Kennedy Krieger Institute, Baltimore, MD, (4)Department of Psychiatry and Behavioral Sciences, Johns Hopkins School of Medicine, Baltimore, MD, (5)The Boston University Medical Center, Boston, MA*

Background: Autism Spectrum Disorder (ASD) affects 1 in 68 U.S. children today and is frequently accompanied by other developmental disorders. Despite the growing burden of obesity and diabetes in preconception and pregnant women, few prospective birth cohort studies have examined their role in the development of ASD. Such study is particularly lacking among the US low-income minority populations, where the burden of obesity and diabetes is high.

Objectives: This study aims to examine the independent and joint effect of maternal preconception and prenatal obesity and diabetes in the development of ASD, intellectual disability (ID) and other developmental disorders (DD) controlling for other important risk factors in a US low-income minority prospective birth cohort.

Methods: The study includes 2734 children (a subset of the Boston Birth Cohort) who were enrolled at birth and followed onward at the Boston Medical Center (BMC) between 1998 and 2014. Data on demographic characteristics, maternal preconception health, pregnancy complications and health behaviors, and birth outcomes were obtained by maternal questionnaire interview after delivery, and from maternal electronic medical records (EMRs). Children with physician diagnoses of ASD, ID and/or other DD were identified through ICD 9 codes in their EMRs up to their last contact with the BMC. Sequential Cox proportional hazard regression was used to examine the independent and joint effect of maternal preconception and prenatal obesity and diabetes on the risk of incident ASD, without and with adjustment for other preconception, prenatal and perinatal factors significantly associated with the risk of ASD. Similar models were fit on the risk of ID and other DD. The adjusted population

attributable fraction (PFA) of the conditions for ASD is calculated based on the final model.
Results: 102 and 125 children were ever diagnosed with ASD and ID, respectively; 864 children without ASD, ID or other psychiatric conditions were ever diagnosed with another DD. Maternal preconception obesity alone, pregestational diabetes alone, and the two conditions combined are associated with 1.72 (p-value 0.03), 2.35 (p-value 0.25) and 3.16 (p-value 0.06) times the risk of incident ASD in children respectively, comparing those with neither condition. Associations of similar magnitudes hold for ID, but much weaker for other DD. The PAF of the two conditions combined for ASD is estimated 15.0% in this population.
Conclusions: This is the first prospective birth cohort study in a US urban low-income minority population to demonstrate that maternal preconception obesity is independently associated with higher risk of ASD in children, while presence of both obesity and pregestational diabetes confers an even higher risk, together, with a substantial PAF. Similar findings in ID but not other DD may suggest possible etiologic link between ASD and ID. More studies are needed to confirm our findings and to elucidate the biological mechanisms underlying the obesity/diabetes and ASD associations.

128 **173.128** Assisted Conception and Risk of Autism Spectrum Disorders in a Large Commercially Insured Population

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Background: Converging lines of evidence suggest the pathogenesis of autism spectrum disorders (ASD) initiates during fetal development. Further, epigenetic modifications and de novo mutations appear to be important for autism etiology. Consequently, exposures that may affect gametes preconception and embryonic development soon after conception are of particular interest. Assisted conception (AC), which may include technical (i.e. IVF) and/or hormonal treatments has been hypothesized as a potential mechanism inducing epigenetic modifications and AC has been linked to a range of adverse birth outcomes. Previous epidemiologic studies have reported statistically significant positive unadjusted associations between AC and ASD risk, while in most instances adjusted associations have decreased in magnitude and no longer remained statistically significant. A few studies reported significantly increased risk among certain subgroups and one study found a significant negative association. Larger studies conducted in a variety of populations appear to be needed to determine if AC is associated with a small, but real increased risk of ASD.
Objectives: To assess the association between AC and ASD risk in a large commercially-insured US population.
Methods: Using the HealthCore Integrated Research Database, a cohort of 157,649 linked mother-child dyads meeting enrollment criteria (mother had enrollment for 12 months prior to delivery date and child had 1) enrollment at either the 3rd or 4[th]birthday, and 2) a minimum of six months of continuous enrollment with at least one claim for a well child visit between ages 2.5 and 4.5) was identified. AC treatments were determined using the medical and pharmacy claims of mothers in the year prior to delivery. ASD diagnosis was determined by ≥1 ICD-9 diagnosis code in the medical claims of children between 18 months and 4.5 years of age. Demographic information (i.e. maternal age, child's sex) was attained from enrollment files and other covariates were based on the claims of mothers and/or children. Crude and adjusted logistic regression was used to estimate odds-ratios. Potential confounders considered for inclusion in adjusted models were maternal age, year of birth, multiple birth, preterm delivery, low birth weight, baby's sex, geographic region, and length of enrollment.
Results: 2,183 mothers (1.4%) had an AC technical treatment of in vitro fertilization or artificial insemination. 1,403 children (0.9%) had a diagnosis of ASD. The crude OR for AC compared to no AC was 2.17 (95% CI: 1.58, 2.96; p<0.0001). After adjustment, the OR was 1.34 (95% CI: 0.96, 1.85, p=0.082).
Conclusions: This study, which uses data from a large privately insured population, is consistent with much of the previous research from larger study populations in suggesting that AC effects on ASD risk are confounded by other ASD risk factors also associated with AC utilization. The magnitude of any real independent effect of AC is likely to be modest – here the adjusted effect was not statistically significant.   Further work in this cohort will include a range of sensitivity analyses that will assess the robustness of the association estimate to measurement error and omitted confounders as well as exploration of the effect of individual AC treatments.

129 **173.129** Association of Induced and/or Augmented Labor with Autism Spectrum Disorder in a Gestational Age-Stratified Utah Cohort

E. Clark[1], *D. A. Bilder*[2], *M. Varner*[1], *S. Esplin*[3], *H. Coon*[2] and *A. V. Bakian*[2], *(1)Obstetrics and Gynecology, University of Utah, Salt Lake City, UT, (2)Psychiatry, University of Utah, Salt Lake City, UT, (3)Intermountain Healthcare, Salt Lake City, UT*

Background: One in 68 children in the U.S. is diagnosed with autism spectrum disorder (ASD). Previous research suggests that environmental factors during childbirth, including induction and/or

augmentation of labor, may contribute to risk of ASD diagnosis in childhood. This association may be modified by gestational age at the time of exposure.

Objectives: Our objective is to evaluate whether induced and/or augmented labor is associated with increased odds of ASD in a gestational age-stratified Utah cohort.

Methods: We performed an epidemiological analysis using data from the Utah Registry of Autism and Developmental Disabilities (URADD) and the Utah Department of Health (UDOH) Office of Vital Records and Statistics. URADD ascertains children with ASD within a three county surveillance area (approximately 70% of the Utah population) by querying records from UDOH, clinics, hospitals and behavioral health centers. Children met the URADD case definition of ASD if they acquired an ASD diagnosis from a qualified health provider such as a developmental pediatrician, child psychiatrist, or clinical psychologist. Selection of cases and controls was limited to children born to mothers between the ages of 15 and 49 years, infants weighing at least 400 grams at delivery, infants born between 24 and 42 weeks' gestation, infants without congenital anomalies, and infants born in the three county URADD surveillance area. The control group included all children not identified with ASD who met inclusion criteria. The resulting study sample was composed of 2219 children identified with ASD (case group) and 166,361 children without ASD (control group) belonging to the 1998, 2000, 2002, 2004, and 2006 birth cohorts ascertained by URADD. Birth certificates contained exposure to labor induction and/or augmentation as well as known ASD risk factors, which were treated as confounders in this analysis. Multiple imputation was conducted for missing interval and ratio-scale birth certificate covariate data. Differences in characteristics between cases and controls were examined using chi-square goodness-of-fit tests. Single and multiple logistic regression models examined the probability of being an ASD case or control as related to labor induction and/or augmentation, adjusting for confounders. The models were then stratified by established gestational age subgroups.

Results: Approximately 1 in 66 children in the cohort had ASD. Compared with children not exposed to labor induction and/or augmentation, children exposed to induction and augmentation, induction only, or augmentation only, did not have increased odds of ASD after controlling for potential confounders related to socioeconomic status, maternal health, pregnancy-related events and conditions, and birth cohort. The gestational age stratified analyses yielded similar results. (Table)

Conclusions: Induction and/or augmentation during childbirth are not associated with increased odds of ASD in childhood in a large gestational age-stratified Utah cohort.

130 **173.130** Autism Risk in Children Born to Women with Perinatal Psychiatric Diagnoses

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Background: Psychiatric disorders affect up to one-quarter of the U.S. population and are particularly common in women of reproductive age. When women with mental health issues become pregnant, their conditions are often unrecognized and untreated because of inadequate screening and persistent stigma that deters spontaneous disclosure of symptoms and previous diagnoses. When a psychiatric disorder is identified, concerns arise regarding its impact on the pregnancy and developing fetus. Maternal mental health disorders have been associated both individually and collectively with autism spectrum disorder in multiple contexts, but most investigations have been performed in restricted populations or have targeted specific maternal conditions.

Objectives: To determine the extent to which maternal psychiatric diagnoses reported during the birth hospitalization were associated with offspring autism risk in a very large, socio-demographically diverse 18-year statewide birth cohort.

Methods: This retrospective cohort study linked California hospital records for 8,951,763 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 provided by the Department of Developmental Services (DDS). 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 autism was the outcome in 42,423 children. Prospective data collection insured that maternal exposures were recorded prior to the child's autism diagnosis. Logistic regression models were created to explore the relationship between maternal psychiatric disorders and autism, adjusting for maternal age, education, race, and country of birth.

Results: California children with autism were similar to those in other investigations, with inflated risk for males, older parents, higher parental educational attainment, and lower risk for Hispanics and mothers born in Mexico. Reported prevalence of psychiatric disorders in pregnancy was far lower than expected, likely reflecting under-recognition of these conditions and under-reporting by clinicians for all but the most severe of presentations. In adjusted analyses, mothers diagnosed with *each* individual psychiatric condition - mood and anxiety disorders as well as schizophrenia - were 1.4-2.2 times more likely to have a child who developed autism (Figure). Mothers diagnosed with *any* mood, anxiety, or schizophrenic disorder during pregnancy were 80% more likely to have a child who developed autism compared with women without mental health conditions (RR= 1.79; 95% CI 1.66, 1.92).

Conclusions: Women diagnosed with a psychiatric disorder during pregnancy were nearly twice as

likely as women without such diagnoses to bear a child ultimately diagnosed with autism. Mechanisms underlying these associations are likely to represent a complex web involving genetic predisposition, alterations in overlapping neurodevelopmental pathways, maternal stress, variations in mother-child interactive behaviors, and / or fetal exposure to certain psychiatric medications. These findings highlight the need for routine prenatal screening for and documentation of psychiatric conditions to improve outcomes for both mother and child. Further, we recommend enhanced neurobehavioral screening for children born to mothers with a history of psychiatric conditions in order to detect early signs of autism and optimize the timeliness of interventions.

131 **173.131** The Development of Chinese Norms for the Autism Spectrum Rating Scale

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Background:
Research on ASD has only started recently in China. Up to now, very few screening and diagnostic instruments were available for the Chinese population; In particular, instruments that require population norms are still very scarce. Three years ago, an important initiative funded by the Ministry of Health was launched to boost autism awareness and clinical and research expertise. As part of this recent program, a national epidemiological survey of ASD among the school-aged population of China was designed. In order to conduct the screening phase of this survey involving 8 provinces, we needed an instrument, properly validated for the Chinese population. After reviewing several instruments, we decide to employ the Autism Spectrum Rating Scale (ASRS) for the epidemiological survey. We first established the reliability and validity of the ASRS in a Chinese pilot sample, and re-examined the factor structure that was proposed in the initial US study. We report here on the part of our study that aimed at establishing population norms for the ASRS.
Objectives: To develop Chinese norms for the Autism Spectrum Rating Scale (ASRS) for both the Parent and the Teacher versions, for children aged 6-12 years. Our specific aims were: a) to recruit a large sample of community participants to establish the norms for the subscales of the ASRS, and; b) to compare Chinesenorms to US norms in order to detect possible cultural differences.
Methods:
A representative community-based study sample was recruited from 4 cities in China. Parents and teachers of selected subjects were invited to complete the Chinese versions of ASRS questionnaire. Higher scores indicate less proficient general social communication skills associated with more ASD traits. Social communication(SC), Unusual behavior (UB) and Self regulation (SR) sub scale scores were standardized to according to a normal distribution with mean of 50 and standard deviation of 10, raw total scores (T score) was computed based on which and then standardized to standardized T-score. The effect of age, gender and site were analyzed. To compare US and Chinese norms, community participants were scored using the 2 sets of norms and correlations between these 2 scores were subsequently calculated. A p-value of 0.05 was retained as level of statistical significance.
Results:
In total 1684 out of 2053 eligible children participated in this study (mean age 8.85+1.78 year; 830 boys (51%). Boys in community-based sample had significant higher scoring in Social Communication (SC), Unusual Behavior (UB), Self-Regulation (SR) and standardized total score (T-score) by 2-3 points than that in girls, Ps<0.001. Minor effects of age were found for both parent and teacher ratings on the ASRS T-scores (r=-0.0856 to 0.1106, Ps<0.001 or non-significant. T-score of the current reference sample showed statistically significant positive correlation with the scores computed based on the norms of the United States (r=0.98, *p*<0.001).
Conclusions:
This is the first application of ASRS in screening ASD in China. The norms of Chinese version of ASRS for children aged 6-12 years old have been proposed.

132 **173.132** Autism Spectrum Screening Questionnaire (ASSQ) in a School-Aged Population in Korea

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Background: Effective and efficient screeners play a critical role in early identification and intervention of children with ASD. The 27-item Autism Spectrum Screening Questionnaire (ASSQ) includes items that assess core ASD features (e.g., social-communication and restricted, repetitive behaviors), as well as other behaviors (e.g., motor clumsiness). The ability of the ASSQ to distinguish autism from non-autism diagnoses is well established in European children (see Ehlers et al., 1999, Posserud et al., 2009, and Mattila et al., 2009).
Objectives: Evaluate psychometric properties of the ASSQ-Korean version (K-ASSQ) in children with ASD drawn from a Korean population-based sample.

Methods: Participants were drawn from two populations: (1) Epidemiological sample including all 7-12-year-old children in a target Korean city (N=24,985, mean ± standard deviation age: 9.08±2.23 years) who were screened with parent- and/or teacher ASSQ (see Kim et al, 2011). For screen positive children (parental ASSQ scores in upper 5[th]percentile and/or teacher ASSQ scores ≥ 10; n=296), best-estimate clinical diagnoses of DSM-IV PDD, DSM-5 ASD and Social Communication Disorder (SCD) were generated, based on ADI-R, ADOS and cognitive assessment, (2) Clinical sample including 135 (80% male) 7-12-year-old children (8.74±1.84 years) who were evaluated at a child and adolescent psychiatric clinic in four university/university-affiliated medical centers. Diagnoses included ADHD (67.4%), Disruptive behavioral disorders (ODD+CD: 7.4%), Anxiety Disorders (15.6%), Depressive Disorders (11.1%), and others (22.2%), with 27.7% having multiple diagnoses.
Convergent validity was examined with the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005). Principal component analyses with varimax rotation were conducted to assess ASSQ factor structure. Nonparametric Mann–Whitney U test was used to compare ASSQ scores of children with ASD to non-autism diagnoses. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the ASSQ were computed.
Results: The correlation between the parent ASSQ and Social Responsiveness Scale (SRS) scores was moderate (0.3 < |correlation coefficient| < 0.7) in the overall epidemiological and clinical samples. ASSQ scores were not significantly associated with IQ. Factor analysis yielded two factors; the first factor included items measuring social interaction, whereas the second included items related to repetitive behaviors, being consistent with revised DSM5 criteria for ASD. Parent ASSQ scores differentiated children with ASD from unaffected children in the epidemiological sample (23.65±9.68 (n=172) vs. 4.39±5.13 (n=23,138); for DSM-5 ASD). In the clinical sample, children with ADHD had higher ASSQ scores than children with affective or disruptive behavior disorders (10.44±8.30 (n=68) vs. 6.87±6.07 (n=15)), but the difference did not reach statistical significance (p-value = 0.176). Using the proposed European cut-off of 13 (Ehlers et al., 1999), sensitivity was high (90.9; PPV=62.0) but specificity was poor (9.3; NPV=38.5). Using cut-offs of ≥ 14 (sensitivity=88.6; specificity=10.2) or ≥ 15 (sensitivity=84.7; specificity=15.7) did not yield considerable improvement.
Conclusions: The present study suggests that the ASSQ can be employed as a valid and effective screening instrument for identification of children with ASDs in Korean children, with a cut-off of 13 for parent scores.

133 **173.133** Autism-Specific Maternal Autoantibodies Associated with Metabolic Conditions

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Background: Approximately 23% of mothers whose child has ASD produce specific patterns of autoantibodies to fetal brain proteins that have been detected in less than 1% of mothers of typically developing children. The biological mechanisms underlying the development of these ASD-specific maternal autoantibodies are poorly understood. Mothers of children with ASD are also more likely, than mothers of typically developing children, to have pregnancies complicated by metabolic conditions including diabetes (type 2 or gestational), chronic hypertension, preeclampsia, and/or obesity. These conditions are characterized by sustained low-grade inflammation and insulin resistance. Chronic inflammation during pregnancy might create an unstable immune environment that is susceptible to generating maternal antibodies that are reactive to fetal brain proteins.
Objectives: This study examines whether these ASD-specific maternal autoantibodies are associated with metabolic conditions during gestation.
Methods: This study included 225 mothers enrolled in the CHARGE (Childhood Autism Risk from Genetics and the Environment) Study whose child (2-5 years old) had a diagnosis of ASD confirmed on both ADI-R and ADOS. Maternal blood specimens collected at study enrollment were analyzed for autoantibodies. Metabolic conditions during pregnancy were ascertained from medical records or structured telephone interview with the mother and included pre-pregnancy body mass index (BMI) ≥30, gestational and type 2 diabetes, chronic hypertension, and preeclampsia. Autism severity was measured using calibrated ADOS scores. We conducted log-linear regression analyses (Poisson regression with robust error variance) to examine associations between maternal metabolic conditions and the presence of ASD-specific maternal autoantibodies. The strength of association was measured by prevalence ratio (PR) and 95% confidence interval (CI).
Results: Forty-four (19.6%) out of 225 mothers had ASD-specific autoantibodies to fetal brain proteins. Mothers with and without autoantibodies did not differ with respect to age, parity, or inter-pregnancy interval. Diabetes and preeclampsia were more common among mothers who had autoantibodies than those who did not (diabetes: 13.6% vs. 7.2%; preeclampsia: 15.9% vs. 9.4%) although these differences did not reach statistical significance. However, when we restricted to mothers of children with severe autism symptoms (autism severity score ≥7; 28 mothers with and 116 without autoantibodies), those with diabetes were 3.6 times more likely to have autoantibodies relative to mothers without metabolic conditions and with a BMI <25 (21.4% vs. 8.6%; PR=3.6; 95% CI 1.4, 9.7). Similarly, mothers who developed preeclampsia were 3 times more likely to have autoantibodies (17.9% vs. 9.5%; PR=3.0; 95% CI 1.1, 8.6). Maternal obesity was not associated with an increased likelihood of autoantibodies.
Conclusions: The biological mechanisms that lead mothers to become sensitized to fetal brain

proteins are not yet understood. These preliminary findings suggest that metabolic conditions during pregnancy, particularly diabetes and preeclampsia, may be associated with ASD-specific maternal autoantibodies. Given that metabolic conditions are more prevalent in mothers of children with ASD than mothers of typically developing children, and these conditions are characterized by dysregulated immune responses (e.g., chronic inflammation, autoantibodies to other proteins), these findings reveal a plausible mechanism that warrants further investigation.

134 **173.134** Autisme and Crime: Is Prevention Possible?

A. van der Reijken[1] and I. A. van Berckelaer-Onnes[2], (1)NIFP, The Netherlands, Sassenheim, Netherlands, (2)Social and behavioral sciences, Leiden University, Leiden, Netherlands

Background: In forensic psychiatry there is a growing interest in people with autism. A positive autism diagnosis has consequences for legal accountability, management and treatment, and risk of recidivism. In literature, case histories and incidence searches are present. Until now it has remained unclear whether there is a relation between autism and perpetrated offences or not. There are different papers about this subject but it is still unknown what the chance is that people with autism become criminals and what the underlying causes are.
Objectives: The first purpose of this study is to investigate whether there are differences between people with autism and neurotypical people who came in contact with the judiciary in (a) type of crime, (b) reason for committing the crime and (c) social demographic features.
Methods: N=156: 54 persons with autism, 102 without autism. All cases were referred to one of the authors, who acted as expert witnesses in the subjects' court cases. The different variables of the cases were retrospectively analysed. In the current study, the kind of crime, the situation in which the crime was committed, the age of the offender, intelligence, family situation, age at the time of the autism diagnosis and comorbid disorders were investigated.
Results: We found no differences in social demographic features. We found significant numerical differences in two types of crime: violence (autism 10% vs neurotypical 38%) and sex involving children (autism 28% vs neurotypical 11%), both "hands on" and "hands off" offences. Furthermore we found that many of the offenders with autism had serious problems at school at an early age and that many of them had mental health care records, but without a correct diagnosis. Most of them had serious problems in social communication, showed a lot of obsessions and were very lonely
Conclusions:

- The differences in violence crimes and sexual crimes are striking.
- A notable number (29%) of the sex crimes concerning children are "hands-off" crimes e.g. downloading child pornography and websex crimes.
- We found a number of cases in which the offenders suffered from obsessions, but there were too few cases for us to be able to prove a correlation.
- It is important to investigate whether the sex crimes are related to loneliness and/or to insufficient knowledge of sex. If so, certain measures should be developed aiming to forestall at least a number of those crimes.

135 **173.135** Changes in Age of First Diagnosis of Autism Spectrum Disorder in Children Born Between 1992 and 2000

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Background: The early diagnosis of Autism Spectrum Disorders (ASD) is critical in improving outcomes for individuals and families affected by the disorder by allowing for timely access to interventions and healthcare. However, early intervention cannot be initiated when ASD diagnosis is delayed.
Objectives: The primary objective of this study is to investigate trends in age of first ASD diagnosis over time. The secondary objective is to identify socio-demographic factors that may influence changes in age of ASD diagnosis over time.
Methods: This study investigated age of first ASD diagnosis among children born between 1992 and 2000. Participants were identified with ASD via population-based surveillance at 8 years of age via the South Carolina Autism and Developmental Disabilities Monitoring Program (SC ADDM), an ASD surveillance program conducted in collaboration with the Centers for Disease Control and Prevention (CDC). This study used a consistent methodology across all study years, thus limiting the impact of evolving interpretations of diagnostic criteria on the age of ASD diagnosis. The timing of community-based ASD diagnosis was confirmed through records-based documentation.
Results: The average age of first ASD diagnosis in this cohort was 56.1 ± 21.0 months. Age of first ASD diagnosis did not change across the identified SC ADDM study years, even when stratified by gender or race. Fewer than 25% of children received diagnoses before the age of 3, and the proportion of children receiving very early diagnoses (i.e. under age 3) did not change over time. Gender, race, and maternal education did not predict the age of first ASD diagnosis; however, children with an intellectual disability (IQ ≤70) were diagnosed with an ASD at an earlier age compared to those with IQ >70.
Conclusions: Study findings suggest that further efforts are needed to reduce the age of first ASD

diagnosis in SC so that more children may have access to the early intensive treatments shown to be most effective for this population. Although the age of first diagnosis did not decline for children born between 1992 and 2000, the age of first ASD diagnosis may decrease in later cohorts due to improving public awareness about ASD, and the increased availability of diagnostic instruments for very young children.

136   **173.136** Differential Gene Expression in Children with Autism Born to Mothers with Obesity and Diabetes

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Background: Autism spectrum disorder (ASD) is one of the most heritable neurobehavioral conditions, but considerable heterogeneity in ASD-concordant twins supports the need to investigate the role of alternative factors in its etiology. Maternal gestational and environmental factors can modify gene expression independent of the genes inherited in-utero and thus influence subsequent neurogenesis and brain development. Underlying mechanisms responsible for these associations are poorly understood. Environmental exposures, maternal physiology and genetic susceptibility may influence offspring ASD risk by altering gene dosage and expression patterns, which may ultimately have a profound influence on the course of neurodevelopment.
Objectives: To determine 1) the extent to which maternal diabetes or pre-pregnancy obesity is associated with differential gene expression in children with ASD and 2) the degree to which 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. ASD diagnosis was confirmed with ADI-R and ADOS. Maternal prepregnancy body mass index and diagnosis of gestational or type-2 diabetes were abstracted from medical records. RNA sequencing of peripheral blood obtained from child participants at enrollment was performed on the Illumina HiSeq 2000 platform. Sequences that failed quality control or had fewer than 30 million reads were discarded, leaving 152 ASD and 73 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. Association of gene expression with maternal prepregnancy obesity or diabetes was analyzed using a negative binomial generalized linear model in the Bioconductor package edgeR. Curated gene interaction data were retrieved from the Comparative Toxicogenomics Database.
Results: In children with ASD, maternal prepregnancy obesity and diabetes were each associated with significant FDR-adjusted differential expression (30 and 5 genes, respectively), compared to those whose mothers lacked these conditions. Differential expression was also present among children with TD exposed to maternal obesity or diabetes, but the genes differed from those found in children with ASD. While 34 of the 35 genes with significant differential expression in the children with ASD were up-regulated, none of these genes had significant differential expression in children with TD. These differentially-expressed gene profiles are affected by hormones such as estradiol, testosterone, and thyroid hormone; micronutrients involved in methylation and immune regulation; medications such as acetaminophen and valproic acid; and exogenous environmental exposures such as endocrine disruptors and volatile organic compounds.
Conclusions: Fetal exposure to maternal obesity or diabetes in children with ASD was associated significantly with up-regulation of a number of genes responsive to several endogenous and exogenous exposures implicated in ASD risk. As these findings were limited to children with ASD, it is reasonable to speculate about the involvement of unmeasured environmental and genetic influences in this relationship.

137   **173.137** Differentiating the Role of Autism Spectrum Disorder and Intellectual Disability in Challenging Behaviors

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Background: Challenging behaviors are frequently reported in both autism spectrum disorders (ASD) and intellectual disability (ID). These behaviors may impede social interactions and learning, and cause harm to the child or others. The relative effects of cognitive level and ASD diagnostic criteria in the occurrence of challenging behaviors are not well understood.
Objectives: The objectives of this analysis were to differentiate the effects of cognitive level, based on standardized assessment tests, and specific DSM-IV-TR diagnostic criteria for ASD on documented occurrence of challenging behaviors. Both externalizing, i.e., aggressive, argumentative/oppositional, hyperactive/inattentive behaviors and temper tantrums, and internalizing behaviors, i.e., unusual responses to sensory stimuli, unusual fear responses, eating/drinking/sleeping abnormalities, and abnormalities in mood or affect are addressed.
Methods: Our study population consisted of 8-year old children in 2000, 2006 and 2008 whose special education and clinical records were reviewed as part of the multisite Autism and Developmental Disability Monitoring (ADDM) surveillance network. Children with documented information on cognitive level (6 categories, from profoundly impaired to above average IQ), ASD case

status, and presence or absence of DSM-IV-TR criteria and behavioral features associated with ASD were included in the analyses. Multilevel mixed effects logistic regression models, accounting for within-site correlations, were used to estimate crude and adjusted odds ratios (ORs) for each associated behavior. Covariates in the adjusted models include cognitive level, DSM-IV-TR criteria for ASD, sex, race/ethnicity, socioeconomic status and number of autism evaluations.
Results: A total of 10,305 children were included in the analyses. Of these, 5581 (54%) met ADDM case definition for ASD and 4724 children had ASD traits but did not meet case definition. Of those with ASD, 35% had co-occurring ID. The crude odds of all eight challenging behaviors were significantly greater in children with ASD than in children with ASD traits only (p values < 0.001). In both crude and adjusted models, ORs for mood abnormalities declined with cognitive level, while ORs for unusual fear responses increased with declining IQ. Qualitative impairments in the DSM-IV-TR communication criteria, in general, were associated with lower odds of externalizing behaviors. In particular, a lack of or delayed language (2a) and impaired ability to engage in spontaneous make-believe play (2d) were independently associated with lower odds of externalizing behaviors and lower odds of mood abnormalities. Children with restricted repetitive and stereotyped patterns of behavior generally had increased odds of both internalizing and externalizing behaviors--specifically, those children who demonstrated encompassing preoccupation with stereotyped and restricted patterns of interest (3a) or inflexible adherence to routines or rituals (3b). Persistent preoccupation with parts of objects (3d) was associated with both a threefold increase in the odds of unusual sensory responses and lower odds of aggressive and argumentative/oppositional behaviors. Increased odds of all of the associated behaviors were associated with documented qualitative impairment in social or emotional reciprocity (1d).
Conclusions: Challenging behavioral features associated with ASD are independently associated with intellectual disability and specific ASD diagnostic criteria. Parsing these relationships may increase understanding of these disorders and help achieve improved clinical outcomes.

138   **173.138** Digit Ratio and Autism Spectrum Disorders: Results from the Avon Longitudinal Study of Parents and Children (ALSPAC) Birth Cohort

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Background: Autism spectrum disorders (ASDs) are complex neurodevelopmental disorders with a preponderance amongst males. The extreme male brain (EMB) theory of autism suggests that increased fetal testosterone exposure may predispose to an exaggerated male cognitive profile. Second-to-fourth digit ratio (2D:4D), a sexually dimorphic trait, is used as a fetal testosterone proxy: lower, masculinized 2D:4D may imply increased exposure.
Objectives: We sought to investigate the association between 2D:4D and ASD, including ASD traits, in the Avon Longitudinal Study of Parents and Children (ALSPAC), a UK-based population study.
Methods: 6015 children were studied (including 56 with ASD). Using logistic regression, we examined for association of 2D:4D with ASDs and four dichotomized ASD traits: the Children's Communication Checklist (coherence subscale), the Social and Communication Disorders Checklist, a measure of repetitive behavior, and the Emotionality, Activity and Sociability scale (sociability subscale). Covariates were occupational class, maternal education and age at 2D:4D measurement.
Results: 2D:4D was not associated with ASDs in males (adjusted odds ratio (OR) per 1-standard deviation increase in mean 2D:4D, 0.88 [95% confidence interval (CI) 0.65-1.21], p=0.435) or females (adjusted OR=1.36 [95% CI 0.81-2.28], p=0.245). Similar associations were observed after further adjustment for IQ. There was one weak association, discordant with the EMB theory, between reduced coherence and increased left 2D:4D in males (adjusted OR=1.15 [95% CI 1.02-1.29], p≤0.05). Given multiple comparisons, this may be consistent with chance.
Conclusions: In this population-based study, there was no association between 2D:4D and ASD diagnosis. There was weak, inconsistent evidence of association between 2D:4D and risk of ASD. These results are discordant with the extreme male brain theory of autism.

139   **173.139** Examining Factors Associated with Trajectories of Daily Living Skills in Preschool Children with ASD in Canada

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Background: Daily Living Skills (DLS) present a significant challenge for preschool children with autism spectrum disorder (ASD). One aspect of DLS that develops early in this period is personal care skills. Child and contextual factors that may influence the developmental trajectories of personal skills in preschool children with ASD warrant a close examination.

Objectives: To examine the association of child and contextual factors associated with the developmental trajectories of personal care skills throughout the preschool years of children with ASD.

Methods: Longitudinal data were obtained from an inception cohort of 319 children across 5 Canadian sites and ascertained at diagnosis (from 2-4 years of age). Data were collected at 4 time points; baseline(T1), 6(T2) and 12(T3) months post-diagnosis, and at 6 years of age(T4). Child-level data at T1 included demographics, ADOS severity, and Problem Behaviors (Aberrant Behavior Checklist). A categorical variable was derived using the Merrill-Palmer-Revised (MPR) to identify groups with higher (>70) or lower (<70) intellectual ability. Contextual-level data included parent-informant measures related to demographics and stress (Parenting Stress Index and Symptom Checklist-90-Revised), as well as community-level data (i.e., site and T1 services). The dependent variable, the Vineland Adaptive Behavior Scales, 2nd ed. Personal Skills [PS] (raw score), was measured at each of T1 to T4.

Descriptive statistics and multi-level modeling (MLM) analyses were conducted. MLM model testing involved a "Step-up" approach, i.e., increasing the complexity of subsequent models by adding child and contextual variables in blocks. To determine if variables were associated with the PS trajectory, evidence for goodness of model fit was examined using the *Bayesian information criterion* (BIC).

Results: Sample description (mean [standard deviation]): Age of ASD diagnosis (38.4[8.5] months); ADOS severity score (7.6[1.7]) at T1; 84% were male; 72% had an MPR Developmental Index standard score <70 at T1; and 62% (MPR <70) and 25% (MPR >70) received Specialized ASD services at T1. PS raw score means [SD] over time were T1 (24[11.3]), T2 (32[12.9]), T3 (38[13.1]), and T4 (51[11.8]). Based on the intercept only model, 70% and 30% of the variance in PS raw scores could be attributed to differences between and within participants, respectively. Adding the child-level variables improved the model; however, incorporating parent- and community-level variables in blocks worsened the model fit. The only variables significantly associated with the PS trajectory were MPR (slope coeff=-0.400, SE=.16, p=0.011; quadratic coeff=.005, SE=.002, p=.018), and Age of diagnosis (intercept coeff=-0.329, SE=.17, p=0.048). Note that the mean baseline levels of PS did not differ significantly between MPR groups.

Conclusions: Child-level variables were associated with influencing PS trajectories, something that context-level variables were unable to demonstrate. Earlier diagnosis and lower intellectual ability were associated with a poorer rate of personal skill growth over time. In this sample, more participants with MPR (<70) had early specialized ASD services likely due to higher severity. These results are similar to findings from a sample of US preschool children with ASD. Next steps will explore other contextual factors potentially associated with personal skill trajectories (e.g., birth order or later preschool services).

140 **173.140** Exploratory and Confirmatory Factor Analyses of the Chinese Version Autism Spectrum Rating Scales

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Background:
The prevalence of autism spectrum disorders (ASD) is unknown in China. Recurrently, a national screening, diagnosis and treatment of ASD are funded by the Ministry of Health was launched to boost autism awareness and clinical and research expertise. Up to now, however, the validated screening instrument is very scarce in China. In particular, before the screening to measure the factor structure of instruments is necessary under the cross-culture environment. As part of this recent program, a national epidemiological survey of ASD among the school-aged population of China was designed. In order to conduct the screening phase of this survey involving 8 sites (n=15000 for each site, total of 120,000), we needed an instrument, properly validated for the Chinese population. After reviewing several instruments, we decide to employ the Autism Spectrum Rating Scale (ASRS) for the epidemiological survey. We report here on the part of our study that aimed at the exploratory and confirmatory factor analyses (EFA & CFA) of the ASRS in a Chinese normative sample.

Objectives:
This study aimed to investigate the EFA & CFA of the ASRS scale under the cross-culture environment, before its application in Chinese population.

Methods:
1625 community based participants aged 6-12 years old, including 830 boys (51.1%) from 4 sites (Shanghai, Guangzhou, Changsha, and Harbin city) in China were investigated. Parents of the recruited subjects were invited to complete the Chinese version of ASRS questionnaire. EFA were performed based on the 71 items in the original US ASRS scale by using SPSS statistical package. Factor loading below 0.3 were removed from the model. CFA were further performed by using the AMOS statistical package program to evaluate the factor structure of the modified Chinese scale.

Results:
Based on the same selection criteria of factor loadings >.30, our analysis retained 70 items (as opposed to 60 items in the US study) loading on a comparable 3 factor structure. In the CFA modeling, the RMSEA value were 0.043 (<0.05). We obtained 0.818 for CFI, 0.856 for GFI, 0.844 for AGFI, and 0.767 for NNFI, all of which were acceptable (>0.7). The content of the 3 factors was similar to that of the US original study, and therefore the factor names were retained. The only difference is that a change in the items numbers for each factor in the China validation sample, with UB, SC, and SR having now respectively 18, 28 and 24 items. The DSM-IV-TR scale was established based on expert judgment as to which items in the ASRS was mapping closely each of the diagnostic criteria for PDD. Therefore, the DSM-IV-TR scale was used in this study as recommended in the original US manual.
Conclusions:
The Chinese version ASRS was modified that the change in the items numbers for each subscale. However, the modified questionnaire is more suitable for national ASD prevalence screening in Chinese general population.

141   **173.141** Gene Expression By Pesticide Exposures during Gestation in the Charge Study, a Case-Control Investigation of Autism Spectrum Disorder

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Background: Pesticide exposures during gestation have been associated with increased ASD risk or symptoms in three populations. To our knowledge, the influence of prenatal xenobiotic exposures on gene expression in early childhood has not been previously explored.
Objectives: 1) To identify genes that are differentially expressed in children living in households where pesticide sprays or foggers were used throughout the gestational period as compared with those not exposed to such applications; 2) To examine differences between children with autism spectrum disorder (ASD) vs. typically developing (TD) controls in pesticide-associated gene expression.
Methods: The study included a multi-ethnic sample of 218 mother-child pairs from the Childhood Autism Risks from Genes and Environment Study (CHARGE) Study at the UC Davis MIND Institute with both RNAseq data and pesticide information. Children were aged 2-5 years. ASD diagnoses (n=145) were confirmed on the ADI-R and ADOS using DSM-5 criteria; controls from the general population were confirmed as having typical development (TD, n=73) based on the Mullen Scales of Early Learning, Vineland Adaptive Behavior Scales and Social Communications Questionnaire. An extensive interview with the mother collected information on household product use, including pesticide sprays and foggers. Frequent use was defined as one or more applications in each of at least 6 months during pregnancy.
Blood samples were drawn into PAX tubes after assessments and stored at -80 degrees until extraction of RNA, which was again frozen at -80. Sequencing was performed on the Illumina HiSeq 2000 platform. Reads were aligned to hg19 using Bowtie and alignments were converted to a counts table using HTSeq. To address differences in sequencing depth between samples, the counts table was downsampled using binomial downsampling. The association of gene expression with gestational exposures to pesticides was analyzed using a negative binomial generalized linear model in the Bioconductor package edgeR to identify significant up- or down-regulation. Analyses were planned in all mother-child pairs combined, and in ASD and TD groups separately, however, low prevalence of frequent pesticide use in TD families prohibited separate analysis of this group. The Comparative Toxicogenomics Database (CTD) and the Kyoto Encyclopedia of Genes and Genomes (KEGG) were searched for pathway and disease annotations associated with each gene.
Results: In both the full sample and the subset of children with ASD, hundreds of genes were differentially expressed comparing children from households with frequent vs. no pesticide applications during gestation. After FDR (false discovery rate) adjustment, 27 remained significant in each of those analyses. Among ASD children, over 96% of the top 50 differentially expressed genes were up-regulated, with only 4% down-regulated, in association with pesticide exposures. Pathways linked to these over-expressed genes include thyroid hormone synthesis, wnt signalling, O-glycan biosynthesis and immune function.
Conclusions: Among 2-5 year old children with ASD, differential gene expression is associated with prenatal pesticide exposures, suggesting possible long-term potent impact on several pathways already linked to ASD, and on some novel ones.

142   **173.142** Interaction Between Maternal 5-HTT Genotype and Prenatal Stress Exposure, Confirmation in Two Independent Samples

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Background: Recent studies suggest prenatal psychosocial stressors during specific prenatal epochs increase the risk of autism. Absence of a 44bp segment of the serotonin transporter gene (5-

HTT) promoter region is related to stress responsivity, and has inconsistently been associated with autism. If maternal presence of at least one copy this stress-associated short allele (S-allele) of 5-HTT increases risk of autism with prenatal stress exposure, one would expect the prenatal stress exposure in autism to be more frequently observed in mothers with the S-allele.

Objectives: Examine the interaction between maternal 5-HTT genotype and prenatal stress exposure in autism.

Methods: Sixty mothers of children with autism at University of Missouri, and 99 at Queen's University were genotyped, accompanied by surveys regarding prenatal psychosocial stress exposure, and timing of these stressors, as with our previous work. Stress exposure incidence was compared between mothers carrying the S-allele and mothers lacking the S-allele using Chi-square, performed separately for the previously reported critical window of months 5-6 of gestation, and for the entire pregnancy.

Results: For both samples, stress exposure during months 5-6 of gestation was significantly higher among mothers with the S-allele (Missouri-p=0007, Queen's-p=0.037), with no relationship for the entire pregnancy (p=0.13) for Missouri, but a significant relationship for the entire pregnancy (0.018) for Queen's. To determine whether the maternal S-allele might increase recall of prenatal stress, the stress surveys were also completed for unaffected siblings pregnancies. Reported stress exposure was not higher in S-allele mothers for unaffected sibling pregnancies.

Conclusions: These data suggest that maternal genotype for stress susceptibility genes is a critical factor in the effect of prenatal stress exposure on autism. Further understanding of the mechanism may eventually allow the possibility of prevention in some cases.

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143 **173.143** Laying the Foundation for Policy: Measuring Local Prevalence for Autism Spectrum Disorder

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Background:

Autism spectrum disorder (ASD) is a neurodevelopmental condition that is characterized by lifelong impairments in social relationships and communication, and repetitive, rigid behaviours, and is the most commonly diagnosed neurological disorder in children. Prevalence estimates are of vital importance for policy makers, particularly for the planning of a variety of support resources. However, accurate prevalence readings are difficult to acquire, and such an undertaking is financially burdensome. Currently suggested prevalence levels have had their accuracy levels questioned, and tend to focus on a national scope. This is problematic in that these reports can mask regional variation. National rates are also less preferred to more narrowed readings, such as on a regional or municipal level. Currently, Canada lacks a national surveillance system that can provide estimates for geographic locales. A better understanding of the rates in more narrow locales is important for policy makers, especially given that individuals may migrate to the province of Alberta to access more funding.

Objectives:

This study sought to ascertain an accurate measure of the number of students with ASD living in the Calgary, Alberta region.

Methods:

With the support of local school boards, student records for children enrolled in grades 1 through 12 in the 2012/2013 school year were accessed and analyzed, with all cases of ASD pulled according to criteria outlined in the DSM-IV. We estimate that 91 per cent of all children enrolled in Calgary and area schools were included as part of this study.

Results:

A total of 160,904 children were included as part of the sample. 1,711 children has an ASD diagnosis on their school record, leading to an overall prevalence of 1 in 94 children across all school boards, which differs significantly from the commonly cited Centers for Disease Control and Prevention rate. This study's rate ranged between the individual boards from 1 in 11 in the "other" school board (likely due to some of the schools in this jurisdiction being tailored to children with ASD) to 1 in 97 for the Catholic Board of Education, 1 in 116 for the Calgary Catholic School District, and 1 in 120 for Rocky View Schools. Across all school boards, the ratio of boys to girls with an ASD diagnosis was 5.2:1. Additionally, 89% of children with ASD were reportedly severe in an educational setting. Interestingly, one school board in the study showed a drop of prevalence in senior grades as compared to younger grades, and no other school showed a coincidental increase in numbers, making it unclear where these students are going.

Conclusions:

Through the analysis of school records, this study provides important information to policy makers that are reflective of geographic variables. The discovered prevalence rate is similar to that identified in national surveillance reports. Important steps forward include regularly updating this data, and conducting this process across the province. Ideally, administrative records could also be used to track individuals beyond Grade 12. This study demonstrated a cost-effective and alternative approach to estimated regional prevalence of ASD.

144   **173.144** Maternal Use of Prenatal Nutritional Supplements and Risk of Autism in the Stockholm Youth Cohort

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Background: Recent epidemiological studies have suggested that prenatal use of folic acid (FA) or iron may reduce risk of autism spectrum disorders (ASD). These findings require verification.
Objectives: To examine associations of prenatal use of FA, iron, and multivitamins and risk of ASD with and without intellectual disability (ID).
Methods: Data on 254,405 mother/child pairs born 1996-2007 (1,074 ASD with ID; 3,700 ASD without ID) were drawn from the Stockholm Youth Cohort, a register-based cohort in Stockholm County, Sweden. ASD case status as of December 2011 was ascertained using national and regional registers covering all pathways to ASD diagnosis and care in Stockholm County, and this approach has been previously validated. Supplement use was assessed at first antenatal visit. The sample was categorized into mutually exclusive user groups: multivitamin or multiple supplement use (N=43,634); FA only use (8,494); iron only use (53,575); and non-use (148,702). Covariates included maternal age, BMI, national origin, family income, antiepileptic use, prior hospitalizations the year before pregnancy, psychiatric history, child gender, and year of birth.
Results: Supplement users were different from non-users across multiple medical and social characteristics. Multivitamin users were older, more likely to be born in Sweden, have higher income, and to be healthier overall than non-users (more likely to have normal BMI, fewer hospitalizations, and less psychiatric illness). Comparatively, folic acid users were older, more likely to be immigrants, have lower income, have normal BMI, have less psychiatric history but more hospitalizations, and greater use of antiepileptic medications than non-users. In adjusted models, compared to risk of ASD with ID (low functioning autism) in non-users, odds ratios (95% CI) were: multivitamin use: 0.79 (0.65-0.95); iron use: 1.10 (0.95, 1.27); FA use: 1.40 (1.04, 1.88). Supplement use was not associated with ASD without ID (high functioning autism).
Conclusions: The apparent increased risk of ASD with ID for FA may be because FA is prescribed for women with neurological disorders that increase risk of child ASD. Although results suggest multivitamin use is associated with lower risk of ASD with ID, confounding is likely since users were different from non-users. Even if associations were causal, whether a particular nutrient is protective cannot be identified since formulations include multiple nutrients. Further investigation is required, especially of the heterogeneous results by presence of comorbid intellectual disability.

145   **173.145** Meconium Exposure, but Not Meconium Aspiration Syndrome, Is Associated with Autism

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Background: As the incidence of Autism Spectrum Disorder (ASD) has risen, much effort has been invested into understanding the genetics involved in this condition. However, a recent twin study concluded that environmental influences feature more prominently than heritability in ASD susceptibility. Studies investigating the prenatal, perinatal, and neonatal risk factors for ASD sometimes offer conflicting results, often failing to consider confounding by numerous covariates and erroneously adjusting for pathway intermediates. One marker of a stressful in-utero environment is fetal passage of meconium, the tar-like primary feces. This fecal matter may coat the lung surface and impair breathing in a condition called meconium aspiration syndrome. Meconium passage and aspiration have both been associated with neurodevelopmental compromise.
Objectives: Our goals are to determine whether fetal meconium passage and/or MAS are associated with autism, and the degree to which any associations could be attributed to the meconium itself or risk factors for and complications of meconium passage.
Methods: This is a retrospective population-based cohort study. We merged the 1991-2001 California birth cohort database provided by the Office of Statewide Health Planning and Development (n=6,088,159) with data from the California Department of Developmental Services to identify children later diagnosed with autism (n=20,326). We searched ICD-9 codes for perinatal stressors, meconium status, and downstream complications. Univariate analyses (autism risk by meconium or MAS) were followed by multinomial logistic regression analyses to account for the effects of confounders and mediators within the causal pathway.
Results: Fetal meconium passage was significantly associated with autism (OR 1.68, CI 1.44-1.86), but not MAS (OR 1.08, CI 0.93-1.25), prior to adjustment. Surprisingly, odds decreased by only a small margin and maintained significance after controlling for confounders and downstream adverse events (OR 1.48, CI 1.31-1.69).
Conclusions: As a marker of fetal stress, meconium's association with autism was expected. The persistent significance following adjustment for perinatal complications is novel, and may reflect our inability to control for other stressors or that meconium represents trauma beyond its antecedents. The lack of association between the most severe presentation of fetal meconium exposure, MAS, and autism is counter to the expected dose-response effect. We postulate that our findings reflect the benefits of aggressive resuscitation received by neonates with MAS. Hydration, oxygenation, and

supportive care may mitigate long-term damage and reduce autism risk in neonates with in-utero meconium exposure.

146 **173.146** Medical Home and Insurance Adequacy Among Children with Autism Spectrum Disorder and Psychiatric Conditions

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Background: Children diagnosed with autism spectrum disorders (ASDs) are characterized by deficits in social communication and interaction, and the presence of stereotyped and repetitive behaviors (APA, 2013). In addition to a primary ASD diagnosis, co-occurring developmental, psychiatric, neurological, or medical conditions are common (Levy et al., 2010). It is therefore unsurprising that children diagnosed with an ASD require substantial support to address not only the core symptoms of ASD, but also the range of co-occurring conditions and symptoms. Although previous research has uncovered limitations in the availability of specialty medical care, including mental health care, as well as a lack of a medical home for children with ASD (Chiri & Warfield, 2012; Krauss et al., 2003), few studies have attempted to delineate how co-occurring conditions are associated with a child's medical care. The current study attempts to address this gap in the literature by utilizing a population-based and clinically diverse sample of children with ASD.
Objectives: Determine the prevalence of children who have a medical home and adequate health insurance by whether or not they have ASD and/or psychiatric conditions.
Methods: Data for children 2-17 come from the 2011-2012 National Survey of Children's Health (NSCH). Children diagnosed with ADHD, anxiety problems, depression or conduct or behavioral problems were considered to have a psychiatric condition. Diagnostic groups of ASD only (n=595), ASD with a co-occurring psychiatric condition (n=1,018), psychiatric condition without ASD (n=8,368), and no psychiatric conditions [including no ASD] (n=75,237) were compared.
Children with a medical home have family-centered medical care that includes a personal doctor or nurse, a usual place of care when sick, no problems with referrals when needed, and support coordinating services. Children with adequate insurance have insurance which their parent reports to have reasonable out-of-pocket costs that provides coverage for the child to receive the services and see the providers necessary to meet their child's needs.
Prevalence estimates were calculated using Stata 12.0, which accounted for the complex survey design of the NSCH. Differences between diagnostic groups were compared utilizing multivariate logistic regression, which were adjusted for the demographics of the child and family.
Results: Children diagnosed with ASD were significantly less likely to have a medical home (36.2%) or adequate health insurance (65.1%) when compared to children without ASD regardless of whether they were diagnosed with a psychiatric condition. Meanwhile, children diagnosed with ASD and a co-occurring psychiatric condition were less likely to have a medical home or adequate health insurance when compared to children only diagnosed with ASD or children without a psychiatric condition. Although children diagnosed with ASD were more likely to have current health insurance compared to children diagnosed with a psychiatric condition, they were less likely to have adequate insurance.
Conclusions: Children diagnosed with ASD and a co-occurring psychiatric condition represent a vulnerable population of children given their needs for increased service and treatment, yet it appears they are the most likely to lack adequate insurance or a medical home.

147 **173.147** Mid-Pregnancy Glucose Intolerance, Gestational Metabolic Conditions and Autism Spectrum Disorder and Developmental Delay

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Background: A growing body of evidence suggests that maternal pre-pregnancy obesity and related conditions – including diabetes and hypertensive disorders – are associated with autism spectrum disorder (ASD) and broader developmental delay (DD). Biological mechanisms underlying associations between maternal gestational metabolic dysregulation and adverse neurodevelopment are poorly understood.
Objectives: The objectives of this study are: 1) to confirm whether maternal glucose intolerance is associated with obesity, hypertensive and diabetes disorders, 2) to examine the degree to which mid-pregnancy glucose intolerance is associated with ASD and DD, and 3) to determine whether glucose intolerance is associated with cognitive development.
Methods: Previously, maternal metabolic conditions were shown to be associated with ASD and DD in comparison to children with typical development (TD) in this population, the CHildhood Autism Risk from Genetics and the Environment (CHARGE) study. Children were born in California, 24-60 months old at the time of recruitment, and living in catchment areas with a biologic parent fluent in English or Spanish. Children with ASD (N=224) and DD (N=82) were recruited through the California Department of Developmental Services, the MIND Institute and referrals. TD controls (N=199) were randomly selected from birth records and frequency-matched to ASD cases on age, sex, and broad geographic region. Maternal pre-pregnancy body mass index, and evidence of metabolic dysfunction (gestational or type 2 diabetes mellitus, preeclampsia and/or chronic hypertension), and late 2nd-

trimester one-hour 50-g oral glucose challenge test (GCT) results (mg/dL), were abstracted from medical records. ASD was confirmed by ADOS and ADIR. DD and TD controls were confirmed by Mullen Scales of Early Learning (MSEL) and Vineland Adaptive Behavior Scales and were free of autistic symptoms. We calculated MSEL developmental quotients (MSEL-DQs). Statistical analyses to examine the relationships between GCT results and outcomes included: ANOVA for maternal conditions, multinomial logistic regression for child diagnosis, and linear regression for MSEL-DQ. Results: A dose-response relationship between GCT values and the severity of metabolic conditions was evident, with the highest GCT values among obese mothers with diabetes and either preeclampsia or hypertension (Table). Each 10 mg/dL increase in 2nd-trimester GCT response was associated with an 8% increased odds of ASD, after adjustment for maternal education, race and age (OR 1.08, 95% CI 1.01-1.16); in the same model, there was no significant change in DD odds with similar GCT elevations.   An analysis controlling for the same maternal factors and child's diagnoses revealed that maternal glucose intolerance of >150 mg/dL was associated with MSEL-DQs that were 5.9 points lower on average compared to scores in children whose mothers had levels <90 (P=0.03). Conclusions: This study presents the first direct evidence that fetal exposure to maternal impaired glucose tolerance is associated with later development of ASD and diminished cognitive function in the exposed child.   Maternal glucose intolerance is part of a dysmetabolic cascade that includes progressive insulin production, increased metabolism, systemic inflammation, accelerated consumption of oxygen and micronutrients such as iron, and oxidative stress – mechanisms implicated in disruption of fetal neuronal proliferation, maturation, differentiation, migration and cortical connectivity.

148   **173.148** Of Decrements and Disorders: Assessing Quantitative Traits Related to Autism Spectrum Disorders in Prospective Epidemiologic Studies of Environmental Toxicant Exposures

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Background: Prenatal and early life neurodevelopment is exquisitely sensitive to environmental toxicant exposures. Identifying the effects of environmental toxicants on autism spectrum disorders (ASD) is particularly important from a public health perspective because many of these exposures are modifiable and may be targeted for intervention. Prospective cohort studies that measure quantitative, dimensional traits related to ASD using standardized psychometric tools may offer alternate approaches to investigating associations with environmental toxicants.
Objectives: To identify the study validity and feasibility impacts resulting from the use of prospective cohort studies that measure quantitative, dimensional autism traits compared to studies of clinically diagnosed ASD in epidemiologic studies of environmental toxicant exposures.
Methods: We considered the impact of this design approach on exposure measurement error, outcome misclassification, selection bias and statistical power.
Results: We identified four main advantages to using prospective designs that measure quantitative, dimensional traits vs. clinically diagnosed ASD in epidemiologic studies of environmental toxicant exposures: 1) Prospective studies enhance exposure assessment by facilitating high quality quantitative measures, such as biomarkers or micro-environmental measurements, during developmentally relevant windows, such as the prenatal and early life periods, which are thought to be the most vulnerable for development of ASD. 2) Prospective cohort studies that measure continuous outcomes are not vulnerable to a control selection bias, which can be introduced when an outside control group is enrolled, because there is no defined case or control group; rather, all children enrolled are assessed and compared across levels of dimensional autism traits that fall along a continuum. 3) Analyzing continuously distributed traits enhances statistical power because traits are measured on all individuals in the cohort and compared across a range of severity in relation to an environmental toxicant exposure; power is therefore not limited by the number of cases in the cohort. 4) Analyzing quantitative, dimensional traits reduces ASD outcome misclassification because rather than lumping together individuals with very heterogeneous phenotypes into one category, which could mask associations, this approach focuses on a single trait underlying ASD, such as social cognition. The psychometric measurement of this single trait reduces outcome heterogeneity and may allow for identification of a more specific exposure-related biologic pathway. This approach is also immune to temporal changes in diagnostic criteria and can include mild or early manifestations of ASD among children that may not otherwise meet diagnostic criteria but share similar challenges. A disadvantage of this approach is that an underlying dimensional trait, such as social cognition, may be shared by other neurodevelopmental disorders, such as attention deficit hyperactivity disorder.
Conclusions: Investigating the determinants of ASD – particularly modifiable determinants such as environmental toxicant exposures – is of great public health importance, given their apparent substantial rise over the past few decades. The use of prospective designs measuring quantitative, dimensional traits of ASD offers a powerful opportunity to provide important clues to the etiology of these disorders and is likely to accelerate the discovery of the role of environmental toxicant exposures as risk factors for ASD.

149 **173.149** Parental Exposure to Occupational Asthmagens and Risk of Autism Spectrum Disorders in a Danish Population-Based Case-Control Study

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Background: There is some evidence that maternal immune activity during pregnancy may be linked to autism spectrum disorders (ASD). Some occupational and environmental exposures, such as asthmagens, can also trigger immune responses. In order to better understand environmental risk factors for ASD, we have sought to determine if occupational asthmagens are associated with ASD.
Objectives: To evaluate the association between maternal and paternal prenatal workplace exposures to asthmagens and ASD in a Danish population-based case-control study.
Methods: We selected our study population from singleton children born at 23-43 weeks gestation in Denmark from June 1993 through December 2007 with a linkage to the mother through the Danish Civil Registration System.   ASD cases were identified in the Danish Psychiatric Central Register using ICD-10 codes. We randomly sampled 4 controls for every case. The study population was further restricted to only include the oldest child for each mother and to exclude those lost to follow-up before age one, children with inconsistent maternal identification numbers across different registers, and children with extreme birth-weights for gestational age. We estimated maternal and paternal occupational exposure to asthmagens by linking Danish International Standard Classification of Occupations codes to an asthma-specific job exposure matrix that yields dichotomous exposure estimates. Maternal and paternal analyses were further restricted to employed mothers and employed fathers, respectively, with sufficient job information to estimate asthmagen exposure. We used logistic regression models to examine the association between parental exposure to any asthmagen and ASD, adjusting for available potential confounders, such as child's sex, child's year of birth, maternal age, paternal age, parity, parental income, parental education, parental psychiatric diagnosis, and parental asthma diagnosis.
Results: We included 6,830 cases and 29,670 controls in our maternal asthmagen analyses. 18.9% of case mothers and 20.6% of control mothers were exposed to asthmagens. The most common maternal asthmagen exposed jobs were nursing associate professionals, institution-based personal care workers, and cleaning staff in non-domestic settings. In our paternal asthmagen analysis (7,799 cases and 32,335 controls), the exposure prevalence was 20.2% and 21.2% among fathers of cases and controls, respectively. The most common paternal asthmagen exposed jobs were carpenters and joiners, market-oriented crop and animal producers, and meat and fish processing machine operators. ASD in the children was inversely associated with both maternal exposures to asthmagens (adjusted OR: 0.88; 95% CI: 0.82 – 0.95) and paternal exposures to asthmagens (adjusted OR: 0.92, 95% CI: 0.86 – 0.98).   Among parents without an asthma diagnosis prior to the child's birth, the adjusted odds ratios for maternal and paternal asthmagen exposure and ASD were 0.89 (95% CI: 0.83 – 0.95) and 0.91 (95% CI: 0.85 – 0.97), respectively.
Conclusions: We observe an inverse association between both maternal and paternal exposures to asthmagens and ASD. Our results may be sensitive to exposure misclassification as well as confounding but they do not suggest that occupational asthmagen exposure is a risk factor for ASD.

150 **173.150** Patterns and Characteristics of Adult Autism Spectrum Disorders (ASD) Related Hospitalizations: A 10 Year Nationwide Trend Analysis

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Background: Despite rising prevalence of ASD, older age being associated with greater hospitalization risk, and greater number of children transitioning to adulthood; extremely few studies (restricted) have examined the utilization of hospital resources by adults with ASD. There is a critical need to examine the patterns in ASD related hospitalizations over time, especially as compared to other adult psychiatric disorders.
Objectives: To examine trends in prevalence rates of ASD as compared to seven other psychiatric disorders for: number of hospitalizations, length of stay (LOS), total hospital charges, and mortality for adults aged 22-64 years over a 10 year period (year 2000-2009). To identify predictors of total hospital charges, length of stay, and mortality associated with ASD-related hospitalizations in a pooled sample (year 2000-2009).
Methods: A retrospective cross sectional analysis using nationally representative hospitalization data from the Health Care Utilization Project, Nationwide Inpatient Sample (HCUP-NIS), AHRQ was performed. The HCUP-NIS is the largest publicly available all-payer inpatient health care database in the US which contains de-identified data from more than 1,000 hospitals, representing a 20% stratified sample of discharges from community hospitals. Study sample included all hospitalizations associated with any diagnosis (ICD-9-CM codes) of eight adult psychiatric disorders: ASD, Schizophrenia, Intellectual Disability (ID), Anxiety Disorders, Bipolar Disorder, Depression, Substance Abuse Disorders, and Attention Deficit Hyperactivity Disorder/ Attention Deficit Disorder (ADHD/ADD). ASD-related hospitalizations were identified as any visit associated with an ICD-9-CM code for 299.xx.

Other psychiatric disorders were identified with their respective ICD-9-CM codes, excluding any comorbid ASD diagnoses. Two sample chi-square tests,logistic and ordinary least square regressions were used for bivariate and multivariate analyses. All analyses were adjusted for complex survey design and weights.

Results: Overall, the study sample consisted of 11,138 adult ASD-related hospitalizations. Rates of ASD-related hospitalizations increased significantly from 3,945 to 19,307 per 1,000 psychiatric admissions over the 10-year period as compared to all other psychiatric disorders except ADHD/ADD (3,040 to 20,858 per 1,000 psychiatric admissions). Although the average total inflation adjusted hospital charges for ASD-related hospitalizations increased significantly ($p<0.01$), the average length of stay, and mortality events were found to decline over the 10 year period ($p<0.01$). ASD-related hospitalizations in general recorded a greater length of stay (7.7 days vs 5.5 days, $p<0.001$), average total hospital charges ($29,541 vs. $24,030, $p<0.001$), and mortality events (1.4% vs. 0.7%, $p<0.001$) as compared to all other psychiatric disorders. Significant predictors for hospital charges were younger age ($\beta=-0.104$, $p<0.05$) and presence of co-occuring conditions such as cancer ($\beta=0.433$, $p<0.001$) and gastrointestinal conditions ($\beta=0.106$, $p<0.001$). Significant predictors for ASD-related mortality included number of diagnostic procedures (AOR=1.29, 95% CI=1.21-1.39), admission via emergency room (AOR=1.71, 95% CI: 1.04-2.80), and presence of a co-occurring condition such as a respiratory disorder (AOR= 4.99; 95% CI=3.04-8.21) and a cardiovascular condition (AOR=2.63, 95% CI=1.68-4.12).

Conclusions: The prevalence of ASD-related hospitalizations is rising among adults. Healthcare providers and policymakers should ensure provision of optimum outpatient services and better care coordination to reduce delayed/foregone care and preventable hospitalizations among adults with ASD.

151 **173.151** Prenatal PBDE Exposure and Early ASD-Related Phenotype in a Risk-Enriched Pregnancy Cohort

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Background: Polybrominated diphenyl ethers (PBDE) are persistent organic pollutants (used as flame retardants in electronics, textiles, and furniture) where prenatal exposure has been linked to adverse neurodevelopmental outcomes in toxicologic studies. One previous epidemiologic study found no association of ASD diagnosis with PBDE concentrations measured in children after the time of diagnosis; the other found a non-significant trend towards greater autistic behaviors assessed by the SRS (Social Responsiveness Scale) in 4-5 year olds with higher prenatal serum levels of BDE-28, but no association with other PBDE congeners.

Objectives: To investigate the association between prenatal PBDE exposure and early ASD-related phenotype in an ASD high-risk pregnancy cohort (the EARLI cohort – comprised of mothers of a child with ASD followed from the start of a subsequent pregnancy). Specifically, we assessed whether elevated prenatal levels of PBDE congeners -28, -47, -99, -100, and -153 were associated with elevated scores on the Autism Observation Scale for Infants (AOSI) at 12 months. (In preliminary analyses from a cohort subsample, 12-month AOSI was found to be predictive of 36-month best estimate clinical diagnosis – ROC AUC=87%, AOSI ≥7 Sn=70% Sp=90%.)

Methods: PBDE congener concentrations were measured in the earliest available prenatal plasma samples for 172 mothers. The association between each PBDE congener and AOSI score, alternatively parameterized as continuous (ln(total AOSI+1)) and dichotomous (total AOSI ≥7) outcomes, was estimated using regression approaches with adjustment for potential confounders. PBDE exposure was categorized into quartiles (the exception being BDE-28, where 48% of the samples had no detectable level and were assigned to the lowest exposure category with the remaining subjects categorized in ascending tertiles). A single summary of all five congener concentrations was also created and categorized into quartiles. Confounders considered included: maternal age, race, ethnicity, pre-pregnancy BMI, parity, gestational age at birth, and geographic location (California vs. east coast study sites).

Results: Median total AOSI score was 4 (IQR 2,8). There were 54 (31%) children with total AOSI score ≥7. Direction of rank correlation between AOSI and PBDE congeners were positive for all except BDE-153, but magnitudes were consistently small and none were statistically significant ($-0.04 \leq r \leq 0.13$ with p-values $0.09 \leq r \leq 0.57$). The figure shows unadjusted ln(AOSI+1) regression results contrasting higher exposure groups to the lowest exposure category. Trend is seen for some congeners but the only unadjusted contrast that approached statistical significance was for the highest BDE-28 exposure category ($\beta= 0.28$; 95% CI -0.02, 0.58; p=0.07). Adjustment for covariates decreased the magnitude of associations and increased p-values (e.g., for the highest BDE-28 category adjusted $\beta= 0.21$; 95% CI -0.13, 0.55; p=0.22). Findings from models of AOSI ≥7 yielded similar results.

Conclusions: Findings from this analysis do not support an association between prenatal PBDE exposure and early ASD-related phenotype. Correlations were strong among PBDE congeners, the

exception being BDE-153, making it difficult to consider independent effects of individual congeners.

152 **173.152** Prevalence of Autism Spectrum Conditions in Mainland China: Pilot and a Whole Population Study

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Background:
The majority of recent prevalence studies of the Autism Spectrum Conditions (ASC) in developed countries have adopted a combination of prospective and retrospective approaches, using standardized diagnostic instruments for case identification. Previous reported prevalence estimates of ASC in mainland China have been much lower than Western estimates (around 1%). This may be partly due to the differences in: 1) study methodology; 2) screening and diagnostic instruments; 3) clinical diagnostic criteria; 4) under-diagnosis of milder subtypes of the spectrum: most children diagnosed are those with classic autism. A recent validation of the Mandarin Chinese Childhood Autism Spectrum Test (CAST) suggested there is an under-estimation of the prevalence of ASC in the general population in Beijing.
Objectives:
1) To apply validated screening and standardized diagnostic instruments to an entire district population in a moderately developed city to establish a prevalence estimate of ASC in an unselected population in mainland China. 2) To conduct a pilot study to test the feasibility of a national prevalence study of ASC in China.
Methods:
Based on the residential records, the Mandarin CAST was distributed to all children aged 6 to 11 years old (N = 7,258 children) in Fengman district in Jilin province. The study had 3 stages. Stage 1: All children between 6 and 11 years old in mainstream primary schools were screened. Stage 2: All screened children who scored highly (at or above the cut-off of 15 on the CAST) were assessed by experienced child psychiatrists using DSM-IV criteria, and then further assessed using the ADOS and the ADI-R. A consensus diagnosis was made between instruments' examiners and psychiatrists. Stage 3: All children (age 6 to 11) in special schools, intervention centres, communities, or at home with an existing diagnosis of ASC, were screened with diagnostic records checked. A random selection of 10 children with an existing diagnosis of ASC who met the cut-off were examined by clinicians and examiners to confirm their diagnostic status. The prevalence estimate was generated after adjusting and imputing for missing values using inverse probability weighting.
Results:
A total of 6,149 questionnaires (participation rate: 85.8%) from mainstream primary schools (Stage 1) and 91 questionnaires (participation rate: 100%) from children with a diagnosis of ASC (Stage 3) were available for analysis. A total of 477 children (7.8%) in mainstream schools met the cut-off of the CAST, and 72 children (79.1%) with a diagnosis met the cut-off. 9 children from mainstream primary schools and 68 children from other settings in this district were found to meet the consensus diagnostic criteria for ASC (78.5% after adjustment). After adjustment and data imputation, the prevalence in this primary school population in China was 108 per 10,000 (95%CI: 86, 135). The sex ratio (boys: girls) of children with ASC was 7:1.
Conclusions:
Using a comparable method, the prevalence estimate of ASC in a moderately developed city in mainland China is similar to those estimates in developed countries. This study confirms it is feasible to conduct a large population-based epidemiological study for ASC in China.

153 **173.153** Prevalence of Regressive Autism from 2000 to 2010: Findings from a Population-Based System

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Background: Estimates of the prevalence of regressive autism have varied widely, from 15% to 50%. This variation may be due to varying definitions of regression and to absence of information from comprehensive population-based studies.
Objectives: To determine the prevalence of regressive autism in 8-year-old children, in the same region, over time, using a modern epidemiologic method and to identify and trends in the prevalence or expression of regressive autism.
Methods: Autism Spectrum Disorder (ASD) case-specific data, from an ongoing multi-year (2000, 2002, 2006, 2010) surveillance system in metropolitan New Jersey (NJ), including information on regression, were analyzed. Regressive autism was defined as loss of skill(s) in areas of speech/language and/or social skill, documented in a professional evaluation, of a child satisfying the

ASD case criteria, according to the Centers for Disease Control and Prevention (CDC) multiple source ascertainment method. Demographic information was from source records. Children were 8 years old in each of the study years. Prevalence estimates were based on the numerator (number of cases confirmed for ASD and regression) and denominator data (post censual) for each study year. Statistical analysis was performed using Chi-square tests and ANOVA.

Results: Regressive autism affected 13%-19% of all ASD children, during the period. The median age of regression was 18 to 24 months.   Male: female ratio for regressive autism was 4:1. For study year (SY) 2000, the prevalence of regressive autism was 1.4 per 1,000; for SY2002, prevalence was 2.0 per 1,000; for SY2006 prevalence was 2.4 per 1,000; for SY2010 prevalence was 3.3 per 1,000, indicating a 74% increase from 2000 to 2010. The prevalence of regressive autism among girls did not change during the period, but increased significantly among boys. For SY2000, the prevalence of regressive autism among males was 1.9 per 1,000. In SY2010, the rate of regressive autism among males was 5.4 per 1,000, an increase of 180%. Regressive ASD prevalence rates increased among White, non-Hispanic children, and African-American, non-Hispanic boys, from 2000 to 2010; however, there was no increase for Hispanic children. White, non-Hispanic children had regressive autism at a rate of 1.8 per 1,000 in 2000 and in SY2010 prevalence was 3.2 per 1,000 (78% increase).   Among African-American, non-Hispanic children, the rate of regressive ASD was 1.4 per 1,000 in SY2000 and 4.2 per 1,000 in SY2010 (200% increase).

Conclusions: Regressive autism accounts for a small but significant proportion of all ASD cases. The proportion of children with regressive autism increased significantly during the study period. The increase in regressive autism prevalence was driven by males especially by African-American, non-Hispanic boys. The reasons for the increase in regressive autism and for the differential increase among African-American, non-Hispanic boys are unknown. More studies are needed to understand the etiology of regressive autism and to define the similarities and differences between regressive autism and non-regressive forms of ASD.

154 **173.154** Rates and Predictors of Psychotropic Medication Use in Children with Autism Spectrum Disorder Ages 2-18 Years Old in a National Population-Based Sample: 1994-2009

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Background: Psychotropic medication use in children with Autism Spectrum Disorders (ASD) is an emerging area of interest. However, little is currently known about changes over time in the use of psychotropics in children with ASD, or the role of socio-demographic factors or comorbid conditions in psychotropic medication use for this population.
Objectives: In a U.S. population-based sample of pediatric outpatient medical visits from 1994-2009, we: 1) Determine rates of psychotropic medication use among children diagnosed with ASD, and 2) Determine if rates of psychotropic medication use in children diagnosed with ASD vary by socio-demographic factors, comorbid behavioral and developmental conditions, and time period.
Methods: Data for children aged 2-18 years (N=158,488) from the 1994–2009 National Ambulatory and National Hospital Ambulatory Medical Care Surveys was used to estimate the weighted percentage (%) of visits with coded ASD diagnoses. In addition, we calculated rates of using any psychotropic medication among children with ASD for the sample overall, and in specific socio-demographic groups and time intervals (with time effects examined in 4 year blocks: 1994-97, 1998-2001, 2002-05, and 2006-09). Multivariate logistic regression was performed to identify predictors of psychotropic medication use in children with ASD. This study was exempted from review by the Cincinnati Children's Hospital Institutional Review Board.
Results: The rate of having an ASD diagnosis among U.S. pediatric outpatient medical visits from 1994-2009 was 0.31% (95% CI 0.24-0.38). Although psychotropic prescription rates at visits for children with ASD increased from 45.2% (95% CI 30.9-59.4) in 1994-1997 to 58.3% (95% CI 49.6-66.9) in 2002-2005 [see Figure], in adjusted analyses 4-year time period was not associated with psychotropic use, nor were gender, race, health insurance status, or demographic region. Among children with ASD, the likelihood of psychotropic prescription was higher in school-age children and teenagers (vs. preschool children), and in those with another behavioral diagnosis (vs. those with no comorbid behavioral diagnosis), while those with comorbid intellectual disability (ID) or developmental delay (DD) (vs. those with no ID/DD) were less likely to receive psychotropic prescriptions [see Table]. The behavioral comorbidities with the highest rates of psychotropic use (per 100 medical visits) in children with ASD were ADHD (86.2; 95% CI 80.5-91.8), mood disorder (85.8%; 95% CI 75.4-96.2), and anxiety disorder (84.4%; 95% CI 72.7-96.1).
Conclusions: Between 1994-2009, children with ASD comorbid with another behavioral diagnosis were more likely to use psychotropic medications, while preschoolers and those with a comorbid ID/DD were less likely to receive psychotropic prescriptions. We did not observe main effects of race, sex, health insurance status, or 4-year time period on psychotropic use in children with ASD. However, further research is needed to better understand if these factors interact such that changes in psychotropic medication use over time vary by sociodemographic group in children with ASD.

155 **173.155** Reliability and Validity of a Short Dietary Intake Questionnaire for Retrospective Collection of Nutrients during Gestation in Autism Studies

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Background:
Nutrition needs increase during pregnancy and are critical for brain development. Evidence is accumulating for a role of gestational nutrition in autism etiology. A new shorter tool for collection of maternal nutritional intake during pregnancy could facilitate research in this area.
Objectives:
To develop a tool to collect dietary and supplement intake during pregnancy with a focus on nutritional factors and timing relevant to neurodevelopment and likely to influence autism risk, and assess the tool's reliability and validity in a high-risk ASD population.
Methods:
Candidate nutritional factors were selected based on a thorough literature review. Retrospective assessments of nutritional intakes during pregnancy were included in the ELEAT (Early Life Exposure Assessment Tool) during a pilot test conducted with participants from the MARBLES pregnancy cohort study of high-risk siblings of children with autism. Retrospective responses were compared with responses to supplement intake questions and/or the previously validated 2005 Block food frequency questionnaire (FFQ) prospectively collected by MARBLES during a pregnancy at least 2 years previously. Longer and shorter versions of the ELEAT dietary module were tested. Nutrient values were calculated for the ELEAT dietary module using reported frequency of intake and nutrient values for foods from the USDA nutrient database obtained through NDSR. Agreement between retrospectively assessed food and nutrient intakes and prospectively reported intakes based on supplement questions and the Block FFQ were evaluated using Kappa coefficients, Spearman Rank Correlation Coefficients (r_s) and Concordance Correlation Coefficients (ccc). Asymptotic 95% confidence intervals (CIs) for Spearman correlations are based on Fisher's Z transformation.
Results:
Supplement questions in both MARBLES and the ELEAT were completed by 114 women. MARBLES FFQ dietary intakes were compared among 54 women who completed the ELEAT long form and among 23 who completed the ELEAT short form. Kappas were moderate for most supplements on whether or not they were taken, but modest for timing. Correlations across most individual food items and categories were fair to moderate on both the long and short ELEAT modules. Most quantified nutrient values from the long form of the ELEAT were moderately correlated ($r_s= 0.3 – 0.5$) with those on the Block FFQ. More nutrients, especially aggregate measures, based on the short ELEAT module had only modest, weak or even inverse correlations with the FFQ, however primary nutrients of interest displayed strong correlations: dietary folate equivalents, $r_s=0.56$ (CI: 0.19, 0.79); iron, $r_s=0.59$ (CI: 0.23, 0.80); fiber, $r_s=0.52$ (CI: 0.14, 0.77).
Conclusions:
Responses on the ELEAT long form dietary and supplement modules were moderately reliable overall, even with recall after several years, and produced nutrient values that were moderately correlated to previously collected prospective measures. As with all FFQs, the ELEAT dietary module is not meant to assess exact nutrient intake for each participant, but rather can be used to rank participants on their responses in terms of food group intake, calcium, iron, folate, potassium, fiber, choline, vitamin K and vitamin C intake. This short ELEAT dietary module can be added to autism studies to retrospectively assess maternal nutrient contributions to ASD etiology.

156   **173.156** Risk Factors for Autism Spectrum Disorder and Intellectual Disability

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Background: The prevalence of autism spectrum disorder (ASD) and the use of artificial reproductive technologies (ART) have risen in the last decades. There is limited and controversial research on the association of ART with ASD and Intellectual Disability (ID).
Objectives: 1.To explore the association between ART use and ASD 2. To explore the association between ART use and ID in individuals with ASD and their unaffected siblings 3. To explore the perinatal risk factors and other variables that may influence the development of ASD and ID
Methods: We used an online self-reported parental survey administered by Interactive Autism Network (IAN) to review the history of ART exposure in probands with ASD and their unaffected siblings. The sample size consisted of 1792 probands (mean age= 9.5 years, SD= 3.7, 82% male). Among them there were 1046 probands (58%) with ASD and 746 probands (42%) siblings without ASD (mean age= 8.7 years, SD= 4.4, 49% male).
Results: The prevalence of ASD was 64% among probands conceived through ART. Fisher's exact test showed no statistically significant difference in these proportions. In order to explore what variables affect the prevalence of ASD, a series of logistic regression analyses with backward Wald deletion was conducted. The child's gender and induced birth showed statistically significant effects on the prevalence of ASD. Males were 5.3 times more likely than females to show ASD (B=1.71, p<0.001) when several variables were controlled for. The children born with induced birth were 1.9 times more likely than those without induced birth to show ASD (B=0.662, p<0.05). Father's age at birth had an

insignificant but a positive effect on the prevalence of ASD; if the father's age was older, the child was more likely to have ASD. In order to test whether or not the same variables used in the previous test had effects on intelligence quotient (IQ) score a series of logistical regressions were conducted. Babies conceived through ART were 8.5 times more likely to have low IQ (B=2.142, p<0.05). The children's higher birth rate had a positive effect on lower IQ score (B=0.045, p< 0.05). The babies with lower birth weight were significantly more likely to have a lower IQ. The babies who had respiratory problems in the newborn period were 200 times more likely to have a lower IQ (B=5.302, p< 0.05). Girls were 14 times more likely to show lower IQ (B=-2.639, p< 0.05). Finally, older mothers were more likely to have a child with lower IQ (B=0.244, p<0.05).

Conclusions: There was no evidence that ART significantly increases the risk for ASD. ASD risk was significantly increased in males and in children who were born with induced birth and was also positively affected by the advanced paternal age. The risk for intellectual disability in both individuals with ASD and in their unaffected siblings was significantly increased by ART and by lower birth weight, prematurity, neonatal respiratory problems, female gender and older maternal age.

157 **173.157** Risks of Non-Affective Psychotic Disorder and Bipolar Disorder in Young People Diagnosed with Autism Spectrum Disorder. a Population-Based Study

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Background: It is not known whether individuals with autism spectrum disorder (ASD) are at increased risk of non-affective psychotic disorder (NAPD) or bipolar disorder (BD).
Objectives: To test two hypotheses: (i) the risks of NAPD and BD in individuals with ASD are increased; (ii) these risks are higher than those of siblings not diagnosed with ASD.
Methods: Case-control study nested within the Stockholm Youth Cohort. This cohort comprises all individuals aged 0-17 years ever resident in Stockholm County during the period 2001-2011. Cases were cohort members ever diagnosed with ASD (N=9,062). The siblings were their full siblings never diagnosed with ASD. Each case was matched with 10 controls of the same sex, born in the same month and year. Since the cohort was followed until 31 December 2011, the oldest members had reached the age of 27.
A distinction was made between ASDs registered before 16 or 28 years of age and between ASDs with or without intellectual disability (ID). The information on the outcome (NAPD or BD) was obtained from Swedish Registers. Using conditional logistic regression analysis we computed Odds Ratios (ORs) for NAPD and BD, adjusted for age, sex, population density of place of birth, personal or parental history of migration, hearing impairment, parental age, parental income, parental educational level and parental history of psychiatric disorder
Results: The adjusted ORs of NAPD and BD for cases of ASD without ID, registered before 16 years, were 5.6 (95% CI: 3.3-8.5) and 5.8 (3.9-8.7), respectively; the adjusted ORs for cases of ASD with ID were 3.5 (2.0-6.0) and 1.8 (0.8-4.1). The adjusted ORs of NAPD and BD for cases of ASD without ID, registered before 28 years, were 12.3 (9.5-15.9) and 8.5 (6.5-11.2), respectively; for cases of ASD with ID, these values were 6.4 (4.2-9.8) and 2.0 (1.0-3.9), respectively. The ORs of NAPD and BD for the non-autistic full siblings of cases registered before 16 years, adjusted for hearing loss, were 1.8 (1.1-2.7) and 1.7 (1.1-2.6), respectively.
As for the impact of school leaving grades, the risks of NAPD and BD for individuals registered with ASD without ID before 28 years of age were higher among average-high performers than among low performers. For low performers the adjusted ORs for NAPD and BD were 11.1 (7.3-16.9) and 4.3 (2.7-6.6), respectively. For average-high performers the adjusted ORs were 18.3 (10.2-33.0) and 12.6 (7.4-21.4), respectively. The numbers of individuals with known school grades registered with ASD without ID before age 16 were small.
Conclusions: A diagnosis of ASD is associated with a substantially increased risk of NAPD and BD. This finding contributes to our understanding of these disorders and has implications for the management of ASD.

158 **173.158** Sensory Processing Abnormalities of Children with Autism Spectrum Disorder

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Background: Sensory abnormalities in children with Autism Spectrum Disorder (ASD) were described in the original papers of Kanner and Asperger. Subsequent studies have suggested that children with ASD exhibit significantly more sensory processing deficits than children with other developmental disorders and show impairment across sensory domains. Few of these studies have been based on large, well-defined populations.
Objectives: This study was conducted to estimate the prevalence of sensory abnormalities in a diverse, population-based sample of eight-year-old children with ASD in metropolitan New Jersey and to identify any demographic differences in the expression of sensory abnormalities.

Methods:
This study was conducted as a comprehensive, retrospective analysis of New Jersey Autism Study (2010) data. ASD ascertainment was by the Centers for Disease Control and Prevention (CDC) active, multiple source, case-finding method, using the DSM-IV-TR-based ASD diagnostic criteria. Reports of sensory abnormalities were recorded in comprehensive medical and educational evaluations and analyzed during the process of ASD case ascertainment. Sensory abnormalities were defined as odd responses to sensory stimuli, such as sounds, smells, or vestibular movement; atypical focus on sensory input, or persistent, odd responses to sensory stimuli, as indicated in one or more professional evaluations conducted before age nine, consistent with the Autism and Developmental Disabilities Monitoring (ADDM) Network definitions and standards. Demographic data came from the source records. Race/ethnicity categories were: white (non-Hispanic), African-American (non-Hispanic) and Hispanic. Cognitive level was defined by intellectual quotient (IQ) from standard tests recorded in the source records. Frequency, distributions, and Chi-square tests were calculated using SAS software.
Results: We identified 432 (62%) ASD-confirmed eight-year-old children with documented indication(s) of sensory abnormalities, reported in comprehensive educational and/or medical evaluations, from a total population of 696 ASD children residing in metropolitan New Jersey. The expression of sensory abnormalities in children with ASD did not vary significantly by sex (male to female ratio 5.6:1), cognitive functioning (IQ) or degree of impairment. However, the expression of sensory abnormalities significantly varied by race/ethnicity (p<.001). White children (70%) were more likely to have sensory abnormalities documented in their records than African-American children (62%) and Hispanic children (50%). Twelve percent of ASD children with sensory abnormalities were diagnosed with Sensory Integration Disorder (SID).
Conclusions:
Previous studies have reported that 76% - 95% of ASD children exhibit sensory abnormalities. Our findings, based on population-based data from a large and diverse region, indicate that approximately 62% of all ASD children have sensory abnormalities reported on professional evaluations, before age nine. The observed ethnicity-based difference in the expression of sensory abnormalities in children with ASD was unexpected and may reflect cultural differences in the reporting of ASD features by Hispanic families and/or by professionals. Additional research is needed to clarify this question and to consider the relation of sensory abnormalities to core ASD features.

159 **173.159** Short and Long Inter-Pregnancy Interval Increases Risk of Autism Spectrum Disorders
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Background: Short and long inter-pregnancy intervals have been associated with increased risk of preterm birth, small for gestational age and adverse neurodevelopmental outcomes including schizophrenia. However, the association between IPI and autism spectrum disorder (ASD) has not been fully investigated.
Objectives: To evaluate the association between inter-pregnancy interval and risk of ASD in a large, multiracial birth cohort from the US.
Methods: We assessed the association between inter-pregnancy interval and risk of ASD in the cohort of children born at Kaiser Permanente Northern California (KPNC) between 2000 and 2009. This birth cohort was matched to the California birth certificate files to identify their siblings born between 1990 and 2009. Children with ASD were identified primarily from ICD-9 diagnostic codes 299.0, 299.8 and 299.9 recorded in KPNC electronic medical records. To identify additional children with ASD who were born at KPNC but left the health plan before being diagnosed with an ASD, we linked the study cohort to the California Department of Developmental Services client databases. Inter-pregnancy interval was defined as the time from the birth of the first child to the conception of the second in a sibship. We used survival analysis and logistic regression models to evaluate the association between inter-pregnancy interval and risk of ASD in second-born children who had a first-born full sibling born at KPNC with no diagnosis of ASD.
Results: Of the 44,413 second-born children who had a first-born full sibling without an ASD, 547 (1.2%) were diagnosed with an ASD by the end of the study period. There were no differences between second-born children with ASD and those without ASD with respect to parental age, maternal education, place of birth, race/ethnicity, and child birth year. After adjustment for child sex, birth year, parental age, and maternal race/ethnicity and education children born after an inter-pregnancy interval less than 12 months or greater than 72 months (5 years) had a 2-3 fold increased risk of ASD compared to children born following an interval of 36-47 months. Respective adjusted hazard ratios with confidence intervals were: <6 months: 2.8 (1.8 - 4.5); 6-8 months: 2.5 (1.6 - 3.8); 9-11 months: 1.9 (1.2 - 2.8); 12-23 months: 1.6 (1.1 - 2.2); ≥ 72 months: 2.3 (1.5 - 3.6). The pattern of association between ASD and IPI was substantially unchanged after additional adjustment for maternal second trimester BMI or change in maternal BMI between the first and second pregnancies.
Conclusions: Inter-pregnancy intervals shorter than 2 years or longer than 5 years are associated with increased risk of ASD, with the shortest (<6 months) and longest intervals associated with the highest risk. The mechanism explaining this association is unknown and requires further research.

160 **173.160** Synergic Effect of GSTP1 and Blood Manganese Concentrations in Autism Spectrum Disorder

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that impairs social interaction and communication. It has been reported that the development and clinical manifestation of ASD may contribute to impaired capacity for methylation and increased oxidative stress. Manganese (Mn) is an essential element for human health and development but its neurotoxic effects are well established. Glutathione-S-transferase (GST) genes, including GST pi 1 (*GSTP1*), GST mu 1 (*GSTM1*), and GST theta 1 (*GSTT1*) encode enzymes that can protect cells from oxidative stress.
Objectives: To investigate whether there is an interaction between the aforementioned GST genes and blood manganese concentrations (BMC) in relation to ASD.
Methods: We used data from 100 ASD cases and their 1:1 age- and sex-matched typically developing (TD) controls (age 2-8 years) from Jamaica. We administered the Autism Diagnostic Observation Schedule (ADOS) and the Autism Diagnostic Interview-Revised (ADI-R) to confirm the diagnosis of ASD. We administered the Lifetime form of the Social Communication Questionnaire (SCQ) to the parents/guardians of potential control children to rule out symptoms of ASD. We also administered a questionnaire to the parents/guardians of both ASD cases and TD controls to collect their demographic and socioeconomic status information, such as ownership of a car by the family, parental education levels, and potential exposure to manganese through drinking water sources and food, especially the types and frequency of fruits, vegetables, and seafood consumed by the children. At the end of interview, about 5 mL of venous whole blood and 2mL of saliva were obtained from each child. Michigan Department of Community Health analyzed 2mL of whole blood for assessment BMC, while the remaining samples were used for genetic analysis in the Center for Human Genetics at University of Texas School of Public Health at Houston.
Results: Using conditional logistic regression with ASD status as a binary dependent variable, we did not find any significant additive effects for *GSTT1, GSTM1, GSTP1,* and a binary BMC (BMC < 12µg/L, BMC ≥ 12µg/L) in ASD. However, we observed a significant interaction between *GSTP1* and binary BMC in relation to ASD, with and without controlling for several potential confounding variables that included parental education, place of child's birth (Kingston parish vs. other parishes), consumption of root vegetables ("yam, sweet potato, or dasheen"), "cabbage", salt water fish, and cakes/buns. Our findings from both co-dominant and recessive genetic models, indicate that among children who had the Ile/Ile genotype for *GSTP1*, those with BMC ≥ 12µg/L had about 4 times higher odds of ASD than those with BMC < 12µg/L, (Recessive model: Unadjusted Matched Odds Ratio (MOR)=4.02, 95%CI: 1.19-13.64; *P*=0.03). After adjusting for the aforementioned potential confounders, among the subgroup of children with genotype Ile/Ile, those with BMC ≥ 12µg/L had about six times higher odds of ASD than those with BMC < 12µg/L, (Recessive model: Adjusted MOR=5.92, 95%CI: 1.05-33.32; *P*=0.04).
Conclusions: These findings suggest a possible synergic effect of BMC and *GSTP1* in ASD. Further investigation of the mechanism through which increased manganese levels may be related to ASD is warranted.

161   **173.161**   Autism Spectrum Disorder Prevalence and Proximity to Industrial Facilities Releasing Arsenic, Lead, or Mercury

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Background: The etiology of autism spectrum disorder (ASD) is poorly understood. Environmental factors such as exposure to heavy metals have been associated with ASD in previous literature. Prenatal and perinatal exposures to arsenic, lead, and mercury as well as air pollutants have been shown to adversely affect birth outcomes in offspring. Additionally, previous studies have reported that proximity to sources of airborne pollutants, including industrial facilities and high-traffic roadways, was associated with ASD diagnosis and school-reported administrative prevalence, respectively.

Objectives: To evaluate the association between ASD prevalence, at the census tract level, and proximity of tract geometric centers to industrial facilities releasing arsenic, lead, or mercury during the 1990s.

Methods: We used data from five participating sites of the Autism and Developmental Disabilities Monitoring (ADDM) Network: Arizona, Maryland, New Jersey, South Carolina, and Utah. ADDM is a multi-state public health surveillance system for ASD and other developmental disabilities established by the Centers for Disease Control and Prevention in 2000 to measure ASD prevalence among 8-year-old children. ASD case status is determined through a systematic review of records from healthcare and education sources such as primary care clinics, hospitals, schools, and diagnostic and treatment centers. These records are reviewed by expert clinician reviewers to determine if behaviors are described in the abstracted data that meet the number and pattern required for an ASD diagnosis based on the Diagnostic and Statistical Manual of Mental Disorders, 4th edition, Text Revision. ADDM data were obtained for 2000, 2002, 2004, 2006, and 2008 surveillance years. Multi-level negative binomial regression models were used to test associations between census tract level ASD prevalence and proximity to industrial facilities, defined by $\leq 10^{th}$ percentile (≤ 10.46km), 10th-20th percentile (10.47km to 19.01km), 20th-30th percentile (19.03km to 27.64km), 30th-40th percentile (27.67km to 37.38km), and $>50^{th}$ percentile (>46.92km), which were documented to have released arsenic, lead, and/or mercury from 1991 to 1999 according to the US Environmental Protection Agency Toxics Release Inventory.

Results: Data from 4,488 ASD cases residing in 2,558 census tracts revealed that in unadjusted analyses, ASD prevalence was higher for tracts within the closest 10th percentile (RR=1.46, 95% CI: 1.13, 1.88), 10th-20th percentile (RR=1.30, 95% CI: 1.04, 1.63), 20th-30th percentile (RR=1.43, 95% CI: 1.15, 1.76), and 30th-40th percentile (RR=1.32, 95% CI: 1.08, 1.60) in comparison to tracts located in the furthest 50th percentile from industrial facilities. After adjustment for demographic and socio-economic area-based characteristics, including proportion of each tract population that was White, Hispanic, college-educated, residing in a rural area, and living below the poverty line, ASD prevalence was only higher in census tracts within the closest 10th percentile compared to those in the furthest 50th percentile (RR=1.27, 95% CI: 1.001, 1.611).

Conclusions: While the results of this analysis are suggestive of a potential association between residential proximity to industrial facilities emitting arsenic, lead, or mercury and ASD prevalence, care should be taken not to over interpret this observation given the borderline statistical significance, the inability to account for other potentially confounding factors, and known inadequacies in the TRI database.

162 **173.162** The Medical Home and Healthcare Transition in Youth with Autism

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Background: A medical home is a recommended concept of care by the American Academy of Pediatrics for all children. A medical home is generally shown to improve child health outcomes, satisfaction with care and promote patient/family centered care. Healthcare transition planning prepares the child to transition to healthcare services as an adult, with the possibility of different healthcare providers and insurance coverage. Children with autism less often receive care within a medical home or healthcare transition planning services than other children and youth with special health care needs (CYSCHN). According to the AAP, AAFP, AOA, and ACP the goal of health care transition planning is to provide uninterrupted health care services that are developmentally appropriate and maximize lifelong functioning. Children with autism receive transition services half as often as other CYSHCN.

Objectives: A major aim of this study is to determine if the presence of a medical home affects the odds of youth with autism receiving healthcare transition services.   This study also assesses the proportion of youth with autism with and without a medical home, and all CYSHCN, who meet certain aspects of transition planning, such as discussing health care needs as the youth becomes an adult.

Methods: This study used data from the National Survey of Children with Special Health Care Needs 2009/10. We used medical home as the main predictor in a logistic regression model to assess odds of receipt of transition planning when controlling for other covariates. The distribution of covariates

was compared in youth with and without a medical home, as were the survey questions that make up the core indicator of "receipt of transition services."

Results: Twenty six percent of youth with autism age 12-17 received care within a medical home, compared to 43% of all youth with special health care needs age 12-17. Youth with autism age 12-17 were more than twice as likely to meet the CAHMI core outcome of transition planning as youth without a medical home (2.57, 95%CI (1.58, 4.18)). Fewer youth with autism met the transition outcome, 21% compared to 40% of all CYSHCN. Youth with autism with a medical home were also more often encouraged by their doctor to take responsibility for their healthcare needs, and were more often talked to about their healthcare needs when they become an adult. Youth with more comorbid conditions and increasing severity of autism were less likely to receive care within a medical home. Having fewer comorbid conditions was also statistically significantly associated with increased odds of receiving transition planning services, as was higher family income and having public insurance versus private.

Conclusions: The presence of a medical home had a positive impact on receiving transition services, as defined by the CAHMI core outcome for transition planning. However, youth with autism are less likely to receive care within a medical home than their peers with SHCN, and are less likely to receive healthcare transition planning. Receiving care within a medical home more than doubled the odds of youth with autism receiving transition planning.

163 **173.163** Three-Generation Family-Wide Morbidity Patterns in Autism Spectrum Disorder: A Danish Population-Based Cohort Study

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Background:
Many associations between specific family morbidity histories and the risk for autism spectrum disorder (ASD) have been reported, although studies have been limited in the range of family members and morbidities under investigation. Better understanding of family morbidity and its role in ASD etiology, e.g., delineating subgroups with different underlying pathogenesis, requires a more comprehensive perspective.

Objectives:
Conduct a family-wide morbidity association study: population-based cohort analysis of morbidity across three-generation families and their associations with ASD.

Methods:
The cohort comprised all Danish births from 1980 through 2010 (N=1,934,672 births) identified in the Medical Birth and Central Person Registers and linked to parents, grandparents and their descendants. Cohort and family members were followed through 2013 for any diagnoses reported to the Psychiatric Central Research Register and National Patient Register. Adjusted hazard ratios (aHR) of the relative risk for ASD in cohort members from family morbidity at the time of ASD diagnosis, calculated for each family member type and each morbidity diagnosis, were estimated with Cox regression methods using separate baseline ASD diagnostic rates in 3-year strata of birth year, adjusting for sex, birth weight, gestational age, parental age. Family history scores (FamHx) by morbidity for each cohort member were based on the sum of the log-aHRs per morbidity and family member type with the morbidity divided by the total number of family members (with and without the morbidity) for the cohort member. Bivariate correlations between family history scores were computed for cohort members. Due to the volume of results, for this abstract example results are reported for 12 morbidities (ASD, attention deficit hyperactivity disorder, intellectual disability (ID), obsessive compulsive disorder, affective disorder, schizophrenia, epilepsy, thyroid disorders, asthma, non-infective enteritis/colitis, dermatitis/eczema, hypertensive disorders of pregnancy) among parents, full/half siblings, and grandparents of cohort families with at least 2 children, only considering the first 2 children and the cohort member was the second child.

Results:
These example analyses and results included 693,331 cohort children (0.9% with ASD). Significant aHRs for ASD were observed across all 12 morbidities and family member types, from 16.4 (fathers with ASD; 95% CI 12.7-21.2) to 1.1 (maternal grandfathers with asthma; 95% CI 1.0-1.3). In ASD, 1%-24% (1%-17% of non ASD) had a morbidity family history. FamHx correlations between psychiatric disorders or between psychiatric and non-psychiatric disorders tended to be stronger in ASD than non-ASD and the correlation patterns suggest hypotheses for further study. For example, in ASD, the correlations between FamHX of ASD and ID, and FamHx of ID and epilepsy, were stronger than the correlation between FamHx of ASD and epilepsy, suggesting consideration of FamHx of ID in investigations of the link between ASD and epilepsy.

Conclusions:
Family morbidity history may pose a significant ASD risk but the majority of persons may lack a family history per morbidity. The family-wide morbidity association approach reveals a comprehensive underlying ASD family morbidity structure and specific morbidity patterns potentially applicable in etiologic analyses.

164 **173.164** Use of Medicare Claims As a Source for Research Prevalence and Utilization of Medical

Care Services in Persons with Autism Spectrum Disorder over and Under Age 65

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Background: There is a lack of information on how adults with autism spectrum disorder (ASD) use medical care services, or how their utilization differs from the general population of persons with other chronic conditions. Persons who are fully disabled under Social Security rules become eligible for Medicare. Medicare claims may be a useful source studying medical services utilization among adults age 18-64 and 65 and over with ASD.
Objectives: Our purpose was to evaluate the feasibility of using Medicare claims to study adults with ASD by determining the number of identifiable persons with ASD in a three year timeframe and to describe the structure, types, and limitations of various Medicare claims files for research.
Methods: The Centers for Medicare and Medicaid Services (CMS) national Limited Data Files (LDS) were used to explore Medicare beneficiaries with ASD diagnoses. LDS files have limited PHI; each file includes 100% of claims for fee-for-services beneficiaries by calendar year except for the Carrier files which are a 5% sample of national professional claims. Any single claim with an ICD9-CM diagnosis of 299, 2990, 2998, 29980 was counted as an ASD case. We tracked unique persons over time and summarized prevalence by age less than and over age 65.
Results: In 2008, there were a total of 36.6 million Medicare Fee-for-service (FFS) beneficiaries. Of these beneficiaries, 66.8% (28.2 million) were 65 and older, and 23.2% (8.5 million) were under the age of 65. There were 3,118 beneficiaries with an ASD diagnosis. Those under age 65 accounted for 90.4% (2,820) of ASD beneficiaries for 2008, while those 65 and older comprised 9.6% (298). Findings for 2009 & 2010 were similar. Over 1,000 persons appear in at least two years (See Table).
Conclusions: The prevalence of persons under 65 with ASD appears adequate to undertake further study. LDS file population estimates for the nation are feasible by up-weighting Carrier claims by 20. Individual outcome may be tracked by linking 5% sample carrier beneficiaries across other files. Cohort effects will have to be considered given the changes in diagnostic criteria over the lifespan of this population. The small number of claims for those over 65 is consistent with the first description of the condition by Kanner in the 1940's. Older persons in this population likely received the diagnosis at an older age. Limitations: The prevalence of ASD in the LDS may be underestimated due to the 5% sample of Carrier claims used in this study. Lack of Medicaid claims means some utilization is not observed, e.g. dual eligibles and persons in long-term-care facilities. The covered population likely represents a severely disabled subset of the larger ASD population. Limitations of the LDS files may be circumvented by use of Research Identifiable files, Standard Analytic Files and Medicare/Medicaid linked files which all include 100% of all claim types by state.

165   **173.165** Utility of Documented Special Education Exceptionality Categories for ASD Prevalence Estimation Among Children Identified with ASD in the ADDM Network

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Background:
Special education exceptionality (SEE) is a label indicating how a student qualifies for special education services in US public schools. The count of children in specific SEEs has been used to estimate disability prevalence. In such systems, disability prevalence by child's race/ethnicity and sex may be influenced by differential ascertainment.
Objectives: To examine SEE classification trends among eight-year-old children with autism spectrum disorders (ASD) over time and across child sex and race/ethnicity subgroups to explore potential utility of SEE categories to estimate ASD prevalence for these population subgroups.
Methods: The Autism and Developmental Disabilities Monitoring (ADDM) Network conducts multi-source population-based surveillance of ASD prevalence in eight-year-old children. Case status is determined by clinician review of education and developmental records for children with variety of disabilities. This study examined data from 2002, 2006, 2008, and 2010 surveillance years (SY). Children were included if they were identified as having ASD following clinician review of health and education data from one of nine sites that participated in ADDM in at least three of four SYs (N=9110). Mixed effects logistic regression models were fit with SY as a fixed effect and site as a random intercept to adjust for underlying site-related characteristics. To evaluate temporal trend, site-specific odds ratios of SEE were estimated for SY 2006, 2008, or 2010 versus the reference SY

2002. Significant Wald tests comparing odds ratios from each SY indicated difference. Additional models were developed, one with sex and a sex by SY interaction term, and another with race/ethnicity (white non-Hispanic, black non-Hispanic, or Hispanic) and a race/ethnicity by SY interaction term.

Results:

In this sample of children with ADDM identified ASD, "autism" was the most common SEE (range: 51.7 to 56.8% over SYs) and use increased 10% from 2002-2010 (P=0.003). "Other health impairment" and "developmental delay" SEEs were less common, but also increased significantly from 2002-2010 (29.1% increase to 9.2% in 2010 and 1800% increase to 6.3% in 2010, respectively). The largest significant decreases were seen among "multiple disabilities" and "intellectual disability" SEEs (both by 52% from 2002 to 2010, P<.001).

Among males, assignment of "autism" SEE ranged from 52.8% to 58.0% over SYs (P=0.01) and among females it ranged from 47.1% to 52.2% (P=0.07). There was no significant interaction between sex and SY (P=0.7).

Assignment of "autism" SEE ranged from 53.7% to 57.1% in both white and black non-Hispanic children and did not change significantly over SYs. Among Hispanic children, assignment of "autism" increased from 38.5% to 55.7% (P<0.001). There was significant interaction between race/ethnicity and SY (P<0.001)

Conclusions:

Although autism exceptionality is the most common SEE among children with ASD identified by ADDM, regardless of sex or race/ethnicity, almost half of children with ASD do not have autism as their primary SEE. An increase in the proportion of Hispanic children with ASD identified by ADDM who have autism SEE may indicate decreasing disparity in identification of ASD by race/ethnicity for special education purposes. Estimating ASD prevalence using autism SEE underestimates ASD prevalence and should be done with caution.

166 **173.166** Validity and Reliability Analysis of Chinese Parent Version of the Autism Spectrum Rating Scales

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Background:

The national screening, diagnosis and treatment of ASD are started recently in China. Up to now, very few screening and diagnostic instruments were available for the Chinese general population; In particular, before the screening to measure the validity and reliability of instruments is necessary under the Chinese culture environment. One years ago, an important initiative funded by the Ministry of Health was launched to boost autism awareness and clinical and research expertise. As part of this recent program, a national epidemiological survey of ASD among the school-aged population of China was designed. In order to conduct the screening phase of this survey involving 8 provinces (n=120,000), we needed an instrument, properly validated for the Chinese population. After reviewing several instruments, we decide to employ the Autism Spectrum Rating Scale (ASRS) for the epidemiological survey. We report here on the part of our study that aimed at the reliability and validity of the ASRS in a Chinese pilot sample.

Objectives:

The primary aim of this study was to investigate the validity and reliability of Chinese parent version of the Autism Spectrum Rating Scale (ASRS), before it is applied in Chinese population.

Methods: 1625 community based subjects aged 6-12 years old, including 830 boys (51.1%) from four sites (Shanghai, Guangzhou, Changsha, and Harbin city) in China and 211 clinic-based participants (aged 6-18, and 87.7% are male) were assessed. All clinic cases were diagnosed with pervasive development disorder under the criteria of DSM-IV, and 10% of which were confirmed by a parental interview using the Autism Diagnostic Interview-Revised (ADI-R). All the parents of recruited subjects administered the Chinese version of ASRS questionnaire, and the Chinese version of the Social Responsiveness Scale Questionnaire (SRS). Test-retest reliability (pair- wised student's t-tests), construct validity using Confirmative factor analysis (CFA) and Pearson correlation, concurrent validity (Pearson correlation) , and discriminate validity (Student's t-tests) for Chinese version parent ASRS were analyzed by using relevant statistical methods. Age, gender and sites effect on the subscales scores and T-scores were analyzed by using multiple linear regressions. Between-group difference (effect size and 95%CI) was reported. SPSS statistical package was used, P<0.05 was deemed as statistical significant level.

Results: Boys in community-based sample had significant higher scoring in Social Communication (SC), Unusual Behavior (UB), Self-Regulation (SR) and standardized total score (T-score) by 2-3 points than that in girls, Ps<0.001. The internal consistency (Cronbach's alpha) were 0.585–0.929, and test-retest reliability (interclass correlations, 0.542–0.749, *p*>0.05). CFA showed fairly good model fitting , concurrent validity was 0.732 compared with SRS scores. Clinical sample showed significantly higher T-scores and the three subscale scores compared with community-based samples. With mean difference of 0.4SD for SC, 0.4SD for UB, 0.3SD for T-score between male and female in clinical case.

Conclusions:

The Chinese parent version of ASRS is a reliable and valid tool for screening autistic symptoms in the Chinese general population.

**Poster Session
174 - Molecular and Cellular Biology**
11:30 AM - 1:30 PM - Imperial Ballroom

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167 **174.167** A Metabolic Profile of Autism Spectrum Disorder from Autism Phenome Project Patient Plasma

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Background: Diagnosis of autism spectrum disorder (ASD) at an early age is important for initiating effective intervention. The current average age of diagnosis in the United States is 4.5 years. Increasing evidence indicates that ASD is a complex disorder that has many causes. Identification of one or more metabolic signatures of ASD from blood samples will offer earlier screening and diagnosis to improve therapy and outcome as well as a richer biological interpretation of the disorder.
Objectives: Stemina conducted a metabolomic profiling study of blood from patients enrolled in the Autism Phenome Project (APP) to evaluate the metabolic signature in children with ASD as compared to typically developing (TD) children. The goal was to determine the most predictive combination of metabolic biomarkers capable of being translated into a broadly available diagnostic test for ASD.
Methods: Plasma was obtained from 180 children (ages 2 to 4) with ASD and 93 age-matched TD children enrolled in the APP. Samples were analyzed using 4 orthogonal LC/HRMS-based methods that measure a broad range of metabolites. The patient samples were split into a training set (127 ASD, 68 TD) of samples for discovery profiling and a validation test set (42 ASD, 21TD) for evaluation of the diagnostic signatures discovered in the training set. Univariate, multivariate and machine learning methods were applied to the training set to identify the most predictive set of metabolic features that are capable of classifying patient plasma samples as being from ASD or TD children. The molecular signatures were evaluated in the validation test set to determine their classification performance.
Results: Univariate analysis identified 292 differential metabolic features (p value < 0.05) between ASD and TD children. Computational models were created using these features that classified the ASD and TD samples in the validation test with a maximum accuracy of 81% and AUC of 0.82 utilizing a minimum of 75 features. Further evaluation of the metabolic features that were altered in children with ASD identified metabolites derived from multiple biochemical processes including lysophospholipids, androgens, and amino acids. A group of metabolic features correlated with the uremic toxin 3-Carboxy-4-methyl-5-propyl-2-furanpropionic (CMPF) were identified that exhibited a large differential abundance (> 10 fold, p val < 1e-6) in a subset of ~20% of ASD patients as compared to other ASD and TD individuals. We are conducting additional studies to determine if this set of features could describe a metabolic subtype of autism.
Conclusions: The metabolomic analysis of plasma identified signatures able to discriminate individuals with ASD from TD individuals. These results form the basis for additional work to 1) developing a diagnostic test to detect ASD in children to improve patient outcomes, 2) gain new knowledge of biochemical mechanisms involved in ASD 3) identify biomolecular targets for new modes of therapy, and 4) identify biomarkers that can be used for personalized treatment and classification of potential responders versus non-responders through analysis of a patient's biochemistry.

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168 **174.168** A Novel Cost-Effective Approach to Derivation of Induced Pluripotent Stem Cells from Epstein-Barr Virus Immortalized Lymphoblastoid Cell Lines

A. L. Wagoner[1,2], D. L. Mack[3], E. E. McKee[1] and S. J. Walker[1,2], (1)Wake Forest Institute for Regenerative Medicine, Winston-Salem, NC, (2)Neuroscience Graduate Program, Wake Forest University Health Sciences, Winston-Salem, NC, (3)Institute for Stem Cell and Regenerative Medicine, University of Washington, Seattle, WA

Background: Autism spectrum disorders (ASD) may be viewed as a collection of heterogeneous disorders that are currently diagnosed based upon DSMV criteria. The vast phenotypic differences that can exist from individual to individual suggest that the underlying etiologies are complex and likely involve multiple genetic and environmental inputs. Given that the availability of tissue, especially brain tissue, from ASD patients is extremely limited, the development of alternative tools to investigate molecular and neurobiological mechanisms is critically important. One key resource for ASD research is immortalized lymphoblastoid cell line (LCLs) banks generated from proband and family member blood samples. Induced pluripotent stem cells (iPSC), derived from these LCLs, can be to generate patient-specific neurons for use in downstream mechanistic studies.
Objectives: The objective of this study was to use LCLs to generate iPSCs for the downstream study

of neurobiological aspects of ASD. The availability of a streamlined, standardized, reproducible, cost-effective, and efficient approach will render the use of well-characterized LCLs for ASD research a gold standard.

Methods: We obtained LCLs from two males (proband and sibling) from the Autism Genetics Resource Exchange (AGRE) and two males (proband and parent) from the NIMH Repository and Genomics Resource (Phelan-McDermid Syndrome [PMDS] patients). IPSCs were generated from all 4 EBV-LCLs by transfection with Epi5 Episomal iPSC reprogramming plasmids. For the first 7 days after transfection, cells were cultured on Matrigel-coated plates in N2B27 based medium. After 7 days, the reprogramming cells were cultured in Essential-8 medium until ready for passaging. PCR, RT-PCR, immunocytochemistry, and a novel assay, the Taqman® human pluripotent stem cell Scorecard™ Panel were used to fully validate endogenous pluripotency of all iPSC clones generated.

Results: IPSCs, generated via transfection with Epi5 Episomal iPSC reprogramming plasmids, were apparent as early as Day 8 post-transfection and ready for propagation as early as Day 18. IPSCs derived from LCLs obtained from the AGRE were propagated to passage 23 first, followed by the PMDS lines, which are currently at passage 10. Two clonal iSPC lines per original LCL were evaluated for normal karyotype, expression of pluripotency markers, and loss of OriP/EBNA-1 expression vectors. We have confirmed these iPSC clones are plasmid-free and EBV-free. Three of four clones had the expected expression of cell-autonomous pluripotency genes and normal karyotype. All clonal lines were allowed to spontaneously differentiate into embryoid bodies and were assayed for pluripotency markers and germline-specific transcripts using the Taqman® human pluripotent stem cell Scorecard™ Panel. Results indicated that all four iPSC lines are suitable for neuronal differentiation protocols. These assays will be applied to the PMDS iPSCs and are expected to produce similar results.

Conclusions: This protocol describes a reproducible method to efficiently generate iPSCs with standardized and cost-effective reagents. IPSCs produced following this improved protocol can be used to generate and evaluate novel *in vitro* models to study a plethora of previously inaccessible neuronal cell types that underlie pathological mechanisms in ASD.

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169   **174.169** A Systems Biology Approach to Drug Discovery in Autism

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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 monogenic disorders with high penetrance for causing ASD, common pathobiological pathways might be identified. Phelan-McDermid syndrome (PMS) is one such monogenic ASD-associated syndrome that is 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 neurobiological 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 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 pathology 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 12 patient/sibling pairs and reprogrammed using a modified non-integrating Sendai virus to express reprogramming factors. At least 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, and the transduced cells are selected with puromycin. Induced neurons are grown for 3 weeks, with mouse astrocytes being added on day 2 to aid in synapse formation, and then cells are harvested and processed for RNA isolation. All samples are subjected to RNA sequencing. The PMS-associated changes in gene expression are then 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: Three patient/sibling pairs have been reprogrammed and high quality clones have been obtained after QC. The remaining 9 patient/sibling pairs are currently being reprogrammed with many clones also having already passed QC. Neuronal induction has been performed on clones from the initial 3 pairs and is being started with clones from additional pairs as they become available.

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 in conjunction with other models of the disease and known drug expression profiles to identify new therapeutics.

170   **174.170** Abnormal Expression of a SERT-Binding Protein, NSF, in Autism: Implications for Pathophysiology in Autism

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Background: Change in serotonin transporter (SERT) function has been implicated in autism. SERT function is influenced by the number of transporter molecules present at the cell surface, which is regulated by various cellular mechanisms including interactions with other proteins. Thus, we searched for novel SERT-binding proteins and investigated. As we presented at the IMFAR 2014, *N*-ethylmaleimide-sensitive factor (NSF) was identified as a novel SERT-binding protein. NSF co-localized with SERT at the plasma membrane, and NSF knockdown resulted in decreased SERT expression at the cell membranes and its uptake function in HEK293-hSERT cells. In addition, NSF endogenously co-localized with SERT and interacted with SERT in mouse brain.
Objectives: The objectives of this study were to address whether expressions of SERT and NSF were changed in autism and whether these expression correlate with clinical variables and symptom profiles.
Methods: We examined the mRNA expression of SERT (SLC6A4) and NSF in the post-mortem brains from 7 subjects with autism and 11 healthy age- and sex-matched control subjects, and in the lymphocytes from 30 male subjects with autism and 30 male healthy age-matched control subjects by quantitative real-time PCR. Additionally, we evaluated the relationships between these expression levels and clinical variables and symptom profiles.
Results: While *SLC6A4* expression was not significantly changed, *NSF* expression tended to be reduced in post-mortem brains, however this potential trend is not statistically significant, and was significantly reduced and correlated with the severity of the clinical symptom in lymphocytes of subjects with autism.
Conclusions: A possible role for NSF in the pathophysiology of autism, through modulation of SERT trafficking, is suggested.

171   **174.171** Austism Spectrum Disorder and the Brain-Gut-Microbiome Axis

*N. E. Furland[1,2] and **M. T. Sindelar**[2], (1)INIBIBB-CONICET-UNS, Bahia Blanca, Argentina, (2)Emily Fenichel Foundation, Bahía Blanca, Argentina*

Background: Autism spectrum disorder (ASD) is a complex neurodevelopmental disorder where a high frequency of gastrointestinal (GI) dysfunction (e.g., constipation, diarrhea, bloating, gas, and history of reflux) is reported. However, the mechanism underlying GI tract defects in autistic children as well as the association between abnormal GI structure and function with ASD is yet to be clearly understood. GABA and serotonin functions as key neurotransmitters at both, the central nervous system and the gastrointestinal tract, and there is accumulating evidence pointing to a critical role for the gut microbiome in regulating normal functioning of tryptophan metabolism and the GABAergic system. There is also substantial overlap between ASD behaviours that could be influenced by the gut microbiota.
Objectives: the aim of this work is to analyse and identify differences on fecal microbiota (as a proxy for gut microbiota), some neurotransmitters levels and SCFA (short chain fatty acids) between autistic children and healthy donors. If the unique microbial flora or metabolic profile is found to be a causative or consequent factor in GI disorders in ASD, it may have implications with regard to a specific diagnostic test, its epidemiology, and therapeutic targeting of the gut microbiota as a viable treatment strategy for ASD
Methods: we analyzed Serotonin and Dopamine, both neurotransmitter monoamines involved in modulating adult cortical plasticity, also GABA and SCFA (short chain fatty acids) profile in fecal samples in a cohort of 30 patients that met DSM V criteria for autism based on ADOS and their typical developed (TD) siblings. The control sample consisted of 35 healthy donors, sex-matched with the case sample.
Results: Autistic patients have a unique microbiome consisting of more clostridial species. Half of all autistic children with gastrointestinal dysfunction were found to have Sutterella, a bacteria which is absent in no autistic children with gastrointestinal dysfunction. Our results show that microbiota and metabolic profiles from ADS children significantly differ from their healthy siblings and controls and suggest a potential correlation with gastrointestinal dysfunction.
Conclusions: Differences in microbiota and some metabolites levels found in ADS children stools versus controls correlates with GI distress. Also CNS neurotransmission can be profoundly disturbed by the gut microbiome in ASD.

172   **174.172** Dynamic Gene Network Analysis of Neuronal Differentiation Identifies Novel Gene-Network Clusters Specifically Enriched for Autism Risk Genes

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Background:
Autism Spectrum Disorders (ASD), and ASD related disorders such as Fragile-X Mental Retardation Syndrome (FXS) or other syndromic disorders with intellectual disability (ID) are hallmarked by aberrant neuronal function and connectivity. Several studies support the hypothesis of a disturbed neuronal maturation underlying these disorders. Genetic studies report an etiological overlap, however, the clinical phenotypes are specific. Thus, we tested if genes associated with ASD, FXS or ID are activated and or regulated in distinct gene-expression modules during ND, and identified the pathways specifically impaired.
Objectives:
We used a neuronal cellular model (SHSY5Y) to explore at systems biological level the role of ASD, FXS and ID implicated genes during neuronal differentiation (ND). We aimed at identifying transcriptional modules that are enriched for risk genes, and that are specifically impaired in the disorders. Identified modules were characterized with respect to their association with morphological changes. This allows us to estimate the functional effect of impaired expression of cluster associated genes.
Methods:
To analyze ND we differentiated SH-SY5Y cells by simultaneous application of retinoic acid and brain derived neurotrophic factor over a time course of two weeks. Whole transcriptome (Illumina HumanHT-12 v4 Expression BeadChips) and morphological development (Sholl parameters of GFP transfected co-cultivated cells) were analyzed at 7 time-points during this process. Significantly regulated genes were identified via t-test, dynamic time warping (DTW) and parallel independent component analysis (pICA) and subjected to weighted gene co-expression network analysis (WGCNA). Identified modules were analyzed for association with morphological development. GO-term enrichment analyses and gene-set enrichment analyses were performed in parallel.
Results:
Most of the mRNA regulation occurred within 168h of differentiation. Comparing transcriptomic patterns in our in-vitro model with published in-vivo Data (Kang et al., 2011) using the CoNTExT Algorithm (Stein et al., 2014) shows cortical identity of differentiated cells as well as a maturity stage corresponding to pcw 16. Identified modules of regulated genes showed specific overlap with ASD, FXS and ID risk genes. Interestingly, also disorder specific enrichment was observed. One module, associated with Retinoic acid metabolism, was enriched for ASD-genes only, whereas the translation implicated module was associated with both, FXS and ASD implicated genes. ID implicated genes were mainly enriched among down-regulated genes. In addition, we show that modules enriched for ASD genes are associated with neurite outgrowth.
Conclusions:
Our results show that risk genes for ASD, FXS or ID do affect similar but distinct modules and allow thus to hypothesize on the differences in the clinical presentation of the disorders. Furthermore we support the hypothesis that genetic variants identified in ASD patients are targeting on the one hand mechanisms implicated in FXS or ID, and on the other hand ASD-specific mechanisms. The latter processes may thus merit further attention when developing strategies to differentiate ASD from other disorders with overlapping symptomatology.

173 **174.173** Epigenetic Alterations in Autism Spectrum Disorder Following the Use of Fertility Treatments

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Background: Autism spectrum disorder (ASD) is a heterogeneous disorder both genetically and phenotypically. It has been estimated that ~25% of ASD cases can be accounted for by genetics, but the additional contributions of environment and epigenetics to the etiology of ASD have yet to be defined. One possible environmental exposure that may impact epigenetic regulation is the use of fertility treatments (FT). To date, FT, including assisted reproductive technologies (ART) and hormonal stimulation of ovulation, contribute to 6% of live-births in the United States annually. FT is associated with increased risks for multiple births, prematurity and low birth weight. Additionally, concerns have been raised about the potential for increased risks for birth defects and neurodevelopmental disorders. DNA methylation (DNAm) alterations are enhanced following FT in etiologically heterogeneous disorders such as Beckwith-Wiedemann and Angelman syndromes. The evidence for a similar effect in ASD is inconsistent.
Objectives: We hypothesize that epigenetic alterations contribute to the molecular etiology of ASD. This work also explores whether FT contributes to the risk of ASD and associated epigenetic modifications.
Methods: We examined DNAm variants (DMVs) in five groups of samples: whole blood from patients diagnosed with ASD and conceived by FT (ASD-FT) (n=27), patients diagnosed with ASD and conceived normally (ASD-NC) (n=21), and unaffected controls conceived normally (n=50). As an approximate control for FT alone, we also compared our results to a set of cord blood samples collected at birth from patients conceived by FT (n=22), with matched cord blood controls conceived

normally (n=22). Whole blood was assessed for DNAm using sodium bisulfite converted DNA followed by the Illumina Infinium HumanMethylation450 BeadChip array, which interrogates >485,000 CpG sites at single nucleotide resolution. The top hyper- and hypomethylated regions will be validated independently by sodium bisulfite conversion followed by pyrosequencing. We employed a novel bioinformatics approach to analyze genome-wide DNAm data that is appreciably more successful in generating statistically significant epigenetic signals in subgroups of ASD cases.

Results: By initially grouping all ASD patients together (ASD-FT + ASD-NC), we identified >3000 DMVs when compared with controls (adjusted $p < 0.05$) with effect sizes of up to 14% difference. When subgroups based on DNAm and variance were identified, these signatures were even stronger at more stringent significance levels (adjusted $p < 0.0001$) and with greater effect sizes (8-28% difference). Within the subgroups, there appears to be a trend towards a higher frequency of use of FT vs. in the remaining ASD patients not placed into subgroups ("Other ASD") ($p > 0.05$). We are now further delineating phenotypic and genomic associations between individuals in these subgroups, examining the functional relevance of the DMVs and analyzing cord blood DMVs.

Conclusions: We have identified DMVs that differentiate between ASD subgroups and controls. These findings support the role of epigenetics in the molecular etiology of ASD and we expect environmental and clinical patient stratification may ascertain specific risk associations. Such associations with epigenetic patterns could potentially be utilized as a diagnostic tool, allowing for earlier detection of ASD in subsets of patients.

174 **174.174** Involvement of Human Endogenous Retrovirus–H (HERV-H) in Autistic Spectrum Disorder

E. Balestrieri[1], C. Cipriani[1], I. Bucci[1], C. Matteucci[1], A. Benvenuto[2], A. D. Argaw[1], P. Curatolo[2] and P. Sinibaldi-Vallebona[1,3], (1)Dept. Experimental Medicine and Surgery, University of Rome Tor Vergata, Rome, Italy, (2)Pediatric Neurology Unit, Neuroscience Department, University of Rome Tor Vergata, Rome, Italy, (3)Institute of Translational Pharmacology, CNR, Rome, Italy

Background:
Human Endogenous Retroviruses (HERVs) constitute about 8–9% of the human genome, closely resemble infectious retroviruses and are considered to be remnants from ancient germ line viral infections, integrated as provirus in chromosomal DNA. During evolution HERVs were amplified and spread throughout the genome by repeated events of retrotransposition and/or reinfection and their integration can alter the structure and/or function of host genes. HERVs expression is implicated in many complex diseases that have multifactorial etiology and genetic basis, including type 1 diabetes, various types of tumors, autoimmune diseases, neuropathogenic diseases such as multiple sclerosis, schizophrenia and attention deficit hyperactivity disorder. In a previous study we demonstrated that peripheral blood mononuclear cells (PBMCs) of autistic patients (ASDs) showed high levels of HERV-H and had the potential to up-regulate HERV-H expression upon stimulation in culture, compared to healthy controls (HCs). HERV-H expression negatively correlated with the age of patients and high levels of HERV-H expression were associated to those with a severe impairment of developmental.

Objectives:
HERV-H expression in PBMCs has been assessed in larger samples of autistic children and in their parents to confirm our data and to evaluate the expression of HERV-H in the previous generation. The effect on HERV-H expression of substances able to modulate the expression of human retroviruses has been analysed. The possible link between HERV-H expression levels and clinical phenotype of the patients, in terms of age, levels of cognitive and adaptive functioning, severity of symptoms, environmental variables (such as parental exposure to toxic substances), recurrent infections and hormone treatments of mothers, has been evaluated.

Methods:
PBMCs from blood samples were stimulated in vitro and treated with different concentrations of Valproic acid (VPA) and non-nucleoside reverse transcriptase inhibitors, Nevirapine (NVP) and Efavirenz (EFV) for 72 hours. RNA from PBMCs was retro transcribed and amplified using primers specific for HERV-H, by real time PCR. A non-standardized questionnaire was administered to parents in order to identify associated risk factors.

Results:
A similar pattern of HERV-H expression, both basal and after stimulation in culture has been observed in ASDs and mothers. VPA treatment restores the HERV-H expression to basal levels in ASDs, induces an increase of the expression in mothers and has no effect in fathers. NEV and EFV decrease the expression levels of HERV-H, although at different concentrations in ASDs, mothers and fathers. Several risk factors related to maternal-fetus system (poliabortivity, hormonal treatment for infertility and history of infection) were highlighted.

Conclusions:
The high expression level of HERV-H in mothers suggests a maternal epigenetic transmission, able to confer an increased susceptibility to the disorder. Environmental factors, exposure to infections and drug treatments, can be considered trigger events that could modify the HERVs expression and the status of immune system in the mothers; modifications that could be in turn responsible of neurotoxicity and impaired synaptogenesis in the earliest stages of neuro-development in utero.

175 **174.175** Modeling Enteric Nervous System Function in Children with Phelan Mcdermid Syndrome

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Regenerative Medicine, Winston-Salem, NC, (2)Neuroscience Graduate Program, Wake Forest University Health Sciences, Winston-Salem, NC, (3)Institute for Stem Cell and Regenerative Medicine, University of Washington, Seattle, WA

Background: Shank3, a critically important scaffolding protein controlling CNS post-synaptic density, is one of the most well characterized genes known to have a functional role in Autism Spectrum Disorders (ASD). Phelan McDermid Syndrome (PMDS), a genetic disorder caused by the deletion of a portion of chromosome 22 containing the Shank3 gene, provides an excellent model in which to study the effects of Shank 3 haploinsufficiency in ASD since PMDS patients exhibit many relevant similarities, including an ASD diagnosis (in >84%) and chronic GI symptoms (reported in >50%). Shank3 haploinsufficiency is thought to be the main contributor to neurodevelopmental abnormalities in PMDS and Shank3 is also expressed in the enteric nervous system (ENS). Therefore, it is likely that deletions/truncations causing neurological dysfunction in the CNS also have a role in the ENS. To explore this relationship we have developed a patient-specific induced pluripotent stem cell (iPSC)-derived *in vitro* model system that can be used to generate and functionally characterize enteric neurons. This model will lead to greater understanding of molecular mechanisms involved in PMDS and ASD, specifically those with GI symptoms.
Objectives: The overall goal of this project is to develop a model system to study ENS dysregulation in ASD. This will be accomplished by selecting lymphoblastoid cell lines (LCL) from PMDS children who have an ASD diagnosis and chronic GI symptoms. PMDS patients who meet these criteria provide a compelling model for the investigation of cross nervous system synaptic dysfunction to increase our understanding of the relationship between of ASD and GI symptoms.
Methods: The steps involved in our model development are fourfold: (1) identify PMDS individuals who have chronic GI disturbances (e.g. GERD or hypomotility) *and* an ASD diagnosis, (2) use lymphoblastoid cell lines (LCLs) from these individuals to generate iPSCs, (3) direct the patient-specific iPSCs down neuronal lineages to make enteric neurons, and (4) characterize the function of these neurons, compared to those derived from individuals with unaffected synaptic proteins, in a smooth muscle co-culture system.
Results: Epstein Barr Virus immortalized-LCLs were obtained from two patients (proband and parent) from the NIMH RGR. IPSCs, generated from EBV-LCLs transfected with Epi5™ Episomal iPSC reprogramming plasmids, were apparent at Day 8 post-transfection and are currently at passage 10. Clonal iSPC lines are being evaluated for patient-specificity, normal karyotype, expression of pluripotency markers, and loss of OriP/EBNA-1 expression vectors. In parallel experiments, neural crest cells (NCCs), differentiated from WT-iPSCs, showed proper gene expression and cell morphology. Neural lineage differentiation methods have now been optimized and will be applied to the PMDS-specific LCL-derived iPSCs for the generation of enteric neurons.
Conclusions: Using a state-of-the-art reprogramming system, LCLs from PMDS individuals in the NIMH RGR have been used to generate iPSCs. We have also demonstrated that iPSCs can be differentiated into NCCs. Our next step will be to differentiate the PMDS-specific iPSCs into enteric neurons and then compare their function to enteric neurons derived from non-PMDS cells.

176   **174.176** Serum Levels of Brain-Derived Neurotrophic Factor (BDNF), Tissue-Type Plasminogen Activator (tPA) and Its Inhibitor (PAI-1) in Children with Autism

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Background: Autism seems to be characterized by altered neuronal cytoarchitecture, synaptogenesis and possibly also cellular immune responses. Neurotrophic factors (NTFs) are central to many facets of the central nervous system (CNS) function, from differentiation and neuronal survival to synaptogenesis and activity-dependent forms of synaptic. BDNF belongs to the family of NTFs and it is active in the mammalian. Plasmin, a serine protease, is involved in many physiologically relevant processes, including haemostasis, cellular recruitment during immune response, tumour growth, and also neuronal migration and synaptic remodeling. Both tissue-type and urokinase-type plasminogen activators can be efficiently inhibited by plasminogen activator inhibitor-1 (PAI-1), a protease inhibitor of serpin family. Tissue plasminogen activator (tPA or PLAT), is found not only in the blood, where it seems as a thrombolytic enzyme, but also in CNS. Studies in the recent decades have shown that tPA may play an important role in the pathogenesis of mental development disorder. So, all of the BDNF, tPA and PAI-1 activities are essential for the hippocampus functions in the autism children.
Objectives: The aim of this study was to investigate the concentrations of BDNF, tPA and PAI-1 levels in children with autism.
Methods: Participants included 93 autistic individuals meeting DSM - IVcriteria(83 boys, 10 girls; ages 2 to 10), and 99 age- and sex-matched healthy children(90 boys and 9 girls; ages 3 to 9)selected from a local public kindergarten and used as a controls group. According to the Childhood Autism Rating Scale (CARS), children with autism were graded for the illness severity. Levels of cytokines in serum were quantified by an enzyme-linked immunosorbent.
Results: Serum BDNF levels in children with autism were 28.49±1101 pg/ml, and significantly higher than those in the normal subjects (21.32±11.12 pg/ml; t=3.42, p=0.001). Serum PAI-1 levels (1316.43±593.86 ng/ml) in the children with autism were also significantly higher compared with children with normal development (592.51±502.19 ng/ml; t=5.72, p=0.000). On the other hand,

serum tPA values (805.47±436.38pg/ml) in children with autism were significantly lower compared with control children (1103.85±562.29 pg/ml; t=2.56, p=0.012).

Conclusions: Serum levels of BDNF, tPA and PAI-1 may be associated with the disease of autism. Focusing on the NTFs, the puzzling aetiology of these cytokines should be further elucidated for the children with autism in the future.

177   **174.177** Synaptic Protein Interaction Network Disruptions Suggest Convergence Among Autism Mouse Models

__S. E. Smith__[1], S. C. Neier[1], T. R. Davis[2] and A. G. Schrum[1], (1)Mayo Clinic, Rochester, MN, (2)Immunology, Mayo Clinic, Rochester, MN

Background: Mutations in genes expressed at the glutamate synapse are commonly reported in autism genetic studies. Moreover, mouse models of autism often show disruptions of glutamatergic transmission and excitatory/inhibitory balance, even when the gene under study is not localized to the synapse. These data suggest that disruption of glutamatergic transmission may be a central component of many different genetic and environmental causes of autism.

Objectives: Use quantitative multiplex immunoprecipitation to identify convergent molecular pathways at the glutamate synapse in different genetic and environmental models of autism.

Methods: In order to test this synaptic hypothesis of autism pathogenesis, we have assembled a quantitative multiplex immunoprecipitation (QMI) assay to measure dynamic protein-protein interaction networks at the glutamate synapse in mouse models of autism. The QMI assay immunoprecipitates a given protein onto a microbead substrate, and quantifies the abundance of co-immunoprecipitated proteins in shared complexes using fluorescently tagged antibodies read by a flow cytometer. Currently, we can simultaneously measure 225 binary protein combinations.

Results: Using QMI, we have analyzed several independent genetic and environmental mouse models of autism and quantified the differences in the synaptic protein interaction network in the hippocampus and frontal cortex. Our results show that when one synaptic protein is deleted (e.g. Shank3), the abundance of many seemingly unrelated protein complexes is affected (e.g. a complex containing Neuroligin3 and GRIN1). By comparing protein network changes in different mouse models using graph-theory-based techniques, we are beginning to identify a set of proteins in shared complexes that are altered in multiple models of autism.

Conclusions: We predict that a better understanding of both levels of individual protein abundance and, critically, the interactions among synaptic proteins, will enable the identification of convergent molecular pathways in different models of autism, and allow the classification of biologically relevant sub-groups of the disorder.

Poster Session
175 - Other
11:30 AM - 1:30 PM - Imperial Ballroom

178   **175.178** An Overview of the Basic Genetic, Epigenetic, and Environmental Factors Relevant to ASD

__D. L. Coury__, Nationwide Children's Hospital, Columbus, OH

Background: The autism spectrum disorders are behaviorally defined neurodevelopmental disorders. The association of autism with certain genetic conditions such as Fragile X syndrome, and the increased risk of medical complications such as epilepsy, has been known for some time. Over the past two decades there has been increased awareness of other medical conditions frequently occurring in individuals with autism.

Objectives: The objective of this presentation is to describe these medical conditions along with an update on recommendations for genetic evaluation in these cases. Participants in the seminar will be able to identify medical conditions and genetic syndromes that have been associated with autism spectrum disorder symptoms. They will also learn which labs to order to screen for medical conditions commonly associated with ASD.

Methods: The genetic factors involved in autism spectrum disorders are complex and poorly understood. Some genetic disorders (Fragile X syndrome, tuberous sclerosis) have been known to have a high incidence of autism. Newer technologies such as chromosomal microarrays have identified additional genetic disorders associated with autism. In addition, certain physical findings may suggest genetic conditions to be ruled out or in, as their presence may lead to close monitoring (e.g., macrocephaly is a common finding in PTEN hamartoma/tumor syndrome; these patients should be monitored for development of tumors) or concomitant treatment.

As research on genetic underpinnings of ASD continues, there is increased attention to potential epigenetic and environmental factors. In recent years multiple factors have been proposed to have an association to ASD, including prenatal (maternal fever, valproic acid exposure), perinatal (caesarean section), and postnatal (bisphenol, high precipitation). Strength of evidence for these and others will be discussed.

The material will be presented through lecture with slides, and a discussion period will follow.

Results: Participants will increase awareness of genetic conditions commonly associated with autism disorders, and acquire knowledge of currently recommended genetic testing in this population. They

will also learn which labs to order to screen for medical conditions commonly associated with ASD. They will become knowledgeable of the environmental exposures that have been found to be associated with diagnosis of ASD.
Conclusions: Participants will increase knowledge of genetic, epigenetic and environmental factors and be better able to collaborate with other disciplines in evaluation and management of individuals with ASD.

179 **175.179** Emerging Tools and Techniques Using Computational Pipelines and Results with NDAR

ABSTRACT WITHDRAWN

Background: We will provide instruction on how to best access the wealth of data now available in NDAR, filtering across omics, clinical, and neuro-signal recordings results and how these data can then be organized specific to a publication or computational result. Objectives: the dynamic filtering of data by most any attribute (e.g. IQ, ADI score, omic alteration, phenotype, or neuro-signal recordings result) in NDAR across numerous repositories offers opportunity for iterative data exploration. This ability, coupled with emerging computational pipelines and analytical tools being actively integrated with NDAR will be presented. Methods: the different approaches available for query/inspection of NDAR data using massively parallel computational capabilities in the cloud or institutional computational environments will be presented. How best to leverage these resources will be discussed.   Results: NDAR allows data, methods, software, and the computational environment to be easily searched and applied to subsets of data that are of interest to an autism researcher. The ability to re-analyze data with small changes to the analysis parameters and to track all of those results, the software and methods used is an emerging area of scientific discovery. Conclusions: Cloud computing is now allowing analysis on a scale never before possible. The techniques used and analysis performed is now shared in a common location and can be made available to others. Learning how to use these very powerful tools and techniques for scientific discovery will be provided.

180 **175.180** Lessons Learned in Performing Secondary Analysis Using NDAR

J. M. Tilford, *Dept. of Health Policy and Management, University of Arkansas for Medical Sciences, Little Rock, AR*

Background: Data from over 80,000 research subjects across many research areas and modalities are now shared in autism and data across other areas of mental health related to the research domain criteria initiative (RDoC) are expected in 2015. Objectives: An overview of the current capabilities to query by lab, paper, phenotypical concept, omic variation, and research subject, coupled with the ability to link results, methods, metadata and outcome measures directly to a publication will be discussed. Methods: Community input on new capabilities and needed improvements to existing infrastructure will be solicited helping improve the infrastructure already available. Results: Examples of efforts to use NDAR for scientific discovery, result replication of research aims, and the different types of data becoming available will be presented.   Conclusions: Understanding how to best use NDAR, the lessons learned in using this infrastructure, the data it contains, and how to improve the data being shared for secondary analysis will be presented.

181 **175.181** Age-Related Improvements in Mind-Reading but Not Parent Reported Empathy in Autism Spectrum Disorders

I. Nagar[1] and A. Gupta[2], (1)Delhi University, New Delhi, Delhi, India, (2)Delhi University, New Delhi, India

Background:
The Mindblindness theory (Baron-Cohen, 1995) of Autism proposes that individuals with autism are deficit in the normal process of empathizing, relative to mental age. Empathizing has been used as a term to encompass the terms 'theory of mind', 'mind-reading', 'and 'metalizing'. Empathizing involves the (1) ability to attribute mental states (emotions) to oneself and others (theory of mind) (2) to have a response that is appropriate to other person's mental states. Few studies have examined age-related changes in the empathizing capacities in individuals with autism.
Objectives:
The goals of the present study were to (1) examine the ability to attribute mental states (2) study the empathizing capacities and (3) to investigate whether there are any age-related changes in mind-reading and empathizing capacities in individuals with autism in comparison to typically developing controls.
Methods:
In this study, children with High Functioning Autism (N=28) aged 8-16 years were compared with age and IQ matched typically developing controls (N=28) on the Children 'Reading the Mind in the Eyes' Task (Eyes Task; Baron-Cohen, 2001) and on the Empathy and Empathy Quotient- Children's Version (EQ-C; Baron-Cohen and Wheelwright, 2004).
Results:
A two-way ANOVA (group by age) analysis for the total correct for eyes task and ratings on EQ-C were conducted. Both the variables showed significant group effects however; only the Eyes task also showed significant age effects in addition the group effects. Interaction of group and age were non-

significant for both the tests. Post hoc comparisons showed significant differences were found in performance on the Eyes task. That is, attribution of mental states was found to be better in older children in comparison to the younger for both HFA and TD groups. No significant differences were found in the reported empathizing capacities of younger and older subgroups for both the groups. Careful comparison of the sample characteristics (gender, verbal IQ, non-verbal IQ) of younger and older HFA groups did not indicate differential sampling.
Conclusions:
Consistent with the 'Mindblindness' theory of ASD, empathizing impairments have been found in autism. Even though no differences have been found in the parent-reported empathy of younger and older children with autism, an increase in accuracy of attribution of mental states observed in older children are suggestive of age-related improvements in the ability to attribute mental states. Since, attribution of emotions is one of the aspects of empathizing, it is interesting to note that improvement in attribution of mental states does not accompany improvement in reported empathy. The findings suggest that children with HFA are slow to develop "mind-reading" skills. The findings observed throw light on the difference between performance on a neuropsychological test and everyday functioning in individuals with Autism.

182   **175.182** Do EF Deficits Ameliorate with Age in Individuals High Functioning Autism? Examining Cognitive Flexibility, Planning, and Working Memory Across Childhood and Adolescence

I. Nagar[1] *and A. Gupta*[2], *(1)Delhi University, New Delhi, Delhi, India, (2)Delhi University, New Delhi, India*

Background: Deficits in Executive Functioning (EF) are notable features in Autism Spectrum Disorder. While, cognitive flexibility and planning have been found to be consistently impaired, the results regarding working memory have been mixed. Few studies have examined age-related performances on EF. Some of the recent studies have reported improvements with age on EF tasks for ASD (Happe, Booth, Charlton, and Hughes, 2006; McGovern & Sigman, 2005; Howlin, Mawhood, & Rutter, 2000).
Objectives: The study aimed to (1) Examine Cognitive Flexibility, Planning, and Working Memory in individuals with HFA in comparison to typical controls (2) Investigate whether there are any age related improvements in EF.
Methods: In this study, children with High Functioning Autism (N=28) aged 8-16 years were compared with age and IQ matched typically developing controls (N=28) on a battery of EF tests. The Number-Letter Switching test and the Tower Test of the Delis-Kaplan Executive Function System (D-KEFS) was used as a measure of cognitive flexibility and Planning Ability respectively. The digit span backward test of WISC-IV was used to assess the working memory of the participants.
Results: A two-way ANOVA (group by age) analysis for the completion time for trail making test (Cognitive Flexibility), total correct for digit span backward task (Working Memory) and total achievement score for the Tower test (Planning) were conducted. All three variables showed significant group and age effects. Interaction of group and age were non-significant for all three tests. Post hoc comparisons showed that in comparison to the TD group, significant differences were found in performances on the cognitive flexibility and planning tests but not on the test of Working Memory, which was found deficit in younger, but not in older children with HFA. Older performed better than the younger subgroups on the Trail Making Test for the HFA group indicating improved cognitive flexibility. Performance on the digit span test fell just short of significance for the HFA group.
Conclusions: Consistent with the Executive Dysfunction theory of ASD, impairments in EF in have been found. However, the findings are contradictory to the reports that profound and generalized impairments in Executive functioning are present throughout development in ASD. While all three EF domains: cognitive flexibility, working memory, and planning were found impaired in younger children with HFA; only cognitive flexibility and planning. Older HFA children when compared with younger HFA children performed better on the cognitive flexibility test. Though significant improvement has been reported on only on the test of cognitive flexibility findings present an encouraging picture suggesting improvements in cognitive flexibility with age in high functioning individuals with autism. They are consistent with the more recent findings that are suggestive of improved adaptation with age in individuals with ASD. Careful comparison of the sample characteristics (gender, verbal IQ, and non-verbal IQ) the younger and older HFA groups did not indicate differential sampling between the subgroups. Future studies that are longitudinal in nature can confirm the present findings and explore the developmental trajectory of EF across different domains and different age groups of ASD.

Oral Session
176 - New Treatments for Early Intervention
1:45 PM - 2:35 PM - Grand Ballroom B

Session Chair: Linda Watson, *Division of Speech and Hearing Sciences, University of North Carolina, Chapel Hill, NC*

1:45   **176.001** Early Intervention Improves Social Processing in Infants at High Familial Risk for ASD

E. Jones[1], *K. M. Burner*[2], *K. Venema*[3], *R. K. Earl*[4], *R. T. Lowy*[4], *J. Kelly*[4], *G. Dawson*[5] *and S. J. Webb*[6], (1)Birkbeck College, University of London, London, United Kingdom, (2)Seattle Children's Hospital,

Seattle, WA, (3)Palo Alto University, Palo Alto, CA, (4)University of Washington, Seattle, WA, (5)Psychiatry and Behavioral Sciences, Duke University, Durham, NC, (6)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA

Background:
Infants with older siblings with ASD have a 20% chance of developing ASD themselves (Ozonoff et al., 2011), and developing early interventions that can prevent or ameliorate the later emergence of symptoms is critical. Such interventions may be most effective when applied in the first year of life, prior to the emergence of behavioral symptoms. However, testing the effects of such interventions is challenging because behavioral measures may not be sensitive to mechanisms of underlying change. In this project, we test the sensitivity to intervention-related change of three measures designed to measure social processing in early infancy.

Objectives:
To assess the effects of an early parent-mediated intervention (Promoting First Relationships) on early social processing measured with electroencephalography (EEG), visual attention and visual preference tasks.

Methods:
Participants were n= 39 infants with an older sibling with a community clinical diagnosis of ASD. After a research visit at 6 months, infants were randomized into an early intervention program (Promoting First Relationships; PFR), or a treatment as usual control group. PFR is a parent-mediated approach that recognizes that early social-emotional wellbeing is rooted in the development of early caring relationships, and that responsive and sensitive caregiving is the foundation for future learning in social-emotional, language and cognitive domains (Kelly et al., 2008). Infants received 8 weekly sessions visits over approximately 10 weeks, administered by a trained interventionist. The post-intervention assessment occurred at 12 months by researchers blind to treatment allocation. Tasks administered at both 6 and 12 months included three experimental assessments of social processing (EEG Videos; Habituation and Visual Preference tasks).   EEG Videos were videos of women telling nursery rhymes (Social) and toys moving (Nonsocial); the key dependent measure was frontal theta power (an index of attentional engagement). Habituation involved repeated presentation of a face or object until looking time dropped to a preset criterion; the key dependent measure was habituation speed (faster indicates better learning). Visual Preference tested preference for female versus male and own- versus other-race faces (the faces that are most common in the infants' visual environment); stronger preferences for normative faces may indicate better social learning or memory.

Results:
Relative to infants who did not receive intervention, at 12 months infants who received PFR during the first year of life habituated more rapidly to faces (but not toys); showed an increase in frontal theta power to social and nonsocial stimuli; and showed enhanced preferences for normative social (but not nonsocial) categories. These effects were significant at the $p<0.05$ level, and were absent during the baseline assessment.

Conclusions:
The changes observed in the treatment group are consistent with better engagement of attention, and faster social learning in infants who received the PFR treatment. These changes should be treated as highly preliminary until longer-term outcomes of this group are known. However, results suggest that experimental measures of social attention may be sensitive to the effects of early treatment for infants at high risk for ASD.

1:57 **176.002** Early Intervention Improves the Flexibility and Focus of Visual Attention in Infants at High Risk for ASD

T. B. Team[1], E. Jones[2], M. W. Wan[3], T. Charman[4], M. H. Johnson[5] and J. Green[3], (1)BASIS, UK, United Kingdom, (2)Birkbeck College, University of London, London, United Kingdom, (3)Institute of Brain, Behaviour and Mental Health, University of Manchester, Manchester, United Kingdom, (4)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (5)Centre for Brain and Cognitive Development, Birkbeck College, University of London, London, United Kingdom

Background:
Infants with older siblings with ASD have a 20% chance of developing ASD (Ozonoff et al., 2011) and are also at heightened risk for associated conditions such as ADHD. Testing the effects of early interventions that could prevent or ameliorate later symptoms requires sensitive biomarkers of the early mechanisms underlying symptom emergence. In this study, we report the effects of an early parent-mediated intervention program (modified Video Interaction to Promote Positive Parenting, mVIPP) on two features of visual attention. First, we examined the ability to shift attention between two stimuli, because slowed disengagement at 12 months is one of the most replicated neurocognitive features of early ASD (Jones et al., 2014). Second, we examined saccadic reaction time variability (sRTV) to a peripheral stimulus. This variable is a robust endophenotype of behavioral-inattentive symptoms of ADHD that is sensitive to treatment (Tamm et al., 2012).

Objectives:
To test whether mVIPP improves disengagement and reduces sRTV in infants with older siblings with ASD, and to assess how these changes relate to infant attentiveness in a naturalistic context (parent child interaction).

Methods:
Participants were n=54 infants with an older full sibling with ASD tested pre- (8 months) and post-intervention (14 months) on a battery of tasks. Between these visits, infants were randomized to receive intervention (n=28) or 'treatment as usual' (n=26 controls). The intervention program consisted of up to 12 therapist sessions over 5 months, plus daily parental practice.
Results:
Tasks included a parent-child interaction, and an eye-tracker Gap task. Here, infants were presented with a central then a peripheral stimulus and saccadic reaction time (sRT) to visually fixate the peripheral stimulus was measured. The central stimulus either disappeared concurrently with the presentation of the peripheral stimulus (Baseline), 200ms earlier (Gap) or remained on screen throughout the trial (Overlap). Key dependent measures were a) the difference in sRT between Overlap and Baseline conditions (disengagement time); and b) the coefficient of variation in sRTs in the Baseline condition (sRTV). Parent child interaction was coded with the Manchester Assessment of Caregiver Interaction (e.g. Wan et al., 2012); the key variable was infant attentiveness.
Conclusions:
Infants who received mVIPP showed a greater decrease in disengagement time than controls (suggesting improved attentional flexibility) and a reduced increase in sRTV between 8 and 14 months. Individual differences in the increase in sRTV between 8 and 14 months were correlated with decreases in attentiveness measured during parent-child interaction. This is consistent with the proposal that sRTV may be a sensitive measure of early attention difficulties. Further analyses will explore relations to other biomarkers and behavioral changes in the same cohort.

2:09 **176.003** Managing Repetitive Behaviours in Young Children with Autism Spectrum Disorder (ASD): New Parent Group Intervention

V. Grahame[1], L. Dixon[2], J. Rodgers[3], H. McConachie[4], D. Brett[5] and A. S. Le-Couteur[5], (1)Northumberland, Tyne and Wear NHS Foundation Trust, Newcastle upon Tyne, England, United Kingdom, (2)Regional Complex Neurodevelopmental Disorder service, NTW NHS Foundation Trust, Newcastle, United Kingdom, (3)Institute of Neuroscience, Newcastle University, Newcastle, United Kingdom, (4)Institute of Health and Society, Newcastle University, Newcastle, United Kingdom, (5)Institute of Health and Society, Newcastle University, Newcastle upon Tyne, United Kingdom

Background:
Repetitive behaviours (RBs) can interfere with a child's ability to learn new skills and engage in daily living activities. Parents report that RBs interfere with family functioning and are among the most stressful behaviours to manage. Parents rarely receive specific advice about their child's RBs.
Objectives:
This pilot randomised controlled trial (RCT) aimed to evaluate feasibility, acceptability and impact of a new 8-week group-based parent intervention which was developed in collaboration with parents of young children with ASD.
Methods:
45 families of children with ASD (3 to 7years) were randomised to immediate or delayed intervention. The outcome measures include blinded expert clinician rated Clinical Global Impressions–Improvement (CGI-I) of child's overall improvement in functioning; level of change in 'target' RRB (independently rated); and parent questionnaires measuring child RRBs & parents' self-efficacy. Measures were taken at baseline, FU1 after 10 weeks, FU2 two months later, and FU3 two months later.
Results:
Parents who attended the group reported that they found the course helpful, and that that it increased their knowledge and confidence in managing RBs; e.g. "I feel more relaxed with dealing with RBs", "I am more confident, have a bank of strategies I can use".
We found significant differences between groups in the primary outcome measure namely improvement in the child's overall global functioning (CGI-I) $t(36.76) = -2.602$, $p = .013$, and in parents' knowledge & confidence (self-efficacy), FU1 $[t (43) = 2.79, p = .008]$; FU2 $[t (42.24) = 2.83, p = .007]$ and FU3 $[t (43) = 4.90, p<.001]$; with the intervention increasing parent self-efficacy by 0.74 (95% CI: 0.34, 1.14). Parents were also asked to choose two target RBs to focus on during the group. Results estimate using fitting trends models that the impact of the intervention was -0.58 (95% CI: -1.24, 0.07), an increase in improvement in the immediate group of over 0.5. The RB particularly sensitive to change was 'Restricted Fixated Interests'; those in the immediate group who chose this RB as their target had significantly greater improvement than those with this behaviour in the delayed group at FU2 ($p = .01$) and FU3 ($p = .002$). Similarly a significant impact of intervention was found for RBQ2 factor 3 'preoccupation with restricted patterns of interest' (FU1, $p= .04$, $\eta p2= .09$; FU2, $p= .02$, $\eta p2= .12$; i.e., moderate to large effect sizes), and for factor 4 'unusual sensory interest' ($p= .04$, $\eta p2= .10$).
Conclusions:
The results of this pilot RCT suggest that a parent group intervention for managing RBs in young children with ASD has potential for beneficial impact. Parents were willing to be recruited and randomised, the format and content of the groups were feasible and acceptable and the outcome measures were appropriate. There is some evidence of greater treatment effect in particular types of RB, suggesting that certain RBs may be more amenable to change than others. A fully powered multi-site trial is now required to establish the efficacy of this intervention.

2:21 **176.004** Design and Outcomes of a Large-Scale Randomized Trial of Parent Training for Children with ASD and Disruptive Behavior

K. Bearss, *Pediatrics, Emory University School of Medicine, Atlanta, GA*

Background: Following the development of the parent training manual and confirmation of feasibility, we launched a multi-site randomized clinical trial in 180 children with ASD and disruptive behavior. Objectives: This presentation reports on the study design and primary results of the multi-site trial. Methods: Subjects (age 3 to 7 years) were randomly assigned to PT (n=89) or to 12 PEP sessions (n=91) for six months. As an active comparator, PEP controlled for time and attention. It provided useful information for parents of young children with ASD, but it did not include any information on behavioral strategies. The primary outcomes included the parent-rated Aberrant Behavior Checklist–Irritability subscale (ABC-I) and the Home Situation Questionnaire (HSQ), as well as the Improvement item of the Clinical Global Impression scale rated by a clinician blind to treatment assignment. The sample size of 180 was necessary to detect a small to medium treatment effect of PT over PEP. Results: Random regression analyses showed that PT was superior to PEP on reducing ABC-I and HSQ scores (effect sizes 0.7 and 0.5; $p < 0.001$ for both outcomes). Sixty eight percent (61/89) of subjects in PT were rated *much improved* or *very much improved* on the CGI-I compared to 40% (36/91) in PEP (chi square = 14.02; $p < 0.001$). Overall attrition was 10% with no difference between groups. Attendance and fidelity were similar to results in our previous pilot studies.
Conclusions: These results strongly support the efficacy of PT as a stand-alone treatment in young children with ASD and disruptive behavior. Future analysis will examine adaptive behavior outcomes and moderators of treatment.

**Oral Session
177 - Implementation of Evidence-Based Practices in Routine Care
Settings: Feasibility, Acceptablity, and Provider Fidelity**
2:40 PM - 3:30 PM - Grand Ballroom B

Session Chair: Linda Watson, *Division of Speech and Hearing Sciences, University of North Carolina, Chapel Hill, NC*

2:40 **177.001** A Pilot Study of an Innovative Service Delivery Model for Training Intervention Providers: Combining Web-Based Learning, Live Instruction and Remote Consultation

A. L. Wainer[1], *B. Ingersoll*[2] *and K. Pickard*[3], *(1)Michigan State University/JFK Partners, Colorado School of Medicine, Denver, CO, (2)Psychology, Michigan State University, East Lansing, MI, (3)Michigan State University, East Lansing, MI*

Background: Individuals with ASD often require intensive and specialized intervention. Despite this need, significant barriers often impede access to evidence-based ASD services in community settings. Given the significant service-need discrepancy experienced by this population, efforts must be made to improve strategies for training community-based service providers in effective ASD intervention. Frequently, community-based service providers gain access to new intervention techniques via written manuals and/or attendance at in-person training workshops. However, there is limited evidence to support the effectiveness of manuals in increasing providers' ability to implement intervention techniques, and intensive training workshops can be both prohibitively costly and time intensive. Thus, it is critical to identify alternative training formats that can better support the dissemination and implementation of evidence-based ASD interventions to community settings. One promising area of research has explored the use of web-based programs to supplement, or even replace, traditional in person provider training models. However, the feasibility and acceptability of such training models in community settings is still largely unknown.
Objectives: An innovative and systematic training protocol was developed to introduce community-based service providers to an evidence-based, social communication intervention, Project ImPACT. The primary goal of the current study was to assess the degree to which community-based service providers found this training protocol to be feasible, acceptable and effective for helping them to implement the Project ImPACT intervention techniques. A second goal of the current study was to determine the effectiveness of the components of the protocol for training providers to effectively implement the intervention techniques.
Methods: Thirty one community-based service providers participated in the current study. Participants engaged in the training protocol, which included: 1) a self-directed web-based tutorial; 2) a one-day interactive workshop; 3) up to three remote skype coaching/supervision sessions. Providers were asked to complete a series of questionnaires and videotaped provider-child interactions at 4 different time points: 1) before completing any training (Time 1); 2) after completing the web-based tutorial (Time 2); 3) after completing the in-person interactive workshop (Time 3); and 4) at six-month follow-up (Time 4). Provider perceptions of the intervention and training protocol, as well as provider fidelity of implementation, were evaluated at each time point.
Results: Results indicate that service providers found this training protocol to be feasible, acceptable and effective for increasing their ability to implement strategies from Project ImPACT. Providers also

improved in their fidelity of the Project ImPACT intervention techniques as they progressed through the training protocol.

Conclusions: This study provides initial evidence for the acceptability and effectiveness of an innovative protocol utilizing internet-technology in conjunction with brief in-person instruction and remote supervision to train community-based service providers in evidence-based social communication intervention strategies. Results suggest that a program like this may serve to overcome barriers associated with traditional provider training models, and may ultimately increase access to evidence-based intervention services for children with ASD in community settings.

2:52 **177.002** Measuring the Impact of Training Community Mental Health Providers to Deliver a Package of Evidence-Based Strategies for ASD on Provider Behavior and Attitudes

C. Chlebowski[1,2], W. Ganger[2] and L. Brookman-Frazee[1,2], (1)Psychiatry, University of California, San Diego, San Diego, CA, (2)Child and Adolescent Services Research Center, San Diego, CA

Background: Publicly-funded community and school-based mental health (MH) programs play an important role in caring for school-age children with autism spectrum disorders (ASD). Previous research indicates that MH therapists in routine care have limited ASD training and do not deliver strategies consistent with evidence-based practices (EBP). AIM HI ("An Individualized Mental Health Intervention for ASD"), a clinical intervention and corresponding training model designed to be delivered by community MH providers with limited ASD experience, was developed to address this gap. AIM HI is a package of EBP strategies that targets challenging behaviors in children with ASD ages 5-13. The training model consists of a workshop and 6 months of consultation.

Objectives: This presentation will report preliminary data collected to evaluate the impact of EBP training for community MH providers on attitudes and practice. Data were collected as part of an ongoing large-scale community effectiveness trial of AIM HI.

Methods: Participants include the first two cohorts of MH providers recruited from 17 MH programs randomized to immediate AIM HI training/implementation (INT; n=59) or to a wait-list control/usual care condition (UC; n=23). Multiple methods and informants were used to measure provider delivery of EBP strategies in treatment including observational (based on videos of therapy sessions coded by blind coders), therapist self-report, and caregiver report. Therapists also reported on their own perceptions of their knowledge and confidence regarding serving children with ASD.

Results: Of the 59 therapists enrolled in the training condition, 100% attended the introductory workshop and 81% (n=48) were considered to have completed the training (attendance at >80% of consultations). Group differences emerged between UC providers (n=23) and INT providers who completed AIM HI training (n=48) when comparing therapist report of delivery of specific EBP strategies. INT therapists reported significantly higher use of EBP intervention strategies (t=2.7 p=.008) than UC therapists. Caregivers also reported higher therapist use of EBP strategies (t=4.1, p<.001) by INT therapists as compared to therapists delivering UC. Differences were also found in therapist report of changes in their knowledge and confidence related to serving children with ASD. Specifically, INT therapists reported significant *increases* in both their knowledge about ASD (t=-10.8, p<.001) and their confidence in (t=-8.8, p<.001) working with an ASD population from baseline to 6 months. UC therapists reported a slight increase in knowledge (t=-3.12, p=.005) but no change in their confidence from baseline to 6 months (t=-.223, p=.826) regarding their perceptions of their ability to work with ASD clients. Lastly, average ratings of EBP strategy use rated by blind observers were significantly higher for INT therapists compared to UC therapists.

Conclusions: Preliminary data indicate that therapist participation in AIM HI training results in changes in MH providers' attitudes and behavior and increased use of EBP intervention strategies based on blind observer, therapist and parent report. Research on efforts to implement evidence-based strategies in community care settings has the potential to improve care for children with ASD served in MH service settings.

3:04 **177.003** Community Mental Health Therapist Perspectives on Changes in Clinical Practice Associated with Training and Delivery of a Mental Health Intervention for ASD

M. Dyson[1], C. Chlebowski[2], N. Stadnick[2] and L. I. Brookman-Frazee[2], (1)University of California, San Diego, San Diego, CA, (2)Psychiatry, University of California, San Diego, San Diego, CA

Background: Publicly-funded community and school-based mental health (MH) programs play a pivotal role in caring for children with autism spectrum disorder (ASD). Previous research indicates that MH therapists have limited ASD training and there are gaps between evidence-based (EB) approaches for ASD and routine MH care. In response, the AIM HI ("An Individualized Mental Health Intervention for ASD"; Brookman-Frazee & Drahota, 2010) clinical intervention and corresponding training model were developed. AIM HI is a package of well-established EB strategies, developed to address challenging behaviors in children with ASD within the context of routine MH services. It was designed for delivery by MH providers with limited ASD experience.

Objectives: The purpose of the current qualitative study is to examine MH therapists' perspectives on changes in their clinical practice associated with training and delivery of the AIM HI intervention. These qualitative data are intended to expand and complement *quantitative* data demonstrating changes in therapists' clinical practice.

Methods: Qualitative data were collected as part of an ongoing large-scale, randomized

effectiveness trial of AIM HI in which MH programs were randomized to immediate AIM HI implementation or to a wait-list control/routine care observation condition. Brief, semi-structured qualitative interviews were conducted with the first cohort of therapists (n=37) from 8 MH programs after completing 6 months of AIM HI training and consultation. AIM HI training involved attendance at an introductory workshop, participation in 11 consultation meetings over 6 months and performance feedback based on review of videos with ongoing clients. Interviews lasted an average of 18 minutes. All interviews were transcribed and two-thirds of interviews (n=25) were randomly selected for in-depth qualitative analysis. The transcripts were coded for a priori and emergent themes using a coding, consensus, and comparison methodology (Wilms et al, 1990).

Results: Preliminary results indicate the following themes regarding therapist perceptions on changes in their practice**:** (1) Increased knowledge of ASD characteristics and comfort and confidence in providing treatment to children with ASD; (2) Increased use of structure in therapy sessions (e.g., use of a session schedule); (3) Increased parent involvement and collaboration in therapy sessions; (4) Increased use of behavioral strategies (e.g., conducting functional assessments of behavior); (5) Increased focus on child and parent skill-building in treatment; and (5) Application of AIM HI intervention with non-ASD clients and settings (e.g., use with ADHD clients).

Conclusions: Therapists reported a number of positive changes in their clinical practice with children with ASD and their caregivers. These qualitative findings complement quantitative findings indicating changes in therapist practice and attitudes towards serving this population associated with AIM HI training. Taken together, this study supports the positive impact of training MH therapists, who do not specialize in ASD, to deliver a package of EB strategies for children with ASD served in publicly-funded MH settings.

3:16   **177.004** Factors Associated with Intervention Uptake in Community Practice: Acceptability, Feasibility, and Implementation Climate

C. Harker[1], S. R. Edmunds[2], L. V. Ibanez[1], C. Froehlig[1], S. Nanda[1], A. Penney[1], R. Talley[1] and W. L. Stone[3], (1)University of Washington, Seattle, WA, (2)UW Mailbox 357920, University of Washington, Seattle, WA, (3)Psychology, University of Washington, Seattle, WA

Background: A research-to-practice gap exists in the use of evidence-based interventions for children with autism in community practice (e.g., Lord et al., 2005). Critical to disseminating evidence-based interventions from 'bench-to-bedside' is understanding the delivery context. Provider ratings of an intervention's *acceptability* and *feasibility* have been found to influence intervention use (Proctor et al., 2011). *Implementation climate,* or the extent to which an intervention is perceived by users as supported and rewarded in their work setting (Klein & Sorra, 1996) is also associated with intervention use (e.g., Dingfelder, 2012). By identifying factors associated with intervention uptake, we can bridge the research-to-practice gap and equip community providers with interventions that are effective *and*appropriate for the settings in which they are delivered.

Objectives: The purpose of the study was to examine factors contributing to intervention uptake among community providers. Specific objectives were to: 1) compare provider ratings of intervention acceptability, feasibility, and work setting implementation climate from post-training to 3-month follow-up; 2) compare ratings of feasibility, acceptability, and implementation climate between providers who are and are not using the intervention, and 3) examine predictors of intervention use.

Methods: Community providers from geographically and ethnically diverse communities across Washington State attended one-day workshops to learn Reciprocal Imitation Training (RIT), an evidence-based intervention for children with autism (Ingersoll, 2008). Providers (*n*=66) rated the acceptability and feasibility of RIT (URP-I, selected items; Chafouleas, 2009) and the implementation climate of their work setting (PICS, selected items; Dingfelder 2012) immediately post-training and at a 3-month follow-up. At follow-up, providers also reported whether they had used RIT with children in their caseload.

Results: Three separate repeated measures ANOVAs were conducted to examine intervention feasibility, acceptability, and climate. All three ANOVAs revealed significant main effects for time (post-training vs. 3-month follow-up), RIT use (Use vs. No-Use), and their interaction, *p*s<.02 (see Table 1). Post-hoc analyses were conducted using Bonferroni's adjustment. At post-training, the Use and No-Use groups were comparable on feasibility, acceptability, and climate ratings, *p*s=.11-.16. From post-training to 3-month follow-up, all three ratings declined significantly for the No-Use group, and acceptability ratings also declined for the Use group, *p*s<.01. At the 3-month follow-up, the Use group reported significantly higher feasibility, acceptability, and climate ratings than the No-Use group, *p*s<.01.

Logistic regression indicated that higher intent to use RIT at post-training increased the likelihood of RIT use at the 3-month follow-up, *OR=4.07*, *p*=02. A significant relation was found between provider background and use of RIT; therapists such as speech-language pathologists were more likely to use RIT than were early childhood/special educators, $X^2(2,n=62)=6.03$, p<.05.

Conclusions: Immediately following training, all community providers perceived RIT as acceptable, feasible, and supported by their workplace. While these ratings remained high for those providers who were using RIT, they decreased over the subsequent 3 months for those who were not using RIT. Intent to use RIT following the training was a significant predictor of intervention use 3 months later.

Session Chair: Sarah Spence, *Neurology, Boston Children's Hospital, Boston, MA*

1:45 **178.001** Cognitive and Biological Pathways to Anxiety in Children and Adolescents with Autism Spectrum Disorders

ABSTRACT WITHDRAWN

Background:
Children and adolescents with autism spectrum disorder (ASD) have a high prevalence of co-occurring anxiety disorders compared to their non-ASD peers (~40%). Anxiety in young people without ASD has previously been associated with changes in cognitive processing and physiological reactivity. However, there has been little research investigating different cognitive and biological pathways that may be associated with anxiety in ASD and how these pathways may relate to each other.
Objectives:
The objectives of this study were as follows; 1) to investigate whether differences in cognitive processing biases and/or differences in physiological responsiveness to psychosocial stress, measured via heart rate and salivary cortisol, are significantly related to anxiety symptoms and diagnoses, 2) to use structural equation modelling to examine the associations between cognitive and physiological processes in relation to heightened anxiety in ASD, and 3) to use receiver operating characteristic (ROC) analysis to examine how well changes in cognitive and physiological parameters predicated anxiety diagnoses.
Methods:
This study included 55 boys with ASD (two groups: 34 with a co-occurring anxiety disorder, 21 without) and 28 male controls, aged 10 – 16 years and with a full-scale IQ ≥70. Anxiety diagnoses were assessed prospectively using the Child & Adolescent Psychiatric Assessment. Participants completed a series of clinical, cognitive (attention bias/interpretation bias) and biological measures (salivary cortisol/heart rate (HR) response to social stress). After comparing the three groups on task performance structural equation modelling was used, within the ASD groups, to investigate the relationships between the cognitive and biological variables and anxiety.
Results:
Results indicated that children with ASD and co-occurring anxiety disorders display more attentional and interpretational biases and a reduced heart rate and cortisol response to social stress compared to those with ASD only and healthy controls. Our SEM model revealed that both attentional biases and physiological responsiveness are significant, but unrelated, predictors of anxiety symptoms in ASD. Finally, ROC analysis revealed that while both HR (AUC = 0.94) and cortisol (AUC = 0.89) were strong predictors of anxiety diagnosis, attentional bias was not (AUC = 0.56).
Conclusions:
Anxiety in children with ASD appears to be related to both cognitive and physiological factors via two independent pathways and may partially explain the high prevalence of anxiety. This has implications for both our understanding of the aetiology of anxiety in ASD and may also inform the development of novel treatment strategies.

1:57 **178.002** Risk Factors for Self-Injurious Behaviors in Autism Spectrum Disorders

G. N. Soke[1], C. DiGuiseppi[2], T. Fingerlin[3], C. Robinson[4], S. A. Rosenberg[5], R. F. Hamman[6] and A. M. Reynolds[1], (1)University of Colorado Denver, Aurora, CO, (2)Epidemiology/Colorado School of Public Health, University of Colorado - Denver, Aurora, CO, (3)National Jewish Health, Denver, CO, (4)Pediatrics and Psychiatry, University of Colorado School of Medicine, Aurora, CO, (5)Department of Psychiatry, University of Colorado School of Medicine, Aurroa, CO, (6)Epidemiology, Colorado School of Pubic Health, Aurora, CO

Background: Self-injurious behaviors (SIB), such as head banging, nail picking, self pinching, and self biting, are often highly repetitive and rhythmic and result in physical harm to the individual. These behaviors are common in autism spectrum disorders (ASD) and may be reported as early as 17 months of age. Early intervention may improve outcomes. Without intervention, SIB may become chronic, resulting in adverse consequences for the individual, the family and society. A more complete understanding of risk factors for SIB in ASD may increase opportunities for prevention.
Objectives: To assess potential associations between risk factors and parent-reported presence of SIB in a large, well-defined sample of children with ASD, and to explore whether identified relationships are modified by sex, IQ, or maternal education.
Methods: This cross-sectional study includes 5012 children aged 2 to 17 years recruited from 2008 to 2012 at 17 sites that are part of the Autism Treatment Network registry. All included children met DSM-IV-TR criteria and also exceeded ADOS-G cut-off scores for ASD. The outcome was parent-reported presence of SIB. Risk factors examined included sociodemographics (e.g., sex, child age, maternal education, race/ethnicity); development (IQ, adaptive behaviors skills scores, developmental regression); autism severity (from calibrated ADOS-G scores); and parent-reported associated symptoms (sensory abnormalities) and behaviors (e.g., aggression, attention problems, anxiety). For

two subsets of participants, parents were also asked for information on parental age (n=3017) and any gastrointestinal (GI) or sleep problems (n=4615), respectively. Site and study year were included in all analyses. We used multiple imputation to account for missing data (proportion of missing data: 0.9-21.3%) and multivariable logistic regression to test the association between SIB and the risk factors, and any modification of identified associations by sex, IQ, or maternal education.
Results: A total of 1683 children (33% of the total sample) had SIB based on parental report. SIB was significantly associated with having: a mother without a college degree (adjusted OR=1.41; 95% CI: 1.22, 1.64), public insurance (aOR=1.41; 1.15, 1.73), developmental regression (aOR=1.35; 1.16, 1.57), aggression (aOR=3.38; 2.92, 3.90), anxiety (aOR=1.47; 1.24, 1.74), hyperactivity (aOR=1.46; 1.24, 1.73), mood problems (aOR=1.74; 1.50, 2.04), and sensory abnormalities (aOR=1.48; 1.23, 1.77). SIB was negatively associated with adaptive behaviors skills scores (aOR=0.97; 0.96, 0.98) and child age (aOR=0.98; 0.92, 0.97). There was no effect modification of these associations by sex, IQ, or maternal education. In the first sub-analysis, SIB was not associated with maternal age (aOR=0.99; 0.97, 1.01) or paternal age (aOR=0.99; 0.97, 1.01). In the second sub-analysis, SIB was more likely to be reported in the presence of sleep problems (aOR= 1.44; 1.21, 1.71) but not GI problems (aOR=1.12; 0.95, 1.32). In both sub-analyses, the prediction model was similar to the main model for the rest of the variables.
Conclusions: Diverse demographic, developmental, somatic, and behavioral characteristics associated with presence of SIB in ASD might help identify phenotypic subtypes, with implications for understanding etiology. These findings may also assist in earlier identification of children with ASD who are at risk for SIB, potentially leading to provision of appropriate interventions and better outcomes.

2:09 **178.003** Relations Between Anxiety and Executive Function in Youth with ASD

C. E. Pugliese[1], *L. G. Anthony*[2], *C. Haake*[3], *J. L. Martucci*[4], *Y. Granader*[2] and *L. Kenworthy*[5], (1)Children's National Medical Center, Washington, DC, (2)Center for Autism Spectrum Disorders, Children's National Medical Center, Rockville, MD, (3)Department of Neuropsychology, Children's National Medical Center, Rockville, MD, (4)Children's National Medical Center, Rockville, MD, (5)Children's Research Institute, Children's National Medical Center, Washington, DC

Background:
Youth with ASD report more anxiety symptoms and have higher rates of anxiety than their typically developing (TD) peers. Anxiety in TD children has been associated with difficulties in executive function (EF) related to a failure to flexibly disengage from negative stimuli (Hollocks et al., 2014). Flexibility impairment, as measured in the laboratory tasks and parent report, is greater among youth with ASD when compared to TD youth. As such, youth with ASD may be particularly vulnerable to the development of negative processing styles associated with anxiety due to deficits in EF and shifting abilities.
Objectives:
To examine whether greater EF problems, particularly cognitive shifting, on parent-report and lab based tasks were related to greater parent-reported anxiety symptoms. An additional aim was to determine whether the EF profile was unique to children with ASD and high levels of anxiety
Methods:
192 youth (34 females) with a DSM diagnosis of ASD between the ages of 6 and 18 (M=10.39, SD=2.50) were evaluated on the Behavior Rating Scale of Executive Function (BRIEF) and Child Behavior Checklist (CBCL). A subsample were administered the Tower of London (ToL). Participants possessed average IQ (M=109.67, SD=16.94) and met CPEA criteria for 'broad ASD' on the ADI-R and/or ADOS. To examine the relationship between anxiety and EF, participants were divided into High Anxiety (n=107) and Low Anxiety (n=85) groups using a mean split on the CBCL DSM Anxiety Problems scale. T-tests examined differences in EF between groups on the BRIEF and ToL. The group was then divided using a mean split on the CBCL DSM ADHD Problems into high (n=92) and low (n=100) problem groups to confirm differentiated EF profiles between the two scales.
Results:
CBCL Anxiety Problems scores correlated significantly with BRIEF Shift (r=0.39, p< .001) and Global Executive Composite scores (GEC; r=0.35, p< .001). There were significant differences between the high and low anxiety group on age and all BRIEF scales except on inhibition scales (see Table 1). While the low anxious group was not significantly elevated on any BRIEF scales, the high anxious group demonstrated clinical elevations (e.g., T>65) on the Shift, Working Memory, Plan/Organize, and Monitor (see Figure 1). There were no significant differences between the high (n=20) and low anxiety (n=38) groups on the ToL. The most significant gap between the low/high anxiety groups was on the Shift subscale (d=0.68), while the low/high ADHD groups were the most different on the Inhibit (d=0.93) and Working Memory (d=1.48) subscale.
Conclusions:
Parent-reported anxiety was associated with behavioral manifestation of EF problems but not deficits on lab-based EF tasks. Notably, the high anxiety group had the greatest difficulty with cognitive shifting. Providing evidence that the difference between high and low anxiety groups on the BRIEF was not simply the result of parent reporting biases across measures, the profile of EF skills was different when the group was divided into high and low ADHD symptom groups. Thus, targeting EF and cognitive flexibility via intervention may reduce anxiety in youth with ASD, or vice versa.

2:21 **178.004** An International Multi-Site Investigation of the Measurement Properties of the Spence Children's Anxiety Scale – Parent Version (SCAS-P) to Report Anxiety Symptoms in Children and Adolescents with ASD

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Background: Elevated anxiety symptoms are present in many young people with ASD and 30-50% are diagnosed with at least one anxiety disorder, but reporting and identifying anxiety symptoms and difficulties in young people with ASD presents many challenges. Research in this field has been hampered by small samples of largely help-seeking participants with existing anxiety conditions, as well as limited research examining the measurement properties of existing anxiety screening tools when used to measure anxiety in individuals with ASD. Currently, no validated informant-based screening measure exists specifically developed for use with this population.
Objectives: This study aimed to (a) examine caregiver-reported rates and symptoms of anxiety in a large international multi-site sample of young people with ASD; (b) investigate the SCAS-P's reliability and validity in measuring anxiety symptoms in this population; and (c) examine the relationship between SCAS-P reported anxiety symptoms and age, gender and measures of autism symptom severity, adaptive functioning and/ or intellectual functioning.
Methods: Participants were 679 6-18 year old children and young people with ASD (591 males) whose data were pooled together from nine different research studies in Singapore (N=241), the UK (N=373) and the USA (N=65). All participants had a clinical/ professional diagnosis of autism, ASD, Asperger's Syndrome or PDD-NOS and most had at least one measure of autism symptom severity available (i.e. Autism Diagnostic Observation Schedule, Developmental Behavior Checklist-Autism Algorithm, Social Communication Questionnaire or Social Responsiveness Scale). IQ data were available for 211 participants and another 238 had available adaptive functioning scores. All but 21 participants were non-help seeking and were recruited from special schools, other community settings or from ASD diagnostic settings at the time of referral for a diagnosis of ASD, but not for anxiety difficulties.
Results: Preliminary analyses show that the internal consistency for the SCAS-P was excellent for the Total score (α =.94) and acceptable to good for all subscales (all α >.70). All item-total correlations were significant at $p<.001$ and the mean item-total correlation was of a medium effect size, while item-subscale correlations were also highly significant and of medium to large effect sizes. There was no significant association between chronological age and total anxiety symptoms and no gender differences were found. The positive association between SCAS-P Total score and autism symptom severity scores was statistically significant and of small to medium effect size. No significant relationship between SCAS-P Total scores and IQ or adaptive functioning scores was found. SCAS-P Total and subscale scores were significantly higher for the 21 participants with ASD and known anxiety difficulties when compared to the other participants recruited from community settings. There were some site/ country differences in caregiver-reported mean scores.
Conclusions: Preliminary analyses show that the SCAS-P is promising with regards to its measurement properties when used to measure caregiver-reported anxiety symptoms in young people with ASD. Our findings are discussed with a focus on advancing assessment of anxiety in ASD.

Oral Session
179 - Medical Comorbidities in ASD
2:40 PM - 3:30 PM - Grand Ballroom A

Session Chair: Sarah Spence, *Neurology, Boston Children's Hospital, Boston, MA*

2:40 **179.001** Ambulatory Care Sensitive Hospitalizations Among Children with Autism Spectrum Disorder

P. S. Carbone[1], P. Young[1], G. Stoddard[1], J. Wilkes[1] and L. Trasande[2], (1)University of Utah, Salt Lake City, UT, (2)NYU School of Medicine, New York, NY

Background: "Ambulatory care sensitive conditions" (ACSCs) are conditions for which appropriate outpatient care prevents or reduces the need for hospitalization. Children with autism spectrum disorder (ASD) may be at risk for hospitalization for ACSCs because of difficulty accessing high quality primary care.
Objectives: The purpose of this study is to describe the prevalence and health care utilization of children with ASD who are hospitalized for ACSCs and compare them with the prevalence and health care utilization for the same conditions in hospitalized children without ASD.
Methods: Using the 2009 Kids Inpatient Database, hospitalizations for an ACSC were examined within

three cohorts of children aged 3-20 years: children with ASD, children with chronic conditions without ASD (CC), and children with no chronic conditions (no-CC). In order to compare the prevalence of each ACSC for the three cohorts we separately analyzed discharges with a primary diagnosis ICD-9-CM code that corresponded to each of ACSCs listed in the table. In order to compare inpatient health care utilization for the three cohorts we analyzed total charges (TC) and length of stay (LOS), for each ACSC.

Results: Within the 24,174 in the ASD cohort, we found that the proportion of hospitalizations for an ACSC was 55.9%, compared with 28.2% in the CC cohort and 22.9% in the no-CC cohort (p<0.001). The most prevalent ACSCs among children with ASD were mental health conditions (e.g. anxiety, depression, mood disorder) (23.5%) and epilepsy (14.7%). Children with ASD were more likely to be hospitalized for a mental health condition, epilepsy, constipation, dehydration, underweight and a dental condition compared with the other cohorts (Table). After adjusting for covariates (age, gender, race, median household income, primary payor, hospital variables [size, location region, teaching status, type] and point of origin of admission), we found that children with ASD were nearly ten times more likely to be hospitalized for a mental health condition (OR: 9.72; 95% CI: 8.39-11.26; p <0.001), nearly seven times more likely to be hospitalized for epilepsy (OR: 6.58; 95% CI: 5.95-7.29; p <0.001) and more likely to be hospitalized for constipation, pneumonia, dehydration, vaccine preventable diseases, underweight and nutritional deficiencies, compared with the no-CC cohort. Adjusting for the same covariates we found that children with ASD were twice as likely to be hospitalized for mental health conditions (OR: 2.19; 95% CI: 1.99-2.41; p <0.001), five times more likely to be hospitalized for epilepsy (OR: 4.99; 95% CI: 4.60-5.41; p <0.001), and were significantly more likely to be hospitalized for constipation, dehydration, and underweight compared with the CC cohort.   The ASD cohort had higher TC and longer LOS for mental health conditions compared with the other two cohorts.

Conclusions: Outpatient efforts to prevent hospitalizations in children with ASD should focus on mental health care needs and seizure management. Other strategies should include actively managing constipation and dehydration, monitoring nutritional status, and immunizing against vaccine preventable conditions. Understanding the reasons for the higher healthcare utilization among children with ASD hospitalized for mental health conditions should be the subject of further research.

2:52 **179.002** Pattern of Autism Spectrum Disorder and Co-Occurring Symptoms in Adopted Children

J. Ezell[1], A. M. Shui[2], K. B. Sanders[3] and J. Veenstra-Vander Weele[4], (1)Psychiatry, Vanderbilt University Medical Center, Nashville, TN, (2)Biostatistics Center, Massachussetts General Hospital, Boston, MA, (3)Psychiatry, Vanderbilt University, Nashville, TN, (4)Psychiatry, Columbia University / New York State Psychiatric Institute, New York, NY

Background: Adoptees have a higher risk for neurodevelopmental and behavioral problems; however there is little research on adopted children with Autism Spectrum Disorder (ASD). In the English Romanian Adoption study (Rutter et al., 2007), nearly 7% of adoptees presented with an array of autistic symptoms classified as "quasi-autism," but this was a largely institutionalized sample that likely is not typical for the general adopted population. Looking more broadly, adoptees have an increased risk for externalizing behaviors, internalizing behaviors, and sleep problems (Juffer et al 2011).

Objectives: To determine whether adopted children with ASD differ from the general ASD population in terms of diagnosis, internalizing and externalizing behavior, sleep problems, and medications.

Methods: We studied 163 adoptees in the Autism Speaks Autism Treatment Network (AS-ATN) in comparison to 5,624 non-adopted AS-ATN participants (age 1.5-17.6 years, M= 6.2 years, SD=3.4). Sex, age, race, ethnicity, IQ, and categorical DSM-IV ASD diagnosis were tested for differences by group (Adopted versus Non-Adopted), using independent samples t-tests for continuous variables and Fisher's exact tests for categorical variables. Logistic regression models were used to examine the association between adoption status and several outcome variables, including co-occurring psychiatric diagnosis, Child Behavior Checklist (CBCL) internalizing and externalizing behavior problems, sleep problems, and medications after controlling for covariates.

Results: The adopted population had a significantly higher percentage of females (27.6%) in comparison to the controls (15.9%). Adopted children were enrolled in the AS-ATN at a significantly older age (M=7.9, SD=3.8 versus M=6.2, SD=3.4; P < 0.001). After controlling for demographics, adoptees received a diagnosis of PDD-NOS significantly more frequently than controls (p<0.001, OR=1.8, 1.3-2.5) and were diagnosed at a significantly later age (p<0.001). No single DSM-IV symptom domain was significantly different between the two populations, nor were ADOS-2 scores significantly different. The adopted population showed greater propensity for externalizing behaviors (p<0.001), internalizing behaviors (p=0.001), and sleep problems (p<0.001). Further, adoptees showed higher rates of CBCL attention problems (p<0.0001), CBCL attention deficit-hyperactivity problems (p<0.001), CBCL anxious/depressed symptoms (p<0.001), and CBCL anxiety problems (p=0.001). Adoptees were also prescribed psychotropic medications (p<0.001) more often than the non-adoptees, including ADHD (p<0.001) and sleep medications (p<0.001).

Conclusions: These results suggest that the population of adopted children with ASD differs from the general ASD population both with regard to diagnostic timing and severity and also with regard to co-occurring behavioral problems. Future research should evaluate the contributions of specific factors associated with adoption such as biological family history, pregnancy history, early childhood

experience, and age at adoption

3:04 **179.003** Predictors of Epilepsy in Children with ASD from a Large National US Sample

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Background: The relationship between ASD and epilepsy is complex but has the potential to yield important mechanistic and therapeutic insights into both disorders. Nevertheless, there is considerable disagreement among epidemiological data that suggest which features of ASD predict the occurrence of epilepsy.
Objectives: To identify predictors of epilepsy in ASD from a large US autism registry.
Methods: The Interactive Autism Network (IAN) is a questionnaire-based autism registry that contains parent-provided clinical data on over 16,000 unique children with ASD. Data from IAN included diagnosis of epilepsy ("Has your child ever had a seizure or been diagnosed with epilepsy?"), intellectual disability (ID) (past diagnosis of ID or currently non-verbal), anomalous motor development/cerebral palsy, sex, autism severity (Social Responsiveness Scale [SRS] total score), history of regression and maternal history of epilepsy. Number of subjects (n) varied by analysis depending on completeness of data. Linear regression was used to characterize the relationship between ASD severity and the diagnosis of epilepsy; generalized linear models were used to characterize the other relationships between potential predictors and the odds of epilepsy diagnosis.
Results: Predictors of epilepsy in children with ASD included ID (odds ratio = 3.3, $n = 8557$; $t = 12.2$; $p < 0.0001$), anomalous motor development (OR = 2.5, $n = 8458$; $t = 11.5$; $p < 0.0001$) and maternal epilepsy (OR = 2.5; $n = 7688$; $t = 3.9$, $p < 0.0001$). The presence of epilepsy increased with? SRS total score of severity by 5.5 points, on average ($n = 4803$). Female sex was associated with an increase in odds of being diagnosed with epilepsy (OR = 1.44; $n = 8557$; $t = 3.5$; $p = 0.004$), but this relationship disappeared when SRS score was controlled for. Contrary to prior findings (Viscidi *et al, PLoS ONE* 2014), controlling for ID did not obliterate the relationship between sex and the presence of epilepsy. A history of regression did not increase the incidence of epilepsy diagnosis.
Conclusions: Consistent with other large studies of ASD, the IAN data suggest a link between ID and increased risk for epilepsy. Contrary to other studies (Viscidi *et al*), intelligence did not mediate other relationships of patient characteristics to epilepsy, perhaps because intelligence in our sample was ascertained by parental report rather than measured IQ used in other studies. Autism severity, anomalous motor development and maternal history of epilepsy were all independent predictors of increased epilepsy risk. The increased risk associated with female sex disappeared once ASD severity (but not presence of ID) was controlled for.

3:16 **179.004** The Behavioural Pediatrics Feeding Assessment Scale in Young Children with Autism Spectrum Disorder: Psychometrics and Associations with Child and Parent Variables

***S. L. Allen**[1], I. M. Smith[2], E. K. Duku[3], T. Vaillancourt[4], P. Szatmari[5], S. E. Bryson[6], E. J. Fombonne[7], J. Volden[8], C. Waddell[9], L. Zwaigenbaum[10], W. Roberts[11], P. Mirenda[12], T. A. Bennett[13], M. Elsabbagh[14] and S. Georgiades[15], (1)Clinical Psychology, Dalhousie University, Halifax, NS, Canada, (2)Dalhousie University / IWK Health Centre, Halifax, NS, Canada, (3)Offord Centre for Child Studies & McMaster University, Hamilton, ON, Canada, (4)University of Ottawa, Ottawa, ON, Canada, (5)University of Toronto, Toronto, ON, Canada, (6)Autism Research Centre, Dalhousie/IWK Health Centre, Halifax, NS, Canada, (7)Oregon Health & Science University, Portland, OR, (8)Communication Sciences and Disorders, University of Alberta, Edmonton, AB, Canada, (9)Faculty of Health Sciences, Simon Fraser University, Vancouver, BC, Canada, (10)University of Alberta, Edmonton, AB, Canada, (11)Pediatrics, University of Toronto, Toronto, ON, Canada, (12)University of British Columbia, Vancouver, BC, Canada, (13)Psychiatry and Behavioural Neurosciences, Offord Centre for Child Studies, McMaster University, Hamilton, ON, Canada, (14)Department of Psychiatry, McGill University, Montreal, QC, Canada, (15)McMaster University, Hamilton, ON, Canada*

Background: Feeding problems negatively affect the health and wellbeing of children with ASD and their caregivers (Sharp et al., 2013), and reportedly occur at very high rates in this population (e.g., 46-89%; Ledford & Gast, 2006). Addressing feeding problems in children with ASD should therefore be a priority; however, research and clinical work have been limited by the lack of adequate standardized measures for quantifying feeding problems in children with ASD.
Objectives: The purpose of this study was to examine the utility of a widely used measure of feeding problems, the Behavioural Pediatric Feeding Assessment Scale (BPFAS; Crist & Napier-Phillips, 2001), when applied to a large, well-characterized sample of preschoolers with ASD. Our primary goal was to identify an appropriate factor structure. A secondary goal was to evaluate the convergent and divergent validity of the BPFAS by examining correlations between feeding problems and child and parent variables of interest including indices of cognitive functioning, adaptive functioning, autism symptoms and severity, behaviour problems, sleep problems, and parenting stress.

Methods: Participants were 374 preschoolers with ASD (314 boys; mean age = 40.89 months) and their families. Participants were recruited within 4 months of a diagnosis of ASD, through five publicly funded regional pediatric health care facilities. We began by conducting a confirmatory factor analysis (CFA) of the original BPFAS five-factor model (Crist & Napier-Phillips, 2001), each of the five proposed latent variables, and a rival one-factor model. None of the models was adequate; thus we conducted a categorical exploratory factor analysis (CEFA) to determine an alternative factor structure. Finally, we used Spearman's rank order correlations to examine the validity of the BPFAS.

Results: The CEFA identified an acceptable three-factor model (root mean square error of approximation = 0.06), accounting for 43.13% of the cumulative variance (see Table 1 for factor loadings). We labeled Factor 1 as Food Acceptance (Cronbach's α = .71), Factor 2 as Medical/Oral Motor (Cronbach's α = .71), and Factor 3 as Mealtime Behaviour (Cronbach's α = .81). Correlational analyses (see Table 2) indicated that feeding problems were positively related to parent-reported autism symptoms, behaviour problems, sleep problems, and parenting stress, but largely unrelated to language and cognitive abilities, or autism severity as indexed by the ADOS severity metric.

Conclusions: These results provide preliminary support for the BPFAS as a measure of feeding problems in preschoolers with ASD. Further research is needed to establish the measurement invariance of the BPFAS across different samples of children with ASD (e.g., children with clinically significant feeding problems, differing age groups, etc.) and across time. In turn, the BPFAS may prove useful as a screening tool for feeding problems in children with ASD, quantifying treatment progress, and advancing research that seeks to identify treatment targets and variables that contribute to the development and maintenance of feeding problems in children with ASD.

Oral Session
180 - Language Interventions in Young Children with ASD: Effectiveness and Impact
1:45 PM - 2:35 PM - Grand Ballroom C

Session Chair: Ann Mastergeorge, *Family Studies and Human Development, University of Arizona, Tucson, AZ*

1:45 **180.001** Does Intelligibility Change As a Function of Increased Spontaneous Communicative Utterances

M. Mladenovic[1], A. C. Holbrook[2] and C. Kasari[3], (1)Semel Institute, University of California, Los Angeles, Los Angeles, CA, (2)Graduate School of Education and Information Studies, University of California, Los Angeles, Los Angeles, CA, (3)UCLA Center for Autism Research & Treatment, Westwood, CA

Does Intelligibility Change as a Function of Increased Spontaneous Communicative Utterances

Background:
Approximately 30% of children with autism qualify as minimally verbal as they transition to school at age 5 (Tager-Flusberg & Kasari, 2013). Many of the children from this population receive years of early intervention focused on increasing discrete language skills and overall speech intelligibility. Recently, an intervention focused on social communication has shown to increase spontaneous communicative utterances in minimally verbal children (Kasari et al., 2014). We have yet to examine how vocalizations, unintelligible and scripted language of minimally verbal children may change in the context of this intervention.

Objectives:
(1) To study the extent to which the total number of vocalizations and unintelligible utterances (TVUU) change over the course of an intervention targeting social attention, play and spoken language.
(2) To compare change in scripted language to change in total spontaneous communicative utterances (TSCU) and TVUU.

Methods:
Participants included twenty minimally verbal children with ASD from an intervention study, using a combination of two existing interventions- Joint Attention, Symbolic Play, Engagement and Regulation (JASPER) (Kasari et al, 2006) and Enhanced Milieu Teaching (EMT) (Kaiser, 1993). All children used fewer than twenty spontaneous, functional words and had received at least two years of prior intervention. Participants were randomized to Speech (spoken language only) or AAC (spoken language plus augmentative/alternative communication device) versions of the intervention. Data were selected from a naturalistic language sample at entry and exit time-points of the study, approximately six months apart. This assessment was transcribed and coded for TSCU, TVUU, and scripted utterances.

Results:
A one-way ANOVA was used to analyze change in TVUU over the course of intervention and between treatment groups. The results indicate that there is a significant difference in the mean change of TVUU between the two groups ($f = 13.73$, $p = .001$), with substantial improvement in the AAC treatment group. In addition, the Pearson Correlation revealed a statistically significant relationship

between the change in TSCU and change in TVUU over the course of intervention ($r = 0.478$, $p < 0.05$). There was not a significant correlation between the change in scripted language and change in TSCU ($r = 0.263$, $p > 0.05$) or between the change in TVUU ($r = 0.163$, $p > 0.05$).

Conclusions:
While increased spontaneous communicative utterances were found as a result of a social communication intervention (as noted in these site specific findings and the larger multi-site study; Kasari et al., 2014), scripted language did not significantly decrease as a result of social communication intervention. These findings denote that overall increases in communication are not related to a reduction in scripted language. Future studies may want to further investigate the function of unintelligible utterances and vocalizations for children who are minimally verbal, and similarly establish the long-term effects on a child's academic and social outcomes.

1:57   **180.002** Assessment of Early Social Communication and Play Skills in Toddlers with Autism By Community Teaching Professionals: The Short Play and Communication Evaluation

S. Y. Shire[1] *and C. Kasari*[2], *(1)University of California Los Angeles, Los Angeles, CA, (2)UCLA Center for Autism Research & Treatment, Westwood, CA*

Background: Children with autism experience delays in the development of nonverbal social communication gestures to request and to share (joint attention) as well as play skills such that intervention is required. Therefore, community stakeholders require valid and reliable tools to assess students' skill level in order to set appropriate intervention targets. The Short Play and Communication Evaluation (SPACE) is a brief measure delivered by community professionals to capture the presence of children's play and social communication skills in order to set communication goals for intervention.
Objectives: First, to examine the degree to which teachers and paraprofessionals can accurately administer the SPACE with toddlers with autism. Second, to examine agreement between the SPACE and established research protocols when identifying children's target joint attention, requesting, and play skills.
Methods:
Participants. Sixty-five toddlers with autism who were enrolled in a larger intervention study were included. Children were developmentally and ethnically diverse with expressive language age-equivalent scores on the Mullen Scales of Early Learning ranging from 2-33 months (*mean*= 16 months) and all families reporting a non-Caucasian ethnicity. Children attended a public early intervention center-based program in two underserved and under-resourced communities of a major metropolitan center. Two classroom teachers and four paraprofessionals were trained to administer the SPACE.
Measures. Three assessments were administered including two well-established protocols: the Early Social Communication Scale (ESCS: Mundy et al., 2003) and Structured Play Assessment (SPA: Ungerer & Sigman, 1981) delivered by trained clinicians. Teaching professionals administered the SPACE, a brief tool combining elements of the ESCS and SPA. Teachers administered the SPACE one-on-one using a standard set of toys and a structured protocol.
 Outcomes. Children's spontaneous initiations of joint attention (including coordinated joint looks, points, shows, and gives), requesting (give and point), and four levels of play skills (simple, combination, pre-symbolic, and symbolic) were examined.
Results: Teaching professionals in under-served communities learned to deliver the SPACE with high fidelity (*mean*= 90.34%). Chi squared test of proportions indicated agreement was not significantly different from expected proportions of 80% agreement and 20 % disagreement between: (a) SPACE and ESCS- joint attention skill target ($p=0.29$), (b) SPACE and ESCS- requesting skill target ($p=0.65$), and (c) SPACE and SPA- play skill target ($p=0.50$). Therefore, the joint attention, requesting, and play targets selected based on students' performance on the brief teacher-administered SPACE, were the same as those selected from the research protocols approximately 80% of the time.
Conclusions: Findings indicate that teachers and paraprofessionals in under-resourced settings can deliver the SPACE with high fidelity with a developmentally diverse group of toddlers with autism. This study extends prior SPACE findings with preschool-age children with autism and indicates that toddlers' early social communication and play skills are also accurately captured using the SPACE. The brief teacher-implemented SPACE led to the same profile of mastered and target skills found using the long research protocols delivered by highly trained clinicians indicating that this short protocol delivered by community stakeholders in real-world settings provides an accurate characterization of children's early social communication and play skills.

2:09   **180.003** Exploring the Impact of Language Facilitation Strategies on Verbal Language in Two Year-Old, Minimally Verbal Children with ASD

C. R. Chiarelli[1], *A. B. Barber*[2] *and R. W. Saffo*[3], *(1)The University of Alabama, Marlton, NJ, (2)Communicative Disorders, University of Alabama, Tuscaloosa, AL, (3)Communicative Disorders, The University of Alabama, Tuscaloosa, AL*

Background:
Approximately 25 percent of individuals with an ASD are considered nonverbal (Autism Speaks, 2014). Limited research focuses on minimally verbal children with ASD for multiple reasons: the

exclusion of children with limited verbal abilities in intervention studies, the highly variable nature of this population with no single set of defining characteristics, and the difficulty finding assessments to identify appropriate level of functioning (Tager-Flusberg & Kasari, 2013). However, Kasari et al., (2014) recently demonstrated that effective interventions could improve the quality and quantity of verbal language in school-age, minimally verbal children. This research study focused on the impacts of language-based strategies often provided by speech language pathologists (SLPs) on the spoken language of children with ASD. SLPs are often the first line of referral for children later diagnosed with ASD due to early communication concerns. However, most of these therapists, especially those working through state-funded early intervention programs, have limited access to autism-specific intervention models (Stahmer et al., 2005). As a result, general language facilitation strategies are often implemented. To our knowledge, no study has measured the effects of these commonly used strategies on the verbal language in minimally verbal children with ASD.
Objectives:
The purpose of this study was to measure the effects of focused stimulation, vertical structuring, and expansions on verbal language in minimally verbal children with ASD.
Methods:
Three children were recruited from a university-based Autism Clinic if they met the following inclusion criteria: (1) clinical diagnosis of ASD (2) under 36 months of age (3) range of 5-21 words; and (4) no prior direct language intervention. Using a multiple baseline AB design across participants, the intervention techniques of focused stimulation, vertical structuring, and expansions were implemented in a play-based setting. Each intervention session targeted functional words chosen by a Child Interest Survey and family goals. The sessions lasted 20 minutes, twice a week for 8 weeks. The MacArthur Bates Communicative Development Inventories (MCDI; Fenson et al., 2007) was administered pre- and post- intervention in order to assess receptive and expressive vocabulary. Words produced by the child and the strategy demonstrated by the investigator were coded from video recordings of each intervention session.
Results:
Intervention has concluded for all participants and data coding is underway. Coding and data analysis are complete for one child thus far and indicated that the total number of different words produced increased and remained above baseline. Expansion was associated with the most words produced followed by vertical structuring then focused stimulation. MCDI post-testing yielded the following findings. Participant one, 32 months on intervention onset, produced 48 more words and understood 76 more words following intervention. Participant two, 27 months, produced 105 more words and understood 149 more words following the intervention. Participant three, 34 months, produced 147 more words and understood 91 more words following intervention. While this design does not allow causative interpretations, the language gains indicated on the MCDI are striking.
Conclusions:
These results contribute to the growing literature regarding effective interventions for minimally verbal children with autism.

2:21 **180.004** Spoken Communication Outcomes for Young Children with Autism: A Meta-Analysis and Meta-Regression

L. H. Hampton[1], A. P. Kaiser[2] and E. Fuller[2], (1)Vanderbilt University, Nashville, TN, (2)Special Education, Vanderbilt University, Nashville, TN

Background: At least 30% of children with autism spectrum disorders (ASD) are persistently minimally verbal even after intensive early intervention for speech and language (Anderson et al., 2007; Tager-Flusberg & Kasari, 2013). Although, some meta-analyses have found positive effects of behavioral interventions on expressive communication (Reinchow & Wolery, 2008; Virués-Ortega, 2010), it is important to understand the extent to which interventions can meaningfully reduce the incidence of minimally verbal status in the ASD population. Additionally, precursors to spoken communication have been identified as receptive language ability (Weismer, Lord, & Esler, 2010), verbal imitation skills (Paul, Campbell, Gilbert, & Tsiouri, 2013; Toth, Munson, Melzoff, & Dawson, 2006), and joint attention (Toth, Munson, Melzoff, & Dawson, 2006). Yet, it is unclear how these predictors interact with different treatment types, doses, and delivery methods.
Objectives: The following questions are addressed in this study: (a) are communication interventions effective for improving spoken language in children with ASD as compared to usual conditions? (b) Are augmented communication interventions effective for improving spoken language in children with ASD as compared to spoken-only interventions? (c) How does effectiveness vary by age, study quality, and type of intervention, and (d) how does effectiveness vary by receptive language, imitation skills, or joint attention?
Methods: Comprehensive searches were conducted using 11 electronic databases through 2014. A total of 1,624 references were reviewed after duplicates were removed. Studies that met the following criteria were included: (a) included a set of participants who were children, younger than 9, with ASD who speak English, (b) a comparison group of either a business as usual treatment or an additional treatment, (c) any behavioral intervention that did not include a pharmacology component, (d) an outcome including a pre-post measure of spoken language, (e) inclusion of a group design component, and (f) were published in English. Any setting for the intervention was included.
Results: Approximately 25 studies are included in the final analysis (final coding is on-going). A meta-analysis of the studies will be completed using a standardized mean difference effect size estimate to

summarize the effects across studies. A standardized estimate will be used because of the heterogeneous measures that will be included. A mean difference score will be used to estimate the effects between groups. A Hedge's g will be used because of the small sample sizes that occur in some of the included studies. A meta-regression will be used to determine the predictors of outcomes as outlined in question (d) above.

Conclusions: The discussion of the results of this meta-analysis will include recommendations for practice and future research regarding the spoken language intervention strategies and areas of need in the field for children with ASD. Although early intervention has made great progress for children with ASD, this study aims to specify the areas of need to better improve the spoken language outcomes for all children this population and to better inform customized intervention decisions for individual children.

Oral Session
181 - Language and Learning Abilities in School-Age Children and Adolescents with ASD
2:40 PM - 3:30 PM - Grand Ballroom C

Session Chair: Ann Mastergeorge, *Family Studies and Human Development, University of Arizona, Tucson, AZ*

2:40 **181.001** Beyond Sentences: Using the Expression, Reception and Recall Instrument (ERRNI) in School-Aged Children with Autism Spectrum Disorder (ASD)

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Background: For school-aged children, most standardized language tests do not extend beyond evaluating the individual word or sentence level. Such measures underestimate the extent of language difficulties that arise when a person is required to generate utterances that hang together coherently to describe an event. Thus, narratives have emerged as a tool to examine language beyond the sentence level. Research on narratives and ASD has focused on detailed analysis of narrative productions in small samples, across wide age ranges, of high-functioning children, adolescents, and adults. Sampling across widely discrepant ages likely masks important language characteristics because different developmental levels of skill are averaged. Plus, the labor-intensive nature of detailed narrative analysis precludes widespread use both in research with large samples and in many clinical settings. In order to characterize the language skills of school-aged speakers with ASD, a standardized test of narratives may be useful. The Expression, Reception and Recall of Narratives Instrument (ERRNI) is one possibility. It assesses narrative production and comprehension, providing standard scores (SS) on the amount of relevant story content or "gist" (Ideas) and, understanding of a story (Comprehension).

Objectives: Objectives were to examine the language of a large cohort of 8- and 9-year-old children with ASD using the ERRNI. We aimed to determine (1) if performance on the ERRNI was different from performance on other standardized language measures, and (2) the ERRNI's relationship to other indices of cognitive and communicative functioning.

Methods: Participants (n=74, 63 males) were selected from *Pathways in ASD*, a multisite Canadian longitudinal study which has followed an inception cohort of rigorously diagnosed children with ASD from time of diagnosis. At a mean CA of 8.6 years, participants were administered a battery of standardized tests, including the Wechsler Intelligence Scale for Children, 4th ed. (WISC-4), Clinical Evaluation of Language Fundamentals-4 (CELF-4), the Children's Communication Checklist – Version 2 (CCC-2), Vineland Adaptive Behavior Scales, 2nd ed (VABS II) and the ERRNI. The Semantic-Pragmatic Profile (SPP; Yitzhak, et al., 2011) was generated from ADOS data collected at the age 6 assessment.

Results: Average performance on ERRNI *Ideas* (SS=78.7) was significantly lower than average performance on the CELF-4 Core Language Composite (CLC) (SS=89.5) ($t(73)=-5.64$, p <.01). ERRNI *Comprehension* SS was comparable to CELF-4 CLC SS. ERRNI *Ideas* and *Comprehension* standard scores were significantly correlated with the WISC Perceptual Reasoning Index (*Ideas* r=.237, p =.042; *Comprehension* r=.407, p <.01), CELF-4 CLC SS (*Ideas* r=.422, p<.01; *Comprehension* r=.567, p<.01), VABS Communication Domain SS (*Ideas* r=.237, p<.05, *Comprehension* r=.334, p<.041) and negatively correlated with SPP raw scores (*Ideas* r=-.317, p=.003, *Comprehension* r=-.207, p=.039). *Ideas* SS was also negatively correlated with CCC-2 Social Interaction Deviance Composite (*Ideas* r=-.216, p=.03), and *Comprehension* SS was correlated with CCC-2 Global Communication Composite

(r=.261, p=.012).

Conclusions: These findings suggest that the ERRNI Ideas index measures skills other than those captured on traditional standardized tests of language structure and content. In addition, ERRNI scores were positively related to adaptive communication and negatively related to scores on the SPP, where higher scores indicate more impairment.

2:52   **181.002** Language and Learning Abilities in 'Unaffected' School-Aged Siblings of Children with ASD

E. E. Drumm[1], S. E. Bryson[2], L. Zwaigenbaum[3] and J. A. Brian[4], (1)University of Toronto, Toronto, ON, Canada, (2)Autism Research Centre, Dalhousie/IWK Health Centre, Halifax, NS, Canada, (3)University of Alberta, Edmonton, AB, Canada, (4)Bloorview Research Institute/ Paediatrics, Holland Bloorview Kids Rehab/ University of Toronto, Toronto, ON, Canada

Background:

Researchers often use the term 'unaffected' to describe siblings of children with ASD who do not have ASD outcomes; however, emerging evidence suggests that the developmental trajectories of many of these siblings are atypical. They are at greater risk of delayed language acquisition and communication impairments during the preschool years, but less is known about their language abilities later in childhood. It is crucial to extend studies beyond early childhood to determine whether early language delays persist or resolve, as well as to examine later-developing skills such as pragmatics, phonological processing, and reading. As children grow and experience increasing psychosocial demands, these advanced language abilities become critical to academic and occupational success and social well-being.

Objectives:

To examine whether 'unaffected' school-aged siblings of children with ASD are at an increased risk for learning and language challenges: Do they fall below normative expectations on measures of phonological processing, reading, and pragmatic language?

Methods:

Eighteen participants (ages 8-11) with an older sibling with ASD were recruited from an ongoing longitudinal study. A standard battery of cognitive, structural language and social-communication measures was completed and the non-ASD status of all participants was determined by an expert clinician. The following primary outcome measures were completed: Comprehensive Test of Phonological Processing (CTOPP-2), Test of Word Reading Efficiency (TOWRE-2), Test of Pragmatic Language (TOPL-2), and Children's Communication Checklist (CCC-2). A series of one-sample t-tests were conducted to evaluate whether siblings' performance differed from the normative samples of these measures.

Results:

The siblings performed significantly below the normative sample in phonological memory (CTOPP-2 nonword repetition, $t(17) = -5.80$, $p < .000$) and phonological awareness (CTOPP-2 phoneme isolation, $t(17) = -4.73$, $p < .000$; blending words, $t(17) = -2.54$, $p < .05$). The siblings performed significantly above the normative sample on all four CCC-2 parent-report scales of pragmatics; Initiation ($t(17) = 3.12$, $p < .01$), Scripted Language ($t(17) = 3.24$, $p < .01$), Context ($t(17) = 2.34$, $p < .05$), and Non-verbal Communication ($t(17) = 2.28$, $p < .05$). Performance on our direct assessment of pragmatics, the TOPL-2, was in the average range; however, it was significantly lower than mean performance on the CELF-4 ($t(15) = 4.63$, $p < .001$). Further, three participants presented with profiles of pragmatic language impairment.

Conclusions:

This sample of siblings with non-ASD outcomes demonstrated impairments in both phonological memory and awareness. Hearing, remembering, and manipulating the sounds in language may take more effort and resources for these siblings. In contrast, word-level reading and rapid naming were intact. Relative to norms, no impairments were found on either a direct child assessment or parent-report measure of pragmatic language, and, somewhat surprisingly, the parent-report measure revealed pragmatic strengths. We recommend that this finding be interpreted cautiously, as differences in pragmatic abilities may not be obvious to all parents and may be exacerbated by differences in frames of reference. When comparing two direct language assessments, pragmatics were significantly lower than structural language. These mixed findings highlight pragmatics as an area for further research.

3:04   **181.003** Audiovisual Integration of Speech and Gesture in Adolescents with ASD

L. B. Silverman[1], N. Gebhard[1], A. R. Canfield[2], J. T. Foley[1] and A. P. Salverda[3], (1)University of Rochester Medical Center, Rochester, NY, (2)University of Connecticut, Storrs, CT, (3)University of Rochester, Rochester, NY

Background: The integration of information across sensory modalities is essential for successful social and communicative functioning in everyday life. Impaired sensory integration abilities in ASD could contribute to the core social and communicative impairments that typify the disorder. Objectives: The purpose of this study was to characterize the nature of sensory integration abilities in ASD, using a set of stimuli that systematically varied the relationship between speech and co-expressive gesture. We had two primary aims. The first aim was to test whether participants integrated speech and complementary gestures, when gesture was not necessary for understanding

the speaker's message (i.e., speech and gesture provided similar semantic information). The second aim was to test sensory integration of speech and supplementary gesture, when integration was necessary for understanding (i.e., speech alone did not provide adequate information).

Methods: Participants were 26 adolescents with high-functioning ASD and 25 typically developing controls matched on age, gender, and VIQ. In Experiment 1, speech and gesture integration was assessed through quantitative analyses of eye fixations during a video-based task. Participants watched a man describing one of four shapes (target, speech competitor, gesture competitor, distractor) shown on a computer screen. Half of the videos depicted natural speech-and-gesture combinations, while the other half depicted speech-only descriptions. Participants clicked on the shape that the speaker described. Since gesture typically precedes speech, we hypothesized that TD controls would visually fixate the target shape earlier on speech-and-gesture trials compared to speech-only trials, indicating immediate integration of audiovisual information. We hypothesized that the ASD group would not show this effect. In Experiment 2, participants watched a man describing one of four pictures, this time including a homophone pair (e.g., baseball-bat or animal-bat). The man's co-expressive gestures provided semantic information required for reference resolution. Participants clicked on the picture that they thought he described. Item accuracy scores were analyzed to determine whether participants appropriately integrated speech and gesture.

Results: Data from Experiment 1 were analyzed using mixed logit models, which predicted the probability that the participant fixated the speech competitor at any point from 200 to 800 ms after the onset of the target word. The model had fixed effects for group (ASD versus control) and condition (speech-only versus speech-and-gesture), and random intercepts and slopes for participants and items. The interaction between group and condition was significant (β=.65, z=2.1, p<.05). For controls, the proportion of trials with a fixation to the speech competitor was significantly reduced in the speech-and-gesture condition (.39) compared to the speech-only condition (.56), suggesting audio-visual integration (β=-.82, z=-3.6, p<.0005). For the ASD group, the effect of condition was nonsignificant (speech-and-gesture: .42 versus speech-only: .40; z<1). For Experiment 2, accuracy scores were analyzed using a mixed logit model, which indicated no group differences.

Conclusions: These findings suggest that individuals with ASD fail to integrate gesture and speech when it is beneficial, but not necessary for understanding (Experiment 1). However, once speech becomes ambiguous, as with homophones, individuals with ASD can utilize semantic information embodied in gesture to improve their comprehension (Experiment 2).

3:16 **181.004** Reading Comprehension, Language Disturbance, and the Social Communication Phenotype of ASD

N. S. McIntyre[1], *P. C. Mundy*[2], *M. Solomon*[3], *T. Oswald*[4], *L. E. Swain-Lerro*[5] *and M. C. Zajic*[6], *(1)UC Davis, Davis, CA, (2)2825 50Th Street, UC Davis, Sacramento, CA, (3)Department of Psychiatry & Behavioral Sciences, University of California-Davis, Sacramento, CA, Sacramento, CA, (4)2825 50th Street, UC Davis, Sacramento, CA, (5)School of Education, UC Davis, Santa Rosa, CA, (6)School of Education, UC Davis, Davis, CA*

Background: Previous research provided preliminary evidence that reading comprehension impairment may be part of the social communication phenotype of higher functioning school-aged children with ASD (Norbury & Nation, 2011; Ricketts et al., 2013). The core features of autism spectrum disorders (ASDs) place these children at risk for oral language difficulties. Proficient structural and higher-order language abilities develop within frequent and high-quality social interactions encompassing a wide variety of topics and activities (e.g. Tomasello, 2003) and have been shown to significantly support reading accuracy and comprehension in children with ASD (e.g. Brown et al., 2013). Therefore a finer-grained analysis of ASD symptomatology, oral language, reading accuracy, and reading comprehension is required to model this complex interactive process.

Objectives: This study was designed provide a detailed model of reading comprehension, reading accuracy, and oral language, and their relation to core symptoms of autism, in a large sample of high functioning children with autism (HFASD).

Methods: This sample consisted of 80 (66 males) 8- to16-year-old higher functioning students with ASD (HFASD; FSIQ≥75; ASD diagnosis confirmed with ADOS-2).   Mplus, version 7 (Muthen & Muthen,1998-2012) was used to generate structural equation models (SEM) that tested relations between ADOStot (ADOS-2 total scores) and three latent variables that were each comprised of multiple indicators (see Figures 1&2 notes for complete list): ReadAcc (reading accuracy), OralLang (structural + higher order language), and ReadComp (reading comprehension).

Results: Previous research on this sample indicated approximately 50% of the students displayed reading comprehension and oral language impairments (McIntyre, IMFAR 2014). Figure 1 displays the SEM model testing the hypothesis that ADOStot and StrcLang explain unique variance in ReadComp, but that ReadAcc does not.   The model fits the data well given the relatively small sample size: χ^2=67.353(50df),p=.0513;RMSEA =.066,90% C.I.=.000-.104;CFI=.947;SRMR=.070. ADOS scores predicted unique variance in ReadComp even after their significant relations with ReadAcc and StrcLang were taken into account. Figure 2 displays the SEM model testing the hypothesis that the addition of three higher-order language indicators to the oral language latent variable would fully mediate the relation between ADOStot and ReadComp. This model provided a better fit to the data: χ^2=102.662(86df),p=.1063;RMSEA =.050,90% C.I.=.000-.083;CFI=.961;SRMR=.076. ADOStot no longer directly explained variance in ReadComp.

Conclusions: Results indicated that core features of ASD play a major role in reading comprehension impairments. However, this role appears to be fully mediated by the relation of ASD symptomatology to oral language abilities in these children, particularly with regard to higher-order language processes (inference generation, gist processing, and narrative understanding). Surprisingly, ADOS scores were also significantly related to reading accuracy abilities in this sample, which provided evidence that in a subset of students the social communication disturbance extends to deficits in phonology, word reading, and rapid naming. However, consistent with prior research (e.g. Newman et al., 2007) a pattern of dissociation between reading accuracy and reading comprehension was displayed. This study provided direct evidence that language and reading impairments are integral to the social communication disturbance in ASD.

Oral Session
182 - Complex Genetic Variants and Models of Autism
1:45 PM - 2:35 PM - Grand Ballroom D

Session Chair: Tychele Turner, *Genome Sciences, University of Washington, Seattle, WA*

1:45   **182.001** Large-Scale Exome Analyses Reveal Novel ASD Genes Impacted By Genetic Variation at All Scales

S. De Rubeis, *for the Autism Sequencing Consortium, Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY*

Background: The genetic architecture of autism spectrum disorder (ASD) involves the interplay of common and rare variation and their impact on hundreds of genes. During the past two years, large-scale whole-exome sequencing (WES) has proved fruitful in uncovering risk-conferring variation, especially when considering *de novo* variation, which is sufficiently rare that recurrent *de novo* mutations in a gene provide strong causal evidence.
Objectives: The Autism Sequencing Consortium (ASC) aims to uncover a large fraction of genetic factors underlying autism and to identify genetic variation at all scales, including single-nucleotide variants (SNVs), indels and larger structural variants (SVs) such as copy number variants (CNVs).
Methods: Results to date indicate that WES will identify ASD risk genes as a linear function of sample size, until samples reach many thousands of cases. Therefore, the ASC intends to analyze large ASD cohorts for ASD genes. Unlike earlier WES studies, we do not rely solely on counting *de novo* loss-of-function (LoF) variants, rather, we use novel statistical methods to assess association by integrating *de novo*, inherited and case-control information for LoF SNVs/indels, missense SNVs predicted to be damaging, and SVs.
Results: Our first analyses on 3,871 ASD cases and 9,937 ancestry-matched or parental controls revealed 33 autosomal genes at a false discovery rate (FDR) < 0.1, and a broader set of 107 autosomal genes strongly enriched for those likely to affect risk (FDR < 0.30). Our dataset is enriched for genes targeted by two autism-associated RNA-binding proteins (FMRP and RBFOX), genes found with *de novo* non-synonymous mutations in schizophrenia, and genes encoding synaptic components. Amongst critical synaptic genes found mutated in our study are voltage-gated ion channels, including those involved in propagation of action potentials (e.g., the Na$^+$ channel Na$_v$1.2 encoded by *SCN2A*), neuronal pacemaking, and excitability-transcription coupling (e.g., the Ca^{2+} channel Ca$_v$1.3 encoded by *CACNA1D*). Our dataset is also enriched for chromatin remodeling genes, including enzymes involved in histone post-translational modifications, especially lysine methylation/demethylation, and regulators that recognize such marks and alter chromatin plasticity such as the emergent ASD gene *CHD8*. More recently, we have looked at SVs in the dataset, especially those hitting an individual gene or portion of a gene (which we term exon dosage variants, or EDVs). We show that we can reliably call SVs and EDVs from WES data and results to date indicate the EDVs are showing a significant contribution to risk. Additional, ongoing analyses examine the ASC data for recessive genes and X-linked genes. Furthermore, the ASC data is being analyzed for evidence of mosaicism.
Conclusions: Our studies have identified a group of 107 high-confidence risk genes that incur *de novo* LoF mutations in over 5% of ASD subjects and have exposed two tightly intertwined pathways - chromatin remodeling and synaptic development – as major themes in ASD risk. These findings are being further extended by evidence on SVs, either deletions or duplications, disrupting discrete genes. Ongoing analyses of the data are identifying recessive and X-linked loci, and evidence for mosaicism in ca. 5% of the ASD samples.

1:57   **182.002** Somatic Mosaicism in Simplex Autism Spectrum Disorder

D. Krupp[1], *Y. Duffourd*[2], *S. Evans*[1], *R. Bernier*[3], *E. J. Fombonne*[4], *S. J. Webb*[3], *J. B. Riviere*[2] and B. J. O'Roak*[1], (1)Molecular and Medical Genetics, Oregon Health & Science University, Portland, OR, (2)Génétique des Anomalies du Développement, Université de Bourgogne, Dijon, France, (3)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, (4)Psychiatry, Institute on Development and Disability, Oregon Health & Science University, Portland, OR*

Background: Autism spectrum disorder (ASD) has a complex genetic architecture, with many potential

contributing risk factors. Somatic mosaicism has previously been implicated as a risk factor in other neurodevelopmental disorders, including lissencephaly, epilepsy, and overgrowth syndromes such as hemimegalencephaly (reviewed in Poduri et al. 2013). Genetic pathways involved in these syndromes have also been implicated in autism etiology, suggesting a potential role for somatic variants in ASD risk as well. However, little is known about how frequent somatic mosaic events may be during development and how their occurrence relates to the pathogenesis of complex disorders.

Objectives: We are systematically characterizing somatic mosaic mutations in 400 families from the Simons Simplex Collection, consisting of both parents, an ASD proband, and an unaffected sibling. Our goals are to determine the rates of mosaic mutations in affected and unaffected children, evaluate transgenerational risk, and to infer when and where in early development these mutations might be taking place. We are also evaluating the incidence of mosaic mutations in genes and pathways previously implicated in ASD risk.

Methods: Exome libraries were generated using the NimbleGen SeqCap EZ Human Exome v2.0 in-solution capture and sequenced on the Illumina platform. We developed a Somatic Mosaic Caller (SMOC) that builds an error model specific to the capture/sequencing method and then identifies significant outliers from this model, distinguishing potential mosaic events from sequencing errors. With this approach, we have been able to detect somatic mosaicism with 2-27% allele frequency in exome and targeted resequencing data. Variants of interest are being validated using a modified molecular inversion probe (MIP) protocol, enabling massive multiplexing of validation sites and samples. These MIPs are synthesized so that each probe molecule, and thus each capture event, incorporates a unique molecular tag. This allows us to achieve statistical accuracy and correct sequencing errors by sampling each tagged molecule multiple times.

Results: Using our SMOC approach, we anticipate identifying most mosaic mutations present at >10% MAF in these samples. To date, we have observed that ~5% of apparent *de novo* mutations in ASD probands show characteristics consistent with somatic mosaic events. We have so far validated somatic mosaic mutations in several genes that also harbor germline *de novo* mutations, including *AKR1C2, FBN1, NAV2, NTNG1,* and *TSNARE1*. These are likely candidates for contributing to disease risk, particularly *NAV2* and *NTNG1. NAV2* functions in neurite outgrowth and cerebellar development, while *NTNG1* has been implicated in Rett's syndrome and schizophrenia. We have also identified a maternal somatic mosaic variant in *ADNP* that was transmitted through germline to the proband, which is heterozygous. This indicates that parental somatic mosaicism can also contribute to disease risk.

Conclusions: Somatic mosaic events are an understudied class of genetic variation that may help explain several phenomena, including multiplex families with subclinical phenotypes and strongly discordant monozygotic twins. This systematic evaluation of somatic mosaicism in ASD families will help elucidate how frequently somatic mutations occur during development and their contributions to the pathogenesis of neurodevelopmental disorders.

2:09 **182.003** Function Based GWAS Identifies Novel Candidate Genes in Autism Spectrum Disorders

L. K. Davis[1], E. R. Gamazon[1], E. O. Kistner-Griffin[2], E. H. Cook[3], J. Sutcliffe[4] and N. J. Cox[1], (1)University of Chicago, Chicago, IL, (2)Medical University of South Carolina, Charleston, SC, (3)University of Illinois at Chicago, Chicago, IL, (4)Vanderbilt University, Nashville, TN

Background: Significant progress has been made in decoding the genetic architecture of autism spectrum disorder (ASD). ASD is highly heritable and polygenic, with risk spread across thousands of DNA variants throughout the genome (Klei et al. 2012). Genome-wide association studies (GWAS) utilizing sample sizes in the low thousands provide only weak and inconsistent evidence for risk alleles of main effect, suggesting that GWAS of ASD remains underpowered to identify individual risk alleles that survive multiple testing correction. Despite this challenge, studies from our group show that nominally associated results from a large family-based test of ASD association (Anney et al. 2010) are enriched for risk alleles that are also associated with gene expression in relevant brain tissues (i.e., expression quantitative trait loci; eQTL), but are not enriched for eQTLs in lymphoblastoid cell lines (Davis et al., 2012).

Objectives: Here we demonstrate a functional-unit based GWAS, which, instead of utilizing all SNPs on the array (the vast majority of which fall under the null expectation of no association), requires only a subset of SNPs that are coding (i.e., missense, nonsense or frameshift) as well those that have been show by previous studies to be cis- or trans-eQTLs involved in regulating gene expression in brain. Coding variants and eQTLs are then assigned to the genes that they affect. The main objective of this study is to use biologically informative genomic annotations to effectively reduce the number of multiple tests conducted, thereby maximizing our power to detect meaningful associations.

Methods: We applied our method to both a discovery and replication cohort, and conducted a meta-analysis including both sets of results. The discovery cohort included 654 probands from the Autism Genetic Resource Exchange (AGRE) and 1,593 unselected iControls. A second, independent replication cohort consisted of 1,679 probands from the Simons Simplex Collection (SSC) and 1,297 controls from the Study of Addiction: Genetics and Environment (SAGE). We constructed gene-level annotations for each known gene in the human genome by annotating each gene with regulatory variation (i.e., eQTLs) previously identified in the parietal cortex and the cerebellum as well as coding variants (nonsense, frameshift, and missense) within the gene. A gene-level p-value was obtained using a combined statistic that integrates SNP-level evidence, derived from the traditional single-variant test, for association with the trait. A total of 13,487 genes, represented by at least two

variants, were annotated and included in each analysis. A Bonferroni corrected p-value of 3.7x10^-6 was imposed to correct for the number of gene-based tests conducted.

Results: The most significant associations discovered were ZNF204P (2x10^-5) within the AGRE/iControl analysis and ITFG2 (2x10^-5) within the SSC/SAGE analysis, although neither result exceeded the threshold for genome-wide significance. However, upon meta-analysis, three genes were found to exceed genome-wide significance including ITFG2 (p=1.01x10^-6), MTHFD2 (p=1.05x10^-6), and ZNF2 (p=1.83x10^-6).

Conclusions: We present a novel gene-based approach to GWAS, which incorporates functional annotations including brain eQTLs and coding variants in a noise-reduction GWAS framework. We present meta-analysis data implicating three genes (ITGF2, MTHFD2, and ZNF2) and evaluate their potential as ASD candidate genes.

2:21 **182.004** Identifying Non-Protein Coding Autism Risk Variants By Computational Analysis of a Large Case Control Sequencing Cohort

A. J. Griswold[1], D. Van Booven[1], N. D. Dueker[1], M. L. Cuccaro[1,2], E. R. Martin[1,2], J. L. Haines[3], J. R. Gilbert[1,2], J. P. Hussman[4] and M. A. Pericak-Vance[1,2], (1)John P. Hussman Institute for Human Genomics, University of Miami Miller School of Medicine, Miami, FL, (2)Dr. John T. Macdonald Foundation Department of Human Genetics, University of Miami Miller School of Medicine, Miami, FL, (3)Department of Epidemiology and Biostatistics, Case Western Reserve University, Cleveland, OH, (4)Hussman Institute for Autism, Baltimore, MD

Background: Application of massively parallel sequencing technologies to autism spectrum disorder (ASD) has focused primarily on sequencing protein coding exons and has identified dozens of genes with rare, recurrent *de novo* loss of function variants. While these variants contribute to the genetic etiology of ASD, there are certain to be other genetic factors that play a role in the pathophysiology. A largely unstudied hypothesis is that, rare, non-protein coding variants contribute to ASD risk.

Objectives: The goal of this study is to computationally assess the functionality of single nucleotide variants (SNVs) identified in a large case-control sequencing study and to prioritize those for future molecular follow-up.

Methods: Our sequencing cohort consisted of 2071 ASD cases diagnosed by DSM-IV criteria and supported by the Autism Diagnostic Interview and 904 age matched controls; all of European ethnicity. We sequenced 17Mb consisting of exons including untranslated regions, evolutionarily conserved intronic areas, and 5kb flanking regulatory regions of 681 genes and evolutionarily conserved regions in 694 associated intergenic loci identified by ASD-GWAS Noise Reduction analysiss (Hussman et al., 2011). We applied three recently published computational methods for prioritization of noncoding variants. 1) FunSeq2 (Function based Prioritization of Sequence Variants v2) scores SNVs by integrating ENCODE annotation, known binding motif sequences, evolutionary conservation, and population variant frequencies. (Fu et. al., 2014) 2) GWAVA (Genome Wide Annotation of Variants) uses noncoding variants in the Human Gene Mutation Database to train a model to score SNVs based distance to gene start sites or known pathogenic noncoding mutations. (Ritchie et. al., 2014) 3) CADD (Combined Annotation Dependent Depletion) implements a machine learning vector using evolutionarily analyses to score SNVs relative to all possible genomic variations (Kircher et. al., 2014). Novel risk variants and genes were identified by clustering of case specific functional SNVs with the highest scores.

Results: We identified 507,924 noncoding SNVs across our entire dataset. To identify individual ASD noncoding variants and genes, we determined the intersection of the top 10% of scores for all three programs and identified 158 candidate SNVs scored highly by all three computational methods. From these, we identified clusters of at least three noncoding rare SNVs (1000 Genomes MAF < 0.01) unique to ASD cases within 15bp. We identified 10 such clusters, including four in regulatory regions of genes playing important roles in neuronal processes implicated in ASD physiology. These included clusters within 2kb of the start site of the neuronal migration gene *ASTN1* and cell adhesion molecule gene *CDH2*. Also, two within 5' UTRs of the MAP kinase *MAP3K8* and the intracellular solute transporter *SLC35A2*.

Conclusions: As lower costs allow generation of sequencing data beyond exomes, application of computational tools for variant prioritization is essential for interpretation of noncoding SNVs. In this study, they have suggested potential novel genes related to ASD pathophysiology. As the first large scale study of noncoding variation in ASD, this investigation adds noncoding variants to the compendium of ASD risk loci and implicate potential novel biological mechanisms, beyond protein coding variations, that contribute to ASD genetic risk.

Oral Session
183 - Epigenetics of Autism
2:40 PM - 3:30 PM - Grand Ballroom D

Session Chair: Tychele Turner, *Genome Sciences, University of Washington, Seattle, WA*

2:40 **183.001** Using Lymphoblastoid Cell Lines to Investigate Altered DNA Methylation in a Subtype of

ASD

V. Hu, The George Washington University School of Medicine and Health Sciences, Washington, DC

Background: Lymphoblastoid cell lines (LCL) have previously been used as an experimental model to examine differences in DNA methylation between monozygotic twins and sib pairs discordant for diagnosis of autism spectrum disorder (ASD). The rationale for using twins and siblings in epigenetic studies is that the identical or similar genotypes of the twins/siblings would increase the probability of identifying differentially methylated genes that were related to the differential diagnosis of the siblings rather than to disparate genotypes.

Objectives: The goals of this study were to: 1) investigate changes in DNA methylation in LCL from individuals with a specific subtype of ASD and their respective non-autistic siblings, 2) relate the differentially methylated genes to ASD-relevant pathways and functions, and 3) explore the potential for class determination (case-control) biomarkers based on methylation signatures.

Methods:

Selection of cases and controls by subtyping analyses: To reduce the confounding effects of clinical heterogeneity on the methylation analyses, we subtyped individuals with ASD by performing cluster analyses of ADI-R scores as previously described (Autism Research 2:67-77, 2009), limiting the cases for this study to those with severe language impairment which was further verified by low scores on the Peabody Picture Vocabulary Test. To further reduce heterogeneity among the 21 sib pairs included in this study, we selected sibling controls of the same gender as the cases.

Analysis of differential DNA methylation in cases and controls: Affymetrix Human Promoter 1.0R GeneChips were used to analyze differentially methylated promoter regions in the DNA of cases and controls. For each sample, DNA enriched for methylated regions by methyl-C immunoprecipitation (MeDIP) procedures and input (total) DNA were hybridized on separate chips. Partek GS Software was used for data analysis of the promoter tiling arrays.

Pathway/functional analyses of differentially methylated genes: Ingenuity Pathway Analysis network prediction software was used to identify functions and canonical pathways represented by the gene sets encompassing the most significant differentially methylated genes. This information is being used to select relevant candidate genes for functional validation.

Results: The most significant differentially methylated genes were identified by both paired and unpaired t-tests, with $P \leq 0.0001$ and a minimum MAT score of ± 5.0. Pathway analyses of the genes from the t-tests show enrichment in gene networks involved in mTOR signaling, Reelin signaling, semaphorin signaling, and axon guidance. Moreover, principal components analyses of the samples based upon the lists of differentially methylated annotated promoter regions show relatively good separation of cases and controls. Application of class prediction algorithms to the sets of differentially methylated genes demonstrated the ability to correctly identify cases and controls with >90% accuracy based on a limited number (e.g., 18-35) of genes/regions.

Conclusions: Significantly differentially methylated genes in LCL from autistic vs. non-autistic individuals suggest pathways that may be aberrantly regulated in ASD. In addition, limited panels of methylation-enriched promoter regions can discriminate between autistic cases and controls with reasonably high sensitivity and specificity. These results suggest that these differentially methylated regions may be useful as "biomarkers" for the subtype of ASD with language-impairment.

2:52 **183.002** Enrichment of Methylation Quantitative Trait Loci Among Genes Associated with Autism Spectrum Disorder

S. V. Andrews[1], C. Ladd-Acosta[1], A. P. Feinberg[2] and M. D. Fallin[3], (1)Johns Hopkins University, Baltimore, MD, (2)Medicine, Johns Hopkins University, Baltimore, MD, (3)Mental Health & Wendy Klag Center for Autism and Developmental Disabilities, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Background: Many of the genes and SNPs previously associated with autism are intragenic and/or do not have a clear functional consequence. A potential function may be expression regulation via epigenetics. The availability of genome-wide DNA methylation data (DNAm), a type of epigenetic mark, together with genome-wide genotype data, has allowed for the discovery of methylation quantitative trait loci (meQTLs): single nucleotide polymorphisms (SNPs) that appear to control DNAm levels at particular loci. Examining meQTL data with respect to previously reported ASD-related variants or genes may provide a functional context for their ASD associations.

Objectives: The purpose of this work was to examine the extent of meQTLs in previously reported ASD-related genes and regions compared to non ASD-related genomic locations.

Methods: In our sample of children with both genome-wide SNP data and genome-wide DNAm data, we performed chromosome-wide SNP-DNAm association testing for each of 401,126 CpG sites to identify SNPs (meQTLs) significantly associated (p < 1E-15) with DNAm levels. This reflects 1.43×10^{11} comparisons, and thus an extreme significance threshold is required. We then tested for enrichment of ASD-related genes, as defined in the Simons Foundation Autism Research Initiative Gene Database (SFARI Gene), among identified meQTLs using a permutation-based test. Samples for meQTL identification were obtained from the Study to Explore Early Development (SEED), a national multi-site autism case-control study of children aged 2-5 years. Genome-wide DNAm was measured using the Illumina HumanMethylation450 BeadChip in peripheral blood-derived DNA among 610 individuals. After

applying rigorous quality control metrics, 607 samples remained for downstream methylation analyses. High quality genome-wide genotyping data, measured by the Illumina Omni1 Quad and Affymetrix Axiom arrays, was available for 591 of the same individuals.

Results: Across the genome, we identified 1,044,683 meQTL SNPs corresponding to 35,779 CpG sites of DNAm. Typically SNP clusters were associated with CpG DNAm clusters. We considered 629 ASD-related genes/regions. We are now performing the ASD-meQTL enrichment tests and plan to present our findings at the conference.

Conclusions: We have identified SNPs that control DNA methylation levels across the genome and will show enrichment of ASD gene associations and meQTLs. This may guide functional insights for previously identified ASD-related variants.

3:04 **183.003** Epigenomics of ASD

ABSTRACT WITHDRAWN

Background: Current data suggest the etiology of autism spectrum disorder (ASD) is multifactorial, likely including genomic and epigenomic alterations. The contribution of epigenetic variants to the molecular etiology of ASD is still unclear. We proposed that the limited success of ASD epigenetic studies to date is due to the limited numbers of epigenetically diverse ASD cases such studies analyzed.

Objectives: To optimize identification of DNA methylation variants (DMVs) relevant to ASD etiology, we planned to stratify ASD cases into subgroups according to clinical and genomic features.

Methods: Our ASD cases were stratified into subgroups using the genotype and/or clinical phenotypes such as somatic growth as secondary ascertainment features. We chose to study two syndromes, Sotos and CHARGE, because such individuals have high comorbid rates of ASD and harbor mutations in epigenes, ie genes known to regulate epigenetic modifications. Specifically, Sotos and CHARGE syndromes are caused by mutations in NSD1 and CHD7 respectively. They present with ID and contrasting growth phenotypes, ie overgrowth and undergrowth respectively. We searched for DMVs in DNA from multiple tissues (blood, fibroblast, or buccal).

We also studied nonsyndromic ASD patients secondarily ascertained by somatic overgrowth (n=50), as well as 50 age-, sex- and ethnicity-matched controls.

DNAm was assessed using sodium bisulfite-converted DNA on the Illumina Infinium HumanMethylation450 BeadChip array, which interrogates >485,000 CpG sites. Hyper- and hypo-methylated regions in ASD were verified by sodium bisulfite pyrosequencing.

Results: We first studied patients with Sotos (n=38) and CHARGE (n=29) syndromes, finding highly specific and sensitive DNA methylation (DNAm) patterns or signatures in blood. Similar signatures were found in other tissues such as fibroblast or buccal cells for each syndrome. Notably, a number of the DNAm variants (DMVs) within these signatures are located in genes previously implicated in ASD etiology, eg PCDH in Sotos and FOXP2 and HOXA1 in CHARGE.

Our second analysis focused on nonsyndromic ASD cases with overgrowth. We identified a subgroup (n=18) with an epigenetic signature clearly distinct from Sotos. These cases were not clinically consistent with a known syndromic diagnosis. They were negative by targeted mutation analysis for several disorders (eg Fragile X, PTEN). Notably, ASD cases positive for PTEN mutations did not share this specific epigenetic signature. We are currently exome sequencing these 18 ASD patients to identify mutations, presumably in a novel ASD gene.

Conclusions: We found that clinical and/or genomic stratification of syndromic or nonsyndromic ASD cases constitute successful strategies to optimize identification of epigenetic variants in ASD. We expect such epigenetic variants will prove to be functionally relevant as many overlap genes already implicated in ASD etiology by genomic studies.

The epigenetic signatures we have discovered have the potential to be translated into diagnostic tools, allowing for earlier detection of ASD susceptibility in some patients. Ultimately we expect that clinical phenotyping, and genomic/epigenomic variant profiling of ASD individuals will optimize our ability to provide early diagnosis, accurate prognosis and personalized therapeutic options.

3:16 **183.004** Epigenetic Alterations Tied to Brain Enlargement in Autism Spectrum Disorder

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Background:
Until recently, little was known about the relationship between brain epigenetic alterations and the genetic risk architecture for autism. Now, strong evidence has emerged to indicate changes in histone methylation that affect hundreds of loci in prefrontal cortical neurons from subjects with autism. Remarkably, these alterations exhibit significant overlap with current estimates of the genetic risk architecture of autism, identifying histone methylation as a promising epigenetic biomarker for genomic loci.

Objectives:
In the present study, we related epigenetic signatures to a key biological phenotype for Autism Spectrum Disorder (ASD), that of brain size. A relationship between these two measures is plausible, since there is ample evidence in the literature relating epigenetic factors to overgrowth, including brain enlargement. Though increased brain size and its proxy, head circumference, have often been

reported for autism – particularly among younger cases – relatively little is known of causal factors for these phenotypes.

Methods:

We addressed this question here, focusing on epigenetic hypotheses. The study employed post-mortem brain epigenetic signature data and brain anatomic dependent measures from the Autism Speaks Autism Tissue Program (N=16). These samples were made available by the Harvard/McLean and the University of Maryland Brain Banks. ChIP-seq libraries from H3K4me3 immunoprecipitates are sequenced with the Illumina Genome Analyzer GAII. We performed single-end sequencing of 36bp reads. To detect regions that were enriched in H3K4me3 in a subset of disease samples against all controls, we ran MACS on each autism sample against the input dataset, retaining a peak if its MACS p-value were < 1E-10 and tag density in the ASD sample were > 0.015.

Results:

Our prediction was that post-mortem brain epigenetic H3K4me3 alterations would be positively correlated with brain weight across subjects. There were wide individual differences in the frequencies of altered epigenetic peaks, and in brain size, with the latter skewed toward increased weight. The predicted relationship was borne out: the nonparametric Spearman correlation coefficient for these cases was r = + 0.58 (p < .05). Moreover, we found that cases with increased brain weight relative to normative data shared peak alterations tied to specific genes linked to brain growth, as referenced in the *NCBI Gene Database*.

Conclusions:

This study extended our findings of widespread brain epigenetic alterations in chromatin structures at hundreds of loci genome-wide in ASD, with overlap between epigenetic and genetic risk maps for autism/IDD. Here we found a significant association between these epigenetic alterations and brain weight, which may be of explanatory value in understanding the underlying biology of brain/cranial enlargement that has been reported for ASD.

Oral Session
184 - Assessment and Measurement of Sensory Issues
1:45 PM - 2:35 PM - Grand Salon

Session Chair: Marisela Huerta, *Weill Cornell Medical College, White Plains, NY*

1:45 **184.001** An Altered Olfactory Profile in Children Diagnosed with Autism Spectrum Disorder

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Background: Many anecdotal observations report altered responses to odors in children and adults with ASD. Indeed, when considering the neural substrates most notably implicated in autism, ranging from ventral temporal structures to the cerebellum, they are highly overlapping with the neural substrates of olfaction. The sniff-response is a phenomenon whereby nasal airflow parameters are rapidly modulated in accordance with odorant content. For example, pleasant odors are automatically sampled with strong sniffs, yet unpleasant odors are sampled with weak sniffs. Thus, by measuring nasal airflow (sniffs) alone we obtain a non-verbal measure of olfactory perception and processing.
Objectives: test the hypothesis that olfactory responses are altered in children with ASD, and that these altered responses may serve early diagnosis.
Methods: We developed a pediatric olfactometer that delivers pleasant and unpleasant odors and measures the concurrent sniff-response. The 10-minute procedure consisted of 20 trials (10 for each valence), each 1-2 seconds in duration, separated by a 30 second inter-trial-interval. During the task, participants watched a cartoon.
Results: Eighteen children with ASD (17 boys, mean age 7±2.3 y) and 18 typically developing (TD) age and gender-matched children (17 boys, mean age 6.7±2.1 y) completed the non-verbal sniff response test. A repeated-measures ANOVA revealed a significant interaction between sniff parameters (volume, mean, peak and duration), odorant valence (pleasant versus unpleasant) and group (TD versus ASD), reflecting significantly larger sniffs for pleasant versus unpleasant odors in the TD group but not the ASD group ($F_{3,34}$=6.16, p<0.001). In addition, we found a strong correlation between the sniff-response and autism severity (R=-0.75, p<0.0005) in which longer sniff durations for unpleasant rather than pleasant odors predicted more severe autism.
Conclusions: Taken together, these results imply a pronounced alteration of olfactory perception that is evident at the early stages of ASD, and is more pronounced with increased autism severity.

1:57 **184.002** Sensory Subtypes and Heart Rate Variability in Children with Autism Spectrum Disorder

A. E. Lane[1] *and* **R. Schaaf**[2], *(1)University of Newcastle, Callaghan, Australia, (2)Thomas Jefferson University, Phildalphia, PA*

Background:
Sensory difficulties are a commonly occurring feature of Autism Spectrum Disorders (ASD) and are

now included as one manifestation of the 'Restricted, Repetitive Patterns of Behaviour, Interests, or Activities' diagnostic criteria. Their inclusion in the DSM as a diagnostic indicator necessitates a more thorough understanding of the mechanisms of these sensory features to guide assessment and intervention practices. Currently subtype classification is based on parent-report data and validation of these using objective measures is needed. Recently it has been reported that sensory features in children with ASD can be classified into sensory subtypes (Lane et al, 2014) and that these subtypes are distinct in the combination of sensory modalities affected and in the severity of symptoms. Based on these subtypes, findings suggest that there are two possible underlying mechanisms of sensory features in ASD: 1) difficulties in sensory reactivity and/or 2) difficulties with multisensory integration.
Objectives:
The aim of this study was to examine heart rate variability (HRV), a measure of autonomic nervous system function, in response to a standardized sensory challenge protocol as a function of sensory subtype   We hypothesized that children with ASD classified as sensory reactive will show significantly lower HRV indicating reduced parasympathetic activity than those classified as having problems in multisensory integration. This study builds on work showing that HRV during sensory challenges may be a biomarker of ASD (Schaaf, et al, 2013).
Methods:
Forty-six children with ASD aged 6-12 years were administered the Sensory Challenge Protocol (McIntosh, et al, 1999). HRV was collected via electrocardiography during baseline and stimulus administration. General Linear Models were applied to examine differences in HRV by sensory subtype.
Results:
Preliminary data shows that participants classified as sensory reactive show lower HRV at baseline and during stimulus administration than those in the multisensory group reflecting lower parasympathetic regulation of behaviour during sensory stimuli. This finding is consistent with Schaaf, et al's (2013) data but adds greater specificity based on sensory subtype and these findings have relevance in that they may be useful for tailoring interventions by sensory subtype.
Conclusions:
Validation of classification of children with ASD by sensory subtype using objective measures such as HRV will provide data needed to individualize treatment planning based on biologic and clinical performance profiles.

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Schaaf, R.C., Benevides, T., Leiby, B., Sandecki, J., (2013). Autonomic Dysregulation during Sensory Stimulation in Children with Autism Spectrum Disorder. Journal of Autism and Developmental Disorders. 10.1007/s10803-013-1924-6.

McIntosh, D. N., Miller, L. J., Shyu, V., & Hagerman, R. J. (1999). Sensory-modulation disruption, electrodermal responses, and functional behaviors. *Developmental Medicine & Child Neurology*, *41*(09), 608-615.

2:09   **184.003** Classifying Patterns of Preschool Aged Children with Autism

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Background: Research suggests that sensory processing differences can help identify clinically meaningful subtypes, or distinct profiles, of children with ASD. Although previous studies have used the Short Sensory Profile to determine subtypes in ASD, a recent study found that the factor structure of the Short Sensory Profile in children with ASD is characterized by patterns of sensitivity, seeking or hyporesponsiveness (Tomchek et al., 2014). Moreover, previous studies have used a wide range of ages to determine subtypes of children with ASD (Ausderau et al., 2014; Lane et al., 2014). Identifying subtypes in a sample of very young children with ASD, as well as considering the roles of sensitivity and hyporesponsiveness, may inform our understanding of sensory features for diagnostic and intervention efforts.
Objectives: We addressed the following research questions: 1) What are the sensory subtypes, as measured by a revised factor structure of the SSP, in a sample of young children with ASD aged 3-6 years? 2) To what extent do unique subtypes differ with regard to child characteristics (i.e., sensory processing, adaptive behavior, communication)?
Methods: Participants included 400 children 3- 6 yrs (mean=49.57 mos.; SD=10.5 mos.). Data was collected from children referred for evaluation received comprehensive interdisciplinary evaluations at a university affiliated tertiary diagnostic center. A Latent Profile Analysis was run to develop a model of groups of subjects who clustered on these variables. The *Short Sensory Profile (SSP;* McIntosh, et al., 1999) was used as the measure of sensory processing. Additional domain specific developmental measures were used to assess performance in adaptive, social, communication and motor areas.
Results: The four profile solution was supported (BIC=5672.7; Entropy=.78), with age, adaptive functioning and sensory symptom severity defining the profiles. Age and sensory symptom severity classified children with Profiles 1 (n=63; older with generalize sensory differences) and 4 (n=94; younger with better coping and fewer sensory differences). Age, developmental functioning, and

differing sensory scores allowed for interpretation of children in profiles 2 (n=42; older with higher developmental performance) and 3 (n=200; younger with lower developmental functioning). Sensory patterns related to low energy/weak, taste/smell sensitivity, seeking, and hyporesponsivity showed variability in these subtypes and were related to child characteristics.

Conclusions: Distinct subtypes in the current study were defined by sensory processing, age, developmental performance. These findings have relevance to the variable presentation of individuals with an ASD and allow for interpretation of phenotypes that include sensory patterns as well as child characteristics. These phenotypes likely have implications for assessment and intervention aimed at increasing children's active engagement required for participation. Additionally, findings may have implications for research studies investigating the etiology of ASDs and the variable responding of individuals to intervention programs. By understanding sensory classifications we create opportunities for tailored treatment approaches that allow intervention to support individualized sensory patterns within participation.

2:21 **184.004** Longitudinal Study of Children's Sensory Response Patterns: Stability, Change and Treatment Effects

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Background: Sensory symptoms, which were recently added to the DSM-5 diagnostic criteria, are highly prevalent in autism spectrum disorder (ASD) (Baranek et al., 2014; Lane et al., 2014; Ben-Sasson, 2008). Sensory response patterns (e.g., hyperresponsiveness, hyporesponsiveness, sensory seeking) are known to impact functional outcomes (Watson et al., 2011; Boyd et al., 2010) and are often targets of intervention. Although cross-sectional research with children suggests differences across age, prospective longitudinal studies of sensory response patterns are lacking, particularly those combining parent report and observed measures.

Objectives: (1) To determine the stability of sensory response patterns from early to later childhood in children with ASD in comparison to those with other developmental disorders (DD). (2) To determine if dosage of traditional therapies (i.e., Occupational Therapy [OT], Physical Therapy [PT], Speech-Language Therapy [SLP]) impacts sensory response pattern scores via main effects or through interactions with earlier sensory scores for children with ASD.

Methods: Children with ASD (n=57) and DD (n=34) ages 2-12 years participated in this longitudinal study. Four measures –two parent report (Sensory Experiences Questionnaire & Sensory Profile) and two observed (Sensory Processing Assessment & Tactile Defensiveness and Discrimination Test-Revised) –were collected at time 1. At time 2 (~3-5 years later) parent-reported sensory measures were collected and structured interviews detailing treatment history between time points were conducted. Treatment was coded for type, and average monthly dosage for OT, PT, and SLP was calculated. General linear models were run separately for the two parent report measures (combined) and the two observed measures (combined) at time 1 to predict time 2 outcomes, for each of the three sensory response patterns. An interaction term for diagnosis (ASD/DD) and covariates (child's age, IQ, gender, time between assessments, mother's education and income) were included. Treatment dosage was subsequently added to determine treatment effects, including interactions with time 1 scores.

Results: Mean sensory symptoms decreased over time, significantly for hyporesponsiveness in the ASD and DD groups (both $p<.05$), and for sensory seeking in the ASD group ($p=.01$). Changes in hyperresponsiveness did not reach significance. The time 1 parent-reported scores were strong predictors of time 2 parent-reported scores for all three constructs (partial r= .65-.73, all $p<.001$). The observed scores did not show strong associations to the later parent-reported scores. There was evidence for treatment main effects on all three sensory response pattern scores at time 2 (all $p<.05$), but in the opposite direction predicted (i.e., higher dosage of traditional therapies between time 1 and 2 was associated with higher sensory scores at time 2). There was no evidence for treatment moderation of time 1 scores on time 2 outcomes.

Conclusions: All three sensory response patterns were strongly stable from early to later childhood when using parent-reported measures. Because treatment was not manipulated in this study, causal inference is limited; however, we hypothesized that children with more severe sensory problems required and/or received more treatment, rather than inferring that treatment led to higher sensory symptoms over time. OT and SLP (not PT) appeared to contribute most to these findings.

Oral Session
185 - Sex Differences: Assessment and Measurement
2:40 PM - 3:30 PM - Grand Salon

Session Chair: Marisela Huerta, *Weill Cornell Medical College, White Plains, NY*

2:40 **185.001** Sex Differences in Social Impairment in Preschool-Aged Children with Autism Spectrum Disorder

*R. T. Johnson, D. D. Li, D. G. Amaral, S. J. Rogers, S. Ozonoff and **C. W. Nordahl**, MIND Institute and Department of Psychiatry and Behavioral Sciences, University of California Davis Medical Center, Sacramento, CA*

Background:
Females are diagnosed with autism spectrum disorder (ASD) less frequently than males, and there is evidence of differing underlying genetic and neurobiological characteristics in females and males with ASD. However, detection of behavioral differences between the sexes within ASD has been inconsistent and controversial.
Objectives:
We sought to explore sex differences in social impairment in young females and males with ASD.
Methods:
Participants were part of the Autism Phenome Project, which includes a large sample of clinically diagnosed children with ASD (mean age 33.28 months) and age-matched typically developing (TD) control children (153 ASD males, 33 ASD females, 58 TD males, 31 TD females). The Social Responsiveness Scale (SRS), a measurement of the presence and extent of social impairments was administered to parents of children with ASD and typical development. Analysis of covariance was used to investigate interactions between sex and diagnosis. Pillai's trace was used as a test statistic. As a post hoc analysis to further investigate sex by diagnosis interactions, we also examined deviation from typical development in a sex-specific manner. We calculated a mean score for TD males and females on the SRS composite as well as each of the sub-scales. Then, for each participant with ASD, a deviation from typical development score was calculated by subtracting the individual score from the same-sex TD mean.
Results:
There were significant sex by diagnosis interactions for the multivariate analysis of the SRS (p = 0.008) as well as on the univariate SRS total score (p < 0.001), suggesting that for children with ASD, the pattern of differences from typical development occurs in a sex-specific manner. Follow-up univariate tests on the sub-scales also exhibited significant sex by diagnosis interactions. Post hoc analyses of deviation from typical development revealed significant sex differences in the deviation scores. Females with ASD always exhibited a larger deviation from TD females than males with ASD relative to TD males.
Conclusions:
A diagnosis of ASD places an individual into a small population defined by similar behavioral characteristics, making potential behavioral differences between subgroups of this population difficult to detect. Most studies evaluating behavioral sex differences in individuals with ASD directly compare males and females with the disorder. Our findings suggest that females with ASD have deviated more from typical development compared to males with the disorder in the degree of social impairment, as measured by the SRS. These findings suggest that females must diverge further from typical development to receive an autism diagnosis and could be considered more severely affected compared to males.

2:52 **185.002** Gender Differences in Age of ASD Diagnosis and Social Characteristics of Children with ASD: From a US National Registry

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Background:
The male to female ratio in Autism Spectrum Disorders (ASD) is large and has remained consistent over several decades. Some studies indicate that the trajectory of ASD development may be different between males and females, including diagnostic age and core symptoms. But only few large sample studies address the different characteristics of social responsiveness in male and female children with ASD.
Objectives:
1. To explore the trend of gender differences in the age of first ASD diagnosis.
2. To measure how ASD symptom severity varies by gender.
Methods:
Data for this study were generated from the Interactive Autism Network (IAN), a national web-based family-powered registry for ASD in the US. Registry data for the target population was collected from November 2006 to January 2013 for 15,644 under-18 children with ASD. Age of first ASD diagnosis was collected for 9,932 children, and a completed Social Responsiveness Scale (SRS) was appropriately scored for 5,103 children. Two sample t-tests were performed to compare age means in different gender groups, and a chi-square test was performed to assess whether gender rate differences are significant according to different diagnostic year, first diagnosis age, ASD diagnosis categories, and ASD symptom severity in different SRS domains characterized social responsiveness.
Results:

The male to female ratio in the target population was 4.54:1, similar to the US CDC ASD surveillance network report of 2014. The mean age of first diagnosis of both Asperger's Syndrome (AS) and PDD-NOS was significantly different in females versus males (AS: F 7.6 ±3.4, M 7.1 ±3.0, p<0.01); PDD-NOS: F 4.0 ±2.5), M 3.8 ±2.3), p=0.031). Later we stratified children with verified first diagnostic age into four age groups (year 0-5, 5-10, 10-15, and 15-18). It demonstrated a trend of increasing female:male ratio in age of first diagnosis (p=0.02), with significant differences in both AS and PDD-NOS (AS: p<0.01; PDD-NOS: p=0.036). For those with completed SRS's, females struggled more on social cognition (p<0.05), while males had more severe autistic mannerisms (p<0.01). In addition, males aged 10 to 15 had more significant difficulties with social awareness and social communication compared to female in this age range (p<0.05). In comparing year of registry enrollment, there was a trend of increased proportion of female children with ASD (p=0.02). The percentage of female children with ASD was significantly increased over time (p<0.05) in comparing early registrants (2006-2009) to later (2010-2013).
Conclusions:
Many causes may lead to a delay in ASD diagnosis in female children with ASD, such as differing natural developmental trajectory, or professional or family under-awareness of ASD symptomatic differences in young female children. This study suggests that boys have more difficulties in social awareness and communication, and girls in social cognition. This may contribute to a later diagnosis in girls. With increased public and family awareness, there appears to be a trend of increased ASD recognition in girls. Future research on gender differences should compare different symptomology. Gender-specific risk factors should be taken into account in identification of ASD, especially for females.

3:04 **185.003** Profile of Girls Diagnosed with Autism Spectrum Disorder in a Clinical Setting

C. Hall, *T. Aronson and S. Hoffenberg, Marcus Autism Center, Children's Healthcare of Atlanta and Emory University School of Medicine, Atlanta, GA*

Background: Autism spectrum disorder (ASD) is estimated to be almost 5 times more common in boys than girls (Baio, 2014) and as such, what we know about the profile of ASD in girls lags far behind what is known about boys. Research has demonstrated greater cognitive impairment in girls (Frazier et al 2014) and later age of diagnosis, which can delay the start of intervention (Kavanagh et al., 2013; Rynkiewicz et al., 2012).
Objectives: The purpose of this study is to analyze the characteristics of girls diagnosed with autism in a clinic setting, including age of diagnosis, rates of diagnosis, and cognitive and adaptive functioning.
Methods: A record review was conducted of 1293 diagnostic evaluations conducted between 1/1/2012 and 9/30/2014 in an autism center serving a diverse population in Atlanta, GA. Children (ranging in age from 19 months to 16 years) were clinically referred and received a diagnostic interview prior to the assessment, confirming the presence of red flags for ASD. Diagnostic evaluations each included a developmental/cognitive measure (e.g., Mullen Scales of Early Learning, Differential Abilities Scale-Second Edition), adaptive measure (e.g. Vineland Adaptive Behavior Scales), and the Autism Diagnostic Observation Scale (ADOS or ADOS -II).
Results: Of the 1293 children who were evaluated, 824 received a diagnosis of ASD, and 108 (13%) of these were girls. There was no significant difference in age of first diagnosis based on gender (Girls M=50.77 months, SD =19.3; Boys M=54.2 months, SD=18.99). Sixty-six percent of the boys evaluated met diagnostic criteria for ASD, whereas only 41% of the girls met diagnostic criteria. Thirty percent of girls had a nonverbal IQ that fell within the average to above average range (IQ > 85), while 28% had average to above average verbal IQ. Girls with average to above average verbal IQ had a significantly later average age of first diagnosis (M=60.28 months, SD=24.08) than those with delayed verbal scores (M=46.36 months, SD=15.35; t(56) = 2.42, p<.05), though this difference was not found with regard to nonverbal IQ. Both verbal IQ and nonverbal IQ were positively correlated with the girls' scores in adaptive communication, daily living skills, socialization and motor skills on the Vineland.
Conclusions: Findings highlight comparable age of diagnosis for boys and girls, a lower rate of diagnosis for girls than boys in a clinical setting, and a later age of diagnosis for girls with higher verbal IQ scores (5.0 years old) compared those with delayed verbal IQ (3.8 years). Thirty percent of girls had average to above average cognitive scores, which is lower than the 46% that has been shown in overall population studies of both boys and girls with autism (Baio, 2014). Higher cognitive scores were associated with better adaptive communication, daily living skills, socialization and motor skills. These findings underscore the importance of continued focus on girls with ASD, particularly those with higher functioning forms of ASD, who may be later to be identified and underrepresented in the literature.

3:16 **185.004** The ADOS-2 and ADI-R: Are There Sex Differences?

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Background:
The research on sex differences in the behavioral phenotype in ASD has found that females demonstrate fewer repetitive behaviors but more communication deficits and greater anxiety and

depressive symptoms than males (Lord et al., 1982; Hartley & Sikora, 2009), with fewer differences in early development (Wijngaarden-Cremers et al., 2013; Reinhardt et al., 2014). While DSM-5 ASD criteria has adequate sensitivity in females with ASD, ranging from .88 to .93 (Huerta et al., 2012), further research is needed to determine whether there are sex differences in the diagnostic instruments used in ASD evaluations.

Objectives:

The goals of this study are to examine the utility of the ADOS-2 and ADI-R in male and female children and adults and to generate recommendations for diagnosis and classification.

Methods:

Participants were drawn from clinic and research datasets from the Center for Autism and the Developing Brain (CADB) and include children and adults with diagnoses of ASD and non-ASD diagnoses. Only one data point, the earliest full assessment, was used per participant. The resulting sample included 620 female and 2065 male children and adults. Sensitivity and specificity analyses of the ADOS-2 and ADI-R were conducted along with item-level analyses. For the purposes of taking into account the developmental and item-level differences in the instruments, the sample was stratified by age and language level.

Results:

The sensitivity and specificity of the new ADOS-2 algorithms was comparable in the male and female sample. In the female participants, sensitivity ranged from .86 (Module 3) to .98 (Module 1), while for the male participants, sensitivity ranged from .86 (Module 2, Under 5 Years) to .97 (Module 1). The specificity of the ADOS-2 algorithms also demonstrated similar patterns in the males and females in our sample. Additional analyses will examine whether there are sex differences in the ADI-R algorithm. Confirmatory factor analyses will also be conducted to examine whether the 2-factor model of ASD symptoms is comparable across the sexes.

Conclusions:

Preliminary study findings indicate that the gold standard instruments used in autism evaluations function similarly across the sexes.