Early Social Communication Behaviors and Their Relationship with Later Social Orienting and Joint Attention Behaviors in Young Children with Autism

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Abstract

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(Under the direction of Elizabeth Crais, Ph.D.)

Infants and toddlers with autism exhibit early social communication deficits, specifically in the exhibition of social orienting and joint attention. The current study examined the social communication behaviors in children at age three who had been identified previously as either at-risk for autism or who were typically developing. The parents of all the children completed the *First Year Inventory* (*FYI*), which is designed to screen infants from the general population for risk of autism. A sample of these infants were given follow-up measures at age three and were evaluated using a coding system quantifying the social communication behaviors children exhibited during the *Autism Diagnostic Observation Schedule* (*ADOS*) evaluation. The relationship between early social communication behaviors reported by parents at 12-months, and later manifestations of these behaviors at age three were examined. Although results did not suggest a relationship between the two time points, limitations of the current study, as well as future steps, are discussed.

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Purpose of Study

Autism is a significant disability that affects a person's social communication abilities throughout his or her lifespan. Even very young children with autism exhibit difficulties in social communication skills including social orienting and joint attention behaviors (e.g., Adrien et al., 1993; Maestro et al., 2002; Osterling et al., 2002; Wetherby et al., 2006; Zwaigenbaum et al., 2005). Both social orienting and joint attention behaviors are critical early learning abilities that encourage further language, cognition, and social skills (Mundy & Stella, 2000). Research has documented that social communication deficits are evident in infants, toddlers, and preschoolers with autism (e.g., Charman et al., 1997; Dawson et al., 2000; Landa et al., 2007; Mitchell et al., 2006; Wetherby et al., 2007). In addition, differences in social communication behaviors exhibited by young children with autism are able to differentiate children with autism from both children who are typically-developing and those with other disabilities (e.g., Baranek, 1999; Charman et al., 1997; Colgan et al., 2006; Dawson et al., 1998; Wetherby et al., 2007). However, little research has examined the trajectory of social communication skills in children with and without autism throughout early childhood.

The current study examined social communication behaviors in young children with and without autism at two time points. First, social communication behaviors were measured

at 12-months of age using the *First Year Inventory* (*FYI*, Baranek, Watson, Crais, &Reznick, 2003). These behaviors were compared with scores from coded videotapes of the children at age three during their *Autism Diagnostic Observation Schedule* (*ADOS,* Lord, Rutter, DiLavore, & Risi, 1999) evaluation. The aim of the study is to determine the relationship between parent report of critical early social communication skills and later manifestations of these behaviors as non-verbal social communication skills. Specifically, this study examined the relationship between social communication scores on the *FYI* (Baranek et al., 2003) and the child's rate of initiative social behaviors, rate of response to social attention, and overall level of social behavior. Results from this study give insight into the nature of early development in children with autism as well as the affect social communication skills can have on subsequent development.

Background and Significance

Introduction

First described by Kanner (1943) as “autistic disturbances of affective contact” and termed “infantile autism,” autism was originally considered a social and communication disorder that manifested itself in early childhood. During the years after Leo Kanner published his seminal work on autism in 1943, autism was considered a low-incidence disability affecting only 2-4 children per 10,000 (National Center on Birth Defects and Developmental Disabilities, 2007). Today, the Center for Disease Control’s Autism and Developmental Disabilities Monitoring Network states that 1 in every 150 children has an autism spectrum disorder (ASD) (National Center on Birth Defects and Developmental Disabilities, 2007). Although the current understanding of autism is more comprehensive than in previous years, research continues its effort to determine the exact nature of autism in young children.

Although researchers do not consider autism to be an “epidemic,” they do acknowledge that a variety of factors have led to an increase in the prevalence of diagnosed autism. First, the current definition of autism in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; APA 1994) is more inclusive than previous definitions of the disability. Second, due to differences in previous diagnostic criteria and lack of understanding of the disability, it is likely that earlier prevalence rates were underestimating the actual incidence of autism. Third, increased awareness among parents, professionals, and

the general public has led to a greater recognition of autism as a possible diagnosis. Regardless of the actual or reported prevalence of autism in the population, it is clear that it is a disorder in need of further research (Wing & Potter, 2002).

Autism is now defined by the *DSM-IV-TR* (and similarly in the *ICD-10;* World Health Organization, 1992) as a disability including three main characteristics: "Qualitative impairments in social interaction; qualitative impairments in communication; and restricted, repetitive, and stereotyped patterns of behavior, interests, and activities" (APA, 2000). The broader category of autism is termed autism spectrum disorders (ASDs) and includes autistic disorder, pervasive developmental disorder-not otherwise specified (PDD-NOS), and Asperger's disorder. All of these disorders have similar basic components listed in the *DSM-IV-TR*, but the exact manifestations of those characteristics, the age of onset, and severity of symptoms vary (APA, 2000).

The *DSM-IV-TR* (2000) and the World Health Organization's International Classification of Diseases (*ICD-10;* World Health Organization, 1992) require that the symptoms of autism manifest themselves before the child is three years old in order to receive a diagnosis (Wing & Potter, 2002). However, the average age at which a child with autism is diagnosed is not until the age of 3 or 4. While we have yet to find a cure, researchers also recognize that early intervention can significantly alleviate the effects of autism (Corsello, 2005; Volkmar et al., 2005). Indeed, current research has been able to identify the characteristics of autism as early as the age of two, allowing the accurate diagnosis of autism by that age (Corsello; Zwaigenbaum et al., 2007). Therefore, in order to better understand how autism manifests itself in children of even younger ages and to better

find and diagnose these children, researchers are investigating the early characteristics of autism using both retrospective and prospective studies of infants (Zwaigenbaum et al.).

Although autism can be diagnosed more readily later in life, research points to the importance of an early diagnosis as it can lead to early intervention services; subsequent decreases in severity of symptoms of autism; and gains in social skills, communication, and cognitive ability. Rogers (1996) examined six different early intervention approaches for children with autism, and determined that intensive and focused early intervention initiated when children were between the ages of 2 and 4 produced better long-term outcomes than the same interventions implemented with older children. The studies also suggested that young children with autism respond more quickly to interventions than children with other severe developmental disorders (1996). Corsello (2005) and Volkmar et al. (2005) also noted the importance of early intervention programs that are introduced in early childhood and include a highly-structured teaching approach, and focus on the child's ability to "learn to learn."

Furthermore, the addition of "Part C" services in 1986 (previously named "Part H;" P.L. 99-457) to the Individuals with Disabilities Education Act (IDEA, 2004, P.L. 108-446) mandates that early intervention be available to infants and toddlers with disabilities. IDEA also includes a "child find" mandate, obligating states to seek out and "find" young children with disabilities through a variety of means (e.g., developmental screenings by a pediatrician, community screenings). As the majority of young children are seen by pediatricians or by some sort of early childhood care provider, it is imperative that information regarding the early development of children with autism is made available to early childhood professionals and physicians, as well as parents (Heward, 2003).

Given the increased diagnosis of autism in young children as well as the importance of early intervention, it is important to understand specifically what the early manifestations of autism are in order to best target intervention strategies and to comply with federal mandates. Research has shown that infants and young children with autism have early social and communication deficits. These deficits include problems in social orienting and joint attention. Research documenting the nature of these early deficits allows practitioners to not only identify children with autism at earlier ages, but to intervene accordingly to alleviate the influence of autism on subsequent development.

Significance of social communication behaviors

As research efforts continue to be focused on the early indicators of autism, it is becoming clear that even before a child is diagnosed with autism, he or she exhibits differences in non-verbal social communication skills. Two prototypical examples of non-verbal communication skills include social orienting and joint attention. Social orienting refers to the child's ability to "spontaneously orient to naturally occurring social stimuli in their environment" (Dawson et al., 2004). For example, a young child will typically turn and look at someone if his or her name is called. Joint attention includes the coordination of attention to an event or object with another person and typically involves the sharing of interest or engagement (Schertz & Odom, 2004). For instance, a child might initiate joint attention by pointing to or commenting on a plane flying overhead, and looking to his or her caregiver to see their response. In doing so, the child initiates an opportunity to communicate and direct the adult's attention to the airplane. Increasingly, researchers support the belief that these types of joint attention and social orienting skills are the building blocks for learning. Therefore research findings in these areas carry broad implications for certain

theories of autism, the early assessment and diagnosis of autism, and the application of targeted intervention efforts.

The social-pragmatic theory of language acquisition stresses the importance of social orienting and joint attention for language acquisition, proposing that language learning requires both a structured social world, and the child's ability to attend to and interpret that social world. This latter task requires orientation to social stimuli, active sharing of interest and attention, and response to similar bids of joint attention and social referencing. Typically developing children are frequently looking at, commenting on, and interacting with people in their environment, which provides limitless opportunities for interaction and learning throughout the day. Research on children's early joint attention skills has documented a strong relationship between early joint attention abilities and later language outcomes, suggesting that non-linguistic joint attention activities support and build later language skills (Bono, Daley & Sigman, 2004; Carpenter & Tomasello, 2000; Mundy, Sigman & Kasari, 1990). Joint attention has also been found to relate to other social-cognitive skills, including gaze following, social referencing, imitative learning, and understanding of intentionality (Carpenter & Tomasello, 2000; Wetherby, Watt, Morgan & Shumway, 2007). Young children with autism exhibit deficits in these areas, and proponents of the social-pragmatic model argue that deficient early social orienting is a core deficit that leads to the later social and communicative deficits characteristic of autism (Carpenter & Tomasello, 2000).

Given the importance of social orienting and joint attention, it appears that early social orienting and joint attention disturbances may be an integral part of the etiology of the problems seen in autism. Indeed, the central features of autism from a social orienting approach may well be related to broader theory of mind deficits and executive dysfunction

present in individuals with autism. Theory of mind can be defined as the ability to infer the mental state of another and how it will affect his or her actions (Baron-Cohen, Leslie, & Frith, 1985). Executive function refers to the "higher level" processes in the brain, especially those related to inhibition, planning, and shifting response (Fisher & Happé, 2005). Studies have demonstrated that individuals with autism struggle with theory of mind and executive function tasks, both in laboratory and natural settings (Baron-Cohen, Leslie, & Frith, 1985; Fisher & Happé, 2005), although it is not clear if either of these cognitive differences are the core impairments seen in autism. Proponents of a more social orienting explanation for the cognitive profile seen in individuals with autism argue that if the frontally-mediated social information processing system is compromised in infants with autism, this could affect subsequent neurobehavioral development, including theory of mind deficits and executive dysfunction (Mundy & Stella, 2000).

Whether or not one argues that social orienting differences are the primary deficits in autism, it is clear that social orienting skills are integral to both language and cognitive learning, as well as later social and pragmatic skills (Mundy & Stella, 2000). Research also offers evidence that early social orienting deficits are the most reliable in differentiating infants and toddlers with autism from both children who are typically developing and those with developmental delays (e.g., Baranek, 1999; Charman et al., 1997; Dawson et al., 2004; Osterling, Dawson, & Munson, 2002). Therefore, early social orienting and joint attention differences should be a major focus of early diagnosis and intervention research.

Social orienting in young children

Social orienting behaviors have been shown to differentiate consistently between infants with autism and infants with other developmental disabilities or who are developing

typically (Baranek, 1999; Lord, 1995; Maestro et al., 2002; Osterling, Dawson, & Munson, 2002; Zwaigenbaum et al., 2005). These behaviors include the child's response to his or her name, attention to stimuli (both non-social and social) and his or her use of eye gaze. Although research has supported some differences by the age of one (e.g., Maestro et al., 2002), the strongest evidence points to a divergence in social orienting behaviors between the first and second year of life that continues into the preschool years (Bryson et al., 2000; Lord, 1995; Osterling et al., 2002).

Typical development. Social orienting is a critical skill very early in a child's development. Before being able to interact with others, infants learn to attend to and differentiate between various stimuli. Newborns are able to fixate on objects and follow their trajectory. Infants also demonstrate a preference for attending to speech sounds over other sounds, and to looking at faces rather than other objects (Westby, 1998). Social orienting refers to the child's ability to react to the types of stimuli present in the environment. Infants, children, and adults all learn from their environment, and the ability to attend to the relevant, specifically social, aspects of the environment is a foundational skill for the shared attention, play, and communication skills that are crucial to early development (Westby, 1998).

Development in autism. When compared to infants with other disabilities, young children with autism are distinguishable based on their attention to social stimuli, indicating that early social differences are mainly specific to autism. At six months of age, infants who were later diagnosed with autism were rated through home videos as being less attentive to social stimuli than their typically-developing peers (Maestro et al., 2002). Analysis of home videos at the age of 12 months also documented that infants with autism exhibited decreased attention to social stimuli and increased attention to objects (Maestro et al., 2002; Osterling,

Dawson, & Munson, 2002). Using a different methodology, the *Autism Observation Scale for Infants* (*AOSI*, Bryson, McDermott, Rombough, Brian & Zwaigenbaum, 2000) was not able to document social differences at the age of 6 months in younger siblings of children with autism, but by 12 months these infant siblings who were later diagnosed with autism were rated as spending less time looking at or attending to people (Zwaigenbaum et al., 2005). For infants who had both autism and an intellectual disability, research documented that they were less attentive to people and less likely to look at objects held by others than those infants with only an intellectual disability (Osterling et al., 2002). Thus, an intellectual disability alone did not account for the differences in social orienting skills seen in the infants with autism. Parents of 2-year-olds with autism also reported that their child was less responsive to an adult's voice and did not consistently orient to it (Lord, 1995). Moreover, compared to both typically-developing infants and infants with other disabilities, infants with autism were less likely to respond to their name by orienting to the speaker (Baranek, 1999; Osterling et al., 2002; Zwaigenbaum et al., 2005).

Difficulty in attending to social stimuli continues past infancy, as research has documented that preschool-aged children with autism have difficulty attending to social stimuli. In addition, preschool-aged children with autism also have difficulty attending to non-social stimuli, although the deficit is less prominent. Compared to children who are typically-developing and those with other developmental disabilities, children with autism more frequently failed to orient to either social (e.g., calling the child's name) or non-social stimuli (e.g., phone ringing) presented in a natural setting (Dawson et al., 1998). Further, the difference between groups was more pronounced in relation to social stimuli. The child's ability to orient to social stimuli was closely related to his or her ability to share attention, but

not closely related to language or nonverbal ability. This suggests that even in older children, attention to social stimuli continues to set the stage for joint attention abilities rather than language or cognition alone (Dawson et al., 1998).

Infants with autism also demonstrate differences in their ability to maintain attention and switch attention. Even before their first birthday, retrospective video analysis of home movies rated infants with autism as having "unstable attention," and being "easily distracted" (Adrien et al., 1993). Infants with autism also had difficulty maintaining and reestablishing their attention when observed through home video tapes (Maestro et al., 2002; Osterling et al., 2002). Retrospective video analysis also found that infants with autism were less likely to be able to disengage their attention and had an increased tendency to fixate on particular objects in the environment (Adrien et al., 1993).

Eye contact and shifting eye gaze are also impaired in infants with autism. Ratings from retrospective video analysis showed one-year-olds with autism as being rated more often on the items "ignores people" and "prefers aloneness" (Adrien et al., 1993). Behavioral markers that distinguished infant siblings (of children with autism) who later developed autism from those who did not included atypicalities in eye contact and visual tracking, and difficulty disengaging visual attention (Zwaigenbaum et al., 2005). Parents reported that their infants with autism had shown difficulty with frequency and intensity of eye contact (Wimpory, Hobson, Williams, & Nash, 2000). Fourteen-month-olds with autism were also rated as having fewer gaze shifts on the *Communication and Symbolic Behavior Scales Developmental Profile* (*CSBS-DP*, Wetherby & Prizant, 2002; Landa, Holman, & Garrett-Mayer, 2007).

As infants with autism grow older, they continue to demonstrate problems with attending. Twenty-month-olds with autism produced less gaze switches of visual attention when compared to toddlers with developmental delays or who were typically developing (Charman et al., 1997). Eighteen- to twenty four-month-olds with autism scored lower than both their typically-developing peers and those with developmental delays on gaze shifting on a social communication measure (Wetherby et al., 2006).

A related skill to shifting attention is the ability to respond to attention bids once already engaged in a social interaction. In a recent study preschool-aged children with autism were assessed for their ability to respond to attention bids in dyadic interactions. When matched on non-verbal IQ to a group of preschool-aged children with developmental disabilities, the group with autism performed worse on dyadic responding to verbal and non-verbal bids for attention (Leekam & Ramsden, 2006). They had the most difficulty with attention bids that used only one modality (e.g., calling the child's name) as opposed to a combination of attentional bids (e.g., calling the child's name plus touch). The children's dyadic orienting skills were significantly associated with their ability to initiate joint attention as well as with their verbal and non-verbal abilities (Leekam & Ramsden, 2006).

In sum, research has demonstrated that attention to social stimuli, attentional flexibility (e.g., shifting attention), and eye gaze are impaired in infants with autism. These deficits appear to continue to be present throughout the preschool years, and also have implications for the development of higher-level attention skills, including coordinating attention with others and initiating interactions to direct another's attention.

Joint attention in young children

One of the most significant findings in research of autism in infancy relates to deficits in initiating and responding to joint attention. Joint attention interactions are those involving coordinated attention between the child and the adult to a mutually interesting object or event (Carpenter & Tomasello, 2000). Joint attention typically involves the sharing of interest and social engagement, and demonstrates the child's understanding that his or her communicative partner is sharing the same focus (Schertz & Odom, 2004).

Typical development. Early precursors to joint attention skills begin around 3 months of age as the infant participates in dyadic interactions with his or her caregivers. By the age of 9-12 months, infants are able to participate (and even initiate) triadic interactions, in which the child and adult coordinate their attention on a third reference point, such as a toy (Mundy & Crowson, 1997).

Joint attention is a critical skill in early development for several reasons. First of all, the ability to coordinate attention with another person reflects earlier social orienting and attention abilities, and therefore joint attention is a secondary skill built on earlier critical skills. Also, joint attention provides a way for children to learn from adults and understand the meanings of events and the intentions of those around them. For example, in responding to joint attention, the infant is able to attend to the event or object the adult is referencing, and therefore learn the label for that item and respond to the adult's interest in it. In initiating joint attention (e.g., gesturing or showing an object to an adult), children are able to share their enjoyment with another and "comment" on their environment, even before they are able to express themselves verbally. Coordinating attention with another precedes and scaffolds

later verbal language and pragmatic development (Mundy & Crowson, 1997; Schertz & Odom, 2004).

Development in autism. Young children with autism exhibit very early deficits in the area of joint attention skills, which contribute to their later difficulties with social communication (Mundy & Crowson, 1997; Schertz & Odom, 2004). Even before their first birthday, infants with autism are distinguishable from peers who are typically-developing based on their ability to coordinate attention with a communicative partner (e.g., Wimpory, Hobson, Williams, & Nash, 2000). This is evident in the types of gestures used by infants with autism, for those who are using gestures at all (Colgan et al., 2006). Sixty percent of a group of 9-12-month-old infants with autism did not use social interaction gestures (compared to 29% of typically-developing infants). In addition, infants with autism who were using social interaction gestures (e.g., pointing, showing) utilized a smaller variety of these gestures even though they were comparable to typically-developing infants in the quantity of gestures and ability to initiate using social interaction gestures (Colgan et al., 2006).

Before their first birthday, infants with autism are also distinguishable from infants with other disabilities based on their joint attention skills. In a structured interview format, using the *Detection of Autism by Infant Sociability Interview* (*DAISI*; Wimpory et al., 2000), not a single parent of preschoolers with autism in this sample reported that they had seen their child exhibit joint attention behaviors by appropriately using referential eye contact, pointing at objects, or following others pointing at objects before the age of 24 months. These infants also failed to share enjoyment by offering or giving objects to others. Although these behaviors were completely absent in the group with autism, over half of the parents of infants with other developmental disabilities reported that their child exhibited these social

behaviors (Wimpory et al., 2000). Based on the research evidence, it appears that the joint attention deficits in infants with autism are not only one of the first indicators of autism, but also are fairly specific to autism and not attributable solely to a delay in development or a cognitive disability.

Between the ages of one and two infants with autism continue to show deficits in joint attention skills. When compared to typically-developing infants, infants with an ASD have difficulty responding to joint attention and initiating joint attention by showing or pointing to share enjoyment (Dawson et al., 2000; Landa, Holman, & Garrett-Mayer, 2007; Werner & Dawson, 2005). These differences were evident even on standardized measures of development, such as the *MacArthur Communicative Development Inventory Infant Form* (Mitchell et al., 2006; Zwaigenbaum et al., 2005). In addition, similar joint attention deficits were found in 20-month-olds with autism when compared to 20-month-olds who had a developmental delay (Charman et al., 1997). Yet in another study, 18- to 24-month-olds with autism performed lower on social communication measures of following gaze or pointing and acts of joint attention when compared to children with developmental disabilities who were matched on age and developmental level (Wetherby et al., 2007).

Comparisons have also been made between children who had “early-onset” autism and those with “late-onset” autism (i.e., parents reported a regression or slowing of skills rather than impairments evident before or at the age of one). In contrast to findings demonstrating that infants with autism were not exhibiting typical levels of joint attention skills, infants categorized as having “late-onset” autism were not significantly different from their typically-developing peers in the area of joint attention (Werner & Dawson, 2005). This was evidenced by their difficulty in responding to joint attention bids by looking at objects

held by others when measured at the age of one. But, by their second birthday, both infants with early- and late-onset autism showed similar social communication deficits (Werner & Dawson, 2005). These findings indicate that although lack of joint attention skills should be a major "red flag" in early development, some infants who develop autism do exhibit some joint attention skills earlier but fail to do so later, so it is also important to continue to monitor infants and toddlers for signs of autism throughout early childhood.

Preschool-aged children with autism also show joint attention differences when compared to typically-developing peers and those with developmental disabilities. When matched by chronological and verbal- and nonverbal-mental age with a group of children with developmental delays, preschoolers with autism were more likely to have trouble with joint attention tasks involving gaze following and declarative gestures (Carpenter, Pennington, & Rogers, 2002). When compared with developmentally matched children with Down syndrome or typical development, children with autism exhibited impaired ability to follow another's gaze or point (Dawson et al., 1998). Joint attention (combined with social orienting) measures was found to be the best distinguisher of 3- and 4-year-olds with autism from children with typical development or development delays who were matched on mental age (Dawson et al., 2004). Three-year-olds with autism also showed deficits in using gestures to direct attention (Mundy, Sigman, & Kasari, 1990) and were less likely to point, show objects, or use eye gaze to communicate (Stone et al., 1997).

When the children with autism did exhibit joint attention skills, they appeared to follow a different sequence of development than would be typically expected. Typically-developing children usually share attention first, then follow attention, follow behavior, direct attention, and then direct behavior (Carpenter, Pennington & Rogers, 2002). For

example, typically developing children would be able to interact with their caregiver first and then follow their caregiver's attention to another object before following their physical behaviors. However, a child with autism may follow and understand the adult's behaviors before they are able to follow the person's attention and share attention with them. For example, 67% percent of the children with autism in Carpenter and colleague's study fit this alternative pattern: following behavior, sharing attention, directing behavior, following attention, and finally, directing attention. It appears that children with autism have an especially difficult time with the attentional aspects of interaction with others, specifically joint attention (Carpenter, Pennington, & Rogers, 2002).

Considering that joint attention skills are the building blocks for language, it is a definite concern that infants, toddlers, and preschoolers with autism all show significant deficits in this area. Since joint attention deficits are unique to autism, it also suggests that greater attention should be paid to joint attention skills specifically and their relationship with the core symptoms of autism. Findings of joint attention skill deficits also have implications for intervention research and implementation.

Methods of researching social communication behaviors in young children

A variety of methods have been used to research the complex issue of social and communication development in infants and young children with autism. Infants with autism have primarily been studied by retrospective or prospective designs to track both the emergence of early autism characteristics and their development over time (e.g., Baranek, 1999; Landa & Garrett-Mayer, 2006; Wimpory, Hobson, Williams & Nash, 2000). Zwaigenbaum et al. (2007) noted the importance of retrospective parental report,

retrospective video analysis, and prospective designs (most often, studies of siblings of children with autism) in researching autism in infancy and early childhood.

Retrospectively studying infants with autism offers a practical way to analyze the presence or absence of autism once the diagnosis has been established. Since infants with autism do not receive a diagnosis at birth, studying the emergence of early autistic behaviors becomes difficult since affected infants are not yet categorized as having autism. Obtaining information about children with autism's early development is possible retroactively through subsequent parent report. Advantages to using retroactive parent report include the parent's ability to observe their child across settings and over time. Parents are often the first to recognize their child may be exhibiting the signs of autism (Zwaigenbaum et al., 2007). However, as parents are often biased observers of their children and often exhibit a less nuanced awareness of developmental milestones, including a deviance or delay in reaching those milestones, parents are not always the most accurate source of information. Still, if researchers are aware of the issues specific to parental report when designing retrospective analyses, this type of research can contribute much to the knowledge base of autism in infancy (Zwaigenbaum et al., 2007). For example, studies using retrospective parental report have documented that infants with autism were not as interested in people or in interactive games, had difficulty responding to joint attention bids, made eye contact less often, and had unusual sensory patterns (Crais et al., 2006; Lord, 1995; Wimpory et al., 2000).

Retrospective video analysis offers a less biased view of early development and allows for systematic analysis of early development. Retrospective video analysis involves collecting samples of videos made by parents of their child before the child was diagnosed with autism or other disabilities. In this way, video footage can be viewed and coded for

specific behaviors without relying on parental memory and the potential influence of the child's subsequent diagnosis. The child's behaviors can be coded by observers who are knowledgeable about early childhood development. However, it can be difficult to obtain video footage that is equal across participants and that offers a full perspective of the event. In addition, it is not possible to know what is happening off camera that may be enhancing or inhibiting the child's ability to perform well. For example, if the infant waves when prompted by dad waving behind the camera, it might be coded as an unprompted, child-initiated gesture, when in fact it was a gestural response to an adult-initiated event. Despite these issues, retrospective video analysis has been a useful tool for documenting the early signs of autism in infancy (Zwaigenbaum et al., 2007). For example, Baranek (1999) analyzed home videos of 9-12 month olds who were later diagnosed with autism and found that these infants had poor visual orientation, delayed response to name, social touch aversions and mouthed objects excessively. Osterling et al. (2002) and Werner and Dawson (2005) also used retrospective analysis of home videotapes to examine the symptoms of autism in infants and noted that infants with autism showed social communication deficits by the age of one and two years.

A third approach to studying autism in young children is to study prospectively a high-risk sample. In order to identify a "high-risk" sample, researchers may use a screening measure (e.g., *CHecklist for Autism in Toddlers*, Baron-Cohen, Allen, & Gillberg, 1992; *FYI*, Baranek, Watson, Crais, & Reznick, 2003) to identify toddlers who appear to be at risk for an ASD or a communication disorder. Another option is to identify samples of children with specific risk factors (e.g., fragile-X syndrome) as between 5% and 46% of males with fragile-X syndrome have autism or autistic-like behaviors (Beirne-Smith, Patton, & Kim, 2006).

However, as these specific risk factors are fairly rare in the general population and are often associated with syndrome-specific qualities, most of the current prospective studies focus on siblings as a high-risk group (Zwaigenbaum et al., 2007).

Siblings of children with autism are often studied as a high risk group because they are at an increased genetic risk for autism, 20 times higher than that of the general population (Zwaigenbaum et al., 2007). Recognizing that autism has a genetic component, researchers often choose to design studies looking at infant siblings of children with autism to better understand the earliest manifestations of autism in development. Measures are taken before the "at-risk" group receives a diagnosis of autism, which then can be analyzed later according to the diagnosis each child receives. Using an at-risk group increases the likelihood of having enough infants who will eventually receive an autism diagnosis to be able to make reasonable conclusions about developmental trends and commonalities (Zwaigenbaum et al., 2007). Studies that have been successful in using this approach include Charman et al. (1998) and Zwaigenbaum et al. (2005). Charman et al. examined the different social-cognitive abilities of a sample of 20-month-olds with autism after identifying these at-risk infants using the *CHAT* (Baron-Cohen, Allen, & Gillberg, 1992). Zwaigenbaum et al. followed 150 infant siblings until the age of 24-months, and discovered that the infant siblings who were later diagnosed with autism showed atypical eye contact, visual attention, imitation, affect, and sensory-oriented behaviors, in addition to being less likely to orient to name and exhibit a social smile at the age of 12 months.

Measuring social communication behaviors

As research has documented the manifestations of autism in infants and toddlers, the next focus concentrates on how to accurately and efficiently identify these children. A variety

of tools have been developed to address this issue. Ideally, a screening tool or test would be able to determine which infants will develop the characteristics of autism, and which will not, before parents or professionals are even aware of any obvious deviance or delay in development. This would allow for early intervention, and could perhaps even be termed early *prevention* efforts. However, this is an extremely difficult task! Infants with autism may be developing on track, then experience a regression or slowing of development (Landa, Holman, & Garrett-Mayer, 2007; Osterling, Dawson, & Munson, 2002; Werner & Dawson, 2005). Autism can co-occur with many other disabilities as well, including an intellectual disability; therefore a good tool would need to distinguish infants with autism from infants with only other disabilities (Osterling et al., 2002). A perfect tool has not yet been made available to all professionals and families that can accomplish this goal. Current efforts have made great progress though, and these tools are allowing more and more infants and toddlers with autism to be identified early (Charman & Baron-Cohen, 2006).

Knowing the characteristics of autism in infants and being able to diagnose autism in young children does not mean that all children with autism are being identified early in their development and receiving diagnoses. There are several reasons why this is the case. One is that autism is a relatively rare disability, and therefore leads to a "low index of suspicion." Another is that infants and toddlers with autism are a very heterogeneous group, and delayed or atypical development does not present itself in the same way at the same time across children. In many of the more mild manifestations of autism spectrum disorders, young children may reach motor and even major speech milestones on time, leading health professionals and parents to believe development is on track until the child reaches preschool and struggles with peer interactions. Finally, as mentioned earlier, standardized instruments

are fairly recent developments and have not reached widespread use among all health professionals and those working with infants and toddlers (Robins, Fein, Barton, & Green, 2001).

A review of the literature demonstrates that there are currently a variety of tools used to find and diagnose infants and children with autism. The first types of tools are screening tools to distinguish infants or children with autism spectrum disorders from the general population and are often referred to as "Level I" screening tools. "Level II" screening tools are used to determine which children have autism out of a group of children already referred as "at-risk" or for having general developmental delays. Screening tools come in the form of parent report questionnaires, observational measures, and checklists. After screening for autism, clinicians can then proceed to diagnose autism in these young children, through structured observations and parent interviews. Finally, tools are available to observe and quantify behavioral manifestations of autism in children.

Level I screening tools are often applied by health professionals to young children to "weed out" those with developmental delays. For example, the *Age and Stages Questionnaire* (Squires, Bricker, & Potter, 1997) and the *Child Development Inventories* (Ireton, 1992) have good psychometric properties and have been successful in identifying a number of children who have developmental delays. However, although these may be able to "catch" some children with autism spectrum disorders, they are not specifically designed to identify children with ASDs.

The *CHecklist for Autism in Toddlers* (*CHAT*, Baron-Cohen, Allen, & Gillberg, 1992) was developed to accomplish the goal of identifying 18-month-olds with autism from the general population. The *CHAT* is composed of 9 parent-directed questions covering 6 areas

of development known to be impaired in toddlers with autism, and 3 areas of development expected to be typically-developing. The initial study used the screening tool on a sample of siblings of children with autism. In this study, all 4 of the children who failed the screen went on to receive a diagnosis of autism, and none of the children who passed the screen were later diagnosed (Baron-Cohen, Allen, & Gillberg, 1992). However, when used by health practitioners on the large general population, the *CHAT* did not have as an impressive sensitivity as reported earlier (Charman & Baron-Cohen, 2006). The *CHAT* has been shown to have a specificity of 98% but a sensitivity of only 38%, indicating that it missed children at 18-months who were later diagnosed with an ASD (Baird et al., 2000). This measure should not be relied upon by pediatricians as a sole screening tool for autism in the population.

The *Modified CHecklist for Autism in Toddlers* (*M-CHAT*, Robins, Fein, Barton, & Green, 2001) was developed to provide a simple screening measure for pediatricians to use during routine office visit. It is an extension of the *CHAT*, and uses the original 9 questions, plus additional questions for a total of 23 questions chosen for their correspondence with autism characteristics. The *M-CHAT* has been successful with 18-24 month old in reliably predicting autism/PDD diagnosis based on the discriminating items (Robins et al., 2001; Zwaigbenbaum & Stone, 2006). However, this tool is still in its beginning stages, and research has not yet validated it as a general population screening toll. Still, this checklist has the potential to provide pediatricians or early childhood professionals with a simple way to screen for autism (American Speech-Language-Hearing Association, 2006).

The *First Year Inventory* (*FYI*, Baranek et al., 2003) is a promising new tool that may allow clinicians to screen for autism at 12-months of age. The *FYI* utilizes parent report at the

age of 12 months using a series of questions addressing both behaviors one would expect to differentiate infants with autism from those developing typically, as well as from those with other developmental delays. The questions address social communication and sensory-regulatory behaviors. The *FYI* provides a straightforward way of accessing parents' knowledge of the child's development and may prove to be a useful tool for distinguishing infants who will receive a diagnosis of autism from the general population (Reznick et al., 2006; Watson et al., 2007). The current study will use social communication scores on the *FYI* to examine the relationship between parents' reports of at-risk social communication behaviors at 12 months of age and later social orienting and joint attention abilities at age 3.

Level II tools are often more efficient than Level I screening tools and may be more effective in distinguishing children with autism from those with more general concerns. Infants with autism are often brought to the attention of service providers and professionals due to general developmental concerns or language delays, and Level II screening tools allow practitioners a way to specify which of these are related to autism (Charman & Baron Cohen, 2006). Current recommendations from the American Academy of Pediatrics (AAP) endorse ongoing surveillance to watch for developmental delays or deviance (including the use of general Level I screening tools), then proceeding to Level II autism-specific screening tools if behavioral "red flags" for autism are noted (Zwaigenbaum & Stone, 2006). In addition, the AAP recommends screening specifically for autism at both 18- and 24-months of age (Johnson, Myer, & the Council on Children with Disabilities, 2007).

In addition to the *CHAT* (Baron-Cohen, Allen, & Gillberg, 1992) and the *M-CHAT* (Robins, Fein, Barton, & Green, 2001), the *Screening Tool for Autism in Two-Year-Olds* (*STAT*) is used as a Level II screening tool for autism (Stone, Coonrod, & Ousley, 2000). The

STAT involves the observation and scoring of the child during a set of structured tasks designed to induce social and communication behaviors. The *STAT* has been successful with children between 24 and 25 months of age in distinguishing children with autism from those with general developmental delays or language disorders. However, the *STAT* is more time and clinician intensive than parent-report measures, so it may not be as readily available or user-friendly as a parent questionnaire format (Zwaigenbaum & Stone, 2006).

In conjunction with the *Communication and Symbolic Behavior Scales Developmental Profile* (*CSBS-DP*, Wetherby & Prizant, 2002) the *Systematic Observation of Red Flags* (*SORF*, Wetherby, Goldstein, Cleary, Allen, & Kublin, 2003) may be useful as a Level II screening for distinguishing young children with autism from those with developmental disorders or language impairments. The *Autism Observation Scale for Infants* (*AOSI*, Bryson, McDermott, Rombough, Brian & Zwaigenbaum, 2000) is an observational tool developed to systematically collect data on early markers for autism in infant-sibling samples. Infants are observed during semi-structured play and given the opportunity to respond to different presses designed to elicit specific target behaviors. If the infant has a certain amount of risk factors evident through this observation, he or she is considered at risk for autism (Zwaigenbaum & Stone, 2006).

Currently, the "gold standards" of autism diagnosis include the *Autism Diagnostic Observation Schedule* (*ADOS*, Lord, Rutter, DiLavore, & Risi, 1999) and the *Autism Diagnostic Interview-Revised* (*ADI-R*, Rutter, Le Couteur, & Lord, 2003). The *ADOS* involves 4 modules, each adapted for age- and language- appropriate levels of assessment. For younger children, the most common modules used are Module 1, for pre-verbal children or those communicating with single words, and Module 2, for children using phrase speech

to communicate. Each module involves different "presses" designed to elicit social communication and determine if the child is able to respond or initiate in a typical manner. The examiner then scores the child's responses and compares it to an autism cut-off score (Gotham, Risi, Pickles, & Lord, 2007).

Although there are tools available to screen for and diagnose autism in young children, few tools are able to quantify the types and quality of the social communication behaviors children are exhibiting. The *Social Orienting Continuum and Response Scale* (*SOC-RS*, Mosconi, 2006) guides clinicians or researchers in viewing the child during their *ADOS* (Lord, Rutter, DiLavore, & Risi, 1999) diagnostic session, and coding for specific social, communication, and emotion behaviors. The child's rate of these behaviors is then calculated, as well as general ratings of level of social behavior and engagement. This tool has the possibility to allow greater insight into the degree of social communication behaviors present, or absent, in children with autism (Mosconi, 2006). The *SOC-RS* has been shown to be a reliable and valid tool for detecting decreased levels of social communication behaviors (including social referencing, joint attention, orienting to name, and social smiling) in 2- and 4-year-olds with autism (Mosconi, Reznick, Mesibov, & Piven, 2009). The current study will utilize the *SOC-RS* to quantify the types of joint attention and social orienting behaviors exhibited by 3-year-olds with and without autism.

Summary

Infants with autism show deficits in their attention to social stimuli, shifting of attention, and use of eye gaze (Adrien et al., 1993; Landa et al., 2007; Maestro et al., 2002; Osterling et al., 2002; Wimpory et al., 2000; Zwaigenbaum et al., 2005), and these deficits are present in preschoolers with autism as well (Charman et al., 1997; Dawson et al., 1998;

Lord, 1995; Wetherby et al., 2006). Joint attention skills build on social orienting skills, and infants with autism are distinguishable from both typically-developing infants and those with developmental delays based on measures of joint attention (Colgan et al., 2006; Dawson et al., 2000; Landa et al., 2007; Mitchell et al., 2006; Werner & Dawson, 2005; Wimpory et al., 2000; Zwaigenbaum et al., 2005). Toddlers and preschoolers with autism exhibit similar difficulties with both responding to and initiating joint attention (Carpenter et al., 2002; Charman et al., 1998; Dawson et al., 1998; Dawson et al., 2004; Mundy et al., 1990; Stone et al., 1997; Wetherby et al., 2007).

Despite these findings, more detailed information about the characteristics of early joint attention and social orienting skills in infants with autism is still needed to assist in the effort to identify these children as early as possible. In addition, research identifying the trajectory of these skills could provide support for or against theories suggesting that social orienting skills are related to language development. Given the importance of social orienting and joint attention skills for later language and communication development, these are important intervention targets as well, and research describing the relationship between early and later social orienting and joint attention behaviors could contribute in this area (Mundy & Crowson, 1997).

In sum, little research has focused on examining the development of social orienting and joint attention skills over time. The current study proposes to examine the relationship between parental reports of social communication behaviors at 12-months of age and the observation of social orienting and joint attention behaviors during videotaped *ADOS* (Lord, Rutter, DiLavore, & Risi, 1999) sessions at age three. The results should offer valuable

insight into the nature of early manifestations of autism, as well as the relationship early social communication skills have with subsequent development.

Aim and Hypotheses:

Aim: To examine the relationship between parental reports of early social communication behaviors and the later manifestations of these skills as non-verbal social communication behaviors.

Hypothesis1: Higher social communication scores on the *FYI* (Baranek et al., 2003) at the age of 12-months will be predictive of lower rates of **initiative social behaviors** as measured on the *SOC-RS* at the age of 3 years.

Hypothesis 2: Higher social communication scores on the *FYI* at the age of 12-months will be predictive of lower rates of **responding to social attention** as measured on the *SOC-RS* at the age of 3 years.

Hypothesis 3: Higher social communication scores on the *FYI* at the age of 12-months will be predictive of lower levels of **social behavior** as measured on the *SOC-RS* at the age of 3 years.

Methods

Participants

Participants for this study were part of a larger study investigating the relationship between infant behavior measured at 12-months of age using the *First Year Inventory* (*FYI*; Baranek, et al., 2003) and developmental outcomes at age three. Participating families were selected from birth records that included a zip code for an address within 20-30 miles of Chapel Hill, NC. Children were excluded if the father or mother identified him- or herself as Hispanic in the birth records, since the *FYI* had not yet been translated into Spanish. Participants were mailed an *FYI* when the child approached the age of 12 months. An *FYI* was sent to 5,941 families and 1,496 were completed and returned, resulting in a 25% return rate. Children were excluded if the *FYI* was not completed within a month of the child's first birthday, if they were preterm infants, or if they had a known medical condition or genetic diagnosis (e.g., cerebral palsy, fragile X syndrome). Families who indicated they would be interested in participating in further research were contacted when their child approached the age of three.

Participants in the overall *FYI* (Baranek et al., 2003) study who completed the first portion of the study (i.e., sent in a completed *FYI*) did not reflect the demographics of the broader population of North Carolina. The *FYI* sample consisted of a higher percentage of more highly educated mothers relative to the population (39% vs. 30% college graduates;

36% vs. 25% post-graduates) and contained a lower percentage of mothers with less education (12% vs. 26% with a high school degree or less; 11% vs. 19% with less than a college degree). In addition, the percentage of white families who responded to the survey was higher than the percentage of black families (30% vs. 9%) (Reznick et al., 2006).

When families were re-contacted for further research participation as their child was turning three, they were asked to fill out two additional measures: the *Social Responsiveness Scale-Preschool* (*SRS-P,* Constantino, 2005) and the *Developmental Concerns Questionnaire* (*DCQ*), an investigator-created form. The *SRS-P* is a parent-report checklist of social and language behaviors. The *DCQ* is a form for parents to report their concerns about their child. Children were selected to be brought into the lab for further testing based on their scores on the three measures: *FYI* (Baranek et al., 2003), *SRS-P* (Constantino, 2005), and *DCQ*. In total, 38 children were brought to the lab for testing of language, social, sensory-motor, adaptive, and cognitive behaviors. Seventeen children were selected because they scored as being at-risk on the *FYI* (Baranek et al., 2003) when they were 12-months of age. Seven children were selected due to their at-risk scores on the *SRS-P* (Constantino, 2005), three were selected because their parents expressed concerns on the *DCQ* that sounded like characteristics of autism, and one child had both a high *SRS-P* score and a high *FYI* (Baranek et al., 2003) score. Ten children whose parents had completed an *FYI* at 12 months and who did not score as at-risk for any sort of developmental delay on the given measures were selected as controls and were also brought to the lab for testing.

Measures and procedures

First Year Inventory (FYI). The *FYI* (Baranek et al., 2003) is a parent-report tool intended to determine which infants (at 12-months) in the general population are at risk for a

later diagnosis of autism. There are 61 questions, with some of the questions presented as yes-no questions, and others as multiple choice questions. The questions reflect the types of behaviors that research has shown to be present or absent in infants with autism by the age of 12-months, and include items related to social communication and sensory-regulatory behaviors. Two primary constructs were formed within the *FYI* (Social-Communication and Sensory-Regulatory) and only items with a strong positive correlation ($r > .30$) were included in their respective construct. Constructs that fell into the Social-Communication domain included social orienting and receptive communication, social-affective engagement, imitation, and expressive communication. The Sensory-Regulatory functions domain included sensory processing, regulatory patterns, reactivity, and repetitive behavior. A final category included the questions that did not correlate strongly enough with any of the constructs to be included in a specific domain. For the purposes of the current study, only the scores from the Social-Communication domain were included in the analysis, in order to examine the specific relationship between at-risk scores in this area of development at age one in relationship to social-communication ability at age three. See Appendix A for the complete *FYI*.

Social Orienting Continuum and Response Scale (SOC-RS, Mosconi, 2006). The *Social Orienting Continuum and Response Scale (SOC-RS*, Mosconi, 2006*)* is a measure designed to quantify social communication and emotion behaviors by coding specific target variables. The original variables on the *SOC-RS* included event variables (referencing, joint attention responding, joint attention initiations, responses to name, emotion sharing, and communicative gestures) and state variables (playing/engaged, disengaged, or not observable). In the original manual, communicative gestures are to be coded as being

interactive, descriptive, requests, or labels. The rater also gives the child an overall social behavior rating at the end of the coding session, as being socially skilled, socially interested but awkward/unskilled, socially inhibited/overactive inattentive or aloof/passive.

The *SOC-RS* was used to code child behaviors from the videotapes of the *ADOS* (Lord et al., 1999) assessment given to the children who participated in the follow-up study of the *FYI* (Baranek et al., 2003). The *ADOS* (Lord et al., 1999) was given as part of a series of follow-up measures to determine the child's diagnostic status as being on or off of the autism spectrum. For the purposes of the current study, the *ADOS* videotapes were used to code for social and communication behaviors that are usually seen as part of the communication "presses" during the *ADOS* assessment.

The author of the current study made adaptations to the *SOC-RS* (Mosconi, 2006) to reflect the focus of the current study specifically on initiative and responsive social communication behaviors, as well as to add details and examples to enhance the *Social Communication Coding Manual.* The definition of referencing was changed from requiring a 2-second look at a person's face, to any instance in which a child looked directly at another person's face. In addition, "emotion sharing" was changed to "shared affect" to ensure that the coding captured even more basic forms of sharing emotion, including when a child smiles in response to another's smile.

One of the most significant changes to the coding manual was the adaptation of the coding gestures to reflect the focus of this study on behaviors that cover a range of intentions used to communicate. The coding definitions were changed to include three primary functions of communication: behavior regulation, social interaction, and joint attention gestures (Wetherby & Prizant, 1993). For example, a pointing gesture could be coded as

behavior regulation if the child pointed to the snack he wanted. A gesture was coded as social interaction, if the gesture was used to enhance a social interaction (e.g., clapping hands to express excitement). Finally, the gesture was coded as joint attention if, for example, the child pointed to the TV across the room and said "wow, look!" Each instance of a gesture was coded according to the coder's perception of the child's purpose in gesturing. Although traditional definitions of joint attention might include pointing to a picture in a book in combination with eye gaze as joint attention, the current study took a slightly different approach. Because each child experienced the same set of events during the *ADOS* (Lord et al., 1999), the book-reading and looking at the picture portion of the test included significantly more pointing gestures than any other portion of the testing time. Rather than giving the child credit for initiating joint attention *each time* he or she pointed to something on the page, joint attention gesture codes were reserved for instances in which the child directed the adult's attention to something *new,* not to an event in which they were already sharing attention. Appendix B includes the coding manual with scoring guidelines that were used to code the videos for this study, adapted from the *SOC-RS* (Mosconi, 2006) and from Wetherby and Prizant (1993).

As tapes were previewed for the study, they were screened to determine if the child was actually visible on camera for more than five minutes. Children were included in the study if the child was on camera for a total of more than five minutes; only one child was excluded due to leaving the testing room and no longer being visible on camera. Frequency scores for the target event behaviors were scored by converting to rates per minute, i.e., the number of social initiations observed per minute of time on camera. If the child was not given the opportunity to respond to his or her name being called, or given a bid for joint

attention, he or she was excluded from further analysis. One case was excluded from analysis due to not meeting criteria for the *FYI* study. Three cases were excluded due to not having complete *ADOS* videotapes. One case was excluded due to incomplete *FYI* (Baranek et al., 2003) scores. Thirty-three videos total were coded and included in the final analysis.

Training and reliability. Videotapes of the *ADOS* (Lord et al., 1999) sessions for each child (n=33) were coded using procedures adapted from the *SOC-RS* (Mosconi, 2006). Another graduate student became reliable at an average of 74% with the author of the current study, using *ADOS* (Lord et al., 1999) videotapes used for training on the *FYI* (Baranek et al., 2003) study. Once the coders were reliable with one another, the remaining videos were coded by either the author of the current study or the reliability coder. Observer drift was avoided by having both coders independently code 20% of the study videotapes at three time points over the course of the data coding. At all three time points, the coders were reliable with one another at 80% (range 74-85%).

Analyses

Variables. The independent variable for this study was the child's ***FYI*** (Baranek et al., 2003) **social communication score at 12-months of age**. Dependent variables were the **rate of initiative social behaviors,** the **rate of responding to social attention,** and the **overall level of social behavior. Rate of initiative social behaviors** included referencing, shared affect, and communicative gestures that were for the purpose of social interaction or initiating joint attention. This dependent variable was calculated by summing the behaviors within the category and converting to rate per minute. **Responding to social attention** was originally to include joint attention responding and response to name. However, 100% of the participants responded to the joint attention bid the first time, so this portion of the variable

was dropped in further analysis. From this point forward, **responding to social attention** included only response to name, and was referred to as the variable **response to name.** This variable was calculated by dividing the number of the child's responses to name by the number of opportunities to respond. **Overall level of social behavior** was an overall level that was rated by the coder at the end of the session. The child was rated as being socially skilled, socially interested but awkward/unskilled, socially inhibited/overactive inattentive, or aloof/passive. The score for overall level of social behavior was rated on a scale of 1-4, with a score of 4 reflecting the socially skilled, and 1 reflecting the aloof/passive behavior.

Statistical analysis. **Hypothesis 1:** Higher social communication scores (i.e., showing a higher risk score) on the *FYI* (Baranek et al., 2003) at the age of 12-months will be predictive of lower rates of **initiative social behaviors** as measured on the *SOC-RS* (Mosconi, 2006) at the age of three years. Rate of initiative social behavior was calculated by summing the instances of referencing, shared affect, social interaction gestures, and joint attention gestures and dividing by the number of minutes of videotape coded. Descriptive univariate statistics were run on the independent variable, *FYI* (Baranek et al., 2003) social-communication construct, including the mean, standard deviation, median, skewness and kurtosis. A scatterplot of age 12-months social communication score (X) and rate of initiative social behavior (Y_1) at age three years was created to visualize the relationship between the two time points. The relationship between the two time points was analyzed using simple linear regression. It was hypothesized that the social communication scores on the *FYI* at one year would be predictive of the rate of initiative social behavior at three years.

Hypothesis 2: Higher social communication scores (i.e., showing a higher risk score) on the *FYI* (Baranek et al., 2003) at the age of 12-months will be predictive of lower rates of

responding to social attention as measured on the *SOC-RS* (Mosconi, 2006) at the age of three years. A scatterplot of 12-months of age social communication score (X) and rate of initiative social behavior (Y_2) at age three was created to visualize the relationship between the two time points. The relationship between the two time points was analyzed using simple linear regression.

Hypothesis 3: Higher social communication scores on the *FYI* at the age of 12-months will be predictive of lower levels of **social behavior** as measured on the *SOC-RS* at the age of three years. A frequency distribution with percentage breakdowns was created. The relationship between the two time points was analyzed using ordinal regression, since the dependent variable is categorical.

Results

The overall aim of this study was to examine the development of social communication behaviors over time. Specifically, this study aimed to determine if there is evidence to suggest that parental report of social communication behaviors at age 12-months was able to predict later manifestations of these same behaviors when observed at 3-years of age. Three hypotheses were posited to examine this aim: high *FYI* (Baranek et al., 2003) social communication scores at age 12-months will be predictive of low initiative social behaviors, low response to social attention, and low overall social behavior scores at age 3 years. The results will be discussed further by providing an overview of the sample characteristics, and the results of each regression analysis.

Sample characteristics

Out of the 33 participants included in the current study, 5 participants (15.2%) had a diagnosis of autism spectrum disorder: 3 participants (9.1%) with PDD-NOS, and 2 participants (6.1%) with autistic disorder. Six participants (18.1%) had another type of delay or disability, including one or more of the following: expressive language disorder, sensory/regulatory concerns, mild mental retardation, attention deficit hyperactivity disorder (ADHD) and a fine motor delay, risk for ADHD and oppositional defiance disorder (ODD), and mild overall delays. The remaining 22 participants (66.7%) were currently considered to

be typically-developing, although some had a history of delays or concerns during the child's earlier development. The average age at assessment was 3 years and 6 months. Only one participant was given a Module 1 *ADOS* (Lord et al., 1999). This child, who has a diagnosis of autistic disorder, was given a Module 1 *ADOS* because of being pre-verbal or only using single words. The remaining 32 participants were given a Module 2 *ADOS*, reflecting that the children were at the language level of using phrases in their speech.

Hypothesis1

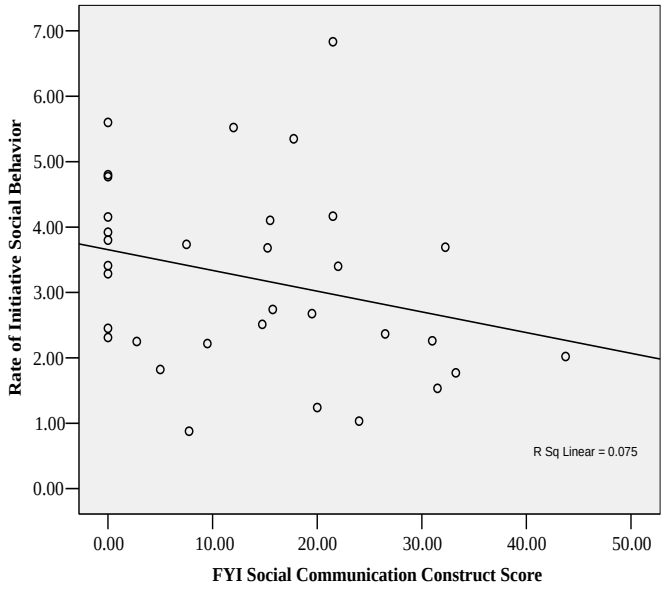
Higher social communication scores on the *FYI* (Baranek et al., 2003) at the age of 12-months will be predictive of lower rates of **initiative social behaviors** as measured on the *SOC-RS* (Mosconi, 2006) at the age of 3 years. Descriptive univariate statistics of the independent variable were examined in order to determine if they reflect a normal distribution. However, given the small sample size, normality may not be able to be expected. Descriptive statistics appear to reflect a normal distribution and are shown in Table 1. The large standard deviation is noteworthy, as it is almost as large as the mean itself. When examining the scores, it is important to remember that a "large" difference in scores may only reflect one standard deviation difference, or even less.

Table 1: Descriptive univariate statistics for age one *FYI* social communication scores

Descriptive Statistics for Independent Variable			
	Mean	SD	Median
***FYI* Social Communication Construct Scores**	13.64	12.47	14.75

The scatterplot of age one social communication score (X) and rate of initiative social behavior (Y_1) at age three is shown in Figure 1. The scatterplot did not suggest a linear relationship between the dependent (X) and independent variable (Y_1).

Figure 1: Scatterplot of linear regression for hypothesis 1



Regression analysis did not detect a statistically significant relationship between the dependent and independent variable, with a one-tailed test at the alpha < .05 level, one-tailed test. F (1, 31) = 2.529, p=.061. It was hypothesized that there would be a negative relationship between the two variables so that as *FYI* social communication scores at 12-months went up, the rate of initiative social behaviors at three years would decrease. Although statistically there was not a strong relationship between the two variables, the relationship was negative, suggesting that the relationship was in the hypothesized direction.

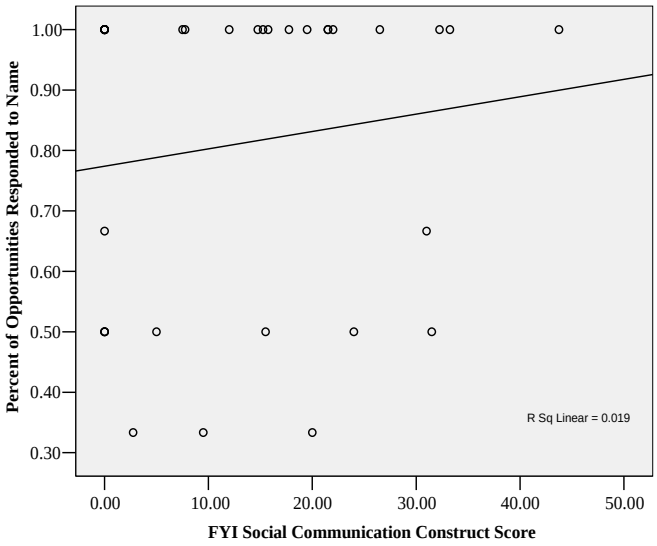
Hypothesis 2

Higher social communication scores on the *FYI* at the age of 12-months will be predictive of lower rates of **responding to social attention** as measured on the *SOC-RS* (Mosconi, 2006) at the age of 3 years. Rate of responding to social attention was originally to

include both response to name and joint attention responding. However, this variable was adapted after coding the video tapes and conducting preliminary analysis on the child's responses during the *ADOS* (Lord et al., 1999). For example, one component of the *ADOS* includes a "press" for the child to respond to a joint attention bid by the examiner. In this press, the examiner makes eye contact with the child, then looks to a motorized toy bunny and says "Look." If the child does not respond by looking at the toy, the examiner will increase the number of forms of communication used, by using eye contact, saying "Look," and pointing. However, none of the children in this study needed additional forms of communication before looking at the bunny and preliminary analysis revealed that all 33 participants responded to the examiner's first bid for joint attention. Thus, this component of the variable was excluded from further analysis as correlations between variables cannot be found if there is no variability among the participants in the group.

Therefore, the resulting number of times the participant responded to his or her name was divided by the number of opportunities he or she had to respond to his or her name. A scatterplot of 12-months of age social communication score (X) and rate of initiative social behavior (Y_2) at age three was created to visualize the relationship between the two time points and appears in Figure 2.

Figure 2: Scatterplot of linear regression for hypothesis 2



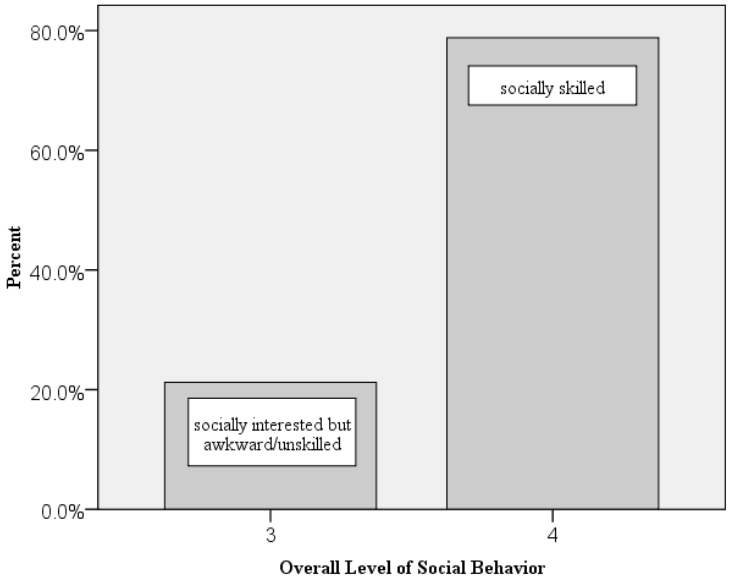
The relationship between the two time points was analyzed using simple linear regression. Results did not indicate that *FYI* (Baranek et al., 2003) social communication scores at age one predicted percentage of response to name at age three, with a one-tailed test at the alpha < .05 level. F (1, 31) = 0.604, p = 0.222. It was hypothesized that there would be a negative relationship between the two variables, but analysis did not reveal a statistically significant relationship, or reveal a negative relationship.

Hypothesis 3

Higher social communication scores on the *FYI* at the age of 12-months will be predictive of lower levels of **social behavior** as measured on the *SOC-RS* at the age of 3 years. The possible overall rating could be “aloof/passive” (1), “socially/inhibited/overactive inattentive” (2), “socially interested but awkward/unskilled” (3) or “socially skilled” (4). None of the participants were rated as either a “1” or “2” on the overall level of social behavior. Seven of the participants (78.8%), including all 5 of the participants with an autism spectrum disorder, were rated as a “3.” The additional 2 participants who were rated as a “3”

were not children with typical development either. One participant who was rated a “3” had a diagnosis of mild mental retardation. The other participant was at risk for ADHD and ODD, and also had a family history of Asperger’s disorder. His mother and teacher expressed concerns that he might have Asperger’s disorder, although he did not meet ADOS criteria when tested during this study. This leaves 78.8% of the participants (N=26) who were rated as being a “4,” representing the highest level of social behavior. Because all participants were rated as a 3 or 4, there is not enough variability within the group to suggest that regression would detect the relationship between the two time points. A bar graph with percentage breakdowns was created in order to visually represent the distribution of overall levels of social behavior seen in the participants, and appears in Figure 3.

Figure 3: Bar graph of percentage of categories of overall level of behavior



The relationship between the two time points was analyzed using ordinal regression, since the dependent variable is categorical. Regression analysis did not reveal a significant relationship between *FYI* (Baranek et al., 2003) social communication scores at age one, and overall level of social behavior as coded at age three, at the $p < .10$ level, ($p=0.187$).

Profile of participants with an autism spectrum disorder (ASD)

Although this study did not purport to examine solely the characteristics of the participants with autism, it is interesting to note the characteristics of this portion of the sample. For example, the only child who was tested with a module 1 *ADOS* (Lord et al., 1999) (indicating he was preverbal or only using single words) was not the child with the highest risk score on the *FYI* (Baranek et al., 2003). This is surprising because it would seem that the child with the lowest communication skills would also have had a higher risk score on the *FYI.* In contrast, the child with the highest risk score on the *FYI,* who would theoretically be exhibiting less social communication behaviors at age three, was able to respond to his name 100% of the time, as did another of the children with an ASD. These contrasts to what would be expected from a sample of children with autism are interesting to note, even though not the aim of the current study. Appendix C provides *FYI* and coding scores for each of the participants

Discussion

The purpose of this study was to examine the relationship between early parent report of social communication behaviors and the subsequent development of these behaviors over time. Parental report of their children's behavior at age 12-months was examined in relationship to focused observation of these same children at age 3. In order to give insight into the nature of early development of social and communication skills in children with and without autism, this study contributed to previous research in the area of early development in children who are later diagnosed with autism. In addition, this study helps describe the relationship between earlier and later manifestations of non-verbal social communication skills, including social orienting and joint attention.

The study's first aim was to examine the relationship between parental report of social communication behaviors at 12-months on the *FYI* (Baranek et al., 2003) and observable *initiative* social communication behaviors at age 3. The study's second aim was to examine the relationship between parental report of social communication behaviors at 12-months on the *FYI* (Baranek et al., 2003) and *responsive* social communication behaviors at age 3. Finally, the third aim of the study was to examine the relationship between parental report of social communication behaviors at 12-months on the *FYI* (Baranek et al., 2003) and the coder's overall impression of the child's level of social behavior at age 3.

Hypothesis 1

It was hypothesized that as social communication scores on the *FYI* at age 12-months increased (showing increased risk) the amount of social communication behaviors exhibited by the child at age 3 would decrease. However, the analysis did not reveal a statistically significant relationship between the two time points. But, the relationship was in the direction hypothesized suggesting that although there may not be a very strong relationship between the two time points, it was a negative relationship. In other words, having fewer social communication behaviors at age one (as shown by a high risk score) is related to fewer social communication behaviors at age three, although not statistically significant.

The results can be explained in multiple ways. First, it may be that in fact, early development of social communication behaviors is unrelated to the later exhibition of these similar social communication behaviors. However, previous research suggests that there is a universal developmental trajectory of social communication skills and early delays or deviance in the development of these skills does affect subsequent development. In addition, similar difficulties with attention to social stimuli, shifting of attention, and the use of eye gaze are seen in both infants and preschoolers with autism (Adrien et al., 1993; Charman et al., 1997; Dawson et al., 1998; Landa et al., 2007; Lord, 1995; Maestro et al., 2002; Osterling et al., 2002; Wetherby et al., 2006; Wimpory et al., 2000; Zwaigenbaum et al., 2005). Social orienting and related joint attention skills are also different in both infants and preschoolers with autism, suggesting that there is a relationship between earlier and later manifestations of these skills (Carpenter et al., 2002; Charman et al., 1998; Colgan et al., 2006; Dawson et al., 1998; Dawson et al., 2000; Dawson et al., 2004; Landa et al., 2007; Mitchell et al., 2006;

Mundy et al., 1990; Stone et al., 1997; Werner & Dawson, 2005; Wetherby et al., 2007; Wimpory et al., 2000; Zwaigenbaum et al., 2005).

Another explanation for these results is that the measures do not adequately describe the behaviors they intended to measure. In this case, social communication behaviors at age 12-months (as measured by the *FYI*, Baranek et al., 2003) could be very closely linked with later social communication behaviors (as measured by the *SOC-RS,* Mosconi 2006), but one or both of the measures was lacking in validity or specificity and did not detect the extent of these behaviors. A third explanation relates to the statistical analysis, as it may have been unable to detect a relationship between the two time points due to the small sample size (n = 33; and a much smaller sample of children with an ASD, n = 5).

Hypothesis 2

It was hypothesized that as social communication scores on the *FYI* at age 12-months increased (showing increased risk) the rate of responding to social attention would be lower in children at age three. Perhaps the most interesting finding related to this hypothesis was that every single child in the study responded to the examiner's joint attention bid on the *first* attempt. This is in contrast to previous research suggesting that preschoolers with autism have an especially difficult time responding to joint attention and shifting their attention to a new object in the environment (Carpenter, Pennington, & Rogers, 2002; Dawson et al., 1998; Dawson et al., 2004). This finding could suggest that the sample of children with autism in this study was a more socially skilled group of children than could be expected in the general population of children with autism. This is also reflected in the fact that only one child in the study was given a module 1 *ADOS* (Lord et al., 1999), meaning he was the only child not able to consistently use phrase speech at the age of three, another significant variation from

the literature. Another interpretation of this finding is that the type of joint attention bid used in the *ADOS* test is different than the measures used to examine joint attention in the previous studies.

Responding to name was not able to be predicated based on the child's *FYI* (Baranek et al., 2003), which could suggest that a child's ability to respond to their name may be a more significant "red flag" in early development, but not necessarily related to later social and communication development. Children's ability to respond to their name in early development is a significant social communication skill, that many infants and toddlers with autism do not exhibit (Baranek, 1999; Lord, 1995; Osterling et al., 2002; Zwaigenbaum et al., 2005). Other research also suggests that preschoolers with autism do not respond to their name consistently either (Dawson et al., 1998). The current study's findings may indicate that this particular sample of children with autism were "higher-functioning" than most children with autism, or that children with autism can learn to respond to their name, even if they were having difficulty with this skill earlier in life.

Hypothesis 3

It is interesting to note that although the *FYI* (Baranek et al., 2003) social communication scores at age one did not appear to be predictive statistically of the overall level of social behavior, all five participants with an ASD were rated as being "socially interested but awkward/unskilled" (score of 3) as well as two other participants, both of whom were not typically developing. These results may suggest that in general, an overall impression of a child's social interaction ability as being unusual may reflect an underlying issue worthy of further investigation. In addition, the rating of all of the participants as being in the top two overall levels suggests that this group of children with autism or other

disabilities were on the higher end of the social skills range in terms of their social ability than was originally expected.

Limitations

The sample size for the study was perhaps the most significant limitation. Small sample size limits the power of the study, making it difficult to determine if the lack of significant findings is due to the smaller sample size or if it truly reflects a small or non-existent relationship between early and later development of social communication behaviors. However, this is not the only study to have a limited sample size, as it is difficult to find large numbers of parents of children to participate in studies related to a disorder that, while relatively common, is still a disability affecting a small portion of the population. As autism is a relatively rare condition within the general population, the number of children with autistic disorder (not just an ASD) was extremely small (n = 2).

In addition, only one of the children with an ASD was not able to use phrase speech, as indicted by the use of a module 1 *ADOS* (Lord et al., 1999), possibly reflecting that only one child in the entire study had a moderate to severe form of autism. One of the items under "qualitative impairments in communication" in the *DSM-IV-TR* (2000) states that a child with autism may exhibit a "delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime." Although not all children with autism will be lacking in spoken language, it does appear unusual that this sample of children with autism did not have any non-verbal children, and only one not using phrase speech, at the age of three. Therefore, the lack of variability within the sample itself does suggest that a regression analysis would not be expected to detect small differences within the group.

One aspect of the study that may have limited the interpretation of the results is the way the time on camera was coded before being calculated as part of the rate. Before beginning coding, it seemed reasonable to calculate the rate of behaviors based on the participant's time on camera. However, after coding the videos it became clear that all minutes on camera are not "equal." For example, the child may have been on camera with the examiner, but the examiner could either be preoccupied with filling out paperwork, or actively engaging with the child. Behaviors such as referencing or shared affect would be more difficult for the child to initiate if the examiner is not already engaged with the child. However, the coding manual did not have specific codes to take this into account, making it unclear when calculating the rate of behaviors if the child's opportunities to exhibit social behaviors were equal.

In addition, not all of the *ADOS* (Lord et al., 1999) sessions were completed by the same examiner, which could affect the amount of social interaction differences seen in different participants. Although each participant completed all sections of the *ADOS,* there is no set time limit for each portion of the test, meaning that each participant spent a varying amount of time in more or less structured activities throughout the taped session. For example, while one child may have spent 30% of the session on the floor playing with toys, another child may have only spent 15% of his or her time playing with toys, and a more significant amount of time looking at a book at the table. Although not documented statistically, both coders noted that children seemed to reference more during time spent at the table, during more structured activities, than they did while playing on the floor. This difference may suggest that children who had more difficulty with activities at the table may

have been “penalized” unfairly by exhibiting less referencing and shared affect behaviors over the course of the session.

As the *FYI* (Baranek et al., 2003) is a new tool that is being piloted, it is not yet validated as a screening tool and may not have detected the subtle differences between the participants’ social communication skills. While continued revisions to the tool may result in a reliable and valid tool to screen for autism in 12-month-olds, currently the tool is in its beginning stages. The *FYI* is being used in additional studies, as well as being translated into Spanish, Chinese, and Hebrew to increase the data on the sensitivity and specificity of this tool. Additional studies should enhance the knowledge of how the *FYI* can be used in the future.

Conclusions and future directions

Studies looking at the development of social communication behaviors in children with and without autism over time are relatively rare and are more difficult to research due to small sample sizes and the relatively “late” identification of children with autism. The current study was unable to find statistically significant results across the groups when comparing the social communication behaviors between two time points. However, the results do have implications for further studies utilizing these or similar measures and procedures, and for recommendations of adaptations to current screening tools.

First, this study has implications for further studies wishing to expand upon the measures and procedures used here. In the future, the *SOC-RS* (Mosconi, 2006) could include more subtle distinctions between levels in order to capture the differences among the social behaviors of participants who are on the higher end of the autism spectrum. In addition, the variability among videotaped sessions of the *ADOS* (Lord et al., 1999) suggests that the *SOC-*

RS (Mosconi, 2006) coding manual could be revised to include more specific coding of the context before being used in the future. These adaptations to the coding manual would allow for a more detailed picture of the child's social level, the way their time was spent during the testing session, and the opportunities for social interaction, giving a more complete picture of the child's social communication abilities. A future study could also use the coding manual with a larger sample size, increasing the power in order to better determine if the tool can detect differences in the population.

In addition to modifying procedures used with the *SOC-RS* (Mosconi, 2006), further studies could enhance portions of the study related to the *FYI* (Baranek et al., 2003). Future studies utilizing the *FYI* (Baranek et al., 2003) could focus on recruiting a higher percentage of minority families and families from a lower socio-economic background. Potentially, this could help increase the variability among the participants in the sample. There is evidence that minority children with autism receive a diagnosis, on average, at a later age than do white children (Mandell, Listerud, Levy, & Pinto-Martin, 2002), thus it is important to include them in screening efforts. If future studies do not include a wider demographic of participants, it may overlook the subset of minority children with autism not receiving an early diagnosis, and therefore not receiving autism-focused early intervention (later affecting follow-up data on these children).

The current study also did not examine the type and amount of early intervention received by the participants in between the data collected at the two time points. This may have affected the ability of *FYI* (Baranek et al., 2003) scores to predict social communication outcomes at age 3, as there was potentially a wide range in the types of interventions that may have been received in the intervening 2-year time period, including no intervention.

Therefore, it can only be surmised that children who were at-risk on the *FYI* at age 12-months, could have received a significant amount of early intervention, increasing their social communication behaviors at age three. Conversely, children who were not at-risk enough to be detected on the *FYI* could have failed to make the expected developmental progress during the intervening two years, and not received any early intervention. These children would exhibit less social communication behaviors at age three than might have been expected given their *FYI* scores. Future studies could take into account the amount and type of early intervention received to better understand the relationship between social communication behaviors exhibited at the two time points.

Secondly, this study's inability to detect statistically significant patterns of behavior between two time points speaks to the continued struggle to design a screening tool that can consistently identify children with autism. Not only is it difficult to detect more subtle differences in individuals with autism who are higher functioning at early ages, but it is difficult to detect these difference in the "late-onset" subset of individuals with autism. For example, there is evidence that some infants with autism appear typical at age 14-months, but either fail to make sufficient progress or regress by 24 months of age (Landa et al., 2007). Therefore, a screening tool at 12-months needs to be able to detect a very small deviance from typical behavior at this age and/or allow for additional screenings to confirm or refute risk status. The current study attests to the need for well-developed tools to fulfill these needs.

Perhaps components of the *SOC-RS* (Mosconi, 2006) coding manual could be refined and the observation of the child's overall level of social behavior could be a second step of the screening process. Parents and early childhood professionals who have been able to spend

a significant amount of time with the child could be able to use this type of overall rating system as a type of level I screening tool, to determine if a child should be seen for further testing for an autism spectrum disorder. Or, as the average time the child was on camera was only 41 minutes, psychologists or pediatricians could possibly spend that amount of time with a child to determine their overall level of social behavior once a child has been identified as being at-risk for autism, and use it as a type of level II screening tool. The overall level of social behavior at age three years did identify the children with autism, once they had been screened and determined as at-risk. In the current study, the children with autism were identified as at-risk either through the *FYI* (Baranek et al., 2003), the *Developmental Concerns Questionnaire* (*DCQ,* investigator-created form) the *Social Responsiveness Scale-Preschool* (*SRS-P*, Constantino, 2005) or a combination of these measures, suggesting that a combination of screening tools may be the most successful.

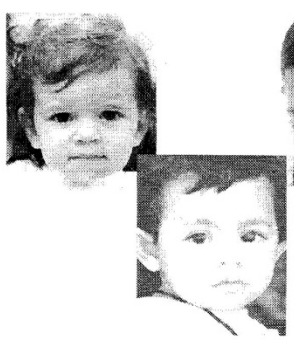
Previous efforts to use observation as part of a screening tool include the original version of the *Modified CHecklist for Autism in Toddlers* (*M-CHAT*, Robins, Fein, Barton, & Green, 2001), and the *Screening Tool for Autism in Two-Year-Olds* (*STAT;* Stone, Coonrod, & Ousley, 2000). While the *STAT* has been able to screen for autism with children who are 24 months of age, and the current study used an observational system with children 3-years of age, there has yet to be an observational screening tool that identifies autism in infants. Current research does not suggest that the *M-CHAT* (Robins et al., 2001) in its current form is an effective tool for screening for autism from the general population. However, as the current study suggests, utilizing the *M-CHAT* or another type of screening tool in corroboration with an observational component by an experienced physician or clinician

could perhaps increase the sensitivity, the percentage of true positives, and specificity, the percentage of true negatives, of the tool.

Although the current study was not able to detect a statistically significant relationship between parental report of social communication behaviors at 12-months of age and later social communication behaviors as observed at three-years of age, it did demonstrate some of the difficulties in examining these types of behaviors in young children with and without autism. Limitations to this study included a small sample size, a need for more specific coding procedures, and a limited range of demographics and characteristics represented in the sample. In the future, research focusing on the development of social communication behaviors over time, as well as on the validity of the *FYI* (Baranek et al., 2003) as a screening tool, and on the *SOC-RS* (Mosconi, 2006) as an observational tool will help determine if the findings from this study are reflective of the actual characteristics of the population.

Appendix A

First Year Inventory



fyi First Year Inventory

Version 2.0

NO TWO BABIES ARE ALIKE. We are interested in some of the behaviors that make your baby unique. There are no right or wrong answers to these questions. They are just descriptions of the range of behaviors we find in one-year-olds. Please answer each question as it applies to your baby within the week before or after your baby's first birthday. Please answer every question and give the most accurate answer you can. Again, we are not looking for any particular answer. We just want to know how your baby behaves and responds in various ways.

Date filled out: _____/_____/_____ (Month / Date / Year)

Baby's gender: ❑ Male ❑ Female

Baby's birth date: _____/_____/_____ (Month / Date / Year)

Birth order: _____ of _____ children born to this mother

Baby's due date: _____/_____/_____ (Month / Date / Year)

Baby's weight at birth: _____

Baby's Mother

Race/Ethnicity: (check 1 or more)

- ❑ White
- ❑ Black/African-American
- ❑ Hispanic/Latino
- ❑ Asian
- ❑ American-Indian /Alaskan Native
- ❑ Native Hawaiian/Pacific Islander

Highest grade completed or degree obtained: _____

Baby's Father

Race/Ethnicity: (check 1 or more)

- ❑ White
- ❑ Black/African-American
- ❑ Hispanic/Latino
- ❑ Asian
- ❑ American-Indian /Alaskan Native
- ❑ Native Hawaiian/Pacific Islander

Highest grade completed or degree obtained: _____

The person filling out this form is the (check one):

- ❑ Mother
- ❑ Father
- ❑ Both
- ❑ Other (specify): _____

For the following questions, check the ONE BOX that best describes how frequently this behavior occurs—Never, Seldom, Sometimes or Often.	Never	Seldom	Sometimes	Often
1. Does your baby turn to look at you when you call your baby's name?				
2. Does your baby seem bothered by loud sounds?				
3. Does your baby seem overly sensitive to your touch (for example, fuss or pull away when you touch him or her)?				
4. During familiar games like "I'm gonna get you," does your baby get excited because he or she knows what will happen next?				
5. Does your baby seem to have trouble hearing?				
6. When you and your baby are facing each other, does your baby turn his or her eyes to avoid looking at you?				
7. In new or strange situations, does your baby look at your face for comfort?				
8. Does your baby ignore loud or startling sounds?				
9. Does your baby spit out certain textures of foods, such as lumpy or chunky pieces?				
10. When you point to something interesting, does your baby turn to look at it?				
11. Is your baby content to play alone for an hour or more at a time?				
12. Does your baby look at people when they begin talking, even when they are not talking directly to your baby?				
13. Does your baby rock his or her body back and forth over and over?				
14. Does your baby look up from playing with a favorite toy if you show him or her a different toy?				
15. Does your baby get upset when you need to switch your baby from one activity to another one?				
16. Is it easy to understand your baby's facial expressions?				
17. Does your baby forcefully press his or her face, head, or body against people or furniture?				
18. Does your baby smile while looking at you?				
19. Does your baby try to get your attention to show you something interesting?				
20. Does your baby try to get your attention to play games like peek-a-boo?				
21. Does your baby try to get your attention to obtain a favorite toy or food?				
22. Does your baby try to get your attention to play physical games, like swinging, tickling, or being tossed in the air?				
23. When your baby is awake and you pick him or her up, does your baby's body feel loose or floppy?				
24. Does your baby copy or imitate you when you make sounds or noises with your mouth?				
25. Does your baby copy or imitate your actions, like sticking out your tongue, clapping your hands, or shaking your head?				
26. Does your baby copy or imitate you when you do something with a toy or object, like shaking a rattle or banging a spoon on the table?				
27. Is it difficult to calm your baby once he or she becomes upset?				
28. Are your baby's sleeping and waking patterns regular from day to day?				
29. Does your baby try to get your attention by making sounds and looking at you at the same time?				
30. Does your baby get stuck doing a simple activity over and over?				
31. Does your baby seem interested in other babies his or her age?				
32. Does your baby babble by putting sounds together, such as 'ba-ba', 'ga-ga-ga', or 'ba-dee'?				
33. Does your baby enjoy staring at a bright light for long periods of time?				
34. Does your baby use gestures such as raising arms to be picked up, shaking head, or waving bye-bye?				
35. When you say "Where's (a familiar person or object)?" without pointing or showing, will your baby look at the person or object named?				
36. Does your baby use the first finger and tip of the thumb to pick up a very small object like a raisin or a Cheerio?				
37. Does your baby seem to get stuck on playing with a part of a toy (such as an eyeball, label, wheel or tag), instead of the whole toy?				
38. Does your baby communicate with you by using his or her finger to point at objects or pictures?				
39. Do you get the feeling that your baby plays or communicates with you less now than in the past?				
40. Do your baby's eyes line up together when looking at an object?				
41. Are your baby's feeding patterns regular from day to day?				
42. Does your baby enjoy rubbing or scratching toys or objects for long periods of time?				
43. Does your baby seem to get his or her body stuck in a position or posture that is hard to move out of?				
44. Does your baby enjoy making objects spin over and over in the same way?				
45. While lying down, does your baby enjoy kicking his or her feet over and over for long periods of time?				
46. Does your baby stare at his or her fingers while wiggling them in front of his or her eyes?				

For the following questions, please circle the ONE ANSWER that best describes your baby.

47. Which of the following best describes your baby's typical play with a favorite toy?
    a. Uses the toy in more or less the same way all the time.
    b. Occasionally finds a new way to play with the toy.
    c. Often explores new ways to play with the toy.

48. Which of the following describes your baby's interest in toys on a typical day?
    a. Plays with one or two special toys most of the time.
    b. Plays with a small number of toys (3-5).
    c. Plays with a large number of toys (6 or more).

49. When you introduce your baby to a new game (peek-a-boo, so-big, patty-cake, etc.) how does your baby respond?
    a. Almost always joins in immediately without any help.
    b. Usually joins in, with a little help.
    c. Joins in only with a lot of help
    d. Doesn't seem very interested in new baby games.

50. What do you typically have to do to get your baby to look up from playing with a favorite toy?
    a. Just show him or her different toy.
    b. Move, shake or make a noise with the different toy.
    c. Take the favorite toy away and give your baby the different toy.

51. What is your baby's usual reaction to somewhat painful experiences, like bumping his or her head?
    a. Doesn't seem to notice.
    b. Reacts a little but gets over it quickly.
    c. Seems very sensitive or cries for a long time.

52. What do you typically have to do to get your baby to turn towards you?
    a. Simply say your baby's name.
    b. Say your baby's name several times.
    c. Say your baby's name loudly or use other means, such as clapping.
    d. Your baby doesn't do this yet.

53. What do you typically have to do to get your baby to smile or laugh at you?
    a. Smiling and laughing is enough.
    b. Usually need to touch and tickle.
    c. Usually need to swing and bounce.
    d. Your baby doesn't do this yet.

54. On a typical night, how many hours does your baby sleep?
    a. 12 or more.
    b. 10-11.
    c. 8-9
    d. 7 or fewer.

55. On a typical night, how many times does your baby wake up?
    a. 0 times.
    b. 1-2 times.
    c. 3 or more times.

56. Which of the following best describes your baby's skill level?
    a. Walks independently.
    b. Walks with hand(s) held, holding a push-toy, or holding onto furniture.
    c. Pulls up to stand but doesn't walk yet.
    d. Does not pull up to stand yet.

57. Which of the following best describes your baby's typical day?
    a. Almost never gets upset.
    b. Gets upset and needs to be calmed 1-3 times.
    c. Gets upset and needs to be calmed 4-6 times.
    d. Gets upset and needs to be calmed 6 or more times.

58. If you start a game by copying or imitating a sound your baby makes, what does your baby typically do?
    a. Doesn't seem to notice the sound.
    b. Looks at you, but doesn't make the sound.
    c. Looks at you and makes the sound.
    d. Plays the game, making the sound several times.

59. When your baby is awake and not eating, does your baby keep a toy or object in his or her mouth?
    a. Almost never keeps a toy or object in his or her mouth.
    b. Sometimes keeps a toy or object in his or her mouth.
    c. Often keeps a toy or object in his or her mouth.
    d. Almost always keeps a toy or object in his or her mouth.

60. Which of the following best describes the way your baby coordinates his or her eyes and hands while playing with a toy?
    a. Almost always looks at the toy that he or she is physically handling.
    b. Sometimes looks at the toy that he or she is physically handling.
    c. Rarely looks at the toy that he or she is physically handling.
    d. Almost never looks at the toy that he or she is physically handling.

61. Please circle all of the following sounds you've heard your baby use in babble, word approximations, or words:

p b t d k g m n w y h s

62. Do you or others (grandparents, doctor, babysitter) have any concerns about your baby's development in any area? If yes, please describe.

63. Does your baby have any unusual physical or medical characteristics? If yes, please describe.

Thank you for taking the time to respond to this questionnaire.
The information you have given us about your baby will help us understand more about how babies are different from one another, and will help us advise parents who may be concerned about their baby's development.
Please return the questionnaire to us in the self-addressed envelope provided.

Appendix B

Adapted from:

Social Orienting Continuum and Response Scale (SOC-RS)

M. W. Mosconi (2006)

Initiative Social Behaviors

When coding initiative social behaviors, code each of the following when they occur, keeping track of which events occur together (e.g., referencing + shared affect + joint attention gesture during bubbles). See coding sheet for format. None of the categories are mutually exclusive: referencing, shared affect, and communicative gestures can each be coded simultaneously. Also note if the gesture or verbalization was for the purpose of behavior regulation, social interaction, or joint attention.

Referencing:

Code as referencing if:

- The child is observed looking directly at another person's face and it is be clear that the child is looking at the person's face and not another part of the body or a proximal object.
- If the adult is off camera, but you can still see a body part or reflection that makes it clear the child is looking at the person's face, code as referencing.
- If you cannot see the child's face or eyes (e.g., back to camera), do not count as referencing.

*If the child looks between multiple individuals, then **Referencing** should be coded for each individual he/she makes eye contact with.

Shared affect:

Code as shared affect if:

- The child exhibits appropriate affect and shares this with another person. This is demonstrated by:
    - Laughing
    - Smiling
    - Change in cadence or tone of voice to indicate emotion (only count as shared affect due to a change in cadence or tone of voice if the child is referring to a new object or event, not just continuing to change voice up and down talking about the same event)
    - Posture is directed towards another person
- It must be clear that the child's change in affect is either directed towards another person or in response to another person's expression of emotion, rather than just expressing an emotion about the event (i.e., is it clear the child is changing their affect *because* someone else is present, or at least in acknowledgement of the other person)
- Change in affect related to the pretend play scheme should not be coded as shared affect, unless it is very clear the child is changing their voice or affect to share what is happening in the play with the adult. (e.g., talking animatedly to the dolls, or having the doll's "voice" laugh or express emotion does not count as shared affect).
- If the adult is off camera, but you can still see a body part or reflection that makes it clear the child is sharing affect with another person, code as shared affect.
- Code as a new instance of shared affect if the child's affect returns to a neutral state before exhibiting another emotion. (e.g.,. the child must stop laughing or smiling in between shared affect events to count it as a new event)

**NOT:

- Events in which the child becomes distressed and seeks comfort by running to another person.
- Events in which the child is exhibiting an emotion as a part of play (e.g., making a crying noise while pretending the baby doll is crying)
- Events in which the child focuses on the examiner after being interrupted (e.g., child is upset that examiner takes the toy away, and looks at examiner while expressing this emotion)

Communicative gestures:

Only behaviors that are appropriate and non-repetitive should be scored here. Sequences in which the child uses another individual's hand or other body part as a tool to serve a specific function (e.g., making a pop-up toy come up), should NOT be scored here. However, if the child reaches towards the examiner's hand to draw them closer or to get their attention or push their hand away, this SHOULD be scored as a gesture.

Determine if the act was a gesture: The following (1, 2, and 3 are adapted from Wetherby and Prizant **********)

1. Was the act a gesture?

_____ giving the object to another person

_____ pushing object toward or away from another person (could be another person's hand or face)

_____ head shaking or nodding

_____ pointing with finger or fingers

_____ raising arms

_____ open hand reaching (may include opening and closing hand repeatedly) –*reaching*- not just grabbing the object

_____ showing object (holding up object toward another person in reference to child's midline and not releasing object)

_____ making depictive gesture (i.e., pantomime-like action or rhythmic movements, such as bouncing up and down to indicate horsy game

_____ enactive movement (i.e., pretending to drink out of an empty cup)

COMMON CONVENTIONAL GESTURES

_____ clapping, dancing (in presence of music/singing & other people), waving bye, nodding head "yes," shaking head "no," using finger to "shhh," shrugs shoulders to indicate "I don't know" or "where did it go?" hugging objects, pretending to sleep, smacking lips, blowing a kiss, finger plays, action to indicate "all gone," playing "so big," waving hands for "too hot," action to show excitement (high fives, thumbs up)

Determine if the gesture was communicative:

2. Was the act directed toward another person?

____ looking at another person's face/eyes

____ using vocalization/verbalization paired with gesture

____ touching person

____ shared context (e.g., both child & adult are looking at a book; child & parent are engaged in a social game)

____ contingent response to other person's words or action (including imitation)

____ persistence in repeating gesture until other person responds

Which communicative function?

3. Did the act serve a communicative function?

____ regulating another person's behavior **(BR-behavior regulation)**

- to get object requested
- to get them to carry out action
- to stop someone from doing something

____ attracting another person's attention to engage in social interaction **(SI-Social Interaction)**

- to initiate or sustain a social game or routine, such as peek-a-boo, patty-cake, etc.
- to provide comfort to another
- teasing
- to ask permission
- gestures used to enhance or expand a communicative exchange (e.g., acting out brushing teeth) counts as a social interaction

____ directing another person's attention to object or event **(JA-joint attention)**

- to look at or comment about an object or event
- to provide information about an object or event
- related to initiating joint attention
- If the child is directing the adult's attention a specific aspect of an event or picture, count at joint attention. To count as joint attention, the child must be directing the adult's attention to a new event or aspect of the event,

not merely pointing to the picture they are already attending to, or pointing to a completed puzzle to show the adult what they made

How to determine number of gestures:

Count as a new gesture if the child resumes a neutral position before gesturing again. E.g., if the child blows a kiss, but keeps his arm in the air and blows a second kiss, count it as one gesture.

Responding to Social Attention

Responds to name:

Code as an opportunity if:

- The child's name is stated and at least a *2*-second pause in which the child's response is observed by the person who called his or her name (Therefore, if a parent or the examiner calls the child's name repeatedly (i.e., more than twice in the 2-second time period) at a rapid rate, or the child's name is followed by or paired with an additional command or gesture within those 2 seconds, no opportunity should be indicated. Also, if the child's name is called in a "sing-song" voice, do not code as an opportunity). If "hey" or "hi" is stated with the child's name, still count it as an opportunity unless "hey" or "hi" is repeated more than once in a row.

Code as + if the child responds to their name by one of the following:

- Turning towards the examiner (it must be clear the child is turning in response to their name being called, and not making a random movement)
- Verbalizing an acknowledgement (e.g., "yeah" or "what")

**NOT: events in which the child repeats his or her name *without* turning towards the examiner. I.e., if the child repeats his or her own name, but turns towards the examiner, it can be coded as responding to name

Joint Attention Responding:

Code as an opportunity if:

- The examiner, parent, or other individual attempt to direct the child's attention to an object or event by:
    - shifting his or her gaze or distal pointing

    **NOT: Pointing to a picture on a page that the child is reading
    - The adult should be directing the child's attention to an object, event or aspect of the object or event that the child was not already attending to (e.g., showing the child how to pop a bubble and directing the child's attention to this new action should be counted as a joint attention opportunity, even if the child was already attending to the bubbles in general)

Code as + or – if the child responds to the joint attention opportunity by:

- shifting his or her gaze to the object or person of interest

Overall level of social behavior

(4) Socially skilled: The majority of interactions appeared to be appropriate for the child's age. This child's social behavior does not present as characteristically autistic. He/she initiates appropriate social interactions with the examiner on multiple occasions. He/she also responds appropriately to the examiner's bids for interaction. He or she also is able to modulate eye contact during the majority of interactions.

(3) Socially interested but awkward/unskilled: This child shows interest in the examiner (or willingness to interact) and awareness that the examiner is attempting to interact. This child initiates interactions during the course of the evaluation, but often does so in an awkward or inappropriate way. A child who repeatedly attempts to play the same game or engage the examiner in a routine could be identified within this subgroup. Children who have difficulty making eye contact or modulating affect during interactions also should be identified here.

(2) Socially inhibited/overactive inattentive: Children who appear shy or anxious during interactions with the examiner should be identified within this subgroup. These children may seldom engage in social interactions with the examiner, but must demonstrate consistent awareness that the examiner is present and attempting to interact. A child who actively avoids the examiner and appears vigilant of his or her presence should be identified here.

(1) Aloof/Passive: Children who appear unaware that the examiner is present during the majority of the evaluation should be identified here. These children should seldom initiate or respond to social overtures. The vast majority of interactions with these children are characterized by a lack of social attention, fixation on objects, and attempts to employ the examiner as a means for obtaining or activating an item.

Appendix C: Participant Scores

ID	Diagnosis	ADOS module	FYI Social Communication Score	FYI percentile (both constructs)	Overall Level of Social Behavior	% of Time Responded to Name	Rate of Referencing *(per min.)	Rate of Shared Affect*	Rate of Social Interaction Gestures*	Rate of Joint Attention Gestures*	Rate of Initiative Social Behaviors*
130	Other	2	.00	20.00	4	100	3.18	.54	.38	.05	4.15
202	Typical	2	15.75	96.00	4	100	1.90	.38	.46	.00	2.74
303	Other	2	24.00	92.00	3	50	.48	.07	.48	.00	1.03
323	Typical	2	17.75	83.00	4	100	3.37	.98	.93	.07	5.35
341	ASD	2	31.50	99.00	3	50	.81	.40	.33	.00	1.53
705	Other	2	12.00	77.00	4	100	3.52	1.00	.96	.04	5.52
809	ASD	2	7.75	62.00	3	100	.63	.02	.22	.00	.88
814	Typical	2	20.00	90.00	4	33	.63	.04	.57	.00	1.24
930	Other	2	.00	65.00	3	100	2.55	.24	.45	.05	3.29
1005	Typical	2	14.75	73.00	4	100	1.98	.16	.35	.02	2.51
1011	Typical	2	.00	5.00	4	50	2.59	.44	.38	.00	3.41
1105	Typical	2	22.00	95.00	4	100	2.40	.42	.58	.00	3.40
1131	Typical	2	15.25	91.00	4	100	2.61	.59	.48	.00	3.68
1239	Autism	1	9.50	76.00	3	33	1.35	.48	.30	.09	2.22
1406	Typical	2	21.50	87.00	4	100	3.22	.22	.69	.03	4.17
1410	Autism	2	5.00	27.00	3	50	1.46	.11	.23	.02	1.82
1508	Typical	2	21.50	94.00	4	100	4.83	.64	1.28	.08	6.83
1513	Typical	2	31.00	98.00	4	67	1.74	.35	.17	.00	2.26
1632	Other	2	7.50	90.00	4	100	3.00	.49	.18	.06	3.73
1938	Typical	2	15.50	90.00	4	50	2.74	.72	.56	.08	4.10
1943	Typical	2	33.25	99.00	4	100	1.38	.27	.13	.00	1.77
2031	Typical	2	32.25	94.00	4	100	3.21	.26	.21	.03	3.69
2102	Typical	2	.00	5.00	4	50	1.97	.16	.32	.00	2.45
2717	ASD	2	43.75	100.00	3	100	1.65	.18	.16	.02	2.02
2730	Typical	2	19.50	99.00	4	100	1.95	.48	.20	.05	2.68
3239	Typical	2	.00	5.00	4	100	4.04	.24	1.31	.00	5.60
3317	Typical	2	.00	12.00	4	50	3.56	.62	.56	.03	4.77
3416	Typical	2	26.50	100.00	4	100	1.66	.29	.37	.05	2.37
3718	Typical	2	2.75	17.00	4	33	1.58	.28	.38	.03	2.25
3805	Other	2	.00	5.00	4	100	1.62	.27	.42	.00	2.31
3816	Typical	2	.00	5.00	4	100	3.75	.28	.75	.03	4.80
3926	Typical	2	.00	5.00	4	100	2.83	.25	.73	.00	3.80
4011	Typical	2	.00	14.00	4	67	2.74	.45	.68	.05	3.92

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