

THE RELATIONSHIP OF DEVELOPMENTAL FUNCTIONING TO SYMPTOM
PRESENTATION IN YOUNG CHILDREN WITH ASD

by

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A THESIS

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ABSTRACT

Objectives: The present study examined the differences between young children with Autism Spectrum Disorders (ASD) and typical development (TD) on developmental skills and core symptoms of ASD. Further, the relationship between core symptoms of ASD and developmental functioning level were assessed. Specific symptoms, joint attention, symbolic play, gestures, and RSB, as well as general symptom categories were assessed in children with ASD ($n=10$) and children with typical developmental ($n=10$) who were matched on mental age and gender.

Method: Measures of social communication, speech, symbolic play, gestures, and joint attention were obtained through the *Communication and Symbolic Behavior Scales* (CSBS: Wetherby and Prizant, 2002). Developmental level was measured using the *Mullen Scales of Early Learning* (MSEL: Mullen, 1992). **Results:** Children with ASD demonstrated decreased abilities in symbolic play and understanding, social communication, joint attention, and gestures compared to children with TD. Children with ASD also demonstrated more RSB with body and objects. Strong correlations among social, symbolic, speech, and gestural were observed. Speech and symbolic skills, as well as social and gestural skills were the only relationships to remain highly correlated even when developmental level was controlled. **Conclusions:** These findings highlight the diagnostic significance of developmental level to core symptoms of ASD. Research aims and the impact of these findings on the development of specific therapy goals are also discussed.

DEDICATION

This thesis is dedicated to all of the children with ASD and their families that participated in my research study. I learned as much from you as you did from me. Thank you so much!

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Introduction

The examination of early development and emerging symptoms of Autism Spectrum Disorders (ASD) in the second year of life compared to typical development is critical to understanding the developmental trajectory of children with ASD. Several studies have noted affected cognitive abilities as well as differences in the development of core symptomology of ASD during the second year of life (Landa and Garrett-Mayer, 2006; Chawarska, Klin, Paul, and Volkmar, 2007), suggesting that this year is critical for documenting cognitive as well as social communication differences between children with typical development (TD) and children with ASD. A study by Werner, Dawson, Munson, and Osterling (2005) described the developmental profiles of children with ASD under 4 years and identified the second year of life as the year in which communication, social, and repetitive symptoms of ASD were most frequently identified by parents of children later diagnosed with ASD and distinguished children with ASD from children with TD. This finding makes the second year of life an important time to identify deviations in developmental for children at risk for ASD. Understanding the developmental trajectory of ASD and its differences to typical development can lead to early detection, early intervention, and the possibility of altering the development of significant ASD symptoms (Shumway and Wetherby, 2009).

During the second year of life, children with TD make significant strides in their ability to communicate through gestures, joint attention, and language. During this time, TD children also develop symbolic play skills that expand their social relationships. These skills do not follow the same course in ASD, and make up the core impairments seen in children with ASD, as listed in the DSM-IV : “pervasive impairments in social communication, including impairments in use of nonverbal behaviors, a lack of seeking to share enjoyment and interests,

and delay in or lack of spoken language and gestures” (American Psychiatric Association, 2000). In order to better understand these milestones and their relationship to the developmental level of toddlers of TD and ASD, some studies have shed light on the relationship between these impairments through documenting the social communication profiles for young children with ASD (Werner et al., 2005; Toth, Munson, Meltzoff, and Dawson, 2006; Chawarska, Klin, Paul, and Volkmar, 2007; Shumway and Wetherby, 2009).

A brief summary of selected core symptoms targeted by this study follows below.

Joint Attention

Joint attention (JA) refers to one’s ability to coordinate attention between self, another person, and an object (Wetherby and Prutting, 1984). An example of joint attention is pointing to an object in the distance and remarking to a conversational partner, “Look at that.” The ability to construct an interaction like this example, however, is among the unique differences found in young children with ASD from TD children. The differences in the JA abilities of TD children from children with ASD are measured by the degree to which a child is able to monitor and regulate their attention and simultaneously respond to the attention of another person in their environment in relation to objects or events in their environment (Mundy, Sigman, and Kasari, 1994; Charman, 1998). This lack of attention to environment and people in it, which is at the foundation of many human interactions, has been the subject of recent studies in young children with ASD.

JA in typical development.

To establish the importance of JA in typical development, several researchers have examined its role in early language learning, cognition, and social interaction.

Carpenter, Nagell, and Tomasello (1998) examined the joint attention abilities of typically developing children at well-baby visits between 9 and 15 months, and compared these abilities to later language and gestural skills at 2 years. Results of testing indicated that the amount of time typically developing children spent in joint engagement with their mothers as well the degree to which mothers used language to follow the focus of their baby's intentions at 9 months predicted children's ability to use gestures and language at 2 years. Authors concluded that joint attention in infants serves as a precursor to intentionality and eventually language. Acquiring joint attention, specifically the ability to take note of the object, person, or event pointed out by another person demonstrates infants are beginning to understand the intentions of others around them. During these early interludes of JA between caregiver and child, typical developing children are able to develop an initiating and responding pattern that is the basis for later referential conversation (Carpenter et al., 1998).

A study by Mundy et al. (2007) supports the development trajectory outlined by Carpenter et al (1998). This study tested typical children longitudinally from 9-24 months using clinical evaluation of JA and play and parent report to measure language. The authors reported that 12-month initiating JA (IJA) and 18-month response to JA (RJA) predicted 24-month language abilities after controlling for general aspects of cognitive development. Although authors noted differences in individual development of IJA and RJA, a developmental pattern did emerge: language arose from the ability of a child to comprehend the intentions of another during moments of JA.

JA in ASD.

Investigation into the JA abilities in children with ASD has gradually expanded. In general, children with ASD show marked impairments in their ability to initiate and respond to joint attention behaviors, limiting their ability to develop social interaction and communication (Mundy et al., 1994; Sigman and Ruskin, 1999; Leekham, Lopez, and Moore, 2000; Charman et al., 2003; Dawson et al., 2004).

Mundy et al. (1994) examined joint attention deficits in children with ASD by comparing them to mental aged matched control groups of children with TD and DD. JA was measured using clinical evaluations of JA in which children were presented with age- specific communication “temptations” and reactions were coded. In this study, behaviors were classified into categories: requesting, joint attention though indicating, and social interaction during turn-taking games. Results indicated that children with ASD showed marked deficits in JA across all categories, and that mental age (MA) may be related to different types of JA, meaning a child’s joint attention skills may be related to their MA. Mundy concluded that JA appears to be a pronounced and consistent deficit across developmental levels for children with ASD.

In a longitudinal study documenting the social competence of children with ASD, DD, and Down Syndrome, Sigman and Ruskin (1999) compared JA and play skills in the preschool years to language and peer engagement skills in middle school. Similarly to Mundy et al. (1994), children with ASD demonstrated unique deficits in JA compared to DD counterparts. In addition, children in the ASD group also demonstrated deficits in play skills, initiation of peer engagement, and responsiveness to the emotions of others not present in children with DD and Down Syndrome. JA was measured using clinical evaluations, similarly to previous studies

(Mundy et al. 1994), while language was determined using standardized measures. Using expressive and receptive language scores, this study determined that JA skills were concurrently associated with language ability and predicted long-term gains in expressive language ability in children with ASD. Additionally, researchers concluded that impairments in initiating bids for JA and impairments in understanding the social function of JA may cause children with ASD to be less likely to initiate social behaviors with peers. Therefore, they miss out on experiencing interactions that are necessary for language, social, and cognitive development (Sigman and Ruskin, 1999).

Leekam, Lopez, and Moore (2000) used a series of gaze point follow tasks to measure JA in children with ASD and DD between 24 and 60 months. Children were matched using a measure of non-verbal ability (+/- 3months). In this study, an examiner acquired the child's attention, and then looked either left or right, towards an object placed out of reach. Response to joint attention was measured. Children with ASD were less able to follow gaze spontaneously as compared to children with DD, a finding comparable to both Mundy et al. (1994) and Sigman and Ruskin (1999).

Charman et al. (2003) measured JA using point-follow tasks to examine differences in joint attention, play skills, imitation, and language abilities in children with ASD and children with Persuasive Developmental Disorder (PDD). In these tasks, toys controlled by the experimenter were activated and responses were tallied for frequency and type. Groups of MA matched children with ASD and PDD were tested at 18, 20, and 42 months. Results of this study indicate that impairments in joint attention can be specifically linked to ASD at 20 months as opposed to PDD. Play skills and language ability were also associated with diagnosis at 20 months. This study also found that receptive, but not expressive, language ability was associated

with joint attention ability at 20 months, which is in contrast to previous findings (Sigman & Ruskin, 1999).

Looking specifically at joint attention and attention to others' distress, Dawson et al. (2004) matched 3-4 year old children with ASD to children with DD and TD on mental age. Mental age was tested using the Mullen Scales of Early Learning (Mullen, 1995), and joint attention, both initiating and responding, were measured using clinical evaluations. Group comparison results indicated that children with ASD made overall fewer attempts to initiate joint attention and were less likely to respond to the examiner's attempts to engage them in joint attention than DD and TD children. In fact, researchers noted that differences in joint attention abilities was one of the most salient differences with comparing children with ASD from children without ASD (Dawson et al., 2004).

Most recently, Naber, Bakermans-Kranenburg, and van IJzendoorn (2008) reported a longitudinal study investigating several types of JA behaviors in children at 24 and later at 42 months. Children with ASD, DD, and TD were matched on chronological age and given joint attention tasks developed by the authors, the Mullen, and the ADOS as a part of an ongoing research study. Development of various types of JA behaviors over time as well as contrasts between groups were recorded. Children with ASD showed significantly fewer JA behaviors at 24 months than comparison groups, and at this age JA behaviors were closely associated with developmental level and severity of autism characteristics. These associations were absent when groups were later tested at 42 months. Children with ASD only differed in one area of JA when tested later, a finding that differs from some previous studies (Mundy et al., 1994; Sigman et al., 1999; Leekham, Lopez, and Moore, 2000; Charman et al., 2003; Dawson et al., 2004).

In summation, JA appears to be a significant impairment in children with ASD as compared to children with TD, DD, and PDD (Mundy et al., 1994; Sigman et al., 1999; Leekham, Lopez, and Moore, 2000; Charman et al., 2003; Dawson et al., 2004; Naber et al., 2008). Additionally, some studies found that JA is related to MA in children with ASD (Mundy et al., 1994; Leekham et al., 2000; Naber et al., 2008) and that language and social skills are closely associated with JA abilities in children with ASD (Sigman et al., 1999; Charman et al., 2003).

Gestures

In addition to showing limited joint attention behaviors as compared to their typically developing peers, children with ASD also show atypical gesture development. Atypical or delayed gesture use presents potential communication setbacks for this population since gestures are “tightly coupled” (p.20) with language both neurologically and developmentally (Iverson & Thelen, 1999). Goldin- Meadow and Morford (1985) observed, “communication in humans is a resilient phenomenon; when it is prevented from coming out the mouth, it emanates almost irrepressibly from the fingers” (p. 46). This observation emphasizes the importance of the relationship of gestures to human communication.

Gestures in typical development.

Oral and manual communication are linked cognitively and share many underlying mental processes (Iverson & Thelen, 1999), making the examination of gestural communication a valuable litmus test of a child’s cognitive and language level. Fenson et al. (1994) used parent report to measure the relationship between early language and gesture. Between 8 and 16 months of age, gestures and language comprehension (but not production) were correlated.

Fenson (1994) suggests that gestures aid in increasing language comprehension and fuel language production. Studies of gesture development have shown that many children use gestures to supplement and clarify speech in the time period preceding complete language acquisition. A review of gesture development literature by Crais, Watson, and Baranek (2009) concluded that gestures are the first indications of intentionally, gestures are used by typical children as their first means of communication, and that in typical children who may be “late talkers” gestures predominate over verbal language for an extended period. These observations demonstrate the value of gesture use in the early years of childhood.

A study by Tomasello, Striano, and Rochat (1999) revealed that gesture use may be additionally related to cognition. This study tested children at ages 18, 26, and 35 months in using gesture/ symbol tasks of increasing difficulty. Children were presented with pairs of symbols- a symbol for an unknown word and a gesture representing an unknown word. As the tasks increased in difficulty, older children preformed better, but gesture symbols were more readily identified in both groups, showing that gestures can be used to supplement knowledge in abstract or novel situations. Thus, gestures in typical development not only support language development, but they can also serve as an adaptive tool in cognitively challenging situations.

Crais et al. (2004) followed 12 typically developing toddlers from 6- 24 months in order to examine the development of deitic and representational gestures. Parent report was used to identify the frequency and expansion of gestural skills as children mature. Authors categorized gestures into various intentionally types: behavior regulation, joint attention, and social interaction. As children cognitively matured, more sophisticated gestures were used to achieve various communicative functions, suggesting that gesture developmental parallels cognitive

development in the prelinguistic stage of development (Crais et al. 2004), similar to previous studies (Tomasello et al. 1999).

Extending these results, Watt, Wetherby, and Shumway (2006) used clinical evaluations to examine the relationship between prelinguistic skills and later language development in 160 children. This study found correlations between inventory of conventional gestures and receptive language outcome, confirming previous findings (Fenson et al., 1994). A large early inventory of gestures will, according to the authors, influence later receptive language outcomes.

Gestures in ASD.

Similar to other areas of social communication, gesture use is impaired in children with ASD (Goodhart and Baron-Cohen, 1993; Shumway and Wetherby, 2009). In these studies, however, children with ASD demonstrated impairments in gestures related to symbolic communication (i.e., joint engagement and social interaction) rather than referential communication (i.e., pointing to pictures in a book).

In Goodhart and Baron-Cohen's (1993) study, children with ASD ages 1 to 7, along with mental-aged matched controls were given clinical evaluations of gesture use. Children with ASD were able to use pointing to reference objects, but an overwhelming majority (90%) did not coordinate a point with an eye gaze to socially reference. Mental-aged matched controls demonstrated both types of pointing, highlighting the social-emotional deficits that are at the core of ASD.

In a retrospective study, Shumway and Wetherby (2009) examined gesture use in 125 children 18 to 24 months of age: 50 who were later diagnosed with ASD, 25 with developmental delays (DD), and 50 with TD. In addition to communicating at a lower rate than children with

DD and TD, children with ASD used a lower proportion of deictic gestures (gestures used to call attention to an object, person, or event). Finally, children with ASD in this study were more likely than children with DD and TD to rely on primitive gestures to communicate (ex. reaching out to touch an adult). However, children with ASD performed equally well to comparison groups when representational gestures were analyzed, similar to previous findings (Goodhart and Baron-Cohen, 1993).

While gesture use has been studied in young children with ASD, few studies have examined gesture use in children with ASD as compared with other core symptoms of ASD or to developmental level in TD and ASD children. Research analyzing gestures in this way carries important diagnostic and intervention implications. Gestures are not only linked cognitively and developmentally to language, but also serve as a scaffold to advancing cognition and expanding language.

Symbolic Play

Symbolic play, a significant developmental milestone, is defined as “the representational use of objects- pretending one object represents another as when a sponge represents a cracker, or imagining that dolls have personal attributes and abilities, as when a doll drives a car” (Kasari, Freeman, & Paparella, 2006). This skill, along with joint attention and gesture use, develops in the second year of life and is a precursor to the development of social skills as well as representational language in typical development (Honey, Leekam, Turner, and McConachie 2007). “Impairments in symbolic play” is listed as diagnostic criteria for children with ASD in the DSM-IV (2002): “lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level.”

Symbolic play in typical development.

Play in young children has long been the subject of study, since it develops parallel to language and is presumed to provide a general context for language learning and the development of valuable cognitive skills (Piaget, 1962; Bates, Benigni, Bretherton, Camaioni, and Volterra 1979; Lifter and Bloom, 1989). Symbolic play provides an environment for language change and challenges a child's growing knowledge base. Several studies have documented the relationship between play and other developmental milestones, such as receptive language, vocabulary, and comprehension, as well as play's relationship to overall development.

Lyytinen et al. (1999) longitudinally examined the play and language skills of typical children aged 14- 42 months. At regular intervals, children were given a clinical examination of symbolic play and parent report measures of language. Symbolic play was significantly correlated at 14 months with receptive language, receptive vocabulary, and comprehension at 42 months. This study confirms earlier hallmark studies of the relationship between language and play (Bates et al., 1979; Lifter and Bloom, 1989). Additionally, authors in this study suggest a cognitive association between play and language as hypothesized by earlier studies (Piaget, 1962).

Symbolic play ASD.

Since the development of symbolic play coincides with language and cognitive growth, the limitations of symbolic play in children with ASD are particularly troubling. Many researchers have described young children with ASD as having limited symbolic play or strictly functional play (Baron-Cohen, 1987; Stone and Yoder, 2001 Charman et al., 2003; Stanley and

Konstantareas, 2007). Research demonstrating a relationship between symbolic play, language, and developmental level has been conflicting.

Stone and Yoder (2001) longitudinally examined the play, imitation, and cognitive abilities of 35 2 year old children with ASD in order to determine their effect on language ability at 4 years. Children in this study demonstrated limitations on measures of symbolic play. Stone and Yoder found that play ability, along with joint attention and imitation at 2 years were associated with language abilities at 4 years, suggesting a relationship at these ages between language and play.

Charman et al. (2003) also found symbolic play to be limited in children with ASD and PDD between 20 and 42 months. Participants were given clinical measures of joint attention, symbolic play, and imitation as well as a parent report of language and a standardized measure of MA. While toy play at 20 months was observed to be limited, it was not associated with language at 42 months, as reported by other studies (Stone and Yoder, 2001).

A study of symbolic play as compared to some other domains of ASD- developmental level, receptive language, expressive language, and social development –by Stanley and Konstantareas (2007) extended the results of both previously reported studies. The profiles of 101 children with ASD between 2 and 18 years were examined retrospectively. Results of a structured play assessment, nonverbal cognitive testing, and parent reports of language were compared. Developmental level and expressive language were both significantly related to symbolic play similar to previous studies (Stone and Yoder, 2001), but receptive language was not. Stanley and Konstantareas (2007) noted a very significant relationship between cognition and play- higher cognitive levels represented higher symbolic play ability, echoing the findings

of previous studies (Baron-Cohen, 1987), and suggesting a reciprocal relationship between these variables.

Children with ASD have been shown to display deficits in symbolic play, though research documenting play's association with other autism symptomology remains sparse.

Repetitive and Stereotyped Behaviors

Repetitive and stereotyped behaviors (RSB) are defined as a general range of behaviors including obsessions, interests, rituals, perseveration, and repetitive use of objects or language. These behaviors form the third diagnostic criteria area for ASD in the DSM-IV (American Psychiatric Association, 2000), which outlines more specific criteria: “encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus; apparently inflexible adherence to specific, nonfunctional routines or rituals; stereotyped and repetitive motor mannerisms and persistent preoccupation with parts of objects.”

Turner (1999) was the first to divide this category of behavior into subcategories of “higher- level” behaviors, which consist of attachments to people or objects, insistence on consistency, repetitive language, and limited interests; and “lower- level” behaviors, which are characterized by repetitive movements of the body or objects. Turner hypothesized that the “higher-level” behaviors can be associated with higher levels of cognition, while “lower-level” behavior can be associated with lower cognitive levels, a framework supported by early research into the nature of ASD (Wing & Gould, 1979).

Additionally, Bodfish, Symons, Parker, and Lewis (2000) found that key differences in the presentation of RSB in typical and ASD populations are frequency and maintenance over

time. This study, using a teacher report form as well as clinical observations, compared an ASD population (n=32) to a mental retardation (MR) group (n=34) and found that RSB is more significantly present in adults with ASD. Type of RSB, frequency, and maintenance over time were distinguishing factors (Bodfish et al., 2000).

RSB in typical development.

While RSB are frequently associated with children with ASD, typical children actually exhibit similar behaviors (Evans et al., 1997, DeLoache, Simcock, and Macari, 2007) throughout early development. Several studies (Evans et al., 1997, DeLoache et al., 2007) have looked specifically at the presence of intense interests and repetitive behaviors in the context of a typical developmental trajectory.

Thelen (1979) observed 20 typical infants in their natural environment from birth to 52 weeks in order to document their rhythmical stereotypies. Thelen (1979) recorded 16,000 instances of motor RSB in these typical infants, categorized into 47 body movement patterns. These infants demonstrated RSB that peaked and declined with motor maturation. Thelen (1979) proposed that motor RSB are manifestations of incomplete cortical control of the maturing muscular system in typical infants, and should decline as muscle groups mature.

Expanding these results to an older population, Evans et al. (1997) used a RSB parent report to examine these behaviors in 1,492 children ranging from 8-72 months. Results of this study indicate RSB occurs early in typical childhood (<12 months) and persists until 3-4 years, where it tapers off. Boys were more likely to exhibit RSB than girls. RSB behaviors related to “sameness” (e.g., insisting on repetition of daily routines and perfectionism) were most present

in this age group. Researchers concluded that the decline in RSB around 4 years is associated with a rise in social communication and emotional development (Evans et al., 1997).

DeLoache et al. (2007) also used parent report to demonstrate the presence of RSB in 177 typical children ranging in age from 11 months to 6 years. Similar to the previous study (Evans et al., 1997), RSB emerged in these children before 18 months and some types persisted until after 4 years. Researchers in this study noted that RSB was primarily present in boys in this sample.

RSB in ASD.

Much early research in RSB was devoted to establishing the presence and studying the nature and focus of RSB in young children with ASD. Several recent studies, instead, have examined the relationship between RSB and other diagnostic parameters of ASD (Bruckner and Yoder, 2007; Honey et al., 2007; Morgan, Wetherby, and Barber, 2008).

Bruckner and Yoder (2007) measured joint attention in young children who engaged in restricted play with objects using systematic clinical observations and developmental play analysis. They found restricted object use in 27 children with ASD (mean age=33.6 months) to be significantly negatively correlated with response to joint attention, motor imitation, and coordinated attention to object and person. This indicated that children who engage in restricted object use are less responsive to bids for joint attention and models to imitate others, replicating previous studies hypothesizing RSB to be imaginatively limiting for young children with ASD (Wing & Gould, 1979).

Similarly, Honey et al. (2007) used parent report to quantify the language, play, and RSB levels in 196 children with ASD ranging from 2-8 years. Researchers here found that repetitive

behaviors were more frequent in children with ASD and were negatively associated with more frequent play behaviors, supporting previous studies that claimed a relationship between RSB in children with ASD and lower imaginative skills (Wing and Gould, 1979; Turner, 1999). Additionally, Honey et al. (2007) observed that RSB behaviors were developmentally related, and that reducing their presence in young children with ASD could increase their imaginative capabilities at certain ages.

Using clinical observation, Morgan et al. (2008) found that children with ASD demonstrated a larger inventory and greater rate of RSB related to objects and body movements than children with TD or DD, echoing previous findings (Bodfish et al., 2000). This study also found a negative correlation between RSB and social and symbolic communication in the second year of life, between RSB in the second year and developmental level, and severity of autism symptoms in the third year of life. This finding suggests a connection between developmental level, RSB, and language in young children with ASD.

While RSB continues to be the subject of study by leading ASD researchers, its relationship to developmental level, joint attention, symbolic play, and language has been recently established (Bruckner and Yoder, 2007; Honey et al., 2007; Morgan et al., 2008). RSB is a core diagnostic marker for children and adults with ASD, and its presence often limits individuals with ASD from developing appropriate imaginative and social skills (Wing and Gould, 1979; Turner, 1999; Bodfish et al., 2000; Bruckner and Yoder, 2007; Honey et al., 2007; Morgan et al., 2008).

Purpose of the Study

Studies examining the core symptoms of ASD under 3 years of age and their relationship to developmental level are emerging as children are being diagnosed with ASD at younger ages. However, few studies have examined the developmental trajectories of young children with ASD compared to children with TD and how their developmental level impacts their symptoms. This line of research holds valuable implications for early intervention. This study had two research aims: 1) To describe differences between specific core symptoms of ASD compared to TD, and 2) To determine the relationship between developmental functioning and symptom presentation in young children with ASD. Using the *CSBS* behavior sample, joint attention, gestures, symbolic play, and RSB, in addition to more general categories of symptom presentation, were measured. It is anticipated that on the *CSBS*, children with ASD will have lower scores on general symptom categories when compared to TD children on the same developmental level. Symbolic and social gesture use is predicted to be less frequent in children with ASD. Initiating and responding to joint attention is predicted to be impaired in children with ASD, and RSB is predicted to be increased in children with ASD. Developmental level is predicted to be negatively correlated with RSB, and positively correlated with all other symptom categories.

Methods

Subjects

The study included twenty children: an ASD group ($n=10$) matched on mental age and gender to TD group ($n=10$). Participant ages ranged from 10 to 33 months (ASD mean age: 27.8 months; TD mean age: 21.9 months). Participants with ASD were recruited through the UA

Toddler Language Program for children with ASD, Mitchell's Place (a school for children with ASD in Birmingham, AL). Children with TD were recruited through local area preschools.

Children in the ASD group were all diagnosed with ASD based on best estimate diagnosis by a clinical psychologist or a diagnostic team.

Children in the control group did not have any preexisting neurological or communicative delays and were matched to the children with ASD based on nonverbal abilities (± 3 months) measured by the Mullen Scales of Early Learning (*MSEL*: Mullen, 1992) and gender. A summary of participant demographic characteristics is presented in Table 1.

Table 1

Demographic characteristics

	ASD (n=10)				TD (n=10)				p value of pairwise differences ASD-TD
	Mean	SD	%	#	Mean	SD	%	#	
Demographic									
Chronological Age	27.60	4.11			20.80	7.25			0.50
Parent's Education, in years completed									
Mother	15.44	1.51			16.65	3.21			-0.23
Father	16.22	3.56			17.63	2.26			-0.23
Males (%)			100.00				100.00		
Firstborn (%)			80.00				80.00		
Ethnicity (%)									
Caucasian			9.00				8.00		
African American			1.00				2.00		

Measures

Communication and Symbolic Behavior Scales (CSBS: Wetherby & Prizant, 2002). Each child was seen with a parent over one or two sessions at the University of Alabama Speech and Hearing Center or at their preschool. During the first session each child was administered the CSBS to obtain a measures of symbolic play, social language, and speech. This evaluative tool provides a standard but flexible format in which the child sits between the examiner and a parent either on the floor or at a table. The child was presented with six communicative temptations, including a wind- up toy, a bag with squeaky toys, a balloon, bubbles, a jar of snacks, books, a kitchen set, and a set of blocks. Spontaneous communicative behavior is encouraged and measured. Colorful pictures adorned the walls to assess response to joint attention.

Throughout the course of the CSBS, the child is presented with a toy or temptation in the following order: wind- up toy, balloons, bubbles, and the jar. The bag of toys is presented following each of these temptations. Next, the child and his or her parent looked at books together. Next, the child and the parent were given a set of kitchen toys and a stuffed animal to probe symbolic play. Finally, the examiner assessed comprehension of objects, names, and body parts followed by constructive play with blocks.

To prompt a child to request help with an object, the examiner used the followed scaffold: (1) the examiner said, “Need help?” with rising intonation, (2) extended an open hand on the table, 12 inches or more from the object, (3) moved the hand to within 3 inches of the object, not touching it, (4) repeat the temptation from the beginning. Between each prompt, the examiner waited 7 seconds. Prompts were only administered in instances where the child did not interact with either the parent or the examiner in response to the presentation of the toy.

Throughout the CSBS, the examiner and the parent responded positively to the child's responses to the toys, and engaged the child when appropriate.

The examiner also provided two pointing opportunities for the child to respond to joint attention in the form of gaze- point follow tasks. In each of these trials, the examiner pointed towards a picture on the wall behind or to the side of the child while saying the child's name and "look". If the child looked in the direction that the examiner pointed, they got credit for that item.

The *CSBS* was videotaped so that the examiner, the child, and the parent were facing toward the camera. The test lasted approximately 25 minutes. Videotapes were scored by the examiner and a trained observer. To achieve clinical reliability on this measure, consensus coding on five samples of children was completed between this investigator and an investigator previously trained on the *CSBS*. occurred on five samples to establish clinical reliability on the *CSBS*. Both investigators were blind to the 5 children's diagnoses during reliability training.

Joint attention is defined as "any act used to direct another's attention to an object, event, or topic of communicative act" (*CSBS*, Weatherby and Prizant, 2002). The child must try and gain either the parent or the examiner's attention to get them to look at something in order to comment or request information. Each communicative temptation or toy provided an opportunity for the child to employ an act of joint attention. Pointing, questioning using rising intonation, and commenting were all acceptable examples of initiating bids for joint attention. Frequency of bids for joint attention were counted and combined. Responding to joint attention was measured by the two gaze- point follow tasks.

Gestures were defined as any nonverbal behavior replacing words to serve a communicative function. That is, gestures must be directed at the adult or the examiner in a communicative act to count on the *CSBS*. Examples of gesture include: giving, showing, pushing or pulling away, reaching, pointing, waving, nodding or shaking their head. Additionally, contact and distal gestures such as pointing to a picture in a book and pointing at a distance were included in the inventory of gestures score. Gestures were tallied throughout the administration of the *CSBS*, and each test item provided an opportunity for the child to use gestures to communicate.

Symbolic play was measured using a set of kitchen toys and a stuffed animal or doll. The child and the parent were each given a set of toys, with instructions to play with the doll and the toys together. Scores were tallied in terms of action schemes, and the child was given higher scores for more complex action schemes. Examples of common symbolic play action schemes include stirring, drinking with a bottle or cup, scooping, and pouring. These action schemes can be combined with others to create more complex action schemes, and can be directed to the child himself, the examiner, the parent or the doll. After the play sample is completed, the child was presented with a set of blocks and instructed to make a tower to determine level of constructive play. For each block stacked, the child receives a point. These two sections are combined with object identification to obtain a total symbolic play score for each child.

The Repetitive and Stereotyped Movement Scales: Companion to the CSBS (RSMS; Wetherby & Morgan, 2007). The *RSMS* was used to code repetitive behaviors that occur within the *CSBS* behavior sample. The *RSMS* measures rate and inventory of repetitive behaviors with body and with objects. Within the repetitive behaviors with objects category, two sets of behaviors are coded: restricted and sameness (Morgan et al., 2009). Behaviors coded within the

body category are flapping arms and hands, patting or pressing a body part, rubbing a body part, and stiffening fingers, hands, or arms. Behaviors coded within the Restricted category of RSB with objects include swiping objects away, rubbing or squeezing an object, rolling, rocking or flicking an objects, and spinning objects. The Sameness category includes collecting objects, moving objects to one location, lining up objects, and clutching objects.

To estimate MA and match individuals in the ASD group to the TD group, the children were administered the *MSEL* at either a second testing time or after a short break following the CSBS. This particular test was used because it provides a continuous measurement of mental age, or developmental functioning level, across the developmental range of children in this study in the areas of fine motor, visual reception, receptive language, and expressive language.

Examples of fine motor tasks were stacking blocks, placing coins into a slotted bank, and tracing and drawing with crayons. Examples of visual reception items were putting together puzzles, sorting items into categories, and matching shapes by size and color. Examples of receptive language items were following familiar and unfamiliar directions, identifying objects, and identifying directions. Examples of expressive language items were naming objects and pictures, answering questions, and repeating numbers and sentences. Items are presented in order of increasing difficulty. A child must answer three questions correctly in a row to establish a basal and must miss three items in a row to establish a ceiling. Each area was assessed on a scale of a approximately 30 items. The test was administered in the same room as the *CSBS*. To match children in the ASD group to the TD group, raw scores for visual spatial skills and fine motor skills were averaged together to obtain a nonverbal level.

Results

Means and standard deviations were calculated for all behaviors. As expected, CSBS composite raw scores and the *MSEL* composite standard score were higher for the TD group than in the ASD group. To determine the magnitude of mean differences between groups on all measures, effect sizes were calculated using Cohen's d , for which a value of $d \geq .20$ is considered small, $\geq .50$ medium, and $\geq .80$ large (Cohen, 1988). Large effect size for gestures raw score, symbolic raw score, and social raw score ($d=2.37$, $d=1.41$; $d=2.5$ respectfully) were obtained. A medium effect size was observed in comparing speech raw scores ($d=.50$) since the groups appeared more similar on speech scores. Mean levels of RSB were lower in children with TD with large effect sizes seen in object inventory ($d=1.39$), object rate, body rate, and body inventory ($d=1.11$, $d=1.14$, $d=1.55$, respectfully), as well as object and body weighted raw scores ($d=1.26$, $d=1.32$, respectively). Differences were not found on the nonverbal matching variable ($d=.01$), however composite T-scores from the Mullen were higher for the TD group with a large effect size ($d=1.53$). Results are reported in Table 2.

A one way ANVOA was conducted to examine group differences on core ASD symptoms in this sample. Of the social communication variables, social raw score had the highest group difference $F(19) = 31.93$, $p < 0.01$. Gesture raw score, $F(19) = 27.53$, $p < 0.01$, was also significantly high. All RSB categories indicated group differences. Object inventory, $F(19) = 10.63$, $p < 0.01$, indicated the most significant group difference, and RSB object weighted raw score was also notable: $F(19) = 7.19$, $p < 0.05$. Although p-value comparison did not reveal significant group differences in speech or symbolic raw scores, a pairwise effect size comparison did reveal medium effect size differences for speech raw scores ($d = 0.50$) and symbolic raw scores ($d = 1.143$). Large effect size differences were also found in social raw

score ($d = 2.527$), gesture raw score ($d = 2.371$), and the MSEL T- score composite ($d = 1.539$), as well as all RSB categories. While groups did not differ on the matching variable, $F(19) = 0.00$, $p < 0.01$, a comparison of composite T-scores did indicate group differences, $F(19) = 10.58$. Since the matching variable represented nonverbal developmental functioning level (by combining raw scores on the fine motor and visual reception portions of the *MSEL*), and the Composite T-Score includes language and takes chronological age into account, this difference is not necessarily surprising.

Table 2

Mean, standard deviations, group differences, and effect sizes

	ASD ($n=10$)		TD ($n=10$)		Pairwise effect size (d) ^a		
	Mean	SD	Mean	SD	$F(19)$	p -value	TD-ASD
CSBS-DP							
Speech raw score	22.150	20.455	31.650	17.185	1.264	0.276	0.505
Symbolic raw score	18.100	17.610	36.700	14.922	6.494	0.020*	1.143
Social raw score	22.241	10.532	48.502	10.251	31.927	0.000**	2.527
Gestures raw score	6.100	2.923	14.200	3.910	27.529	0.000**	2.371
MSEL							
MSEL Fine Motor/Visual Reception Raw	23.700	6.143	23.750	5.832	0.000	0.985	0.008
MSEL T -Score Composite	77.5	28.722	109.200	12.461	10.579	0.004**	1.539
RSM							
RSB body rate	1.900	3.315	0.000	0.000	2.136	0.247	-1.146
RSB body inventory	0.400	0.516	0.000	0.000	2.134	0.200	-1.549
RSB body weighted raw score	0.999	1.515	0.000	0.000	2.410	0.209	-1.319
RSB object rate	4.200	4.638	0.800	1.475	4.858	0.082	-1.112
RSB object inventory	1.900	1.449	0.400	0.699	10.631	0.006**	-1.397
RSB object weighted raw score	3.467	3.081	0.666	1.175	7.186	0.019*	-1.316

* $p < .05$ ** $p < .01$

^aEffect size based on Cohen's $d \geq .20$ = small, $.50$ = medium; and $.80$ = large

p-values are Welch corrected for violation of homogeneity of variance

To assess the relationship between developmental level (nonverbal ability) and ASD symptoms, Pearson Product Moment correlations were completed and are presented in Table 3.

These correlations indicate that many early symptoms of ASD are correlated with one another as well as with nonverbal ability. Significant correlations among *CSBS* measures were observed between speech and symbolic raw scores, as well as between social and gesture raw scores. Nonverbal ability was significantly correlated with speech raw scores and symbolic raw scores. inventory, as well as between object rate and object inventory. Significant moderate correlations Nonverbal ability was moderately correlated with gesture raw scores and negatively with RSB object inventory. Among RSB measures, body inventory was moderately negatively correlated with *CSBS* speech raw score and symbolic raw score. Correlations between variables for the TD group are presented in Table 3a. Significant correlations were found between most variables and between variables and the MSEL matching variables. These correlations confirm what is known about the relationships between social communication variables and developmental level in early childhood.

Table 3

Correlations between variables in ASD group

	<i>CSBS</i>				<i>MSEL</i>		<i>RSB</i>					
	SP	SYM	SO	G	FV	T	BR	BI	BWR	OR	OI	OWR
<i>CSBS-DP</i>												
Speech raw score (Sp)	1.00	0.98**	0.63	0.44	0.80**	0.86**	-0.42	-0.67*	0.86**	-0.60	-0.41	-0.63*
Symbolic raw score (Sym)	0.98**	1.00	0.70*	0.51	0.86**	0.87**	-0.45	-0.65*	0.87**	-0.60	-0.33	-0.63
Social raw score (So)	0.63	0.70*	1.00	0.76**	0.67*	0.68*	-0.35	-0.36	0.68*	-0.54	-0.44	-0.62
Gestures raw score (G)	0.44	0.51	0.76**	1.00	0.30	0.54	-0.21	-0.32	0.54	0.17	-0.21	-0.22
<i>MSEL</i>												
MSEL Fine Motor/Visual Reception Raw (FV)	0.80**	0.86**	0.67*	0.30	1.00	0.72*	-0.40	-0.40	-0.43	-0.69*	-0.38	-0.76*
MSEL T -Score Composite (T)	0.86**	0.87**	0.68*	0.54	0.72*	1.00	-0.35	-0.52	-0.42	-0.69*	-0.52	-0.71*
<i>RSM</i>												
RSB body rate (BR)	-0.42	-0.45	-0.35	-0.21	-0.40	-0.35	1.00	0.74**	0.98**	-0.13	-0.16	0.03
RSB body inventory (BI)	-0.674*	-0.652*	-0.36	-0.32	-0.40	-0.52	0.74**	1.00	0.85**	-0.08	-0.09	0.08
RSB body weighted raw score (BWR)	-0.51	-0.54	-0.40	-0.26	-0.42	-0.43	0.98**	0.85**	1.00	-0.12	-0.15	0.05
RSB object rate (OR)	-0.60	-0.60	-0.54	0.17	-0.69*	-0.69*	-0.13	-0.08	-0.12	1.00	0.81**	0.95**
RSB object inventory (OI)	-0.41	-0.33	-0.44	-0.21	-0.38	-0.52	-0.16	-0.09	-0.15	0.81**	1.00	0.85**
RSB object weighted raw score (OWR)	-0.63	-0.63	-0.62	-0.22	-0.76*	-0.71*	-0.03	0.08	0.05	0.95**	0.85**	1.00

*p<.05 **p<.01

Note: Correlations are Pearson Product-moment correlation coefficients

Table 3a

Correlations between variables in TD group

	CSBS				MSEL	
	SP	SYM	SO	G	FV	T
CSBS-DP						
Speech raw score (Sp)	1.00	0.78**	0.87**	0.77**	0.91**	0.82
Symbolic raw score (Sym)	0.78**	1.00	0.71*	0.54	0.81**	0.16
Social raw score (So)	0.87**	0.71*	1.00	0.91**	0.87**	-0.13
Gestures raw score (G)	0.77**	0.54	0.91**	1.00	0.82**	-0.28
MSEL						
MSEL Fine Motor/Visual Reception Raw (FV)	0.91**	0.81**	0.87**	0.82**	1.00	0.15
MSEL T-Score Composite (T)	0.82	0.16	-0.13	-0.28	0.15	1.00

*p<.05 **p<.01

Note: Correlations are Pearson Product-moment correlation coefficients

Note: Correlations for RSB categories were not included since RSB was not as prevalent for the TD group.

Partial correlations holding developmental level constant were also conducted to further examine how the relationship between ASD symptomology may be mediated by developmental level. Results are presented in Table 4. After controlling for developmental level, only two significant correlations remained: speech raw score and symbolic raw score, and gesture raw score and social raw score.

Table 4

Partial Correlations with developmental level controlled

	CSBS				RSB					
	SP	SYM	SO	G	BR	BI	BWR	OR	OI	OWR
CSBS-DP										
Speech raw score (Sp)	1.00	0.91**	0.10	0.10	-0.33	-0.59	-0.41	0.12	0.09	0.08
Symbolic raw score (Sym)	0.91**	1.00	0.28	0.26	-0.41	-0.53	-0.46	0.14	0.31	0.07
Social raw score (So)	0.09	0.28	1.00	0.80*	-0.20	-0.03	-0.20	-0.10	-0.13	-0.23
Gestures raw score (G)	0.10	0.26	0.80*	1.00	0.11	0.02	0.06	0.13	0.08	0.11
RSM										
RSB body rate (BR)	-0.33	-0.41	-0.20	0.02	1.00	0.69	0.98	-0.05	-0.43	-0.26
RSB body inventory (BI)	-0.59	-0.53	-0.03	0.12	0.69	1.00	0.81*	-0.73*	-0.49	-0.47
RSB body weighted raw score (BWR)	-0.41	-0.46	-0.20	0.06	0.98	0.81*	1.00	-0.60	-0.47	-0.34
RSB object rate (OR)	-0.12	-0.14	-0.10	0.13	-0.50	-0.73*	-0.60	1.00	0.80*	1.00
RSB object inventory (OI)	-0.10	-0.31	-0.13	0.08	-0.43	-0.49	-0.47	0.80*	1.00	0.85**
RSB object weighted raw score (OWR)	-0.07	-0.08	-0.23	0.12	-0.26	-0.47	-0.34	0.89**	0.85**	0.89**

*p<.05 **p<.01

Note: Correlations are Pearson Product-moment correlation coefficients

Considering the heterogeneous nature of ASD and the wide spectrum of skills presented by children with ASD, it is important to examine how many children exhibited the variables measured. JA was measured on *CSBS* in two ways. First, participants were given two opportunities during the sample to respond to joint attention (RJA) by following a point. If participants followed that point, they were given one credit for that item. Participants were also given six opportunities during the *CSBS* (during each communication temptation) to initiate joint attention (IJA) with another person. IJA was tallied across the sample. Table 5a details the total proportion of IJA and RJA separated by diagnosis. It is evident from the table that not only did children with ASD demonstrate fewer instances of JA, they were more impaired by IJA than RJA.

Table 5b and 5c indicate the number of children who demonstrated at least one instance of each gesture and RSB measured during the *CSBS* Behavior Sample. It is clear from comparison of the groups that a fewer number of children with ASD demonstrated individual gestures than children in the TD group. In likewise fashion, greater RSB were exhibited by children with ASD.

It is important to note that these behaviors were measured during the behavior sample and therefore there were a limited number of opportunities to engage in the behaviors measured. Gestures were only measured within communicative acts, so even though a child may have the capability to demonstrate a skill, it was not coded unless it occurred within a communicative act.

Table 5a

Mean Proportion of IJA and RJA demonstrated by children within CSBS Behavior Sample

	<u>ASD (n=10)</u>	<u>TD (n=10)</u>
IJA	27	85
RJA	35	65

Table 5b

Number of children in each group who demonstrated individual RSB during CSBS Behavior Sample

	<u>ASD (n=10)</u>	<u>TD (n=10)</u>	<u>Total</u>
<i>RSB with body</i>			
Flaps arms	2	1	3
Pats/presses	0	0	0
Rubs body	1	0	1
Stiffens fingers	1	0	1
<i>RSB with objects</i>			
Swipes object	2	0	2
Rubs squeezes	0	2	2
Rolls	0	1	1
Rocks flips	5	1	6
Spins	2	0	2
Collects	1	0	1
Moves places	1	0	1
Lines up	0	0	0
Clutches	2	0	2

Table 5c

Number of children in each group who demonstrated individual gestures during CSBS Behavior Sample

	<u>ASD (n=10)</u>	<u>TD (n=10)</u>	<u>Total</u>
<i>Gestures</i>			
Gives	6	10	16
Shows	1	9	10
Pushes away	5	7	12
Reaches	7	10	17
Points	4	9	13
Waves	4	7	11
Nods head	0	2	2
Shakes head	1	1	2

Discussion

The purpose of this study was twofold: 1) To describe differences between specific core symptoms of ASD compared to TD, and 2) To determine the relationship between developmental functioning and symptom presentation in young children with ASD. It is clear from comparison of the groups that a fewer number of children with ASD demonstrated individual gestures than children in the TD group. This finding supports previously documented research that young children have reduced gesture repertoire when compared to children with TD (reference). A particularly striking difference is the number of children who demonstrated a showing gesture. This gesture was measured when a child held an object up to another person to show or share it, making this gesture representative of joint attention. Previous studies have found the absence of this gesture to be a red flag for ASD (Osterling and Dawson, 1994; Wetherby et al., 2004). Additionally, pointing, giving, and waving were all significantly decreased in the ASD sample. While giving and waving have been shown in previous studies to be delayed (Goodhart & Baron-Cohen, 1993; Shumway and Wetherby, 2009), data regarding ASD deficits in pointing have been mixed. This study revealed that only 4 out of 10 children in the ASD sample demonstrated this skill.

Joint attention skills were additionally delayed overall in children with ASD, similar to previous findings (Mundy et al., 1994; Sigman et al., 1999; Leekam et al., 2000; Charman et al., 2003; Dawson et al., 2004). In fact, children with ASD only demonstrated 27 attempts to initiate joint attention as compared to 85 for the TD group. In responding to joint attention, the ASD group only demonstrated 35 attempts compared to the TD 65. Naber (2004) found that joint attention was linked to developmental level in children at 24 months, but that this association disappears at 42 months. This coincides with our study's findings that social communication

skills, like joint attention, are closely tied to developmental level in children with ASD less than 3 years of age.

In general, a low number of children demonstrated RSB with body. More children demonstrated RSB with objects. The rocking, flipping, flicking object category was demonstrated by the most children in the ASD group. This finding is consistent with Turner (1999)'s framework regarding subcategories for repetitive behaviors. Few children in this sample demonstrated any "higher- level" behaviors (i.e.,attachments to people or objects, insistence on consistency, repetitive language, and limited interests). Only 1 child with ASD collected objects. The rest of the RSB demonstrated by this sample would be considered "lower- level" behaviors, characterized by repetitive movements of the body or objects. Turner (1999) hypothesized that the "higher-level" behaviors can be associated with higher levels of cognition, while "lower-level" behavior can be associated with lower cognitive levels. Interestingly, both children who demonstrated the clutching behavior and the child who collected had above average composite T-scores on the *MSEL*, supporting Turner (1999)'s hypothesis that higher cognitive levels correspond to higher level RSB. There has been some conflict in research as to the nature of the relationship between RSB and developmental level, and the relationship between RSB and other ASD symptoms. Results from this sample indicate, based on the absence of a significant relationship between RSB and other diagnostic domains after developmental level was controlled, that RSB is closely tied to developmental level in early childhood.

A strong relationship between developmental level and symptom presentation in ASD is indicated in this sample of young children. A number of strong correlations disappear when developmental level is held constant. Results from this sample suggest that developmental level drives ASD symptoms in early childhood, and that these impairments exist secondary to

developmental level for the ages represented by this sample size. Only the significant correlations between speech and symbolic raw scores, as well as between social raw scores and gesture raw scores remain among the social communication variables once developmental level is controlled. Speech raw score represents number of sounds, words, and sentences a child used during the *CSBS*, and the symbolic raw score represents a child's ability to understand object names and to play both constructively and symbolically. Gesture raw score represents the inventory of conventional and distal gestures used during the *CSBS*, and social raw score represents the communication rate, emotion and eye gaze, shared positive affect, and communication attempts made by each child during the *CSBS*. Such a significant relationship between speech and language in children under three would seem to indicate the need for play to be a critical part of any language intervention for young children with ASD, especially since language has been so closely tied to play in previous studies (Piaget, 1962; Bates et al., 1979; Lifter and Bloom, 1989). Additionally, the significant relationship between gestures and social skills should guide interventionists working with children with social communication delays to concentrate their efforts on gestures as a part of intervention.

Strengths and limitations

Some limitations must be considered when interpreting the results of this study. First, the ASD group consisted of a heterogeneous group of children, with variations on developmental level as well as social communication skills. To match the wide range of cognitive functioning in the ASD group, the TD group also consisted of children with a wide range of chronological ages as well as functioning levels. This range of chronological ages spanned developmental ages, especially in the TD group, and could have altered group differences. However, a strength of this study was how closely individuals in the groups were matched to one another, which allows

researchers to be confident that groups were comparable. In addition, many of the children with ASD who participated in this study had been diagnosed at early ages, and may have received early intervention services that targeted promoting social communication skills. Social communication skills are generally one of the goals for early intervention for children with ASD, and the intervention for these children may have impacted the children in this sample in a positive direction.

As mentioned before, variables were only seen in the context of the *CSBS*. Thus, the opportunities to demonstrate skills were limited since each child was only allowed to show behaviors in the context of a communicative act. However, the format of the *CSBS* also allows for children to communicate at a higher frequency than they might typically in their natural environment, since children are presented with a series of tempting toys and activities in a short period of time. In addition, testing used to measure social communication and RSB was conducted in a controlled environment, instead of at home. Testing anxiety may have caused some participants to show less than their actual capabilities. However, the benefit of the *CSBS* is that it provides a standard, flexible format in which to consistently evaluate participants, so the design of the study allows individuals to be comparable.

Another limitation to the validity of the study is the small sample size. While diagnosis for children with ASD under 3 is increasing, the national average remains slightly higher- 5.7 years in 2009. Since so few children nationally are diagnosed under 3, it was difficult to identify participants for this study in this age group. In order to increase external validity, more expansive research should be conducted.

Clinical implications

Of particular interest to further researchers are the differences seen in correlations and partial correlations when nonverbal ability was held constant. Since many correlations previously seen were no longer significant when nonverbal ability was held constant, we can consider nonverbal ability tightly coupled with many of the variables in this sample. This finding has not been found in much of the literature dealing with ASD symptomology in children under three. In this study, this relationship that developmental level has with some specific symptoms of ASD was certainly true for gestures, symbolic, and social communication. Further research into the nature of social communication profiles in children ASD under three should be conducted to determine the role of developmental level on the unfolding of ASD symptoms.

One particular set of findings with clinical implications in the field of Speech-Language Pathology are the differences found among *CSBS* social communication variables. Speech is not the largest area of difference when looking at children with comparable developmental levels. Speech raw score effect sizes only revealed medium magnitude differences between ASD and TD groups, indicating that the groups were different on speech raw scores but this difference could not be considered large and was the smallest among social communication variables. Largest effect sizes are seen in gesture use and social communication (i.e., emotion and eye gaze, communication rate, and communication function). Effect sizes here were larger than any other variable, making gestures and social communication skills the primary differences seen between children with ASD and children with TD in this sample. Symbolic understanding is the next highest (i.e., object understanding and play skills), and its effect size is still much larger than that of speech.

Previous research has shown that symbolic understanding is critical to developing representational speech (Piaget, 1962; Bates et al., 1979; Lifter and Bloom, 1989), gesture use and language ability scaffold on one another (Tomasello, 1999; Crais, 2004), and social communication serves as the basis of intentional communication (Carpenter et al, 1998; Mundy et al, 2007). SLPs are often the first line of referrals for young children with potential ASD or who are diagnosed with ASD, and SLPs lead in service providing for this population. With all this in mind, SLPs working with children with ASD under three should carefully consider their intervention approaches. Rather than selecting traditional language therapy or choosing an intervention that focuses primarily on language outcomes, SLPs should consider developmentally appropriate intervention techniques that specifically target social communication and joint attention, gestures, and symbolic play.

Future Directions

The findings in this study only begin to provide a comprehensive picture of the relationship between ASD core symptoms and how those symptoms are mediated by nonverbal abilities. In order to provide a more comprehensive picture of the symptom profiles of young children with ASD and their developmental trajectories, future research should examine these relationships longitudinally in children with ASD.

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