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In This Issue

Coordinator's Column

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Welcome to the new year and another issue of SIG 1's *Perspectives on Language Learning and Education*. The new year is a great opportunity to reflect on the passage of time and progress that we are making professionally.

Looking Back

In the spring of 2012, the SIG 1 Coordinating Committee held its annual meeting at the ASHA National Office in Rockville, MD. While there, we met with ASHA staff, updated the SIG 1 work plan, and drafted plans for continuing education (CE) offerings for the next 12–15 months. Throughout the year, the Coordinating Committee met via monthly conference calls to address the continuing business of our SIG. In the autumn, SIG 1 continued our tradition of offering an annual SIG 1 Live Online Chat in October. The title of our 2012 online chat was "Narrative Assessment and Intervention." Our expert panelists were Doug Peterson from the University of Wyoming, Janet Dodd from Chapman University, and Lizbeth Finestack from the University of Minnesota. If you were not able to attend this event when it occurred live, you may wish to read the content of the session by accessing the archived chats at www.asha.org/events/live/.

The 2012 ASHA Annual Convention in Atlanta, GA, in November was a wonderful place to meet old friends and learn new information. On the first day of Convention, Judith Kuster conducted our SIG 1 Short Course on "'Netting' Free & Evidence-Based Information on the Internet." The next day, SIG 1 co-sponsored an invited session with the Language and Learning in School Age Children and Adolescents convention planning committee. Douglas Fuchs, professor of special education, and Nicholas Hobbs, chair of Special Education and Human Development at Vanderbilt University, were our co-sponsored speakers. Fuchs specializes in reading disabilities, peer-mediated instruction, classroom assessment, school restructuring and reform, and special education policy. His session, titled, "Intensive Instruction: What Is It and Why Do We Need It," examined evidence-based approaches to the highest tier of the Response to Intervention (RtI) educational paradigm.

In addition to planning our Convention Short Course, co-sponsoring the invited speaker session, and conducting an affiliates meeting at Convention, two of your SIG Coordinating Committee members also served on the Language and Learning in School Age Children and Adolescents Convention topic-planning committee for the 2012 Convention. SIG representation on Convention topic-planning committees is a new component of the SIG restructuring. We believe that this collaboration is very helpful in promoting coordinated efforts across various ASHA CE offerings, and we are happy to continue to serve SIG 1 affiliates through these activities. Planning high-quality CE opportunities for SIG 1 affiliates is one of your Coordinating Committee's highest priorities. If you have suggestions for speakers or topics for future events, please contact any SIG 1 Coordinating Committee member with your ideas, or voice them on the SIG 1 ASHA Community.

Looking Forward

For 2013, your SIG 1 Coordinating Committee members remain Lisa Price, Assistant Coordinator; Geralyn Timler, Online Activities Coordinator; Erin Taylor-Stone, CE Content

Manager; and Donna Boudreau, *Perspectives* Editor. I will continue to serve as the Coordinator. In addition, during this upcoming calendar year I will represent SIG 1 as a member of the Council for Clinical Specialty Recognition (CCSR) during a term beginning January 1, 2013, and ending December 31, 2013. Meanwhile, Donna Boudreau will represent SIG 1 on the 2013 ASHA Annual Convention Language in Infants, Toddlers, and Preschoolers topic-planning committee.

This issue of *Perspectives* marks the second year that SIG 1 has been able to offer four issues of this practitioner-focused publication. In addition, we are establishing a tradition of dedicating the January issue to the topic of autism spectrum disorders. Recall that our first January issue in 2012 was also devoted to this topic, with Lynn Hewitt from Bowling Green State University serving as guest editor. Linda Watson, from the University of North Carolina at Chapel Hill, serves as the guest editor for the current issue. We hope that you find this issue to be informative and helpful. As always, we strive to have *Perspectives* address issues that are of the greatest value and interest to our affiliates. Let us know whether you like the idea of continuing to reserve the January issue for the topic of autism spectrum disorders.

Each of us on your SIG 1 Coordinating Committee hopes that you find the content of every *Perspectives* issue to be highly informative and clinically relevant. It is our sincere desire to provide timely information and CE offerings that support your professional activities. We are always open to your suggestions and comments about *Perspectives* and SIG 1–sponsored events. You can contact any of us through the ASHA Community, or you may e-mail me directly at lmh3f@virginia.edu.

May your 2013 be productive and joyous!

Translating Between Research and Practice in Serving Infants at Risk for ASD

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Disclosure: Linda R. Watson is Principal Investigator and Elizabeth R. Crais is Co-Principal Investigator on a study of parent-mediated early intervention for infants at risk for ASD (2010–current). Watson and Crais are also named investigators on a grant from Autism Speaks to University of North Carolina–Chapel Hill; they receive no salary support from this grant.

In research studies, we are now able to identify many infants who are at risk for later diagnoses of autism spectrum disorders (ASD) as early as 12 months of age. The authors are part of a research team developing and testing a tool for early identification and also testing the efficacy of an early intervention for infants at risk for ASD. Challenges encountered in this research highlight some of the issues that speech-language pathologists and other professionals serving the infant/toddler population may face. This article uses our research team's experiences to raise some of the ethical and practical concerns regarding translating from research to practice in early identification for this population, and the potential implications for early intervention policies and services.

In the context of growing research on the early development of infants later diagnosed with autism spectrum disorders (ASD) and public health concerns about the increasing prevalence of ASD, early identification of these children is a high priority within translational research. At its best, translational research involves community stakeholders and researchers across disciplines working in a bidirectional way to influence the decisions made about research and practice that advance the wellbeing of the community (Kon, 2008). With a higher prevalence of ASD than once suspected—1 in 88 (Centers for Disease Control and Prevention [CDC], 2012)—and autism awareness campaigns at national and global levels (e.g., Learn the Signs, Act Early, www.cdc.gov/ncbddd/actearly/index.html; World Autism Awareness Day, www.autismspeaks.org/what-autism/waad), parents and clinicians alike are concerned with effective strategies for identifying children at risk as early as possible and promoting better outcomes.

In response to the needs, the Program for Early Autism Research, Leadership, and Service (PEARLS; www.med.unc.edu/ahs/pearls) team at the University of North Carolina at Chapel Hill is engaged in a program of translational research aimed at early identification (prior to 18 months of age) and intervention for infants at risk for ASD. We draw on our team's experiences and the current research literature to examine some of the challenges—first in translating "from research to practice," then later in translating "bidirectionally" between researchers and community stakeholders—for the wellbeing of this young age group.

Conceptual Basis for Intervention With Infants at Risk for ASD

In practice, the primary aim of earlier identification of ASD risk is to provide access to intervention services at an earlier age. No studies have tested the impact of beginning intervention between 12–18 months of age, before the symptoms of ASD are fully apparent in most children, compared to beginning intervention at a later age when diagnostic criteria can be more confidently applied. But, beginning intervention in infancy in this population is conceptually of interest in part due to recent neurodevelopmental research. More sophisticated conceptualizations of age-old nature-versus-nurture debates currently recognize the importance of transactional effects between genetic/neural mechanisms and environmental factors (Beauchaine, Neuhaus, Brenner, & Gatze-Kopp, 2008). This transactional model is directly applicable to the hypothesis that behavioral interventions beginning as soon as risk for ASD can be detected will be efficacious. Genetic factors are now viewed as establishing susceptibility to ASD rather than being deterministic. A number of candidate susceptibility genes for ASD are related to synaptic functions (Geschwind, 2009). Typical brain development during the first year of life is characterized by rapid proliferation of neurons and neural connections, with a relative lack of efficiency in functioning (Webb, Monk, & Nelson, 2001). Neural connections are shaped by experience, some strengthened and elaborated and others weakened or eliminated, depending on differential stimulation (Bethea & Sikich, 2007). Some have proposed that ASD reflects a disruption in the shaping of neural connectivity (Courchesne & Pierce, 2005). Introducing behavioral interventions with 1-year-olds, when neural shaping processes first become prevalent, arguably could lead to more typical neural connectivity, in turn leading to more normal child–environment transactions.

Red Flags for ASD Around the First Birthday

Increased knowledge of group-level differences between infants later diagnosed with ASD and other infants has emerged from different research approaches, including retrospective parent reports; retrospective analyses of infant home videos of children later diagnosed with ASD, other developmental disabilities (DD), or typical development; prospective studies of infant siblings of children diagnosed with ASD; and prospective studies of population-based samples. Table 1 provides a summary of potential red flags at 9–12 months of age. Data across studies suggest that consistent ASD markers are elusive up through 6 months of age, but that toward the end of the first year, numerous group differences emerge, especially between infants who go on to be diagnosed with ASD compared to typically developing infants. Although group differences suggest the possibility of identifying at least some infants at risk for ASD by 12 months of age, the translation of these findings into effective early identification presents challenges.

Table 1: Potential Risk Markers for ASD in Infants 9–12 Months of Age

Behavior	**Method & References**	
Sensory-Motor and Attention Features		
- More seeking deep pressure - More overly sensitive to touch	Retro video Retro report	Baranek, 1999 Watson et al., 2007
- More likely to seem not to hear - Less orienting to novel visual stimuli	Retro video Retro report	Baranek, 1999 Watson et al., 2007
- More repetitive motor actions - More repetitive activities with objects - More repetitive body movements	Retro video Retro report Prosp sibs	Osterling, Dawson, & Munson, 2002 Watson et al., 2007 Ozonoff et al., 2008

- More unusual posturing	Retro video	Baranek, 1999
- More visual fixations - More unusual visual explorations of objects - More difficulty with disengaging attention	Prosp sibs Retro report Retro video Prosp sibs	Zwaigenbaum et al., 2005 Watson et al., 2007 Baranek, 1999 Ozonoff et al., 2008
- Less likely to: reach into birthday cake; clap; stack blocks; scribble; bang on high-chair tray	Retro report	Gernsbacher, Sauer, Geye, Schweigert, & Hill Goldsmith, 2008
Self-Regulation		
- More self-regulatory difficulties - Less regulated sleep patterns - More difficult to calm when upset - More frequent and intense distress reactions	Retro report Retro report Prosp sibs	Gomez & Baird, 2005 Watson et al., 2007 Zwaigenbaum et al., 2005
Expressive Language and Communication		
- Lower expressive language standard scores	Prosp sibs	Zwaigenbaum et al., 2005
- Smaller consonant inventory - Less babbled syllables with consonants	Prosp sibs Prosp pop Retro report	Paul, Fuerst, Ramsay, Chawarska, & Klin, 2011 Veness et al., 2012 Watson et al., 2007
- Fewer vocalizations directed to others - Less coordination of vocalizations and gaze - Less initiation of communication	Prosp sibs Prosp sibs Prosp pop Retro report	Zwaigenbaum et al., 2005 Ozonoff et al., 2010 Veness et al., 2012 Watson et al., 2007
- Smaller gesture inventory - Fewer communicative gestures - Fewer pointing and showing gestures - Fewer pointing gestures to communicate - Less likely to gesture for joint attention	Prosp sibs Prosp pop Retro report Retro video Retro video	Zwaigenbaum et al., 2005 Veness et al., 2012 Watson et al., 2007 Osterling et al., 2002 Watson, Crais, Baranek, Dykstra, & Wilson, in press
Receptive Language and Communication		
- Lower standardized receptive language scores	Prosp sibs Prosp sibs	Zwaigenbaum et al., 2005 Ozonoff et al., 2010
- Less response to name - Less response to joint attention - Fewer phrases understood - Less response to “Where’s [familiar person or object]?”	Prosp sibs Retro video Retro report	Zwaigenbaum et al., 2005 Osterling et al., 2002 Watson et al., 2007
Play		
- More play with part of toy vs. whole toy - More likely to play with only a few toys	Retro report	Watson et al., 2007

Other Social Features		
- Atypical eye contact - More averting gaze from others' eyes - Less gaze to faces - Less looking at others	Prosp sibs Retro report Prosp sibs Retro video Prosp pop	Zwaigenbaum et al., 2005 Watson et al., 2007 Ozonoff et al., 2010 Osterling et al., 2002 Veness et al. 2012
- More content to play alone - Less interest in other babies - Harder to get baby to play social games - Harder to elicit social smile - Less imitation of others' behaviors - Less looking at objects held by others	Retro report Retro video	Watson et al., 2007 Osterling et al., 2002
- Harder to read baby's facial expressions	Retro report	Watson et al., 2007

Key: *Retro report* = Retrospective parent reports on infant behavior; *Retro video* = Analyses of home videos of children during infancy; *Prosp sibs* = Prospective studies of infant siblings of children diagnosed with ASD; *Prosp pop* = Prospective population-based sample

American Academy of Pediatrics Practice Guidelines on ASD Screening

In the United States, the American Academy of Pediatrics led the way in pushing for population screening for ASD by issuing clinical guidelines (Johnson & Myers, 2007) calling for routine screening for ASD for all toddlers at 18 and 24 months of age. But for infants younger than 18 months, the American Academy of Pediatrics report recommends only general developmental screening and surveillance for risk markers for ASD. Without implying that the challenges related to research-to-practice translations in screening for ASD at 18 months of age and older have been resolved, this article aims to stimulate consideration of ethical, policy, and implementation issues associated with the potential for screening infants for risk of ASD at younger ages.

Research to Practice: Development of an Early Autism Screening Tool

Our team has developed a screening tool called the First Year Inventory (FYI; Baranek, Watson, Crais & Reznick, 2003). The FYI was an attempt to translate the cumulative body of research regarding the many group differences or "red flags" for ASD in infants into an effective early screener. The current version (FYI 2.0) is a 63-item parent questionnaire normed for 12-month-olds. The conceptual framework of the FYI groups ASD risk factors into two broad domains: *social-communicative* and *sensory-regulatory behaviors*.

In an early effort to validate the FYI 2.0, we recruited parents of preschoolers with ASD, other DD, and typical development to fill out a retrospective version of the FYI (FYI-R; Watson et al., 2007) based on their recall of their child's behaviors at 12 months of age. Among the preschoolers with ASD, 35 of 38 scored above the 90th percentile on their total risk scores on the FYI-R, whereas none of the 40 children with typical development did so. The total risk scores of the children with other DD overlapped considerably as those of the children with ASD, suggesting the challenges in distinguishing these groups in infancy. At an individual item level, however, children with ASD had higher risk scores on the FYI-R than children with other DD, particularly on many items related to social orienting, receptive communication, and social-affective engagement, as well as a scattering of items related to imitation, expressive communication, sensory processing, reactivity, and repetitive behavior. These results were promising in suggesting that a set of key items might identify 12-month-olds who would go on to get a diagnosis of ASD.

Our later research, aimed at prospectively identifying 12-month-olds who would later be diagnosed with ASD, revealed differences between what parents recall retrospectively about their children's behaviors at 12 months of age and what they report when the infants are actually that age. For example, in retrospect, many parents reported that their child with ASD seemed to have trouble hearing in infancy (Watson et al., 2007). In two prospective samples followed by our team, however, only 1 parent of 16 infants later diagnosed with ASD reported that the infant seemed to have difficulty hearing. There were similar discrepancies on other items reported retrospectively versus concurrently, such as the infant's imitation of actions on objects or interest in other babies.

Another issue encountered in trying to translate research findings into an early ASD screening tool is that group differences from more comprehensive studies of a particular domain of behavior may not be easily captured when translated into concise questions on a parent questionnaire. For example, several studies have reported fewer communicative gestures among 12-month-olds later diagnosed with ASD compared to those with other DD or typical development (see Table 1). However, in our two prospective FYI samples, parents of only 2 of 16 infants later diagnosed with ASD indicated their child had limited gestures at 12 months of age.

An additional challenge in evaluating and refining the research-to-practice translation of a screening tool like the FYI is the need for data on later diagnostic outcomes. The PEARLS team followed up on our normative sample FYI 2.0 when the children were 3–4 years old (Turner-Brown, Baranek, Reznick, Watson, & Crais, in press). This study permitted us to revise our scoring algorithm and estimate the positive predictive value of the FYI 2.0. The scoring algorithm that best balanced between sensitivity (identifying as many infants later diagnosed with ASD as possible) and positive predictive value (minimizing false positives) was one that set dual cut-off risk scores in the FYI domains of social-communication and sensory-regulation. With this algorithm, we identified 4 of 9 infants who were diagnosed with ASD by the time of follow-up, for an estimated sensitivity of 44%; the other 5 children diagnosed with ASD by age 3–4 years did not meet risk criteria on the FYI at 12 months of age, and thus were "false negatives." This result was not especially surprising in light of other research regarding variable patterns of emergence of ASD symptoms, suggesting only about half of children with ASD are manifesting symptoms by the age of 12 months (Ozonoff, Heung, Byrd, Hansen, & Hertz-Picciotto, 2008). The positive predictive value for this sample was 31% for ASD—that is, 4 of 13 infants who scored at risk on the FYI were diagnosed with ASD by follow-up. The other 9 infants identified by the FYI were "false positives" for ASD. However, an additional 7 of these 9 infants who scored at risk had diagnoses of other DDs or parent-identified concerns about development at age 3–4 years, meaning that 85% of infants identified by the FYI went on to have either ASD or other developmental concerns. This follow-up study was invaluable in contributing to the ongoing development of the FYI, but highlighted several challenges:

- we had to wait 2–3 years after the initial screening with the FYI for the children to reach an age where we could expect most children with ASD to be reliably identified;
- the symptoms of infants later diagnosed with ASD overlap considerably with symptoms of infants with other developmental concerns;
- our follow-up on an original sample of about 1,000 infants yielded only 9 children with ASD diagnoses, giving us very limited statistical power for analyses comparing this subgroup to other subgroups, such as children with other DD, to determine which FYI items might be more sensitive to ASD; and
- a large follow-up study yielding more optimal statistical power would require a commensurately large amount of funding, which would rest on this type of research

being considered a high priority by funding agencies in the context of many competing ASD research priorities.

Bidirectional Research and Practice Challenges

In an effort to gain stakeholder input on early screening for ASD, the PEARLs team conducted a series of focus groups with primary care providers and gained further insight into potential translational challenges (Crais et al., 2012). From an implementation perspective, primary care providers were concerned with issues such as the time required for ASD screening (i.e., they wanted a short screening tool), following up on positive screening results, and reimbursement. For financial reasons, they wanted a free or inexpensive tool. From an ethical perspective, they did not want to cause parents needless distress related to false positive identification, nor did they want to refer parents without assurance that adequate community services would be available. Many primary care providers felt inadequately prepared to address questions related to ASD in their practice.

Comparing the primary care providers' concerns expressed during our focus groups to the current research on early ASD screening reveals significant research-to-practice gaps. In our own research program, for example, we have not yet found a small set of items to reliably identify 12-month-olds at risk for ASD, and sensitivity and positive predictive value of the current FYI would likely not meet the expectations of these primary care providers. Research-to-practice gaps can be illustrated with other ASD screening tools as well. The most widely researched early ASD screener is the Modified Checklist for Autism in Toddlers (M-CHAT; Robins, Fein, & Barton, 1999a), a 23-item parent questionnaire designed to screen toddlers, 16–30 months old. For failed M-CHAT screenings, a follow-up parent interview is used to reduce the number of false positives (Robins, Fein, & Barton, 1999b). Comparing the performance of the M-CHAT by age groups, Pandey et al. (2008) found a positive predictive value of .61 when using the M-CHAT for community screenings of older toddlers (24–30 months), but a value of only .28 for younger toddlers (16–23 months). Based on the comments in our focus groups (Crais et al., 2012), primary care providers likely would be concerned with the number of false positives reflected by those positive predictive values, especially for younger toddlers. Further, some of our focus group participants were using the M-CHAT but unaware of the availability of follow-up questions.

Perhaps a more extended conversation of the goals of early ASD screening and the current research evidence would bring researchers and community practitioners to a more optimistic perspective on the potential benefits of ASD screening in infancy. Similar to our findings with the FYI, other ASD screening research has demonstrated that the majority of infants and toddlers identified but not subsequently diagnosed with ASD (i.e., the false positives) have other developmental problems, or exhibit concerning behaviors that warrant monitoring (Miller et al., 2011; Pandey et al., 2008; Pierce et al., 2011; Robins, 2008). Referrals for developmental assessments (including in-depth assessment of ASD symptoms), therefore, are highly appropriate for infants and toddlers flagged in ASD screenings.

Another screening challenge is that definitive data on the sensitivity of early ASD screening tools are scant, because determining sensitivity depends on follow-up data on children who screen negative. Children with ASD who are higher functioning and have milder symptoms are often not diagnosed until school-age (CDC, 2012), suggesting that follow-up studies need to be completed years after the original screenings to get an accurate estimate of missed cases. Due to the heterogeneity in the emergence of ASD symptoms across the first few years (Ozonoff et al., 2008) and documented patterns of regression at mean ages slightly older than 2 years (Wiggins, Rice, & Baio, 2009), screening in the early part of the second year likely will miss many cases. Thus, practitioners might be reluctant to screen infants younger than 18 months due to low sensitivity. If, however, screenings are repeated and surveillance is ongoing, as recommended by the American Academy of Pediatrics (Johnson & Myers, 2007), what level of sensitivity is required to make a first-time screening around 12 months worthwhile? For example, if we could identify at 12 months one-third to one-half of the children who will eventually get an ASD diagnosis, would this warrant an earlier routine ASD screening than currently recommended?

Beyond the issue of sensitivity of ASD screening tools at different ages, other questions need addressing. In particular, what is the efficacy of interventions with infants at risk for ASD? Although comparisons of child outcomes for interventions initiated before versus after 18 months would be empirically informative, researchers proposing such studies would need to demonstrate that their study design addressed potential ethical concerns related to delaying intervention for some at-risk infants or toddlers. Also, even if research supports the efficacy of early interventions for infants at risk for ASD, the value at a societal level would only accrue if effective interventions could be delivered in community settings at a cost offset by the eventual benefits. Policy-makers and practitioners are faced with a dilemma not uncommon in efforts to use evidence-based practices: the available empirical data rarely offer indisputable guidance for decision-making. The development of clinical practice guidelines (e.g., Johnson & Myers, 2007) in the absence of definitive evidence can be beneficial, however, in clarifying what research questions need addressing in order to improve practices at the community level.

Studies of community implementation highlight additional unresolved ASD screening challenges. Even though ASD-specific screening of toddlers is recommended by the American Academy of Pediatrics, primary care providers do not always follow these guidelines. For example, recent studies have reported rates of routine screening for ASD among pediatricians and family practice physicians range from 22% (Pierce et al., 2011) to 28% (Gillis, 2009). Identifying and addressing barriers to full implementation of ASD screenings by primary care providers is an important goal for translational research.

Further issues in ASD screenings in community practice include difficulties following up with parents either due to parents not responding or declining follow-up. For example, Dietz, Swinkels, van Daalen, van Engeland, and Buitelaar (2007) found that 31% of parents of children who failed an ASD screening at 14–15 months of age did not follow through on recommendations for a second screening. Understanding parents' reasons for not following up, and the extent to which their decisions result in missed early diagnoses, could inform implementation decisions. For example, parents may not follow through because they are not concerned about their child's development at young ages, when the risk markers for ASD are less salient to them. Indeed, Wetherby, Brosnan-Maddox, Peace, and Newton (2008) found that only half of the parents of infants under the age of 15 months who were later diagnosed with ASD expressed concerns. Therefore, future translational research could focus on strategies for communicating effectively with families about ASD screening results.

Another issue in the translation of research to practice is that primary care providers who do screen do not always refer children based on the results. In one study (Pierce et al., 2011), pediatricians screened more than 10,000 1-year-olds using the Infant-Toddler Checklist (ITC; Wetherby & Prizant, 2002). Although it is a broad screener and not ASD-specific, the ITC appears to be quite sensitive to ASD (Wetherby et al., 2008). Of 1,318 infants who failed the screening, only 346 were referred to the researchers who followed up on the failed cases. In these situations, the primary care providers may have overruled the results based on their clinical judgment that the infant was not at risk for developmental problems. Thus, more research on the decision-making process used by primary care providers regarding referrals would be useful in planning for broad-based ASD community screening.

Finally, programs for broad-based community ASD screening of young children outside of their medical homes (e.g., through childcare programs) have not been widely described or studied, and warrant attention in translational research to address the public health priority of early ASD screening. Speech-language pathologists who work with infants and toddlers are also in an ideal position to screen for early ASD symptoms. With existing practices, disparities in age of diagnosis of ASD continue to exist based on factors such as socioeconomic status, race, and ethnicity (CDC, 2012; Fountain, King, & Bearman, 2011), highlighting the need to examine alternative screening strategies that would close these gaps.

Implications for Early Intervention for Infants at Risk for ASD

Unique issues arise when comparing early intervention decisions for infants at risk for ASD with those for children already diagnosed. Most states require substantial delays or a diagnosed condition associated with a high likelihood of DD for toddlers to be eligible for Part C services. In an ongoing intervention study by our team, developmental assessments were completed on 49 infants (13–15 months of age) who scored at risk for ASD on the FYI 2.0. Using North Carolina Part C eligibility criteria, 26 of these infants would be eligible based on the extent of their developmental delays; however, 23 would not. Among the ineligible infants, 18 had one or more developmental subtest scores greater than one standard deviation below the mean. In following up thus far on 17 of these ineligible children 20–23 months of age, 5 exhibited symptoms consistent with an ASD diagnosis, and an additional 3 showed enough symptoms to warrant ongoing monitoring.

Our experiences in this study point to another major challenge ensuing from screening infants for risk of ASD: some infants show red flags for ASD and indeed are later diagnosed with ASD, but do not have dramatic developmental delays at 12–15 months. The parents of these infants may feel ambivalent about whether they should be concerned or not, and about whether to seek services or “wait and see.” If they do seek services, they likely will find that Part C services are not available and that insurance coverage for services may be difficult to obtain in the absence of a diagnosis. Further, those families who can afford to pay for services may have difficulty locating community providers with expertise with this population.

Conclusions

We have the capability of identifying infants at risk for ASD through parent-report screening tools, and implementing interventions with these infants has conceptual support from neurobiological research. A sizeable proportion of these infants at risk will later be diagnosed with ASD; many will not have ASD, but will be later identified with other developmental problems; and a few of them will have no later developmental concerns. Currently, we cannot reliably diagnose ASD in most toddlers until 18–24 months of age or later, leading to a time gap between the age at which we can identify risk signs of ASD and the age at which we can provide definitive differential diagnoses. Translational research related to screening and serving infants at risk for ASD is ongoing, but currently is insufficient to provide solid empirical foundations for policy development and practice decisions related to serving infants who show risk for ASD but are not yet old enough to be reliably diagnosed. Yet, the increasing prevalence and increasing autism awareness have engendered a sense of urgency to identify children with ASD and implement interventions as early as possible. Stronger alliances between community stakeholders and researchers could address this public health need by fostering more efficient and effective translations between research and practice in serving infants at risk for ASD.

References

Baranek, G. T. (1999). Autism during infancy: A retrospective video analysis of sensory-motor and social behaviors at 9–12 months of age. *Journal of Autism and Developmental Disorders, 29*, 213–224.

Baranek, G. T., Watson, L. R., Crais, E., & Reznick, S. (2003). *First-Year Inventory (FYI) 2.0.* Chapel Hill, NC: University of North Carolina at Chapel Hill.

Beauchaine, T. P., Neuhaus, E., Brenner, S. L., & Gatze-Kopp, L. (2008). Ten good reasons to consider biological processes in prevention and intervention research. *Development and Psychopathology, 20*, 745–774.

Bethea, T. C., & Sikich, L. (2007). Early pharmacological treatment of autism: A rationale for developmental treatment. *Biological Psychiatry, 61*, 521–537.

Centers for Disease Control and Prevention. (2012). Prevalence of autism spectrum disorders: Autism and Developmental Disabilities Monitoring Network, 14 sites, United States, 2008. *Morbidity and Mortality Weekly Report, 61*(No. SS-03), 1–19.

Courchesne, E., & Pierce, K. (2005). Why the frontal cortex in autism may be talking only to itself: Local overconnectivity but long-distance disconnection. *Current Opinion in Neurobiology, 15*, 225–230.

Crais, E. R., McComish, C., Humphreys, B., Watson, L., Baranek, G., Reznick, S., . . . Earls, M. (2012). *Primary care providers' views on ASD screening at 12-18 months* [Manuscript in preparation].

Dietz, C., Swinkels, S. H., van Daalen, E., van Engeland, H., & Buitelaar, J. K. (2007). Parental compliance after screening social development in toddlers. *Archives of Pediatric and Adolescent Medicine, 161*, 363–368.

Fountain, C., King, M. D., & Bearman, P. S. (2011). Age of diagnosis for autism: Individual and community factors across 10 birth cohorts. *Journal of Epidemiology and Community Health, 65*, 503–510.

Gernsbacher, M. A., Sauer, E. A., Geye, H. M., Schweigert, E. K., & Hill Goldsmith, H. (2008). Infant and toddler oral- and manual-motor skills predict later speech fluency in autism. *Journal of Child Psychology and Psychiatry, 49*, 43–50.

Geschwind, D. H. (2009). Advances in autism. *The Annual Review of Medicine, 60*, 367–380.

Gillis, J. M. (2009). Screening practices of family physicians and pediatricians in 2 southern states. *Infants and Young Children, 22*(4), 321–331.

Gomez, C. R., & Baird, S. (2005). Identifying early indicators for autism in self-regulation difficulties. *Focus on Autism and Other Developmental Disabilities, 20*(2), 106–116.

Johnson, C. P., & Myers, S. M. (2007). Identification and evaluation of children with autism spectrum disorders. *Pediatrics, 120*(5), 1183–1215.

Kon, A. A. (2008). The Clinical and Translational Science Award Consortium and the translational research model. *The American Journal of Bioethics, 8*, 58–60.

Miller, J. S., Gabrielsen, T., Villabos, M., Alleman, R., Wahmhoff, N., Carbone, P. E., & Segura, B. (2011). The Each Child Study: Systematic screening for autism spectrum disorders in a pediatric setting. *Pediatrics, 127*, 866–871.

Osterling, J. A., Dawson, G., & Munson, J. A. (2002). Early recognition of 1-year-old infants with autism spectrum disorder versus mental retardation. *Development and Psychopathology, 14*, 239–251.

Ozonoff, S., Heung, K., Byrd, R., Hansen, R., & Hertz-Picciotto, I. (2008). The onset of autism: Patterns of symptom emergence in the first years of life. *Autism Research, 1*, 320–328.

Ozonoff, S., Iosif, A. M., Baguio, M. F., Cook, I. C., Hill, M. M., Hutman, T., . . . Young, G. S. (2010). A prospective study of the emergence of early behavioral signs of autism. *Journal of the American Academy of Child and Adolescent Psychiatry, 49*(3), 256–266.

Ozonoff, S., Macari, S., Young, G. S., Goldring, S., Thompson, M., & Rogers, S. J. (2008). Atypical object exploration at 12 months of age is associated with autism in a prospective sample. *Autism, 12*, 457–472.

Pandey, J., Verbalis, A., Robins, D. L., Boorstein, H., Klin, A., Babitz, T., . . . Fein, D. (2008). Screening for autism in older and younger toddlers with the Modified Checklist for Autism in Toddlers. *Autism, 12*, 513–535.

Paul, R., Fuerst, Y., Ramsay, G., Chawarska, K., & Klin, A. (2011). Out of the mouths of babes: Vocal production in infant siblings of children with ASD. *Journal of Child Psychology and Psychiatry, 52*(5), 588–598.

Pierce, K., Carter, C., Weinfeld, M., Desmond, J., Hazin, R., Bjork, R., & Gallagher, N. (2011). Detecting, studying, and treating autism early: The one-year well-baby check-up approach. *The Journal of Pediatrics, 159*, 458–465e6.

Robins, D. L. (2008). Screening for autism spectrum disorders in primary care settings. *Autism, 12*, 537–556.

Robins, D. L., Fein, D., & Barton, M. L. (1999a). The Modified Checklist for Autism in Toddlers (M-CHAT). Storrs, CT: Authors.

Robins, D. L., Fein, D., & Barton, M. L. (1999b). *Follow-up Interview for the Modified Checklist for Autism in Toddlers (M-CHAT FUI).* Storrs, CT: Authors. Retrieved from www2.gsu.edu/~psydlr/DianaLRobins/Official_M-CHAT_Website_files/M-CHATInterviewREV.pdf

Turner-Brown, L. M., Baranek, G. T., Reznick, J. S., Watson, L. R., & Crais, E. R. (in press). The First Year Inventory: A longitudinal follow-up of 12-month-old to 3-year-old children. *Autism.*

Veness, C., Prior, M., Bavin, E., Eadie, P., Cini, E., & Reilly, S. (2012). Early indicators of autism spectrum disorders at 12 and 24 months of age: A prospective, longitudinal comparative study. *Autism, 16*, 163–177.

Watson, L. R., Baranek, G. T., Crais, E. R., Reznick, S. J., Dykstra, J., & Perryman, T. (2007). The First Year Inventory: Retrospective parent responses to a questionnaire designed to identify one-year-olds at risk for autism. *Journal of Autism and Developmental Disorders, 37*, 49–61.

Watson, L. R., Crais, E. R., Baranek, G. T., Dykstra, J. R. & Wilson, K. P. (in press). Communicative gesture use in infants with and without autism: A retrospective home video study. *American Journal of Speech-Language Pathology.*

Webb, S. J., Monk, C. S., & Nelson, C. A. (2001). Mechanisms of postnatal neurobiological development: Implications for human development. *Developmental Neuropsychology, 19*, 147–171.

Wetherby, A. M., Brosnan-Maddox, S., Peace, V., & Newton, L. (2008). Validation of the Infant Toddler Checklist as a broadband screener for autism spectrum disorders from 9 to 24 months of age. *Autism, 12,* 487–511.

Wetherby, A. M., & Prizant, B. M. (2002). *Communication and Symbolic Behavior Scales Developmental Profile*. Baltimore, MD: Paul H. Brookes.

Wiggins, L. D., Rice, C. E., & Baio, J. (2009). Developmental regression in children with an autism spectrum disorder identified by a population-based surveillance system. *Autism, 13*, 357–374.

Zwaigenbaum, L., Bryson, S., Rogers, T., Roberts, W., Brian, J., & Szatmari, P. (2005). Behavioral manifestations of autism in the first year of life. *International Journal of Developmental Neuroscience, 23*(2–3), 143–152.

Cultural Considerations in Serving Children With ASD and Their Families: Asian American Perspective

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The author of this article reviews cultural differences that will guide clinicians when providing services to Asian American children with autism and discusses culturally based clinical issues/suggestions for working successfully with Asian American families. Theory is followed using examples from three sources: (a) the author's direct experience, (b) a Korean parent support group, and (c) a one-time open dialogue event among Asian parents of children with autism and professionals who serve them.

Asia is a relatively large continent that includes East Asia (China, Hong Kong, Japan, Macau, Mongolia, Korea, and Taiwan), South Asia (Brunei, Burma, Cambodia, East Timor, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, and Vietnam), and the Pacific Islands (Samoa, Hawaii, and Guam). Each country has its own language and unique culture. However, given that the cultures are broadly similar (i.e., there are more cultural similarities than differences), some generalizations are possible. This article first reviews culturally based issues commonly observed in Asian Americans. Speech-language pathologists (SLPs) will encounter these cultural issues when serving Asian American children with autism. Secondly, useful strategies to serve these children/families are presented. This article links theoretical information to the observations accumulated from three sources: (a) direct personal experiences as a person born and raised in Korea until beginning doctoral training in the United States (naturalized U.S. citizen), (b) being the host of a 2-hour monthly parent support group with Korean American parents (mostly mothers) of children with autism in Southern California since 2007, and (c) hosting a one-time (half-day) open dialogue event among 16 Asian parents and 33 professionals who serve them in 2010.

Cultural Differences in Asian American Children With Autism

It is important for SLPs to be aware of cultural differences because they could result in miscommunication or conflict between clients/parents and clinicians. Below, some of these differences are described.

Cultural Stigma of Autism/Developmental Disability

Asian culture is a more collectivistic culture than many Western cultures. Members of this culture are also sensitive to the perceptions of others. An abstract percept of each individual's "social self-worth" is referred to as *face* (Ting-Toomey & Kurogi, 1998). This concept is applicable to all human beings (everyone has one's own face to maintain), but it is much more critical for Asians (or Asian Americans). When they experience losing face, it creates conflicts and usually results in face-saving efforts. Face-negotiation theory (Ting-Toomey, 2005) explains how individuals resolve conflict situations. When an Asian family has a child with any developmental disability (e.g., autism, Down syndrome, cerebral palsy, cleft palate/lip, etc.), it creates conflict between perceptions of the parents and others, which results in “shame” to the family (Parette, Chung, & Huer, 2004). To maintain their face, many Asian or Asian American parents of a child with a developmental disability become disconnected from grandparents of the child and other family members, either to hide the fact that the child has a disability or to cope with the parental stress of the disability not being accepted once it is revealed.

As an example, the cultural stigma of disability was observed in a Korean American couple who planned to bring their daughter with Down syndrome to visit her grandparents in Korea. This child has experienced severe medical challenges (tube-dependent feeding for severe feeding problems, cleft palate, and additional diagnosis of autism). The father of the child has been involved actively in the management of the child’s medical care. He frequently attended workshops on various topics. After 4–5 years of efforts to keep their daughter’s medical condition relatively stable, the parents decided to bring her to meet her grandparents. However, this plan was blocked by the grandparents, who did not want to see this child, and the trip had to be cancelled. It was due to grandparents’ desire to save their face by not revealing the child’s disability to their friends and family. Another example came from a Korean mother living in Korea, who hid her son’s diagnosis of autism because it was looked down on by family members and people outside the family. She experienced frustration by others’ disrespect during their outings. Their face negotiation effort to manage the social stigma pushed the family away from their home land and they immigrated to the United States.

Emphasis on Education/Academics

Historically, Korean culture (and many others in Asia) has placed a very high value on academics. This has been reflected in four social classes in the order of scholars, farmers, engineers, and businessman. The social class concept has been diluted significantly and the order of preference has changed over time. Currently, the value on academic performance of children has been elevated with changes in family structures (having only one or two children instead of several, many females maintaining their career, etc.). An educated family wants to maintain the family tradition, while uneducated parents perceive education as a means to transform their children’s future by having more opportunities to secure a better, more respected job (Son, 2005). Polarization of educational gaps has emerged (i.e., children from highly educated, high-income families perform significantly better than children from low-income, less-educated families; Rhu, 2007). To fulfill the core academic values, many Korean parents aim to place their children at the top-tier competitive schools within Korea and abroad. Consequently, parents become extremely sensitive to an academic institution’s “brand name” (e.g., Harvard University over many other excellent private/state universities).

Recently, there has been influx of Korean immigrants to the United States. This phenomenon might be accounted for by a *push* (push people away from their home land) and *pull* (pull people into a new country) factor immigration model (Peterson, 1958). An extremely competitive and academic success–oriented educational style for typically developing children and the social stigma of special needs children serve as push factors from Korea (Lee, 2008; Parette et al., 2004). Pull factors include more educational opportunities for typically developing children and better special education programs for children with developmental disabilities in the United States. Families who immigrate for their children with special needs, and who have the financial assets, may start small businesses as a means to survive in the United States (Yoon, 1997). People who do not have the financial means to start their own business may seek employment in settings that do not require English proficiency or specific skills such as working at ethnic grocery stores and restaurants, painting jobs, driving cabs, and the like. Some have even abandoned their established careers (e.g., teachers, lecturers at colleges, employees at various companies, etc.) in their home country (Min, 1984). In recent years, a new form of family structure has emerged in an effort to educate their children in the United States. In this case, mostly fathers stay in the homeland to support the family financially and the mothers live in the United States with their children. This is referred to as a *gilugi* or *geese* family (referring to the migratory nature of the family member), in which once or twice a year, either the father visits the family in the United States, or the family may visit the father in the homeland (Lee, 2008). Separation of the family for their children's education is a difficult concept for most Americans to understand, but it is relatively common for many Korean parents; they see it as important to sacrifice their personal life for their children's education (Lee, 2008; Son, 2005).

Due to this historically rooted perspective, academic performance remarkably outweighs functional daily living skills for Korean parents. The overall cultural/societal emphasis has a spill-over effect on clinical intervention for children with disabilities. It can create dissatisfaction for parents when non-academic skills are suggested as intervention goals. Clinicians should be mindful about this cultural perspective when sharing the functional/ecologically valid intervention goals. Clinicians are highly likely to encounter dissatisfaction from the parents. For example, a student clinician at our university clinic recently treated a Korean American high school student who had autism (moderate severity level). The clinician set goals of improving social skills in daily living contexts (e.g., grocery shopping, ordering at restaurants, etc.). However, the mother of the client wanted the clinician to focus on math and writing skills so that he could improve his academic performance at school. It took several counseling sessions to explain the importance of building independent/functional living skills that are developmentally appropriate.

Another context in which cultural beliefs about education impact children with disabilities is the parents' decision to pursue additional therapies for their child. Shin (2002) has reported a difference between American and Korean mothers in the purpose or reasoning behind using supplemental private services. Culturally, many parents in Korea place their children in after-school private tutoring centers. This often poses a financial burden on the family. With limited financial resources, Korean American parents who have children with developmental disabilities often utilize tutors due to their familiarity of tutors for typically developing children, instead of providing professional services such as speech-language therapy. American mothers are much more likely to use their resources for private SLP services. This difference is a clear reflection of the Korean perspective on the importance of academics.

This cultural viewpoint may also lead parents to choose specific therapies that most closely reflect their cultural perspectives. For example, Korean (and other Asian) parents tend to perceive applied behavioral analysis (ABA) interventions favorably, which could be related to the structures used in ABA. Most Korean parents tend to prefer structured rather than play-based activities (author's observation). This may originate from their preference on academic over functional skills–training. The author asked mothers, who participated in a research study, to play with their child as they would typically do at home as part of research data collection. Several mothers reported that playing would be more difficult than teaching their children at a table. Some even expressed that they would like to learn how to play with their children.

Authoritarian/Hierarchical Perspective Toward Professionals

Asian cultures tend to be authoritarian, which is reflected in the parental decision-making process. They rely on the professional's perspective, because professionals are perceived as those who have the knowledge. Therefore, they rely on a professional's input as presented, rather than questioning professional decision (Blanche, 1996). This cultural view is often coupled with Korean parents' tendency to be less comfortable with naturalistic/environmentally based therapies. Often, Korean parents (and Asian American parents) of children with autism perceive that the ABA therapist is doing everything, including helping their child's social skills and verbal communication skills. This could be because some ABA therapists inform the parents that they help social and communication skills, and parents take that information within their authoritarian perspective. It should be noted here that some ABA approaches teach social skills.

Communication Styles

Communication styles have been framed in high-context and low-context communication (Gudygunst, 2001; Shu-Minutoli, 1995). *High-context* styles are indirect, infer meanings from the context, have interpersonal sensitivity, use silence, and use emotions to guide one's behavior. *Low-context* styles are direct, dominant, dramatic, animated, and open. Typically, Asian Americans follow a high-context style and European Americans follow a low-context communication style. These styles also interact with age and social status (Park & Kim, 2008). If clinicians are not sensitive to the high-context communication style, this could result in misunderstanding. For example, at the onset of Individualized Education Program (IEP) meetings, small-talk may be used to put meeting participants at ease. A few Korean American mothers reported to the author their perception of the small talk at the IEP meeting as "not taking the meeting as seriously as the mothers did." This clearly would not be the intention of the school personnel and likely to be a case of unintended miscommunication caused by communication style differences. Another example occurred when the author hosted the open dialogue event. A European American student alerted the author that a Korean American student volunteer was not actively participating in hosting the Korean American guests. It turned out that the Korean American student followed the high-context communication style of being less dominant/dramatic and being silent more frequently as she interacted with guests who were older than she.

Suggested Strategies to Work Successfully With Asian American Parents of Children With Autism

It takes mutual efforts to work successfully with Asian American parents of children with autism. The suggested strategies below involve clinicians' relationship-building efforts with the parents and clinicians' transforming their new cultural understanding into enhanced sensitivity.

Suggestions to Benefit Parents

It will be beneficial to discuss cultural differences with parents and their impact on how parents might feel about certain situations. IEPs could be one situation where cultural differences could impact the parents greatly. It is critical to establish a trusting, understanding, and collaborative relationship with parents, especially those whose English proficiency is limited (Lynch & Hanson, 1998). An example of building trusting relationships between parents and school personnel was selected from the open dialogue event discussed above: A couple of Korean parents expressed their appreciation when a school teacher assisted them personally in setting IEP goals prior to the meeting, and took the time to discuss the child's progress on the IEP goals. Communication is key to establishing the relationship.

Suggestions for Clinicians

It is a very abstract and difficult process to put oneself into other people's shoes. It is only feasible to understand the daily experiences of recent immigrants who have children with autism if we reflect on it often. Videotaping interactions with Asian American parents in clinical settings can be very helpful. Some Korean parents may feel uncomfortable being videotaped. However, if the clinician explains that the purpose of videotaping is to identify any culturally based misunderstanding, it will likely be more accepted. By analyzing the interaction (and carefully observing communication styles), we can identify any unintended miscommunication or communication breakdowns and ultimately enhance the intercultural communication. After clinicians identify unintended miscommunications, reviewing those segments with parents will help the parents understand its direct benefit for their child. Taking multicultural issues as part of routine continuing education credit is another suggestion. Multicultural issues, at times, refer to surface-level issues (e.g., living in a neighborhood or having coworkers of people of various ethnic heritages) without any intercultural connection. Such shallow encounters could create surface-level cultural knowledge that is not processed internally within an individual as part of his/her cultural competence. It is mandatory for clinicians to monitor their cultural competence regularly and continuously by taking continuing education opportunities, preferably with more hands-on learning opportunities, rather than simply reading or listening to lectures. A final suggestion would be to take time to experience Asian American cultural events to develop more substantial understanding of Asian American cultures and to increase the cultural understanding of various Asian American cultures. Experiencing the culture may be the most effective form of clinical education.

Conclusions

This article discussed cultural differences in Asian Americans in the social perception of autism/disability, significant values on the academic performance, authoritarian perspectives on professionals, fuzzy perceptions on the professional responsibilities, and communication style differences. Based on these cultural issues, it is suggested that clinicians try to establish more trusting interpersonal relationships with the parents of this population. This can be accomplished through mutual efforts. Two components of the efforts to decrease any existing barriers between Asian American parents and clinicians are (a) more frequent discussions of cultural differences and its potential impact on the children we serve and (b) more frequent reflections by clinicians on their inter-cultural sensitivity.

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References

Blanche, E. I. (1996). Alma: Coping with culture, poverty, and disability. *The American Journal of Occupational Therapy, 50*, 265–276.

Gudygunst, W. B. (2001). *Asian American ethnicity and communication*. Thousand Oaks, CA: Sage.

Lee, D. (2008). A study of the wild geese fathers' conflicts on education for children. *The Journal of Research in Education, 11*(32), 21–46.

Lynch, E. W., & Hanson, M. J. (1998). Steps in the right direction: Implications for interventionists. In E. W. Lynch & M. J. Hanson (Eds.), *Developing cross-cultural competence: A guide for working with young children and their families* (pp. 491–512). Baltimore, MD: Paul H. Brookes.

Min, P. G. (1984). From white-collar occupations to small business: Korean immigrants' occupational adjustment. *The Sociological Quarterly, 25*(3), 333–352.

Parette, P., Chung, S-J. L., & Huer, M. B. (2004). First-generation Chinese American families' attitudes regarding disability and educational interventions. *Focus on Autism and Other Developmental Disabilities, 19*(2), 114–123.

Park, Y. S., & Kim, B. S. (2008). Asian and European American cultural values and communication styles among Asian American and European American college students. *Cultural Diversity and Ethnic Minority Psychology, 14*(1), 47–56.

Petersen, W. (1958). A general typology of migrating. *American Sociological Review, 23*, 256–266. doi:10.2307/2089239

Ryu, H. G. (2007, Summer). Social class and educational gap. *The HRD Review*, 62–73.

Shin, J. Y. (2002). Social support for families of children with mental retardation: Comparison between Korea and the United States. *Mental Retardation, 40*(2), 103–118.

Shu-Minutoli, K. (1995). Family support: Diversity, disability, and delivery. *Yearbook in Early Childhood Education, 6*, 125–140.

Son, J.-J. (2005). Sociological analysis on the phenomenon of Korean students studying abroad. *The Journal of Research in Educational Sociology, 15*, 95–120.

Ting-Toomey, S., & Kurogi, A. (1998). Facework competence in intercultural conflict: An updated face-negotiation theory. *International Journal of Intercultural Relation, 22*(2), 187–225.

Ting-Toomey, S. (2005). The matrix of face: An updated face-negotiation theory. In W. B. Gudykunst (Ed.), *Theorizing about intercultural communication* (pp. 71–92). Thousand Oaks, CA: Sage.

Yoon, I.-J. (1997). A cohort analysis of Korean immigrants' class backgrounds and socioeconomic status in the United States. *Korean Journal of Population and Development, 26*(1), 61–81.

Zhang, C., & Bennett, T. (2003). Facilitating the meaningful participation of culturally and linguistically diverse families in the IFSP and IEP process. *Focus on Autism and Other Developmental Disabilities, 18*(1), 51–59.

The Perception of the Relationship Between Affective Prosody and the Emotional Content in Utterances in Children With Autism Spectrum Disorders

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Children with autism spectrum disorders (ASD) were compared to children with specific language impairment (SLI) and typically developing (TD) children and adults in their ability to perceive and judge the emotional information conveyed by happy, neutral, and sad prosody. Authors found that high-functioning verbal children with ASD have an implicit sensitivity to emotional prosody, but are unable to explicitly judge the emotion of the same prosody. Children with SLI showed they were better able to judge the emotional prosody, similar to TD children, although not as well as adults. The findings indicate that, unique to the children with ASD, there is a disconnect between the implicit processing of emotional prosody and the explicit labeling of the emotion in prosody. This is promising for interventions aimed at facilitating the abilities of ASD children in their everyday understanding of emotional prosody in conversation.

Purpose

The umbrella term *autism spectrum disorders (ASD)* refers to a group of developmental disorders characterized by three diagnostic features: delayed or impaired language abilities and communication deficits, impaired social skills, and a restricted set of interests and/or repetitive behaviors (American Psychiatric Association [APA], 2000). It is estimated that 1/88 children now receive a diagnosis of ASD (Centers for Disease Control and Prevention, 2012). This substantial increase in the number of children who carry a diagnosis has serious repercussions for clinicians in the field of communication disorders. Increasingly, therapists in various settings will find themselves either specializing in autism or experiencing a rise in the proportion of children and adults on their caseload with ASD. To that end, it is of critical import to be well versed in all aspects of ASD, an unquestionably heterogeneous spectrum of disorders in the expression of the phenotype and, thus, extremely complex with regard to the multitude of issues involved in the treatment of those with ASD.

This article focuses on one aspect of language comprehension: *prosody*, or the rhythm and tune of speech. At first glance, prosody might appear to be a rather constrained focus, given the wide range of language abilities in ASD. As one considers the many linguistic and social aspects of communication that are influenced by prosody, however, it becomes clear that prosody is quite complex as well. In the description of the functions of prosody below, the link between ASD symptomology and prosody becomes apparent. The experiments presented focus on one of these functions: The understanding of emotional information as it is conveyed by prosody.

What is Prosody?

Prosody is a term used in linguistics to describe the rhythm and tune of spoken language. The perception of prosody is derived from changes in pitch, duration, and intensity in the speech stream (Beckman & Ayers, 1997; Pierrehumbert & Hirschberg, 1990), and it influences the interpretation of many linguistic and social aspects of communicative acts.

For example, prosody can determine the meaning of a word when the stress pattern of a homograph is changed. The word *record* is a verb if pronounced with iambic stress (reCORD) but becomes a noun when pronounced with trochaic stress (REcord; Kelly, 1996). At the level of syntax, prosodic structure can determine the meaning of a sentence when words are grouped together in the utterance through the use of prosodic phrasing and boundary tones (Price, Ostendorf, Shattuck-Hufnagel, & Fong, 1991; Pynte & Prieur, 1996). For an ambiguous sentence like, “Touch the monkey with the banana,” two interpretations could be made. When pronounced with a boundary after *monkey*—“Touch the monkey, with the banana”—the sentence means to use a banana to touch the monkey. On the other hand, if there is no such phrasing, it could be interpreted to mean touching the monkey that is holding the banana, as opposed to the one not holding a banana (Snedeker & Casserly, 2010).

Furthermore, even when syntax is only temporarily ambiguous for a short period in an utterance, such as whether or not a word is a direct object, prosody guides the interpretation. In the sentences, “When Elmo eats the pizza is hot,” versus “When Elmo eats the pizza it’s hot,” it is ambiguous mid-stream as to whether or not the noun phrase *the pizza* is the direct object of *eats*; later in the sentence, the ambiguity is resolved, upon encountering either *is*, where *the pizza* is not the direct object, or *it’s*, where *the pizza* is the direct object. This is the strongest case for how critical prosody is to sentence processing, because the syntax is resolved by the syntax alone, and prosody is not necessary for the correct interpretation (Kjelgaard & Speer, 1999; Wingfield & Klein, 1971). In fact, based on studies by Speer and colleagues, it is now generally accepted that prosody is fundamentally important to syntactic parsing (Frazier, Carlson, & Clifton, 2006).

At levels above and beyond the sentence, prosody is related to aspects of discourse structure, such as introducing new information through the use of emphasis or stress on the information introduced into a conversation (e.g., Clark & Haviland, 1977), as well as to contrast one piece of information with another piece of information (Bolinger, 1961). Prosody tends to drop in its pitch contour at the end of many utterances, and changes in speaking rate and other variables occur at the level of the discourse (Beckman & Ayers, 1997; Speer, Wayland, & Kjelgaard, 1994; Swerts, 1997). Taken together, these variables indicate the social-pragmatic information regarding taking the perspective of others and social conventions, such as when a speaker is finished and it is therefore appropriate to interject or respond.

Layered upon the rich and complex relationship between prosodic structure and the various linguistic forms is the emotional information carried by the prosody of an utterance, also known as *affective prosody*. Prosody informs listeners as to whether a speaker is happy, angry, or sad, for example. There is evidence to indicate that affective prosody can be communicated independently of verbal comprehension—that listeners are able to accurately decode emotions in unfamiliar languages (e.g., pseudo-languages, foreign languages) at above-chance level (Banse & Scherer, 1996; Jaywant & Pell, 2011; Pell, Paulmann, Dara, Alasseri, & Kotz, 2009; Thompson & Balkwill, 2006). This suggests that there may be an underlying set of acoustic cues that typical listeners reliably draw upon to interpret affective prosody.

Prosody, Development, and ASD

A wealth of research has shown the myriad ways in which typically developing (TD) infants are sensitive to prosody and its importance to language and social development, beginning with the earliest days of life. At 3 days of age, infants recognize the prosody of their own language versus other languages (Christophe, Gout, Peperkamp, & Morgan, 2003). Juscyk and Mehler and their colleagues discovered many ways in which infants and babies are sensitive to prosody, such as recognizing where word boundaries occur in the speech stream, and recognizing syntactic units that correspond to prosodic structure (e.g., Cutler & Norris, 1988; Juscyk & Aslin, 1995; Mehler et al., 1988). Fernald and others also contributed to the body of knowledge with studies of *motherese*, or *infant-directed speech*, and showed that babies preferred the exaggerated and higher pitch of child-directed speech to that of adult-directed speech (e.g., Cooper & Aslin, 1990; Fernald, 1985; Fernald & Kuhl, 1987). More recently, this behavioral work was confirmed in event-related potential (ERP) studies in which differences emerged in processing infant- versus adult-directed speech at 6 months of age (Zangl & Mills, 2007), and at about this time, infants also can differentiate emotional prosody in speech (Grossmann, Oberecker, Koch, & Friederici, 2010).

These lines of research led psycholinguists to propose a theory referred to as *prosodic bootstrapping*. The theory is that prosodic structure, given that it is the first linguistic form available to a child, is used to hold speech in working memory so that vocabulary can be acquired, syntax can be developed, and the rules of phonology derived (e.g., Speer & Ito, 2009). Beyond the linguistic aspects of language development, the preference for child-directed prosody, the early recognition of emotion in prosody, and the preference for positive emotional prosody (Singh, Morgan, & Best, 2002) allow the child to bond with adults and understand the social world in which they live, and contribute significantly to the acquisition of language (Kuhl, 2007).

Recently, the relationship between prosody and ASD has gained increasing attention (e.g., Diehl & Berkovits, 2010). Perception of prosody for children with ASD has been observed to be a challenge (Diehl & Berkovits, 2010; Järvinen-Pasley, Peppé, King-Smith, & Heaton, 2008; McCann & Peppé, 2003), as well as the expression of prosody (Shriberg et al., 2001). It has been long documented that children with ASD interpret language literally (Kanner, 1946), and therefore do not understand when a speaker is being sarcastic or ironic (Lindner & Rosén, 2006). Very young children later diagnosed with ASD are less responsive to the sound of their mother's voice (Tager-Flusberg, Paul, & Lord, 2005), unlike TD infants who prefer their mother's voice as well as infant-directed speech. Children with ASD also make errors in interpreting whether an utterance is a question or a statement (Järvinen-Pasley et al., 2008) and have a difficult time understanding tone of voice (Lindner & Rosén, 2006).

While the bulk of research in this field indicates that children and adults with ASD have difficulties interpreting emotion in prosody, some studies found that individuals with ASD show an ability to recognize emotion in affective prosody as well as TD peers (e.g., Chevallier, Noveck, Happé, & Wilson, 2011; Grossman, Bemis, Skwerer, & Tager-Flusberg, 2010; Loveland et al., 1997). Although some aspects of prosody appear to be spared in some children with ASD, whereas others are impaired, it is clear that prosody is a key factor to understanding the difficulties in social communication for children and adults with ASD.

There are at least two ways in which deficits in prosody perception in ASD may have a significant impact. First, with regard to acquisition of linguistic forms, a weakened ability to recognize prosodic structure could lead to delays in the acquisition of vocabulary, phonology, and syntax, which affects the majority of children with ASD. Second, with regard to social development, a weaker ability to interpret prosody related to emotional content could lead to multiple misunderstandings of the social world, as well as difficulty in forming social bonds with others. Social impairments are diagnostic of ASD. The current study is related to this second way in which prosodic perception would be linked to ASD. The question posed is: How do children with ASD process the prosodic information related to happy and sad emotions?

We examined comprehension of prosody by children with ASD who were on the high-functioning end of the spectrum and compared them to TD children and adults, as well as to children with specific language impairment (SLI), in order to tease apart processing differences from TD children and adults that were due to language difficulties versus those that were ASD-specific. We employed a paradigm of matching and mismatching prosody, following along the lines of prior work investigating prosody and syntactic parsing (Kjelgaard & Speer, 1999). The premise is that if prosody matches the content of the utterance, it should facilitate processing, whereas if prosody does not match the content of the utterance, it should interfere with processing. Important, the matching and mismatching conditions must be compared to a baseline condition in which prosody is uninformative as to the content. The baseline comparison clears up the question of whether a difference in processing between matching and mismatching is a function of matching prosody facilitating or mismatching prosody interfering with processing for listeners (Kjelgaard & Speer, 1999).

Method

Participants

Twenty-three young adults who were lab members and colleagues volunteered for participation. Three groups of children were recruited. There were 35 TD children from the Carlisle, MA, school system, all of whom were in regular education and were native English-speakers (mean age = 101 months, or 8 years 5 months). They were identified as TD by their teachers and parents, were not receiving special education services, and were recruited through a collaborative relationship between the school system and the research group. Through flyers, postings, and parent groups, we recruited the following to participate in a longitudinal study of genetic and phenotypic markers of ASD and SLI: 23 children with a diagnosis of autism, as determined by the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000), Autism Diagnostic Interview-Revised (ADI-R; Rutter, Le Couteur, & Lord, 2003), and clinical judgment using DSM-IV criteria (APA, 2000); and 21 children who met criteria for SLI according to their scores (> 1 STD below the mean) on the omnibus Clinical Evaluation of Language Fundamentals (CELF-R; Semel, Wiig, & Secord, 1987) and developmental history of delayed language. A subset of subjects from the longitudinal study agreed to participate in this secondary study. The E. K. Shriver Internal Review Board approved all recruitment and research procedures. The children with ASD and SLI did not differ in age ($F < 1$), and both groups had a mean age of 9;5 years. The two groups also did not differ significantly on total IQ ($F(1,39) = 2.12$, $p = .15$), nonverbal IQ ($F(1,39) = 1.1$, $p = 2.9$), or verbal IQ ($F < 1$), as measured using the Differential Abilities Scales.

Table 1. Mean Age and IQ Measures for Children With Autism and SLI (Standard Deviation in Parentheses)

Group	**Mean Age in Months**	**Mean IQ**	**Mean Nonverbal IQ**	**Mean Verbal IQ**
Autism (N = 23)	113.13 (27.8)	84.3 (15.7)	87.7 (14.3)	83 (21.8)
SLI (N=21)	113.56 (26.1)	97.2 (14.7)	92.8 (16.4)	88.5 (12.5)

The adults and TD children were analyzed separately to establish the typical adult pattern as well as the developmental pattern of prosodic facilitation and interference. As no standardized IQ scores were collected for the TD group, they were not matched to the ASD or SLI group. The SLI and ASD contrast groups were age- and IQ-matched for comparison.

Stimuli

Sentences were created that contained semantic information that was either happy or sad. Two examples follow:

Happy content:	When Mike pets the puppy, it's wagging its tail.
Sad content:	When Mike hits the puppy, it's whining.

A clinical psychologist (R. Joseph, PhD), was asked to judge the semantic content of the sentences. The psychologist was a member of the research laboratory and an expert on emotion processing and thereby deemed a reliable judge. Those that were judged to be happy or sad were used for recording. The sentences were then produced under three conditions: happy, neutral, and sad prosody. The speaker was an actress, musician, and a psycholinguist trained in prosodic theory (K. Dobroth, PhD).

The prosodic manipulations were based on the literature regarding acoustic properties of emotion in speech (Bachorowski & Owren, 1995; Banse & Sherer, 1996; Cosmides, 1983; Murray & Arnott, 1993). Sad prosody was generally lower in pitch, slower, and ended with lowered pitch. Happy prosody was spoken at a faster rate, was higher in pitch, showed several high-pitch excursions, and ended with a high pitch. Neutral prosody contained a mid-range pitch with no rise at the end. All sentences were pronounced under all three prosodic conditions so that the prosody matched the semantic content (e.g., happy prosody on a happy sentence), was neutral with regard to the content, or mismatched the content (e.g., happy prosody on a sad sentence). Acoustic analysis of pitch was used to validate the prosodic manipulations. Examples of the waveforms for happy, sad and neutral prosody, in which the intended pitch patterns can be seen, are presented below (Figures 1, 2, and 3).

Figure 1. Happy Prosody

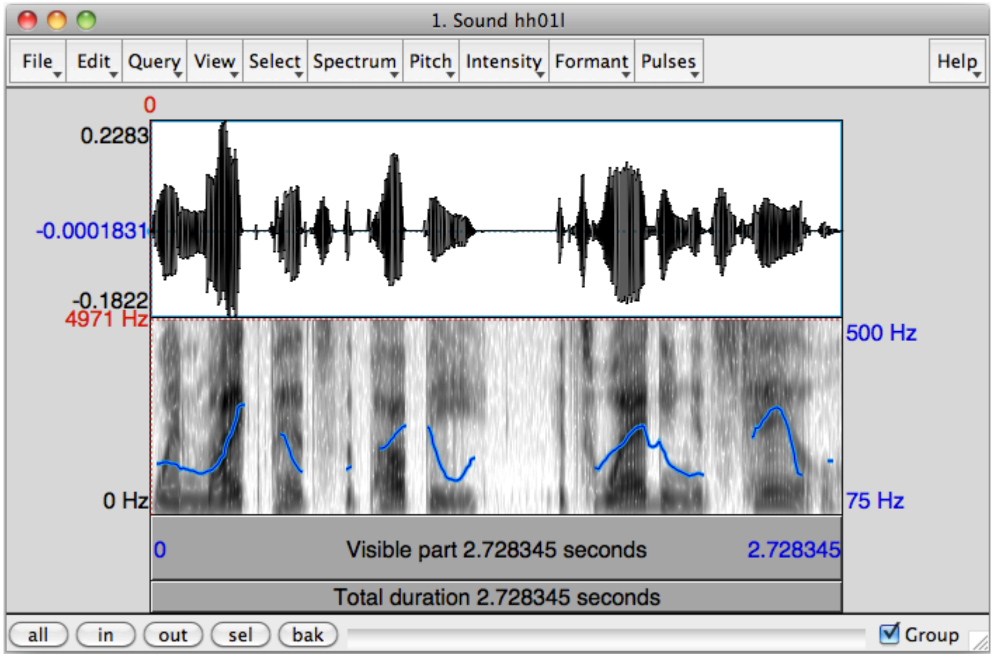


Figure 2. Sad Prosody

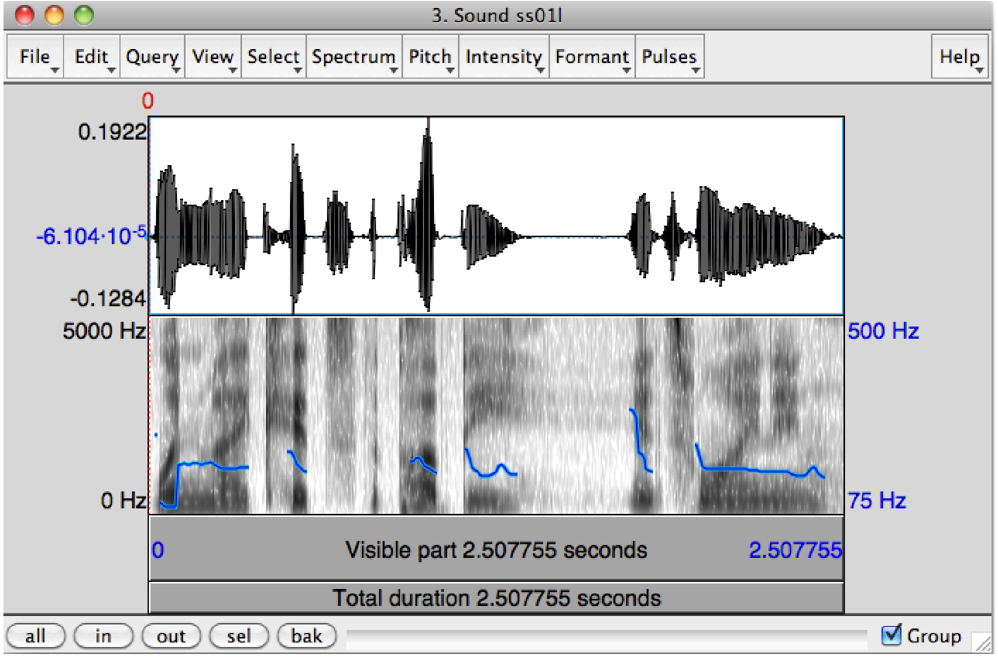
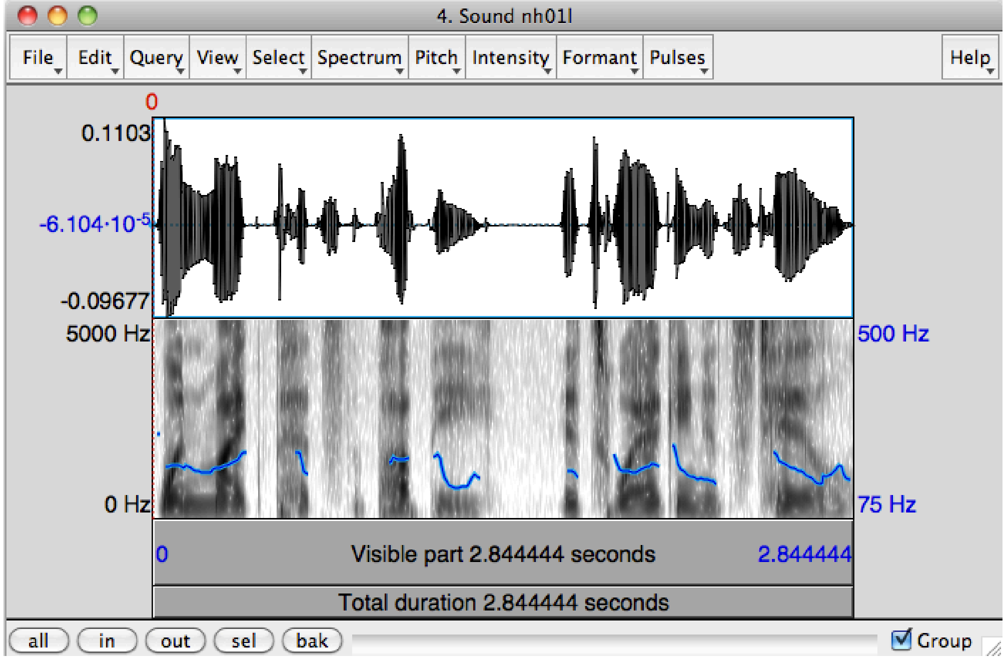


Figure 3. Neutral Prosody



Acoustic Analysis

The average minimum and maximum pitch was measured at several locations in the sentences, at the first word (W1), the verb (V), the following noun phrase (NP), and the final word of the sentence (Final). Results supported the intended prosodic manipulations. There were a total of 108 stimuli. Multivariate ANOVAs were used to analyze the measurements. For the maximum pitch, there were main effects of prosody at all locations (All *F*s > 19) but no prosody X content interactions (all *F*s < 1.2). For the minimum pitch, again, there were main effects of prosody at all locations (all *F*s > 21) except for the final location, where, the effect was smaller ($F(2,102) = 3.4$, $p = .03$). There were no significant prosody X content interactions at any locations. Happy prosody was higher in pitch at all locations and ended with a higher pitch relative to neutral and sad prosody. Additionally, sad prosody was lower in pitch than all other conditions. Important, the happy and sad conditions were consistent regardless of whether they were pronounced in a matching or mismatching condition upon inspection of data.

In the experiment, a Latin Square rotation was used to counterbalance the stimuli so that participants heard only one version of a sentence, but an equal number of representations within a condition. There were 6 presentation sets; each included 18 experimental sentences with 3 examples of each condition (in the 3 prosody X 2 content design). Ten filler sentences were included that were not of an emotional nature and had different syntactic structure in order to prevent listeners from noticing a pattern in the stimuli.

Procedure

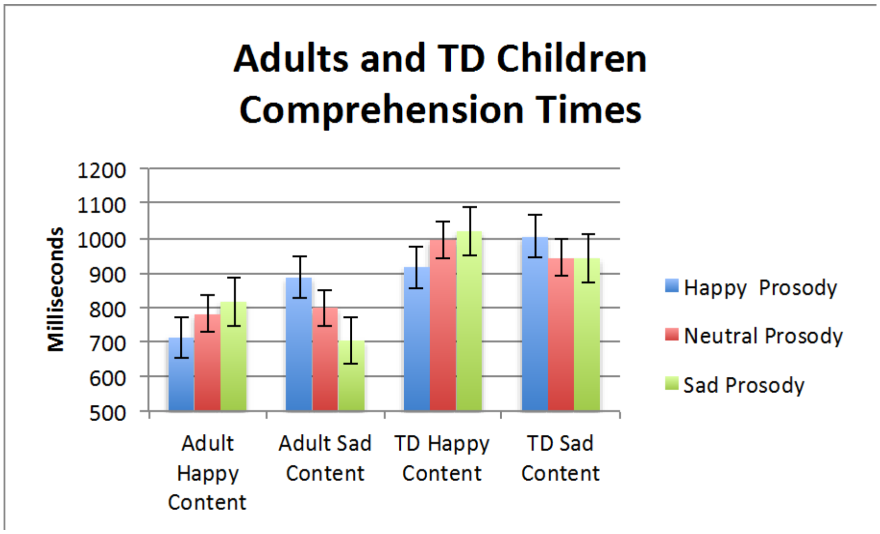
The experiment used a two-alternative forced-choice task to measure comprehension time. Responses were collected on a Macintosh laptop for the adults and TD children and on a Macintosh desktop with a touchscreen monitor for the ASD and SLI children. Participants were presented with two line drawings as they listened to each sentence. They were asked to choose the picture that matched the content of the sentence and were instructed to respond as quickly and accurately as possible. The two drawings were always highly similar and varied only by one dimension, such as the action of the figures. For the adults and TD children, the sentences were played on headphones and responses were collected with key presses. For the ASD and SLI groups, sentences were presented over amplified speakers and responses were collected using a touchscreen. Comprehension times were measured from the offset of the sentence to the button press or screen touch.

Following the reaction-time study, participants were asked to make two judgments about the emotional information contained in the utterances: one was about the emotion of the prosody and the other about the emotional semantic content. First, they were asked to listen to the same sentences, but to ignore the words and decide if the speaker sounded as if she were happy, sad, or neither. On the computer screen, they chose between a happy, sad, or neutral face and responded accordingly (key press for adults and TD, touchscreen for ASD and SLI). Finally, they were asked to listen to the sentences a third time, but this time to listen only to the words of the sentences and decide whether it was about something happy or sad. This task had participants choose between only a happy or sad face.

Results

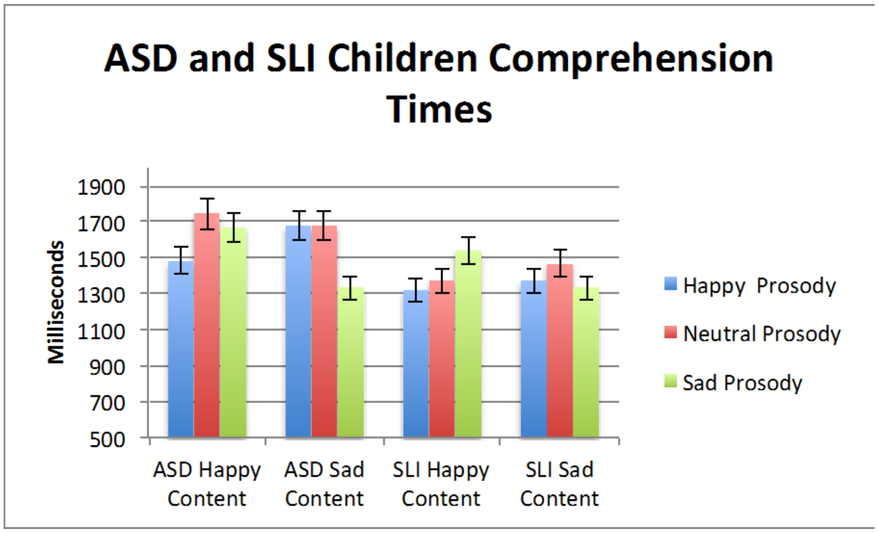
Repeated measures ANOVAs were used to analyze comprehension time for the adults and TD children. A main effect of group was found, $F(1,55) = 4.04$, $p = .04$. Children were generally slower to perform the task (mean adults = 783.02 msec; mean TD = 969.47 msec). A significant prosody X content interaction was found, $F(2,55) = 3.88$, $p = .02$, and revealed that the predicted patterns of facilitation and interference were found for both adults and children. Processing speed for both adults and TD children was slower when the emotional prosody did not match the emotional content of the sentence and faster when the emotional prosody matched the emotions of the semantic content.

Figure 4. Reaction Time Results for Adults and TD Children in Milliseconds



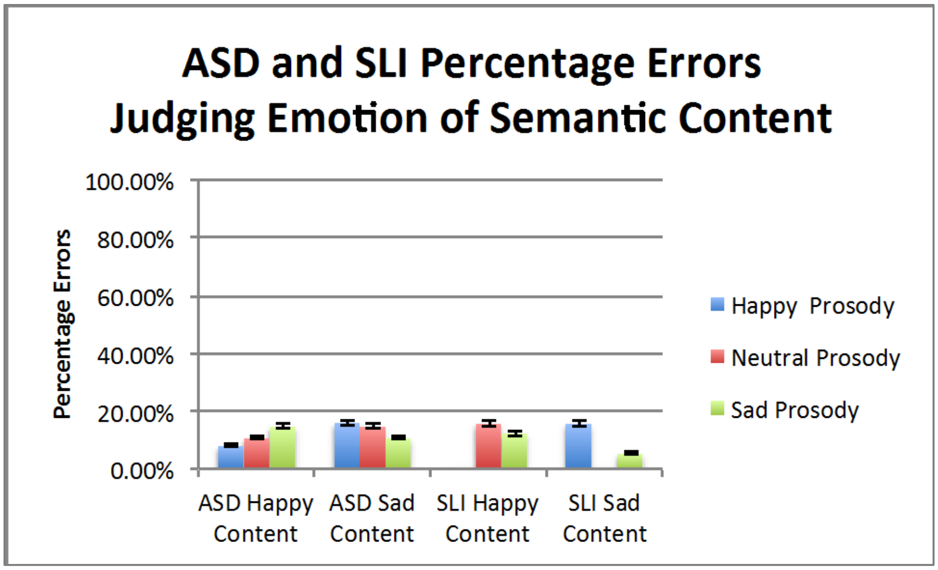
For the children with ASD and SLI, repeated measures ANOVA also revealed a significant interaction for prosody X content interaction (*F* (2,41) = 3.87, *p* = .05). There was an influence of prosody on the comprehension of the sentences for both SLI and ASD children. There was no significant difference between the two diagnostic groups; they showed the same pattern of facilitation and interference and roughly the same overall processing speed (mean ASD = 1597.42 msec; mean SLI = 1401.06 msec).

Figure 5. Reaction Time Results for Children With ASD and SLI in Milliseconds



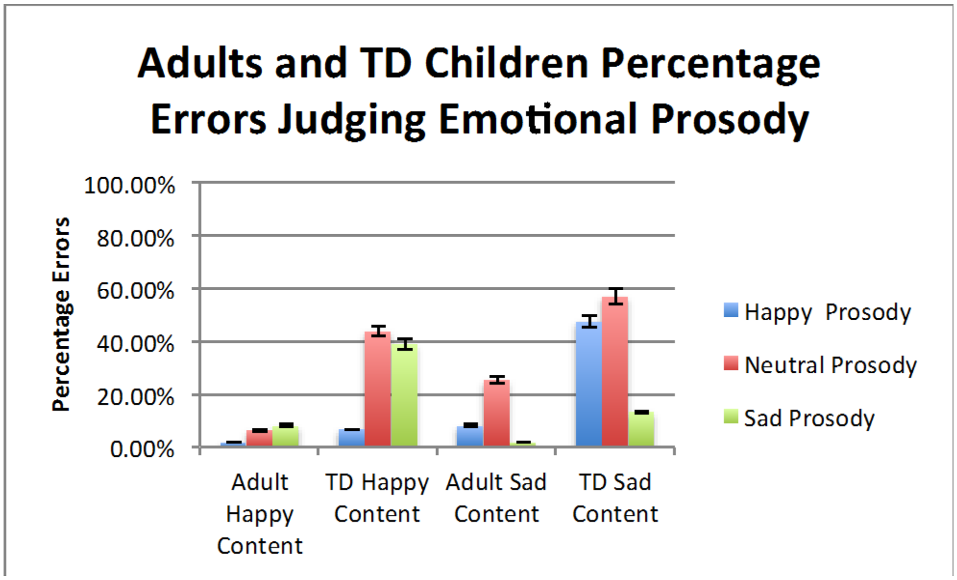
Not surprising, the adults and TD children did very well on judging the emotional semantic content. The adults and TD children were very accurate—mean percent errors, adults = 0, mean TD = 5%—and no differences were found. For the children with ASD and SLI, however, there was a significant interaction of prosody X content, *F* (2,41) = 4.0, *p* = .02, and three-way interaction of prosody X content X dx, *F* (2,41) = 3.11, *p* = .05. Surprising, the children with ASD showed a pattern of facilitation and interference (matching more accurate than mismatching conditions), whereas the errors for the children with SLI were more sporadic.

Figure 6. ASD and SLI Percentage Errors Judging Emotion of Semantic Content



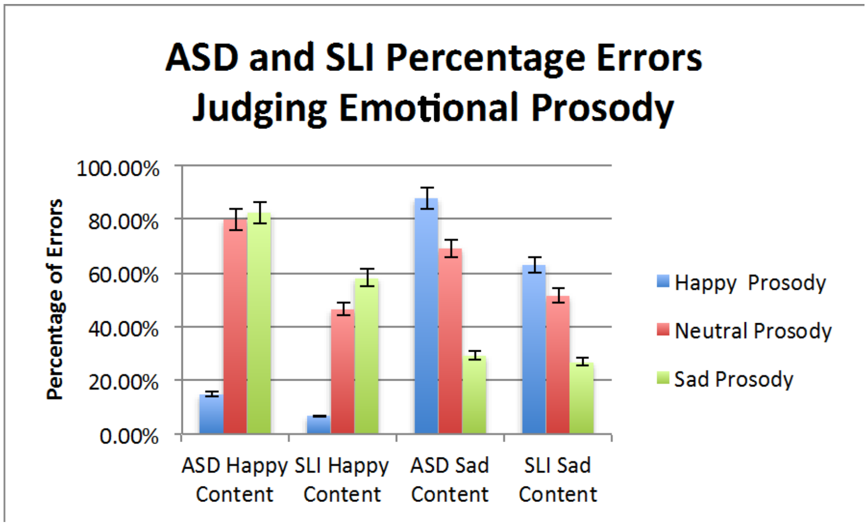
In the analysis of the responses for which participants were asked to ignore the words, and judge only the voice of the speaker, repeated measures ANOVA revealed several findings. Adults and TD children showed main effects of prosody, *F* (2,53) = 7.99, *p* < .0; content, *F* (1,54) = 11.00, *p* < .01; a prosody X content interaction, *F* (2,53) = 11.02, *p* = .02; and a prosody X content X group interaction, *F* (2,53) = 4.258, *p* = .019. TD children showed interference effects when prosody mismatched the semantic content, but also made as many errors in the neutral condition, indicating that the neutral condition had an emotional valence for the children that was not perceived by adults. There was also a main effect of group, *F* (1,54) = 25.91, *p* < .01. The adults were more accurate overall (mean adult = 17.55% errors; TD = 25.48% errors).

Figure 7. Adults and TD Children Percentage Errors Judging Emotional Prosody



In the analysis of the ASD and SLI children, repeated measures ANOVA revealed main effects of prosody, *F* (2,42) = 10.23, *p* < .01; content, *F* (1,43) = 8.88, *p* < .01; and a prosody X content interaction, *F* (2,42) = 71.94, *p* < .01). The ASD children were most accurate with matching prosody and content, and both the neutral and mismatching conditions showed higher errors. The SLI pattern, however, showed more accuracy overall and a pattern similar to the TD children. This indicates that the ASD children were unable to ignore the words of the utterance and judged the emotion of the voice based on the content of the utterance alone. There was also a main effect of group, *F* (1,33) = 8.377, *p* < .01. The ASD children were less accurate overall (mean ASD = 60.67% errors; mean SLI = 42.23% errors).

Figure 8. ASD and SLI Percentage Errors Judging Emotional Prosody



Discussion

Adults and TD children showed similar patterns of facilitation and interference of emotional prosody in the processing of sentences with emotional content. They also showed the ability to judge the semantic content with high accuracy and only showed a developmental difference in what was apparently the most difficult task: judging the emotional prosody of the utterances while ignoring the words of the utterances. The adults were more accurate at this task. The TD children and adults thereby established the predicted hypothesis that matching and mismatching prosodic information related to emotions would facilitate and interfere with processing of sentences with an emotional valence.

For the two clinical groups, high-functioning verbal children with ASD showed a sensitivity to emotional prosody at an implicit level, as evidenced by facilitation and interference in their comprehension of sentences for which emotional prosody matched or mismatched semantic content, as well as when asked to judge the emotional semantic content of the same utterances. Prosody affected their accuracy. On the other hand, when asked to perform judgments with regard to the emotional prosody, they were unable to ignore the semantic content, and took a “literal language” strategy of relying on the words of the utterance to make their judgments. They differed from the children with SLI who were better able to make these judgments. The autism-specific finding was that although ASD children were affected by emotional prosody, they were unable to accurately label the emotion conveyed in the emotional prosody.

With regard to prosodic bootstrapping, it could be argued that the sensitivity of the ASD children to emotional prosody is, in part, what puts them at the high end of the spectrum. Though the argument has intuitive appeal, without a contrast to lower-functioning ASD, however, it remains speculative. Some evidence in support of this notion comes from recent work by Chiew (2012), in which minimally verbal children with ASD did not show the same sensitivity to emotional prosody (with semantic information filtered out).

Clinical Implications

There are important clinical implications arising from this study. The disconnect between implicit processing of language and explicit metalinguistic judgments of emotional prosody provides an opportunity to explore in evidence-based therapies. For example, if one were to work toward making the implicit sensitivity to emotional prosodic information explicit, it may be possible to teach children with high-functioning ASD how to interpret emotional information in speech. Along the lines of reasoning of some of the social skills–training programs, perhaps explicit teaching of emotional prosody can pull into awareness how to interpret emotional prosody for these children.

A hint that this intervention strategy may be possible comes from Chiew (2012), who was able to systematically train minimally verbal children with ASD to judge the emotions of filtered speech by employing a scaffolding strategy with multiple exemplars of emotional prosody stimuli. As participants became successful at a particular level of scaffolding, one aspect of the scaffolding was removed until eventually the minimally verbal children were making metalinguistic judgments of emotion independently.

If successful, an intervention based on scaffolded training would have a significant impact on social functioning and quality of life for those with ASD. Imagine if a child with ASD were able to explicitly articulate the emotional state of his/her peers, as opposed to only being able to interpret the literal language that leads to so much misunderstanding. Intuition suggests that this kind of teaching could extend to other “non-literal” functions of prosody as well, such as in teaching how to interpret sarcasm.

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References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC: Author.

Bachorowski, J., & Owren, M. J. (1995). Vocal expressions of emotion: Acoustic properties of speech are associated with emotional intensity and content. *Psychological Science, 6*, 219–225.

Banse, R., & Sherer, K. R. (1996). Acoustic profiles in vocal emotion and expression. *Journal of Personality and Social Psychology, 70*, 614–636.

Beckman, M. E., & Ayers, G. (1997). *Guidelines for ToBI labeling.* Columbus, OH: Ohio State University.

Bolinger, D. (1961). Contrastive accent and contrastive stress. *Language, 37*(1), 83–96.

Centers for Disease Control and Prevention. (2012, March 29). *New data on autism spectrum disorders.* Retrieved from www.cdc.gov/Features/CountingAutism/

Chevallier, C., Noveck, I., Happé, F., & Wilson, D. (2011). What’s in a voice? Prosody as a test case for the Theory of Mind account of autism. *Neuropsychologia, 49*, 507–517.

Chiew, J. (2012). *The perception of affective prosody in children with autism spectrum disorders and typical peers* (Master’s thesis). MGH Institute of Health Professions, Boston, MA.

Christophe, A., Gout, A., Peperkamp, S., & Morgan, J. (2003). Discovering words in the continuous speech stream: The role of prosody. *Journal of Phonetics, 31*, 585–598.

Clark, H., & Haviland, S. E. (1977). Comprehension and the given-new contrast. In R. O. Freedle, *Discourse production and comprehension* (pp. 1–40). Norwood, NJ: Ablex.

Cooper, R., & Aslin, R. (1990). Preference for infant-directed speech in the first month after birth. *Child Development, 61*, 1584–1595.

Cosmides, L. (1983). Invariances in the acoustic expression of emotion during speech. *Journal of Experimental Psychology: Human Perception and Performance, 9*, 864–881.

Cutler, A., & Norris, D. G. (1988). The role of strong syllables in segmentation for lexical access. *Journal of Experimental Psychology: Human Perception & Performance, 14*, 113–121.

Diehl, J. J., & Berkovits, L. (2010). Is prosody a diagnostic and cognitive bellwether of autism spectrum disorders? In A. Harrison (Ed.), *Speech disorders: Causes, treatments, and social effects* (pp. 159–176). New York, NY: Nova Science Publishers.

Fernald, A. (1985). Four-month-old infants prefer to listen to Motherese. *Infant Behavior and Development, 8*, 181–195.

Fernald, A., & Kuhl, P. (1987). Acoustic determinants of infant preference for Motherese speech. *Infant Behavior and Development, 10*, 279-293.

Frazier, L., Carlson, K., & Clifton, C. (2006). Prosodic phrasing is central to language comprehension. *Trends in Cognitive Neuroscience, 10*(6), 244–249.

Grossman, R., Bemis, R., Skwerer, D., & Tager-Flusberg, H. (2010). Lexical and affective prosody in children with high-functioning autism. *Journal of Speech, Language, and Hearing Research, 53*, 778–793.

Grossmann, T., Oberecker, R., Koch, S. P., & Friederici, A. D. (2010). The developmental origins of voice processing in the human brain. *Neuron, 65*, 852–858.

Järvinen-Pasley, A., Peppé, S., King-Smith, G., & Heaton, P. (2008). The relationship between form and function level receptive prosodic abilities in autism. *Journal of Autism and Developmental Disorders, 38*, 1328–1340.

Jaywant, A., & Pell, M. (2011). Categorical processing of negative emotions from speech prosody. *Speech Communication, 54*, 1–10.

Jusczyk, P., & Aslin, R. (1995). Infant's detection of the sound patterns of words in fluent speech. *Cognitive Psychology, 29*, 1–23.

Kanner, L. (1946). Irrelevant and metaphorical language in early infantile autism. *American Journal of Psychiatry, 103*, 242–246.

Kelly, M. (1996). Using sound to solve syntactic problems: The role of phonology in grammatical category assignments. In J. L. Morgan & K. Demuth (Eds.), *Signal to syntax* (pp. 263–283). Mahwah, NJ: Erlbaum.

Kjelgaard, M. M., & Speer, S. R. (1999). Prosodic facilitation and inhibition in the resolution of temporary syntactic closure ambiguity. *Journal of Memory and Language, 40*, 153–194.

Kuhl, P. (2007). Is speech learning 'gated' by the social brain? *Developmental Science, 10*, 110–120.

Lindner, J., & Rosén, L. (2006). Decoding of emotion through facial expression, prosody, and verbal content in children and adolescents with Asperger's syndrome. *Journal of Autism and Developmental Disorders, 36*, 769–777.

Lord, C., Risi, S., Lambrecht, L., Cook, E. H., Leventhal, B. L., DiLavore, P. C., . . . Rutter, M. (2000). The Autism Diagnostic Observation Schedule–Generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders, 30*(3), 205–223.

Loveland, K., Tunali-Kotoski, B., Chen, Y., Ortegon, J., Pearson, D., Brelsford, K., & Gibbs, M. (1997). Emotion recognition in autism: Verbal and nonverbal information. *Development and Psychopathology, 9*, 579–593.

McCann, J., & Peppé, S. (2003). Prosody in autism spectrum disorders: A critical review. *International Journal of Language and Communication Disorders, 38*, 325–350.

McCann, J., Peppé, S., Gibbon, F., O'Hare, A., & Rutherford, M. (2007). Prosody and its relationship to language in school-age children with high-functioning autism. *International Journal of Language and Communication Disorders, 42*, 682–702.

Mehler, J., Jusczyk, P. W., Lambertz, G., Halsted, N., Bertoncini, J., & Amiel-Tison, C. (1988). A precursor of language acquisition in young infants. *Cognition, 29*, 143–178.

Murray, I. R., & Arnott, J. L. (1993). Toward the simulation of emotion in synthetic speech: A review of the literature on human vocal emotion. *Journal of the Acoustic Society of America, 93*, 1097–1108.

Paul, R., Augustyn, A., Klin, A., & Volkmar, F. (2005). Perception and production of prosody by speakers with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 35*, 205–220.

Pell, M., Paulmann, S., Dara, C., Alasseri, A., & Kotz, S. (2009). Factors in the recognition of vocally expressed emotions: A comparison of four languages. *Journal of Phonetics, 37*, 417–435.

Price, P., Ostendorf, M., Shattuck-Hufnagel, S., & Fong, C. (1991). The use of prosody in syntactic disambiguation. *Journal of the Acoustical Society of America, 90*, 2956–2970.

Pierrehumbert, J., & Hirschberg, J. (1990). The meaning of intonational contours in the interpretation of discourse. In P. Cohen, J. Morgan, & M. Pollack (Eds), *Intentions in communication* (pp. 271–311). Cambridge, MA: MIT Press.

Pynte, J., & Prieur, B. (1996). Prosodic breaks and attachment decisions in sentence parsing. *Language and Cognitive Processes, 11*, 165–192.

Rutter, M., Le Couteur, A., & Lord, C. (2003). *ADI-R: Autism Diagnostic Interview—Revised: Manual.* Torrance, CA: Western Psychological Services.

Semel, E., Wiig, E. H., & Secord, W. (1987). *CELF-R: Clinical Evaluation of Language Fundamentals--Revised.* New York, NY: Psychological Corporation, Harcourt Brace Jovanovich.

Shriberg, L., Paul, R., McSweeny, J., Klin, A., Cohen, D., & Volkmar, F. (2001). Speech and prosody characteristics of adolescents and adults with high-functioning autism and Asperger syndrome. *Journal of Speech, Language, and Hearing Research, 44*, 1097–1115.

Singh, L., Morgan, J. L., & Best, C. (2002). Infants' listening preferences: Baby talk or happy talk? *Infancy, 3,* 365–394.

Snedeker, J., & Casserly, E. (2010). Is it all relative? Effects of prosodic boundaries on the comprehension and production of attachment ambiguities. *Language and Cognitive Processes, 25*(7–9), 1234–1264.

Speer, S. R., & Ito, K. (2009). Prosody in first language acquisition: Acquiring intonation as a tool to organize information in conversation. *Language and Linguistics Compass, 3*(1), 90–110.

Speer, S., Wayland, S., & Kjelgaard, M. M. (1994). Effects of speaking rate and paragraph structure on the production of sentence prosody. *The Journal of the Acoustical Society of America, 95*(5), 2979.

Swerts, M. (1997). Prosodic features at discourse boundaries of different strength. *Journal of the Acoustical Society of America, 101*(1), 514–521.

Tager-Flusberg, H., Paul, R., & Lord, C. (2005). Language and communication in autism. In F. Volkmar, R. Paul, A. Klin, & D. Cohen (Eds), *Handbook of autism and pervasive developmental disorders* (pp. 335–364). Hoboken, NJ: John Wiley & Sons.

Thompson, W., & Balkwill, L. (2006). Decoding speech prosody in five languages. *Semiotica, 158*, 407–424.

Wingfield, A., & Klein, A. (1971). Syntactic structure and acoustic pattern in speech perception. *Perception and Psychophysics, 9*, 23–25.

Zangl, R., & Mills, D. L. (2007). Increased brain activity to infant-directed speech in 6- and 13-month-old infants. *Infancy, 11*(1), 31–62.