Joint Attention, Imitation, and Repetitive Behaviors as Predictors of Autism and Expressive Language Ability in Early Childhood

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ABSTRACT

SIGNE MARIE BOUCHER: Joint Attention, Imitation, and Repetitive Behaviors as Predictors of Autism and Expressive Language Ability in Early Childhood
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The detection of early characteristics of autism and language impairments is critical in providing early interventions for a child with delays. Using a sample of 864 children in the Chapel Hill area, this study investigates the link between joint attention, imitation, and repetitive behaviors at 12 months and likelihood of displaying characteristics of autism or language delays at 24 months. Results indicated that joint attention, imitation, and repetitive behaviors were related to the display of characteristics of autism ($p < 0.0001$; $p < 0.002$; $p < 0.0001$) as well as for later language impairments ($p < 0.001$, $p < 0.0001$; $p < 0.027$). Finally, within a sample of children who were determined at risk for autism, joint attention and imitation predicted language delays ($p < 0.0001$; $p < 0.05$). These findings formulate a better understanding of characteristics of autism and language delays in early childhood.

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CHAPTER 1

Introduction

Autism is a neurodevelopmental disorder that is characterized by impairments in reciprocal social interaction, verbal and nonverbal communication, and the display of a restricted range of interests and behaviors (Wing & Gould, 1979). Specifically, the Diagnostic and Statistical Manual of Mental Disorders, (DSM-IV-TR) describes social impairments in autism as exhibiting difficulty in the nonverbal behaviors that are used to sustain social interactions, such as eye gaze, gestures, and facial expressions. In addition, social impairments can consist of developmentally inappropriate peer relations, a lack of spontaneous interest in sharing with others, as well as a lack of social reciprocity. Communication deficits, as defined by the DSM-IV-TR, constitute a delay in language development, impairment in sustaining conversation, repetitive use of language, or lack of spontaneous or social imitative play at a developmentally appropriate level. The final category for autism as defined by the DSM-IV-TR is restricted, repetitive, or stereotyped patterns of behavior. The criteria in this category include restricted patterns of interest that are abnormal in intensity, inflexible adherence to routines or rituals, repetitive motor mannerisms, or persistent preoccupation with parts of objects. At least one of these three areas of impairment must be present before the age of three for a diagnosis of autism (DSM-IV-TR).

The criteria listed in the DSM-IV-TR, however, may not be the most appropriate means of diagnosing autism in very young children, as some criteria are more applicable for

older children (Stone et al., 1999). Thus, several studies have been conducted to identify early signs of autism in infants and toddlers who later develop into the DSM-IV-TR's definition of autism. These studies have been conducted through retrospective video analysis, retrospective parent report, sibling studies, and parent-report screening measures.

Based on information obtained from past studies, early predictors of autism include deficits in social communication, such as diminished eye contact, fewer anticipatory postures, and limited affective engagement (Volmar, Chawarska & Klin, 2005). Osterling, Dawson & Munson (2002) found that children with autism oriented less to their name and looked at others less frequently than children with mental retardation. Furthermore, children with autism and children with mental retardation used gestures less than typically developing children. Baranek (1999) found that early characteristics of autism may include excessive mouthing of objects, poor visual orientation, social touch aversions, and delayed response to their name. Maestro et al. (2002) found early attention differences in children with autism in that they are more likely to divert their attention to nonsocial stimuli than social stimuli compared to typically developing children.

Three early predictors of autism are of particular interest, including joint attention, imitation, and repetitive and/or stereotyped behaviors. These variables are of special interest because they appear early in life and seem to correlate with important skills. Furthermore, because language delays have been considered one of the most easily identified characteristics in young children with autism, joint attention, imitation, and repetitive behaviors are of interest in regard to their relationship with expressive language as well. The aim of this study is to explore characteristics that may be evident in very young children who will eventually receive a diagnosis of autism and/or language delay.

The Development of Joint Attention in Typically Developing Children

Joint attention can be defined as "a cluster of behaviors that share the common goal of communicating with another person about a third entity in a nonverbal way" (Bruinsma, Koegal, & Koegal, 2004). In infants, joint attention usually refers to the shared attention between the child, an adult, and an object; however, joint attention is a broad term that encompasses many behaviors, such as joint engagement with another object through referential looking, attention following, and declarative gestures, such as pointing and reaching (Carpenter, Pennington, & Rogers, 2002). Because of the breadth of the term, joint attention behaviors are often categorized as "responding to joint attention" or "initiating joint attention." Response to joint attention refers to when the child responds to another person's bid to engage a third entity, which is typically seen through pointing or eye gaze alternation. Initiation of joint attention is when the child seeks another person's attention to invite them to engage in a third entity (Bruinsma et al., 2004). A primary function of joint attention is to communicate nonverbally with others. In addition, joint attention is also considered a *social* construct in which a child is sharing some outside object or reference point with another person (Jones & Carr, 2004).

For the purposes of this study, joint attention will be operationalized based on the definitions and processes describing joint attention from the current literature. Specifically, joint attention in this study is defined based on the description of Mundy et al. (2000) as "the capacity of an infant to coordinate her attention with a social partner vis-à-vis an object or event." Thus, a child gaining his or her parent's attention by pointing, socially referencing, or using eye gaze would be examples of initiating joint attention. Likewise, a child

responding to similar bids of joint attention from a parent, such as pointing, social referencing, or eye gaze is also considered to be joint attention for the purposes of this study.

A reliable developmental pattern of joint attention skills has been found in typically developing children (Carpenter, Nagell, & Tomasello, 1998). Joint attention abilities typically emerge between the ages of 9 and 14 months (Slaughter & McConnell, 2003). Infants normally engage in joint attention by first *sharing attention* with adults by alternating gaze between the object of interest and the adult. The second joint attention skill to emerge is that of *following attention*. Specifically, infants tend to follow others' attention by responding to a point or eye gaze. Next, infants typically *follow others' behavior* by imitating adults' actions on objects. Finally, declarative and imperative gestures, such as points and reaches, develop. These declarative gestures are considered initiating joint attention behaviors, whereas sharing and following attention are considered to be examples of responding to joint attention. Thus, infants are able to direct others' attention and behavior themselves around the first year of life (Carpenter et al., 1998). This process of joint attention usually occurs first though parent-child interactions and then progresses to sharing attention with peers (Jones & Carr, 2004).

Joint Attention as an Early Indicator of Autism

Research consistently demonstrates that children with autism have impaired joint attention skills when compared to typically developing children. Moreover, such deficits in joint attention in children with autism are evident in infancy. Specifically, retrospective parent reports of the first two years of their child's lives have suggested that children with autism exhibit decreased frequency and referential use of eye contact. These children also demonstrated diminished frequency and use of showing, giving, and pointing to objects as

well as difficulty following points, which are all components of joint attention (Wimpory, Hobson, Williams, & Nash, 2000). Osterling & Dawson (1994) conducted a study examining videotapes of the first birthday parties of children who were later diagnosed with autism. This study revealed that children with autism displayed significantly fewer joint attention behaviors, as defined by pointing and showing, than typically developing children at 12 months of age. However, the sample in this study was rather small, as eleven children were used in each of the two groups. Yirmiya et al. (2006) examined the differences between siblings of children with autism and siblings of typically developing children in regards to social engagement at four and fourteen months of age. This study found that siblings of children with autism made fewer nonverbal requests and gestures than siblings of typically developing children. Surprisingly, significantly more siblings of children with autism responded to their name than siblings of typically developing children. The authors hypothesized that this finding may be a result of the parents having an older children with autism and thus, they have practiced having their child response to their name in a structured setting.

Carpenter, Pennington, & Rogers (2002) also found delays in joint attention abilities in a group of children with autism with a mean age of 48.8 months in comparison to typically developing children and developmentally delayed children, particularly in regards to following gaze and declarative gestures. However, despite these deficits, children with autism followed the same pattern of joint attention development as typically developing children. Specifically, both groups first shared attention with an adult through alternating gaze, then followed attention and others' behavior, and finally, directed attention through points and reaches. Thus, when joint attention skills develop in children with autism, they

follow a sequence similar to typically developing children in regards to sharing, following, and directing. Similarly, MacDonald et al (2006) found that two- and three-year-old children with autism responded less to bids of joint attention than did four year olds with autism as well as typically developing children. Additionally, the findings of this study suggest that significantly fewer children with autism initiated joint attention when compared to typically developing four year olds.

Finally, impairments in joint attention have been found to differentiate children with autism at 20 months of age from other infants with mental retardation, even when matched for developmental and language delay (Charman et al., 1998). Because deficits in joint attention can be observed during infancy and because these deficits can discriminate between children with autism and children with mental retardation, deficits in joint attention have been considered one of the earliest apparent characteristics of autism (Jones & Carr, 2004). Yirmiya & Ozonoff (2007) recognize the difficulties in differentiating autism from developmental delays and mental retardation in infancy; however, they report that early differences in joint attention are common in infants who later receive an autism spectrum disorder diagnosis.

Joint Attention and Language Development in Typically Developing Children

Joint attention deficits have been linked to later language development in typically developing children (Tomasello & Farrar, 1986). This link is significant, as it has been suggested that impairments in joint attention affect language because language is learned partly through episodes of joint attention. Specifically, when an adult directs a child's attention, the object is usually labeled. Deficits in joint attention may limit the amount of language that the child is processing (Jones & Carr, 2004; Baron-Cohen, Baldwin, &

Crowon, 1997; Morales et al., 2000). In contrast, typically developing children learn object labels during episodes of joint attention, which may enhance receptive vocabulary development (Tomasello & Farrar, 1986). Thus, weak joint attention skills could lead to delayed language development.

Joint attention has been associated with language ability in typically developing infants as young as 6 months of age. In a comprehensive study using a young sample (Morales et al., 2000), joint attention was measured using the Early Social Communication Scale (ESCS) at 6, 8, 10, 12, and 18 months of age in typically developing infants. Results indicated that joint attention served as a predictor for vocabulary development at 30 months as measured by the MacArthur-Bates Communication Development Inventory (CDI). Specifically, responding to joint attention at 6, 8, 10, and 18 months was significantly correlated with language outcome at 30 months, even when controlling for earlier language status. Responding to joint attention at 12 months was significantly correlated with language outcome at 24 months. Even measures of joint attention and EEG coherence at 14 months have been shown to correlate with language development at 24 months (Mundy, Fox, & Card, 2003). In this study, joint attention was assessed using the ESCS periodically from 6 to 30 months, while language was assessed using the CDI at 24 months. Responding to joint attention at 14 months was significantly related to the total vocabulary measure at 24 months, but not at 18 months.

Differences exist in the literature regarding the relationship between joint attention and expressive versus receptive language in typically developing children. Specifically, Morales, Mundy, & Rojas (1998) found that 6 month olds who have a greater capacity for following the direction of their mothers' gaze generally had larger receptive vocabularies at

12 months and larger expressive vocabularies at 18, 21, and 24 months, as measured by the CDI. Although Morales, Mundy, & Rojas (1998) found joint attention to predict both expressive and receptive language, Charman et al. (2000) found that joint attention abilities at 20 months are predictive of receptive language at 44 months. In contrast, Markus, Mundy, Morales, Delgado, & Yale (2000) found that responding to joint attention at 12 months was positively correlated with expressive language at 18 months, but not with receptive language. Finally, Mundy & Gomes (1998) found that initiating joint attention at 14 months significantly predicts expressive language at 17 months, and responding to joint attention significantly predicts receptive language.

Joint Attention and Language Development in Children with Autism

Studies have been conducted to examine the relationship between joint attention and language in young children with autism as well. For example Dawson et al. (2004) compared three to four-year old children with autism to typically developing children and developmentally delayed children, matched for mental age. Joint attention was assessed using the Autism Diagnostic Observation Schedule-G (ADOS-G) and the ESCS, whereas language was assessed through the Vineland Adaptive Behavior Scales and the Mullen. Combined impairment in joint attention and social orienting differentiated children with autism from both typically developing and developmentally delayed children. Charman et al. (2003) examined the specific relationship between joint attention and receptive and expressive language in a young sample of children with autism. Joint attention was measured at 20 months using a series of three toy tasks described by Butterworth and Adamson-Macedo (1987), while language was assessed at 42 months using the Reynell

Developmental Language Scales. Joint attention predicted receptive language but not expressive language.

Stone & Yoder (2001) measured joint attention in children between ages 2 and 3 years and then followed up for expressive language outcomes at 4 years. Joint attention and language were positively correlated, but this relationship did not reach statistical significance. One possible explanation for these results is that this study only examined initiating joint attention, rather than responding to joint attention and only examined expressive, but not receptive, language ability.

Bono, Daley, & Sigman (2004) found that better joint attention skills predict greater language development in children with autism. Using a sample with an initial mean age of 46.68 months who were re-assessed a year later, children were administered the ESCS and either the Reynell Developmental Language Scales or the Clinical Evaluation of Language Fundamentals- Revised (CELF). Both initiating and responding to joint attention were positively correlated with language development. Sigman & McGovern (2005) explored this relationship longitudinally and found that joint attention skills in preschoolers continue to predict language gains in adolescence and even adulthood. Specifically, language was assessed in early childhood using the Reynell Scales of Language Ability, and joint attention was measured using the ESCS. At middle childhood and adolescent follow ups, language was assessed using the Reynell Scales for participants with limited language abilities and the CELF for participants with more advanced language abilities. For joint attention, adapted versions of the ESCS were used for the follow-up samples. Gains in language from preschool to adolescence were predicted by responsiveness to joint attention and initiation of

requesting behaviors, when controlling for initial language level. However, joint attention measured in middle childhood did not predict language gains in adolescence.

Summary of Joint Attention Literature and Future Directions

Joint attention is generally impaired in children with autism. Given that this impairment is seen early in life, it is possible that deficits in joint attention may precede an actual diagnosis of autism. Furthermore, deficits in joint attention have not only been linked to autism, but also to later language impairments in both typically developing children and children with autism. Specifically, joint attention skills have been examined in typically developing infants as young as 6 months of age, and a predictive relationship between joint attention and later language ability has been established. However, the youngest age in which joint attention skills have been examined in children with autism in relation to their language ability is 20 months of age, which is largely due to the difficulty of early diagnosis of children with autism. Thus, it would be helpful to examine the nature of this relationship in children who are younger than 20 months and who are at risk for an eventual diagnosis of autism.

The Development and Function of Imitation in Typically Developing Children

In the 1960s, Piaget posited that imitation abilities are evident shortly after the birth of an infant, with more complex imitation skills, such as the ability to imitate actions on objects, emerging at the end of the first year of life (Piaget, 1962a). Imitation has been described as an early tool that young children use to learn about their environment and master new behaviors (Meltzoff & Moore, 1983). Studies conducted recently have verified that imitation abilities begin early in life (Rogers & Pennington, 1991). For example, Heimann & Ullstadius (1997) demonstrated that children typically imitate tongue protrusion

and mouth opening during the first month of life. However, as Piaget suggested, recent studies report that more definitive imitation skills emerge around 12 months of age. Specifically, at 12 months, imitation most often takes place through imitating actions on objects and by imitating vocalizations (Heimann & Ullstadius, 1999).

Imitation functions as a means of communication for infants in the pre-linguistic period. In particular, imitation occurs both verbally and nonverbally and can be viewed as a way of communicating with adults. Through the imitation of body movements, vocalizations, and facial expressions, infants gain a sense of connectedness with adults (Nadel, Guerini, Pexe, & Rivet, 1999). Another social function of imitation for young children is that it provides information about the actions and intentions of others from which the child can learn (Rogers, 1999). Imitation can also be goal-directed when a child imitates an action as an attempt to cause the repetition of an event (Uzgiris, 1999). Not only does imitation foster communication and social interactions with adults, but also Uzgiris suggests that imitation in infancy serves as a method of social communication among peers. Specifically, joint play among peers in early childhood appears to rely on communicating through imitation. Once language is mastered, imitation becomes less functional and is used less often (Nadel, Guerini, Peze & Rivet, 1999). Thus, the function of imitation is particularly critical in early development

For the purposes of this study, Piaget's definition of imitation will be used. Piaget (1962b) describes numerous forms of imitation at different stages of child development, some that appear earlier than language acquisition and some that appear concurrently with langauge acquisition. For example, sensorimotor imitation, which typically occurs just before the first year of life, refers to the child's effort to copy a presented model. In contrast,

according to Piaget, deferred imitation occurs later in a child's development and is defined as when the child's imitations take place in the absence of a model (Gruber & Voneche, 1995). In the present study, imitation refers to the immediate copying of basic sounds and/or actions when the child is presented with a model.

Imitation in Children with Autism

Children with autism typically display deficits in imitation abilities (Smith & Bryson, 1994). Based on a review of eight imitation studies conducted in the 1970s and 1980s, Rogers and Pennington (1991) concluded that a core deficit in children with autism is motor movement imitation. In addition to deficits in motor imitation, their review also revealed that children with autism demonstrate moderate difficulty in imitating affective expressions as well as higher level symbolic imitation. These deficits are evident compared to typically developing children as well as individuals with mental retardation who have been matched for mental and chronological age. Based on this review, Rogers & Pennington (1991) suggest that because of the social nature of imitation in infancy, this deficit in children with autism may significantly affect social development. Similarly, imitation deficits in children with autism were found by Rogers, Bennetto, McEvoy & Pennington (1996), who compared the performance of adolescents with autism on facial and manual imitation tasks with the performance of these tasks by typically developing adolescents. In addition, the two groups were compared in regard to their performance on pantomime tasks in which they were asked to imitate an action with and without a real object in their hands. The autism group was able to perform an action with an object in hand, but not without (i.e., the pantomime condition), which suggests that a motor impairment is not an underlying cause of an imitation deficit.

Recent studies have examined imitation abilities in much younger children with autism and have found similar deficits as in the older population. Charman et al. (2005) found deficits in imitation in infants with autism at 20 months of age. Specifically, compared to both typically developing children and children with developmental delays, the children with autism exhibited weaker motor imitation skills, replicating past findings. Similarly, Rogers, Hepburn, Stackhouse, & Wehner (1997) found that children with autism with a mean age of 34 months displayed more impaired overall imitation, oral-facial imitation, and imitation of actions on objects than children with Fragile X, developmental delays, or typical development. In addition, imitation ability was linked to the developmental level of all children in the study. Imitation in children with autism was specifically related to the severity of their autism as well as their joint attention skills. Based on these findings, Rogers et al. (2003) proposed that imitation deficits appear to be a primary indicator of autism in early childhood.

Stone et al. (1997) suggested that children with autism exhibit a delayed pattern of imitation that is similar to that of typically developing children, rather than a disorganized pattern of imitation. Specifically, looking at children under the age of 3 and a half years, language was assessed using the CDI, whereas imitation was measured using the Motor Imitation Scale (MIS), an assessment involving the manipulation of objects and body movement imitation. Children with autism and children with developmental delays displayed greater difficulty with imitation of body movements than imitation of actions using objects than typically developing children. Moreover, like typically developing children, children with autism and developmental delays had greater difficulty when imitating non-meaningful versus meaningful actions. Thus, while children with autism have delays in

imitation skills, the sequence in which these skills emerge is the same as typically developing children. Beadle-Brown & Whiten (2004) support the hypothesis that children with autism exhibit a delayed pattern of imitation. In their study, although younger children, both with and without autism, had more difficulty with the imitation tasks, their ability improved with age. Thus, imitative ability in children with autism follows the typical pattern consistent with mental age, though it is slightly delayed based on chronological age.

Imitation and Language Development in Typically Developing Children

Limited research has been conducted examining the relationship between imitation and language development in typically developing children. However, Charman et al. (2000) found a connection between imitation and language in 20 month-old infants. Specifically, the examiners used the Meltzoff (1988) tasks in which they modeled actions with objects three times before providing the child with an opportunity to imitate the action. In addition to the imitation task, language was measured at both 20 months and at 44 months using the Reynell Developmental Language Scales. No concurrent correlation was found between imitation and language ability at 20 months. However, imitation at 20 months did significantly correlate with expressive language at 44 months, but not with receptive language. Charman et al. (2000) concluded that the predictive relationship and the lack of a concurrent relationship is not well understood and warrants further investigation. Carpenter, Nagell, & Tomasello (1998) also found that the age of emergent imitation skills, particularly regarding gestures, was moderately related to the age of emergent language skills in typically developing children between the ages of 9 and 15 months. More studies are needed to explore the relationship between imitation and later language abilities in typically developing children.

Imitation as a Predictor of Language Development in Children with Autism

More research is also needed to examine the relationship between imitation and language in children with autism. Charman et al. (2003) found positive associations between imitation as measured at 20 months and language as measured at 42 months in children with autism. The Meltzoff (1988) imitation task was used in this study as well as the Reynell Developmental Language Scales. Results revealed that receptive, but not expressive, language outcomes resulted in a significant relationship with imitation at 20 months. Specifically, greater responsivity to the imitation tasks at 20 months was positively correlated with higher language at 42 months.

Although Charman et al. (2003) found a relationship between joint attention and receptive language ability, other studies have found a predictive relationship with expressive language ability. For example, Stone and Yoder (2001) found that motor imitation abilities in children with autism between 2 to 3 years of age predicted expressive language skills at 4 years. Using the Motor Imitation Scale (MIS), motor abilities were evaluated at both the initial and follow-up assessments. Language was assessed using the CDI as well as the Sequenced Inventory of Communication Development-Revised, a direct observation measure at age 2, and the Preschool Language Scale, also a direct observation measure, at age 4. Stronger imitation skills at age 2 predicted better expressive language outcomes at age 4, even when controlling for initial language ability at age 2. Finally, Stone, Ousley & Littleford (1997) found that motor imitation at age 2, particularly relating to body imitation, predicted expressive language abilities on the CDI one year later.

In contrast to these studies, Rogers et al. (2003) found that imitation was not linked to language ability. In this study, the Imitation Battery was administered, which consists of

manual acts, actions on objects, and oral-facial tasks. Expressive language was measured using the composite from the Mullen Scales of Early Learning. Although this study demonstrated that imitation was impaired in children with autism, there was no relation between imitation deficits and later language ability. One hypothesis for the lack of correlation between imitation and expressive language is that developmental age was controlled for. Another explanation is that the imitation tasks used in this study were more complex than those used in past studies. Specifically, the tasks in this study entailed using novel actions on objects rather than familiar actions. In addition, a baseline condition was used in this study, which differs from previous studies, such that the children were required to shift to a new action on the same object for the experimental condition. Perhaps the inherent social nature of imitation tasks results in a disadvantage for children with autism, which may partly explain some of their imitation deficits.

Summary of Imitation Findings

Imitation skills emerge within the first year of life, and infants may use imitation as a means of communication with others. Children with autism have exhibited deficits in imitation as early as at 20 months of age when compared to typically developing children and even children with mental retardation or developmental delays. Although few studies have examined the relationship between imitation and later language abilities in typically developing children, imitation has been shown to predict language ability in children with autism. However, Rogers et al. (2003) reported conflicting results in that imitation was not linked to later language ability. These conflicting results suggest that further investigation is warranted to determine if a predictive relationship exists. Thus, imitation can be viewed as a

likely early characteristic of autism that is also possibly linked to language impairments, making it an important variable to investigate at a young age.

Repetitive and Stereotyped Behaviors in Children with Autism

As mentioned earlier, one of the DSM-IV-TR's general criteria for autism is the display of restricted, repetitive, and/or stereotyped patterns of behavior, interests, and activities (DSM-IV-TR). Within these criteria, a repetitive pattern of behavior can include displaying stereotyped motor movements, nonfunctional routines, restricted interests that are abnormal in intensity, and/or a preoccupation with parts of an object. Within the literature on repetitive behaviors of children with autism, the term "repetitive behavior" encompasses a broad range of behaviors including stereotypies, rituals, self-injury, tics, dyskinesia, akathisia, and perseveration (Lewis & Bodfish, 1998). In the present study, repetitive behavior in young children is defined as displaying motor stereotypies, having a preoccupation with parts of an object or toy, and/or exhibiting intense interests.

Repetitive behaviors have been thought to function as a reward for the child, reducing stress or anxiety, or increasing sensory stimulation (Lewis & Bodfish, 1998). Repetitive behaviors occur more frequently in children with autism who have low cognitive ability or have mental retardation (Lewis & Bodfish, 1998). Similarly, Bodfish, Symons, Parker & Lewis (2000) found that the severity of the repetitive behavior, as measured by the Repetitive Behavior Scale, predicts the severity of autism, as measured by the Autism Behavior Checklist. This study was conducted with adults with autism and adults with mental retardation, who were matched for age, gender, and IQ.

The specific timing of the emergence of repetitive behaviors in children who have autism is unclear. Militerni, Bravaccio, Falco, Fico & Palermo (2002) compared the

repetitive and stereotyped behaviors in children with autism aged 2-4 years versus children aged 7-11 years. Younger children displayed more motor and sensory repetitive behaviors than the older children, whereas the older children displayed more complex repetitive behaviors than the younger children. The motoric behaviors seen more frequently in the younger children consisted of stereotypical trunk movements, such as rocking, and stereotypical limb movements, such as flapping. Sensory repetitive behaviors were defined as licking, sniffing, tapping, self-stimulation, as well as higher intensity sensory behaviors, such as self injurious head banging. In contrast, complex repetitive behaviors seen more frequently in the older children were actions that occurred during play or repetitive speech, such as repetitive use of words, sentences, or parts of dialogue. In addition, results showed that children with lower IQs exhibited more motor and sensory repetitive behaviors in comparison to children with higher IQs, who were more likely to demonstrate the more complex repetitive behaviors. The same effects were found for the degree of autism, as measured by their scores on the Childhood Autism Rating Scales.

Repetitive Behavior as a Predictor of Autism in Young Children

In an analysis of retrospective videotapes of first birthdays, Osterling, Dawson & Munson (2002) found that infants who were eventually diagnosed with autism engaged in repetitive motor actions significantly more frequently than typically developing infants. However, infants eventually diagnosed with mental retardation also had increased repetitive behaviors compared to typically developing infants. In contrast, Wetherby et al. (2004) did find differences between those groups. In this study, two year olds with autism were compared with typically developing two-year olds and developmentally delayed two-year olds based on videotapes of the Behavior Sample, which is a standardized, face-to-face

evaluation of the child's interactions with a parent and clinician. According to the videotape analysis, repetitive movement and posturing of the body, arms, hands, or fingers were displayed by half of the children with autism, and repetitive movements with objects was displayed in almost three-fourths of the children with autism. These rates of repetitive behavior in children with autism were significantly greater than rates in the developmentally delayed sample and the typically developing sample.

Baranek (1999) analyzed retrospective videos of typically developing children, developmentally disabled children, and children with autism between the age of 9 to 12 months and found that unusual posturing of body parts occurred more frequently in infants eventually diagnosed with autism and developmental disabilities than in typically developing children. Object stereotypy or repetitiveness significantly discriminated children with developmental disabilities from typically developing children, but did not discriminate children with autism from typically developing children. These studies suggest that repetitive behaviors can be indicative of autism or some form of cognitive delay in children as young as one year of age.

In contrast, Werner, Dawson, Osterling & Dinno (2000) analyzed retrospective videos of typically developing children and children with autism recorded when they were less than one year of age. No significant differences were found between the two groups regarding repetitive behaviors. Lord (1995) suggested that restricted and repetitive activities and interests should not be used for diagnostic purposes in children with autism until closer to age three due to insignificant differences in comparison with typically developing children. Based on Autism Diagnostic Interview (ADI) scores for restricted, repetitive behaviors, children with autism increased repetitive behaviors from age two to three years,

whereas typically developing children decreased repetitive behaviors from age two to three years. Thus, differences were more noticeable between typically developing children and children with autism at age three years due to decreased abnormalities in the children without autism at this age. Stone's (1999) findings are similar to those of Lord (1995). Specifically, Stone found that restricted and repetitive behaviors were not consistently observed in two-year olds with autism. Furthermore, adherence to routines or rituals was observed infrequently in two year old children with autism, supporting the findings that repetitive behavior may emerge later in the developmental course of autism.

Summary of Repetitive Behaviors in Children with Autism

The criteria of the DSM-IV-TR describes repetitive behaviors as restricted, repetitive, and/or stereotyped patterns of behavior, interests, and activities in individuals with autism. Repetitive behaviors may differ depending on the age of the child with autism. This idea is particularly true in infancy, and mixed results have been obtained. Specifically, while some studies have found notable repetitive behaviors during the first year of life in children who eventually develop autism, other studies conclude that repetitive behaviors do not become evident until closer to age three years. Further examination of repetitive behaviors in young children who are eventually diagnosed with autism is important as a clear picture has yet to emerge at such a young age.

Identifying Children who are At Risk for an Eventual Diagnosis of Autism

Children who are at risk for an eventual diagnosis of autism were identified using the First Year Inventory (FYI). The FYI is a 63-item checklist that is administered to parents of 12-month-old infants (Reznick et al., in press). The FYI elicits information about a range of behaviors that indicate risk for an eventual diagnosis of autism. The first 46 items of the FYI

require the child's parent to select the frequency with which they perceive their baby to exhibit a range of behaviors on a 4-point scale, ranging from "Never" to "Often." The next fourteen items on the questionnaire asks parents to complete a sentence to best describe their child by circling one of four different options. Finally, one item asks parents to circle sounds that their baby is able to say, and two items asks parents about developmental, physical, and/or medical concerns. The FYI also includes demographic questions regarding the baby's birth date, due date, gender, birth order, birth weight, and the parent's race and educational attainment. The FYI takes between ten to fifteen minutes to complete.

Target behaviors elicited within the items of the FYI were identified based on findings from current literature, including retrospective parent reports about the infancy of children with autism, retrospective video analysis of children with autism, case studies of infants later diagnosed with autism, prospective studies of children whose siblings are diagnosed with autism, and prospective studies of a community sample. Based on this body of literature, a list of target behaviors that could indicate of a later diagnosis of autism was generated. This list of behaviors was then organized into two broad categories: "Social-Communication" and "Regulatory." Social-communication behaviors include failure to respond when the child's name is called, delay in babbling or language development, joint attention deficits, poor eye contact, lack of social interest, and abnormal imitation skills. Regulatory behaviors include abnormal duration of gaze, hyper-responsivity to sensory stimuli, irregular sleeping and eating patterns, irritability, motor stereotypies, and excessive mouthing of objects.

From this list of behaviors related to autism in early childhood, questions were formulated to generate a parent's report of the frequency of the behavior. The wording of

items on the FYI was refined by reaching a consensus among six to ten professionals in the field as well as parents of children with autism. In addition, three pilot mailings were conducted to further refine the wording of the items and the response alternatives by clarifying ambiguous questions and increasing the sensitivity to unusual behavior.

The construct validity of the FYI was measured by Watson et al. (2007). In this study, parents of preschoolers with autism completed the *First Year Inventory – Retrospective Version (FYI-R),* which is the FYI written in the past tense. In addition to parents of children with autism, parents of typically developing children and parents of developmentally delayed children (not on the autism spectrum) also completed the FYI-R as comparison groups. Children in the study spanned in age from 14 to 75 months, and their parents completed the form based on their recollection of their child at 12 months of age. The results of the study indicated that children with autism received significantly higher risk scores for autism than children with developmental delays and typically developing children. These results strengthen the validity of the FYI to screen for risk factors specific to an autism spectrum disorder.

For this study, the purpose of the FYI is twofold. First, the FYI is used to measure joint attention, imitation, and repetitive behaviors in young children through parent report. Secondly, the FYI is used to identify a group of children who are at risk for an eventual diagnosis of autism. Specifically, children who receive a high risk score on the FYI are considered to be showing characteristics that may be associated with a later diagnosis of autism. The FYI can be found in Appendix 1.

It is important to clarify that because the FYI is a screening measure for autism, but not a diagnostic instrument, these children cannot reliably be referred to as "having autism."

However, children who have scores in the elevated ranges on the FYI are showing behaviors that are typical of children who will eventually have a diagnosis of autism. Thus, children with elevated scores on the FYI will be referred to here as being at notable risk for an eventual diagnosis of autism.

Research goals and research questions

The research goals of this study are twofold. First, to examine early predictors of autism at a younger age than has been examined in the literature. Although recent studies have revealed a clearer depiction of atypical behaviors in infancy and toddlerhood in children who will eventually be diagnosed with autism, more information is needed to clarify these findings. Joint attention, imitation, and repetitive behaviors are three variables that seem particularly relevant and thus, warrant further study in infancy. Each of these variables have been operationalized for the purpose of this study.

Second, to examine early predictors of later language delays. Language delays are a primary characteristic of autism and are one of the most troublesome concerns for parents and professionals. Many predictors of autism may overlap to serve as predictors of language delays, as autism and language impairments are closely related in young children. Thus, investigation of this relationship is important in order to obtain a better understanding of autism in young children.

For the purposes of this study, we will focus on expressive language throughout the study because it is considered a more critical variable in the context of autism (Stone & Yoder, 2001). For example, while receptive language impairments can be compensated for with interventions, such as visual strategies and instructions, expressive language remains a major concern in children with autism. In addition, expressive language ability is more

easily measured than receptive language during the early stages of language development, as there can be variability in parental judgment as to what their child understands receptively at this young age. Expressive language, on the other hand, can be more concretely and definitively observed.

My research goals lead to three major hypotheses:

Hypothesis 1. Deficits in joint attention are evident in very young children with autism (Charman et al., 1998; Carpenter et al., 2002; Wimpory et al., 2000). However, only one study has examined joint attention in children who will eventually have a diagnosis of autism when they are as young as 12 months (Osterling & Dawson, 1994). This study examined the relationship between joint attention and autism retrospectively and with a small sample size. In contrast, a prospective study with a larger sample size has yet to be conducted.

Second, joint attention in typically developing infants as young as six months old is correlated with later language ability (Morales et al., 1998; Morales et al., 2002). However, clarification is needed regarding the relationship between joint attention and language in children with autism, as conflicting findings have been reported. Whereas many studies have found a significant relationship between joint attention and language in children with autism (Charman et al, 2003; Sigman & McGovern, 2005; Bono et al., 2004), some studies have not replicated these findings (Stone & Yoder, 2001). Differences in these findings make it important to examine this relationship. In addition, no studies have investigated this relationship in a sample this young before in children with autism.

I predict that joint attention at 12 months will be associated with the display of characteristics of autism and expressive language abilities at 24 months using the entire

sample of children. Specifically, low joint attention will be associated with a greater likelihood of displaying characteristics of autism and low expressive language scores. In addition, joint attention will predict expressive language ability within a group of children who display characteristics of autism using a subset of children who are at risk for an eventual diagnosis of autism.

Hypothesis 2. Imitation abilities are impaired in children with autism (Rogers & Pennington, 1991; Rogers et al., 1997). However, the youngest sample measured was 20 month old children (Charman et al., 2005). Because of the importance in identifying early characteristics of autism in infants, it is critical to examine this relationship in children as young as possible.

Additionally, very little is known about the relation between imitation and language ability in typically developing children. Although the research is limited, Charman et al. (2000) found a positive relationship between imitation at 20 months and expressive language at 44 months in typical children. Imitation as a predictor of language has been more widely investigated in children with autism, though the findings in the literature are not consistent regarding the nature of this relationship. Whereas imitation has been positively related to language in children with autism in some studies (Charman et al., 2003; Stone et al., 1997; Stone & Yoder, 2001), Rogers et al. (2003) found no relationship between imitation and language ability. Furthermore, while most studies have found that imitation predicts expressive language (Stone & Yoder, 2001; Stone, Ousley, & Littleford, 1997), Charman et al. (2003) found that imitation predicted receptive, but not expressive language. Not only is there as need to clarify these findings, but also no studies have examined this relationship in children who are 12 months of age.

Despite some inconsistencies in the findings in the literature, the majority of the studies have found a relationship between imitation and language and many have found a relationship between imitation and expressive language in children with autism. Furthermore, imitation is an early form of communication, thus, intuitively it makes sense that imitation and language would be linked. Thus, the following hypothesis is based upon these justifications.

I hypothesize that imitation at 12 months will be related to the display of characteristics of autism and language delays in children at 24 months using the entire sample. Specifically, a delayed pattern of imitation at 12 months will be associated with a greater likelihood of displaying characteristics of autism and lower expressive language abilities at 24 months. In addition, imitation will predict language outcome within a group of children who display characteristics of autism using a subset of children who are considered at risk of an eventual diagnosis of autism.

Hypothesis 3. Findings have been inconsistent regarding the development of repetitive behaviors in young children who are eventually be diagnosed with autism. Whereas some studies report evidence of repetitive behaviors in infants (Baranek, 1999; Wetherby et al., 2002; Osterling et al., 2002), others report that repetitive behaviors manifest themselves in most children with autism closer to the age of three years (Lord, 1995; Stone, 1995). Thus, repetitive behaviors in young children who exhibit characteristics of autism will be examined in the present study.

Very limited research has been conducted examining repetitive behavior and language ability. Joint attention and imitation have an intuitive association with the development of language. In contrast, repetitive behaviors, in isolation of other variables, do

not have an intuitive link to language development in a normative population. Additionally, no prior research points to an association between repetitive behaviors and language in a normative sample. However, in children with autism, evidence of repetitive behaviors at 12 months may have an association with later language development since both repetitive behaviors and language impairments are later critical features of autism.

Based on these justifications, I hypothesize that repetitive behaviors at 12 months will be associated with a greater likelihood of displaying of characteristics of autism in the entire sample. However, I predict no association between repetitive behaviors at 12 months and having expressive language delays at 24 months of age. Finally, I hypothesize that repetitive behaviors will predict language outcome within a subset of children who are at risk for an eventual diagnosis of autism.

CHAPTER 2

Method

Design

This study employs a prospective longitudinal design with parent-report data collected for children at 12 and 24 months of age.

Participants

Data on the 12-month old sample was collected from August 13th, 2004 through April 29th, 2005 through weekly mailings of the FYI (Reznick, Baranek, Reavis, Watson, & Crais, in press). Families' names were obtained from a database developed by Dr. Steven Reznick based on birth certificates on file with the North Carolina Department of Health and Human Services. The FYI was mailed to families who lived within 20 – 30 miles of Chapel Hill, N.C. one week before their child's first birthday. Because the FYI has not yet been translated into Spanish, families were excluded if either parent identified themselves as Hispanic on the birth certificate (19.7%). As an incentive, parents were informed that if they completed and returned the FYI, they would be entered into a drawing to receive $100.00.

The total number of eligible families during the time frame of the mailing was 6,304 (Reznick et al., in press). Of the FYIs that were mailed out, 363 were returned by the post office as undeliverable. Thus, 5,941 FYIs are assumed to have been delivered. Of the presumably delivered FYIs, 1,499 were completed and returned, resulting in a 25% return rate. Returned FYIs were excluded from data analysis if parents had completed the FYI more than four weeks after the child's birthday and also for preterm infants, as they are less

likely to have reached normative age-related developmental milestones. Children who had known medical conditions or genetic diagnosis, such as cerebral palsy, cystic fibrosis, Down syndrome, or fragile X syndrome, were also excluded from the original phase of the study. In addition, some parents did not give permission to be contacted for future studies. Given these exclusions, a total of 1,085 families were eligible to participate in the present study.

For the original mailing, 50.3% of the returned FYIs were completed for male infants, and 49.7% were completed for female infants (Reznick et al., in press). Mothers completed the FYI 83% of the time, fathers completed the FYI 5% of the time, and both parents completed the FYI 12% of the time. In regards to ethnicity, 85% of the returned FYI were completed for white infants, 10% were completed for black infants, and 5% were completed for infants falling in an "other" category for ethnicity. Finally, data gathered from the education attainment question revealed that 12% of the parents who completed the FYI had finished high school or less, 11% had some college, 39% were college graduates, and 36% had some post-graduate education.

Data collection for the 24-month old sample began on October 10th, 2005 and continued through April 25th, 2006. The 1,085 families who returned the FYI in the 2004-2005 mailing were eligible for inclusion in the next phase of the study. However, because the data collection process began approximately two months later for the 24 months old than the 12 month olds, parents of children whose birthdays had already passed (August through mid-October birthdays) were asked to rate their child's behavior based on their current functioning rather than retrospectively at 24 months.

Of the 1,085 families who received packets in the mail, 26 were returned as undeliverable, and 865 were completed, resulting in an 81% return rate. The sample of 24-

month old participants was evenly divided by gender with 52.7% females and 47.3% males. Children ranged in age from 23 months to 28 months, with a mean age of 24 months. Eighty-eight percent of the 24 month sample was white, 7% was African American, and 5% fell into the "other" category for ethnicity. In regards to maternal education, 10% of the mothers completed high school or less, 10% completed some college, 40% completed college, and 37% had some post college education.

It is also important to examine the characteristics of those who did not respond to the 24-month old mailing. Completed forms during the second phase of the study were returned by 58% of the original families who returned the FYI during the first phase of the study. There were some differences between the families who returned the forms and those who did not. Specifically, there was a slight but statistically significant tendency for families with girls (62%) to return the materials when compared to boys (55%), χ^2 (1) = 6.43, $p < 0.05$. Also, there were differences in the distribution of education and race for responders versus non-responders, χ^2 (4) = 12.69, $p < 0.05$ and χ^2 (3) = 19.93, $p < 0.01$, respectively. Specifically, less educated mothers and African American mothers were less likely to respond, although the absolute differences were small. Thus, mothers from all categories of education and race were well-represented in the sample.

FYI risk scores for children in the focal sample were significantly lower than FYI risk scores for the non-responders, F (1, 1470) = 23.5, $p < 0.01$, with means of 6.39 versus 7.98. This difference is predictable given that Reznick et al. (in press) found that less educated African American mothers reported higher FYI risk scores for their children. However, the difference is difficult to interpret, as it could reflect actual differences among children or social-cultural differences in how mothers respond to the FYI questions. Because the

absolute difference in FYI risk score is relatively small and because there is considerable overlap in the distribution of FYI risk scores for responders and non-responders, the present results can likely be generalized to a broader population.

Measures

Three measures were collected. The First Year Inventory (FYI) provided data regarding joint attention, imitation, and repetitive behaviors at 12 months of age. The Toddler Short Form of the MacArthur Communication Development Inventory (CDI) was used to assess language development at 24 months. The Modified CHAT (M-CHAT) was used to assess symptoms of autism at 24 months.

First Year Inventory (FYI).

The FYI was administered to collect data on a sample of 12-month old children. Because each question on the FYI probes for a behavioral characteristic of autism at 12 months of age, an infant who displays more of these characteristics of autism can be considered at risk for an eventual diagnosis (Reznick et al., in press). Thus, a scoring system was created to identify children who score in the "at risk" range for an eventual diagnosis of autism based on the parents' responses to each individual question.

First, eight constructs were developed from the FYI using a traditional item-total correlation approach (Nunnally, 1978), which could be labeled "construct shaping." Through this approach, the eight constructs that emerged were: Social Orienting & Receptive Communication; Social-Affective Engagement; Imitation; Expressive Communication; Sensory Processing; Regulatory Patterns; Reactivity; and Repetitive Play. Nine items did not fit appropriately within these eight constructs for which a final category was created and labeled, "Assorted Items" (Reznick et al., in press).

To develop the scoring system, each construct was converted to a common scale wherein children whose parents report more atypical observations receive a higher risk score since the number of questions within each construct varies. Risk scores for each construct range between 0 and 50. These risk scores are based on risk-points awarded for individual questions within the construct that were determined based on their percentile score of the normative sample. Specifically, a risk-point total near the 50th percentile of the normative samples receives a risk score of 10, a risk-point total near the 75th percentile receives a risk score of 20, a risk-point total near the 90th percentile receives a risk score of 20, a risk-point total near the 95th percentile receives a risk score of 30, a risk-point total near the 98th percentile receives a risk score of 40, and a risk-point total near the 99th percentile receives a risk score of 50. The overall FYI risk score is calculated by summing the construct risk scores and dividing by 8, which is the number of constructs.

For the purposes of this study, the total FYI risk score will be used to determine whether or not a child displays characteristics that suggest that the child is "at risk" for an eventual diagnosis of autism. In addition, for the purposes of this study, these risk points will be used to determine atypical versus typical behavior within the joint attention, imitation, and repetitive behaviors constructs. Specifically, two of the eight constructs elicited by the FYI are "imitation" and "repetitive play" (Reznick et al., in press). The items within these two constructs are found in Appendix 2. This table includes Cronbach's alpha values as a measure of internal reliability. Cronbach's alpha for the imitation construct is 0.64, and Cronbach's alpha for the Repetitive Behavior construct is 0.78, both which demonstrate strong internal reliability.

The FYI does not have a specific joint attention construct, but rather a "social orienting and receptive communication" construct, which encompasses many joint attention behaviors as well as other communicative behaviors. Because the aim of the study is to focus on joint attention as a predictor variable, an additional construct was created consisting of only joint attention behaviors. This construct was created based on behaviors that theoretically relate to joint attention, and it contains items that do not overlap with the imitation and repetitive play constructs. The items within the FYI that comprise each of these three constructs are listed in Appendix 3. Cronbach's alpha value of 0.74 is also included in the table for the joint attention construct, demonstrating strong internal validity.

Table 1 lists the relation between the three focal constructs used here and the other constructs that can be derived from the FYI. As would be expected, joint attention correlates with social orienting & receptive communication, social-affective engagement, and expressive language because the joint attention items are drawn from these constructs. The relation between joint attention and imitation reflects the general coherence of the social-communication construct. Imitation is also correlated with the other social-communication variables. Repetitive play is correlated with sensory processing, but was relatively independent of the other variables in the regulatory construct.

MacArthur-Bates Communicative Development Inventories (CDI) Short Form (Toddler version).

The toddler short-form version of the MacArthur-Bates Communicative Development Inventory is a parent-report measure to assess the communicative skills of infants and toddlers (Fenson et al., 2000). Whereas the toddler long form consists of 680 words, the toddler short form CDI is a 100-word vocabulary production checklist that includes both

early and late-appearing words to eliminate basal and ceiling effects. In addition, the toddler short form asks the parent to respond "Not Yet," "Sometimes," and "Often" as to whether their child has begun to combine words. The CDI short form is often used in research studies or in clinical practices when a rapid, brief assessment of a child's language level is needed or when parental literacy is low. Scores on the toddler short form correlate strongly with the scores on the toddler long form (r = 0.99) (Fenson et al., 2000).

Two parallel versions of the toddler short-form exist: Level II, Forms A and B. Form A was used in this study. Form A's reliability using Cronbach's alpha has been estimated at 0.97, and its concurrent validity is 0.74 when compared to other measures that assess similar skills. Fifty-two percent of the words on Form A are nouns, 18% are verbs, 15% are adjectives and adverbs, and 15% are pronouns, prepositions, and other parts of speech.

Modified Checklist for Autism in Toddlers (M-CHAT).

The Modified Checklist for Autism in Toddlers (M-CHAT), developed by Robins et al. (2001), is a 23 item yes/no parent-report checklist of items that can be used as a screening tool for autism in 24 month old children. The M-CHAT was adapted from the Checklist for Autism in Toddlers (CHAT: Baron-Cohen et al., 1992). The original CHAT consists of nine items that are posed to the parent by a physician and five items that rely on home observation of the child by a home health visitor. This measure is administered at 18 months of age. The M-CHAT has improved sensitivity from the CHAT in identifying autism, as it extended its focal age group from 18 months to 24 months. Furthermore, home observations are no longer a part of the M-CHAT, allowing a more simple screening administration through parent report. The M-CHAT has also broadened the range of behaviors elicited in the questions to identify a greater range of children with autism and has been shown to be both

reliable and valid. Specifically, in a study assessing its validity, children with autism or a pervasive developmental disorder failed more items than typically developing children and were significantly different on all 23 items except two of them (Robins, Fein, Barton, & Green, 2001). However, the M-CHAT is not intended to be used as a diagnostic measure for autism, but rather as an initial screening tool.

The M-CHAT scoring procedure designates children at risk for autism if they fail any three items (Robins et al., 2001). In addition, children who fail two or more specific items (questions 2, 7, 9, 13, 14, and 15) are also considered to be at risk for autism. These specific items were derived from a discriminant function analysis of M-CHAT data for 600 participants. The M-CHAT also includes items relating to joint attention, imitation, and repetitive behaviors, as these are critical behaviors associated with autism; however, the items in the M-CHAT elicit a range of other behaviors associated with autism as well. Thus, the specific FYI constructs of joint attention, imitation, and repetitive behaviors and the M-CHAT do not overlap considerably.

Procedure

Parents received a packet in the mail at the time of their child's first birthday and returned the FYI as well as a form indicating their consent to participate in future studies. The M-CHAT and CDI were mailed to the participants two weeks before the child's second birthday to allow the parents ample time to complete the questionnaires before their child's second birthday. Because the mailing began two months later for the 24-month old cohort than for the 12-month old cohort, some parents received their packet a few weeks after their child's second birthday. These parents were asked to complete the questionnaires based on their child's current age rather than respond retrospectively. To increase the return rate of the

completed measures, a five dollar bill was enclosed in the packet as an incentive as well as a return addressed, stamped envelope.

Families who did not return completed questionnaires received a phone call between two to three weeks after the child's birthday to ensure that they received the packet. Phone calls were made to 271 participants (25%) who did not return their questionnaires. Of these 271 phone calls, 156 (58%) families were reached, and 115 (42%) had disconnected or changed phone numbers. Of the 156 participants who were reached by telephone, eighty-two (53%) returned the questionnaires.

CHAPTER 3

Results

Most of the 854 children who comprise this sample display a few characteristics of atypical development based on the FYI. Because development at this age varies among individuals, and because judgment among parents may be idiosyncratic, some minor deviations from the typical course of developmental are expected. This slight atypicality does not indicate that these children are a particularly unique group to examine from a developmental perspective, as some variability is not unusual. However, within the large sample of 854 children, the FYI can be used to identify a subgroup of children whose parents are detecting notably atypical behavior.

This study focuses on the relationship between specific predictors and outcomes of interest in the group of children who fall above the 95th percentile on their total risk FYI score. These children are referred to as the "at risk group" in the sense that they display many of the same characteristics of infants who eventually receive a diagnosis of autism. It is important to note that the cut-off for this categorical distinction is somewhat arbitrary, as the FYI is a new measurement tool without established qualitative thresholds. The 95th percentile cut-off was chosen after running analyses for the 90th, 98th, and 99th percentiles, which yielded very comparable results to the 95th percentile. Thus, the 95th percentile was chosen because it incorporates a large enough sample size for sufficient power, but is not overly inclusive. In addition, the 95th percentile is commonly used as a cut-off point on other measures, including the CDI.

Additionally, the FYI constructs can be used to identify subgroups of children whose parents detect notable atypicality for a particular characteristic or ability, such as joint attention, imitation, and repetitive behaviors. In these analyses, results are reported based on the 95th percentile as the cut-off value to determine "at-risk" joint attention, imitation, and repetitive behavior thresholds. The results were also calculated using the 90th, 98th, and 99th percentiles as cutoffs. All four cutoff percentiles yielded similar results, so only results for the 95th percentile are reported here, as it provides a large enough sample group and is not overly inclusive.

It should be noted that the hypotheses section of this document was organized separately by the constructs of joint attention, imitation, and repetitive behavior. However, the results will be organized slightly differently due to the organization required to analyze the data most efficiently. Specifically, the analyses will be reported by comparison type with all three constructs combined. In turn, the discussion will be aligned with the organization of the hypotheses section, with a focus on each construct in turn.

Specific constructs at 12 months and autism risk at 24 months

To test the hypothesis that poor joint attention, imitation, and increased repetitive behaviors is related to overall risk for autism, a two by two Chi square table was calculated between children in the "at risk" versus "no risk" categories on the M-CHAT (based on standard scoring procedures) and children in the "risk" versus "no risk" categories for joint attention, imitation, and repetitive behaviors (based on being above the 95th percentile on the FYI). There was a significant relationship between being at risk on joint attention and failing the M-CHAT, χ^2 (1) = 27.702, $p < 0.0001$. Similarly, there was a significant relationship between being at risk on imitation and failing the M-CHAT, χ^2 (1) = 9.3427, $p < 0.0022$.

Finally, risk on repetitive behaviors was also significantly related to risk on the M-CHAT, χ^2 (1) = 20.2279, $p < 0.0001$. Interestingly, the relationship between imitation and likelihood of autism was notably lower as compared to the other two predictor variables.

Specific constructs at 12 months and language at 24 months

My second research question is whether joint attention, imitation, and repetitive behaviors at 12 months predict expressive language delays at 24 months. Correlations were calculated between joint attention, imitation, and repetitive behaviors at 12 months and expressive language ability at 24 months using the entire sample of children to determine the relationship between the predictors and the outcome variable in a typical population. The results indicated that joint attention scores at 12 months are significantly correlated with language scores at 24 months, $r (852) = -0.164$, $p < 0.001$, as is imitation, $r (852) = -0.195$, $p < 0.0001$, and repetitive behavior, $r (852) = -0.075$, $p < 0.027$. The correlation coefficient for repetitive behavior is significantly lower than the correlation coefficient for imitation ($z = 2.48$, $p < 0.05$) and marginally lower than the correlation coefficient for joint attention ($z = 1.84$, $p <0.05$), suggesting that imitation and joint attention have a stronger link to expressive language than repetitive behaviors.

Given that each of the constructs has positive correlations with other constructs that contribute to the overall risk score, it is important to make sure that these correlations do not emerge because the construct is essentially a proxy for the autism score. To test this possibility, partial correlations were conducted for each construct with the mean of the other constructs removed from the relation. That is, the correlation between joint attention and language, with the average of sensory processing, regulatory patterning, reactivity, and repetitive behavior removed, and parallel partial correlations for the other constructs. With

the effect of other constructs removed, joint attention was still correlated with language, r (857) = -.14, p < .0001, and imitation was still correlated with language, r (857) = -.15, p < .0001, but the relation between repetitive behavior and language was negligible, r (857) = -0.03.

Fenson et al. (1992) report wide variability in vocabulary production among children at the same age. In particular, gender may play a role in this variability, as females produce slightly higher percentile scores than males at 24 months. Additionally, in a sample of children aged 8 through 14 months, Bauer, Goldfield & Reznick (2002) found that girls developed language at a faster pace than boys. Specifically, the results demonstrated that the children within this sample fell into either fast or slow trajectories, and girls more often fell within the fast trajectory for lexical development than boys.

Thus, separate correlations were conducted for each gender within this sample of high risk children as well. The relationship between the three constructs, joint attention, imitation, and repetitive behaviors with later language ability was also analyzed for boys versus girls within the entire sample. For boys, a significant relationship was found between joint attention and language, r (402) = -0.167, p < 0.001, and between imitation and language, r (402) = -0.142, p < 0.005. The relationship between repetitive behaviors and language was not statistically significant, r (402) = -0.046, p < 0.35. A similar pattern was found for girls in that joint attention and imitation were related to later language ability, r (448) = -0.143, p < 0.002, and r (448) = 0.253, p < 0.0001 respectively, but not between repetitive behavior and language, r (448) = -0.110, p < 0.02.

Specific constructs at 12 months and language at 24 months in a subset of at risk children

The final question was whether joint attention, imitation, and/or repetitive behaviors predict language delays in children who are at risk for an eventual diagnosis of autism. There was a strong, significant relationship between joint attention and language, $r(34) = -0.507$, $p < 0.0001$ and between imitation and language, $r(34) = -0.358$, $p < 0.05$. In contrast, repetitive behaviors and language were unrelated. Additional analyses were conducted to determine whether the correlation coefficients were significantly from each other. The correlation coefficients for joint attention and imitation were not significantly different. The correlation for joint attention was significantly larger than the correlation for repetitive behavior, ($z = 2.21$, $p < 0.01$), but the correlation coefficients for imitation and repetitive behavior did not differ.

Correlation analyses were also run separately for boys and girls. Twenty-four boys fell above the 95th percentile of risk on the FYI. For these 24 boys, there was a significant relationship between joint attention and language, $r(23) = -0.362$, $p < 0.08$, but not between imitation and language, $r(23) = -0.208$ or between repetitive behavior and language, $r(23) = -0.181$. There were 11 girls above the 95th percentile on the total FYI. Of these girls, a very strong relationship was found between joint attention and language, $r(11) = -0.825$, $p < 0.001$, and between imitation and language, $r(11) = -0.798$, $p < 0.003$, but repetitive behavior and language were not related.

CHAPTER 4

Discussion

Hypothesis 1

The first hypothesis was that joint attention at 12 months would be associated with the display of characteristics of autism at 24 months, and specifically that low joint attention would be associated with a greater likelihood of displaying characteristics of autism. The results support this hypothesis. Specifically, joint attention at 12 months, as measured by the FYI construct, was significantly related to risk for autism at 24 months based on the M-CHAT.

This finding is consistent with the current literature. Specifically, retrospective studies report fewer joint attention behaviors at 12 months in children later diagnosed with autism (Osterling & Dawson, 1994; Wimpory, Hobson, Williams & Nash, 2000); however, the present study was conducted prospectively rather than retrospectively. Other studies have found a similar link between joint attention and characteristics in children slightly older than the sample in the present study (i.e., Carpenter, Pennington & Rogers, 2002). Thus, this study adds to the current literature in that it demonstrates a link between joint attention and autism prospectively in a younger sample than in previous studies.

In addition, joint attention was hypothesized to be associated with expressive language abilities at 24 months, with low joint attention associated with low expressive language ability. The findings of this study also support this hypothesis. Specifically, joint attention in 12 month olds, as measured by the FYI, was related to later language ability in

24 month olds, as measured by the CDI, and lower joint attention abilities predicted lower language scores.

The results regarding joint attention and language replicate the findings in the current literature. Morales et al. (2000) reported that joint attention at 6, 8, 10, 12, and 18 months as measured by the ESCS predicted vocabulary development at 30 months as measured by the CDI. Similarly, Markus, Mundy, Morales, Delgado, & Yale (2000) found that responding to joint attention at 12 months was positively correlated with expressive language at 18 months. The present findings replicate this effect using a parent-report measure of joint attention drawn from the FYI.

The final prediction within the first hypothesis is that joint attention would be associated with language ability within a group of children who are at risk for autism. The literature suggests that joint attention abilities are related to language abilities in children with autism. Specifically, children with autism have deficits in joint attention that predict language impairments when compared to typically developing children (Dawson et al. 2004; Charman 2003). As hypothesized, a significant relationship between joint attention and language was found at 24 months. Specifically, low joint attention scores on the FYI construct were correlated with lower CDI scores within children who were in the 95th percentile for total FYI scores.

This hypothesis is also consistent with evidence in the literature. Specifically, in an sample of children with autism with a mean age of 47 months, Bono, Daley, & Sigman (2004) found that joint attention was linked to later language abilities, as did Charman et al. (2003) between 20 and 42 month olds. The present study examined the relationship between 12 and 24 months, which is a younger age than in the aforementioned studies.

Hypothesis 2

The second hypothesis relates to imitation. Specifically, it was hypothesized that imitation at 12 months would be associated with the display of characteristics of autism at 24 months. In particular, it was hypothesized that low imitation scores would be linked to a greater likelihood of being at risk for an eventual diagnosis of autism. The present findings support this hypothesis. Specifically, imitation at 12 months, as measured by the FYI, was significantly related to risk for autism at 24 months based on the M-CHAT.

Several studies support these findings. Rogers et al. (1997) found that children with autism display more impairments in imitation than typically developing children as well as children with other developmental delays. Stone et al. (1997) also demonstrated that children with autism show a delayed pattern of imitation. Finally, Charman et al. (2005) found deficits in imitation in children with autism as young as 20 months. However, the current findings replicate these findings in children eight months younger than in previous studies.

It was also hypothesized that imitation would be related to later expressive language ability. Specifically, it was hypothesized that poor imitation at 12 months would be associated with lower language scores at 24 months. As predicted, lower imitation scores on the FYI were significantly related to lower CDI language scores at 24 months.

The finding that imitation predicts language in typically developing children makes sense from the perspective of contemporary theories of language development. For example, imitation has been theorized to be an early stage of communication for children before they become verbal (Nadel, Guerini, Pexe &Rivet, 1999). Thus, if imitation is a precursor to language, poor early imitation skills should result in delayed language. The current literature regarding the link between imitation and language is limited, but consistent with the findings

of the current study. Carpenter, Nagell, & Tomasello (1999) found that the age of emergent imitation skills was related to the age of emergent language skills in 9 to 15 month olds. Charman et al. (2000) reported a connection between imitation at 20 months and expressive, but not receptive language in 44 month olds. These investigators concluded that the relationship between imitation and overall language ability was not well understood and warrants further investigation. The current study also found a relationship between imitation and expressive language, but in a slightly younger sample than in the study of Charman et al. (2000). Thus, this study provided further insight and information regarding the relationship than imitation and language than was previously reported.

Finally, within a subset of children who are at risk for an eventual diagnosis of autism, it was predicted that low imitation skills at 12 months would be associated with lower language abilities in 24 month olds. The literature has demonstrated that children with autism have early deficits in imitation. Further, they display language impairments. Thus, it makes sense that imitation would predict language impairments within children with autism, and several studies have shown this relationship. For example, Charman et al. (2003) found that lower imitation in 20 month olds is associated with lower language abilities in 42 month olds with autism. Stone and Yoder (2001) and Stone, Ousley & Littleford (1997) also found a similar relationship between imitation and language ability in preschool aged children with autism. In the current study, a significant relationship was found between imitation and language within the group of at risk children. These findings are not surprising based on the previous research relating to this hypothesis. While the present study reveals a similar relationship, the sample age is considerably younger. Thus, a better picture of characteristics of autism and its predictors is provided by this study.

Hypothesis 3

Third, it was hypothesized that the display of repetitive behaviors at 12 months would be related to being at risk for an eventual diagnosis of autism. The findings of this study indicated that repetitive behavior at 12 months, as measured by the FYI construct, was significantly related to risk for autism at 24 months based on the M-CHAT. The literature presents conflicting evidence for repetitive behaviors as a predictor of autism. Osterling, Dawson & Munson (2002) noted that children with autism exhibited more repetitive behaviors than typically developing children at one year of age, and Baranek (1999) found that developmentally delayed children displayed more object stereotypy or repetitiveness than typically developing children at one year. In contrast, Werner, Dawson, Osterling & Dinno (2000) found no such differences, and Lord (1995) concluded that repetitive behaviors could not be used as a diagnostic criterion at this young age.

Thus, the present findings support the findings of Osterling, Dawson & Munson (2002), Wetherby et al. (2004), and Baranek (1999) who reported significantly more repetitive behaviors (i.e., body movements or object stereotypy) in children with autism than typically developing children at 12 months of age. The primary difference between this study and previous studies is that rather than relying on retrospective measures, this study was conducted prospectively. Therefore, in addition to supporting the findings that repetitive behaviors are evident in children as young as 12 months, a different methodological design was employed, strengthening these findings.

It was also hypothesized that repetitive behaviors at 12 months would *not* have a relationship with expressive language ability at 24 months. Whereas joint attention and imitation are clearly related to language development, repetitive behaviors can be viewed as

relatively unrelated to the development and acquisition of language. Thus, no clear link would be expected between repetitive behaviors and language. The present findings support this hypothesis: repetitive behavior was not significantly related to expressive language at 24 months. No previous studies have looked directly at this relationship, thus no comparisons can be made.

Finally, it was hypothesized that within a subset of children who are at risk for an eventual diagnosis of autism, repetitive behaviors at 12 months would be related to later expressive language difficulties at 24 months of age due to the overall link between repetitive behavior and autism, and between autism and language. The literature relating to early repetitive behaviors and autism does not directly focus on language as an intermediate variable. However, because some researchers have concluded that repetitive behaviors are present in young children with autism, and because language deficits are a hallmark characteristic of autism, it was hypothesized that a predictive relationship would be found between repetitive behaviors in 12 month olds and later language ability in 24 month olds. The present results did not yield a significant association between repetitive behaviors and language abilities in children at risk for an eventual diagnosis of autism.

Gender Findings

This study also examined gender differences for the relationships between the construct variables and risk for autism and language. Within the entire sample, a significant relationship between joint attention and language as well as imitation and language was found for boys and girls, separately, but not for repetitive behavior and language. These findings are to be expected, as they mirror the overall findings. However, within the subset

of at risk children, the relationship between imitation and language was positive, but not statistically significant, for boys. In contrast, this relationship was significant for girls.

The literature examining the relationship between imitation and language in children with autism do not analyze the findings by gender. Additionally, the studies examining joint attention, imitation, and repetitive behavior in relation to language ability to do not separate their findings based on gender differences. One reason for not presenting gender findings may be because many of these studies contain a small number of female participants, which makes sense given that the ratio of autism in males is substantially larger. Thus, gender differences would be difficult to examine. Despite the lack of previous literature looking at these specific relationships, it is known that boys tend to have less advanced language than girls at 20 months (Fenson et al., 1992). Thus, it is possible that variance in language scores might be influenced by different variables for the two groups.

Limitations

A primary limitation of this study is the reliance on parent report measures rather than direct observation. Parent judgment can differ from parent to parent, whereas a trained clinician may capture a more consistent perspective of the child. Joint attention in particular is a difficult construct to capture through parent report, and it is more accurately assessed through observation. On the other hand, parent report allowed us to amass a notably large sample, and particularly a sample that included a sizable subset of children who are deemed to be at risk for an eventual diagnosis of autism.

Several limitations relate to the measures used for this study. First, the construct definitions were limited to items on the FYI. For example, the joint attention construct consists of 10 items, the imitation construct consists of 6 items, and the repetitive behavior

construct consists of 11 items. While these items are certainly relevant, a set of more exhaustive constructs could have been devised by using or creating another measure. Similarly, the measures used in the study are screening tools for autism and language delays and cannot definitively diagnosis these conditions. These screening tools are limiting in that the results are less conclusive and more speculative based on the current knowledge base of autism in early childhood. However, autism cannot be reliably diagnosed in children as young as 12 months, and thus, screening tools are necessary for current studies. Another limitation related to measures is that the FYI is yet to be standardized, though thus far, it has been shown to be a valid instrument (Watson et al., 2007).

In regards to the procedure, conducting the study through mailings also elicits methodological limitations. Specifically, participants are non-random in that those who returned the questionnaires may be parents with more concerns regarding their child's development. Thus, this study may represent more children with difficulties than expected in the general population. Additionally, parents who cannot read are less likely to return the questionnaires. Finally, only one parent rather than both parents typically completes the questionnaires, which also limits the perspective given for the child.

Future Directions

Broadly speaking, this study provides useful clinical information on the presentation of autism and language delays in early childhood. By identifying characteristics that are present at such a young age in at-risk children, parents and pediatricians can be cognizant of these early signs. Specifically, this study suggests that joint attention, imitation, and repetitive behaviors are behaviors worth noting in the first year of life. Thus, a child with significant deficits in these areas may benefit from a screening for a developmental delay,

which may result in a more comprehensive evaluation. In regard to language, imitation and joint attention skills should be heeded by parents in children as young as 12 months. Having a clearer picture of autism and language delays at a young age can aid in earlier detection. Earlier detection, in return, can lead to earlier intervention, which can often lead to more promising results than intervening later in life. Furthermore, since these variables are likely to be early signs of autism, it may be useful for early interventions to specifically target these areas of deficits. For example, a parent or therapist can work with a child to build their joint attention skills by teaching a child to point. More research could also be conducted to determine the most effective method of targeting these areas of deficit.

This study is also important in serving as a launching pad for future studies. A future study may also investigate the link between other constructs on the FYI and the display of characteristics of autism or language delays. For example, it may be interesting to explore the relationship between sensory issues and later characteristics of autism. It may also be worthwhile to look at the relationship between the language constructs on the FYI and the scores on the CDI.

The present study also provides useful information regarding characteristics of autism at 12 months and 24 months as well as information regarding language at 24 months that can serve as a basis for a more involved longitudinal study. Additional studies may determine what characteristics are evident in children who are later definitively diagnosed with language impairments and autism, providing more powerful results. Furthermore, based on the results, future studies may want to examine the relationship between repetitive behaviors and those children who exhibit characteristics of autism. Specifically, because the results of the study indicated a relationship between repetitive behaviors and autism, and because the

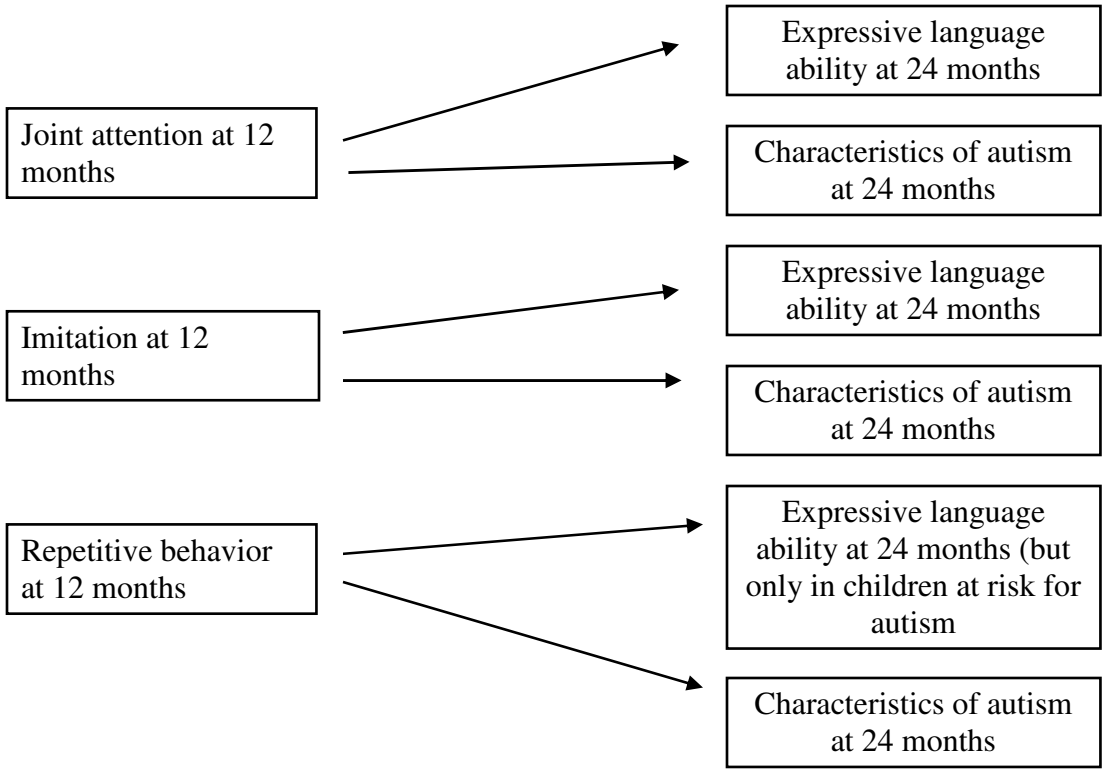
literature is divided between the onset of repetitive behaviors in children with autism as being at one year versus three years, it would be interesting to explore this relationship at three years. Finally, this study may be used to compare the properties of the FYI and M-CHAT as screening measures, which could further validate the FYI. Thus, while this study presently offers important findings, it also provides a large data base that will be useful for future studies.

To conclude, autism spectrum disorders are currently being diagnosed at an early age. It is important to obtain a clear picture of autism so that clinicians, parents, pediatricians, and other child development specialists can detect early signs of this disorder. Similarly, it is important to have knowledge regarding early characteristics associated with language delays. Thus, this study can provide useful information to health care providers and researchers in order to most appropriately treat young children with special needs as well as provide a large data base for future studies.

Table 1. The relation between joint attention, imitation, and repetitive behavior constructs and the other FYI constructs

	Joint attention	Imitation	Repetitive Behavior
SOCIAL COMMUNICATION			
Social Orienting and Receptive Communication	0.69974	0.25103	0.17374
	<.0001	<.0001	<.0001
Social-Affective Engagement	0.66755	0.27866	0.11588
	<.0001	<.0001	<.0001
Imitation	0.31230	1.00000	0.03722
	<.0001		0.2764
Repetitive play	0.57352	0.33066	-0.01065
	<.0001	<.0001	0.7556
REGULATORY			
Sensory Processing	0.08101	0.11391	0.32531
	0.0177	0.0008	<.0001
Regulatory Patterns	0.03288	0.04755	0.04293
	0.3363	0.1643	0.2092
Reactivity	0.06339	0.07711	0.06484
	0.0636	0.0240	0.0578
Repetitive Play	0.10017	0.03722	1.00000
	0.0033	0.2764	

Figure 1. Representation of the primary hypotheses



Appendix 1. The First Year Inventory

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: _____/_____/_____

Baby's birth date: _____/_____/_____

Baby's due date: _____/_____/_____

Baby's Mother
Race/Ethnicity:(check 1 or more)
□ White
□ Black/African-American
□ Hispanic/Latino
□ Asian
□ American-Indian /Alaskan Native
□ Native Hawaiian/PacificIslander
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/PacificIslander
Highest grade completed or degree obtained:_____

The person filling out this form is the (check one): □ Mother □ Father □ Both □ Other (specify): _____

Baby's gender: □ Male □ Female

Birth order: _____ of _____ children born to this mother

Baby's weight at birth: _____

For the following questions, check the ONE BOX that best describes how frequently this behavior occurs—Never, Seldom, Sometimes or 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 2. FYI Items within imitation and repetitive behavior constructs

Imitation Construct (Alpha = .64)

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?
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.
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.
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.

Repetitive Behavior Construct (Alpha = .78)

11. Is your baby content to play alone for an hour or more at a time?
13. Does your baby rock his or her body back and forth over and over?
30. Does your baby get stuck doing a simple activity over and over?
33. Does your baby enjoy staring at a bright light for long periods of time?
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?
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?
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).

Appendix 3. FYI items within the joint attention construct

Joint attention construct (Alpha = .74)

1. Does your baby turn to look at you when you call your baby's name?
10. When you point to something interesting, does your baby turn to look at it?
12. Does your baby look at people when they begin talking, even when they are not talking directly to your baby?
14. Does your baby look up from playing with a favorite toy if you show him or her a different toy?
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 tosses in the air?
29. Does your baby try to get your attention by making sounds and looking at you at the same time?
38. Does your baby communicate with you by using his or her finger to point at objects or pictures?
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.

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