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Communication deficits in babies with autism and Pervasive Developmental Disorder - not otherwise specified (PDD-NOS)

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COMMUNICATION DEFICITS IN BABIES AND INFANTS WITH AUTISM AND PERVASIVE
DEVELOPMENTAL DISORDER – NOT OTHERWISE SPECIFIED (PDD-NOS)

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Abstract

Autism Spectrum Disorders (ASDs) are characterized by pervasive impairments in communication, socialization, and repetitive behaviors or interests. While there is a growing interest in early ASDs, very few studies have looked at the nature of these impairments before age 3. In order to better strengthen early assessment and intervention for ASDs, more knowledge is needed in this area. The current studies aimed to determine if, and in what ways, communication impairments are present in infants and toddlers (17-37 months) diagnosed with autism and Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS). In the first study, infants with autism and PDD-NOS (i.e., the ASD group) were compared to typically developing infants. In the second study, three groups were compared: autism, PDD-NOS, and non-ASD related developmentally delayed. Differences in communication impairments were assessed using the endorsement of communication items found on the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT), Part 1. Differences in overall communication impairments were assessed, as well as differences on specific communication items. Results found that infants with an ASD exhibit greater communication impairments than do typically developing infants, with all items displaying significant differences. Additionally, significant differences were found in overall communication impairments between all three groups in the second study, with the majority of items differentiating between the groups. The implications of these results, as well as directions for future research, are discussed.

Introduction

In recent years, there has been a surge of public interest in Autism Spectrum Disorders (Evans et al., 2001). Autistic Disorder (more commonly referred to simply as autism), is characterized by severe, pervasive deficits in the areas of social skills, communication and repetitive behaviors or restricted interests. Deficits in communication are of great concern for a number of reasons. For example, communication deficits have been found to have an inverse relationship with the frequency of challenging behaviors, such as self-injury (Bott, Farmer, & Rohde, 1997; Mancil, Conroy, Nakao, & Alter, 2006). Of recent increased interest is the early identification and diagnosis of autism and other Autism Spectrum Disorders (ASDs; Matson, Wilkins, & González, 2008c; Werner, Dawson, Osterling, & Dinno, 2000). Although many emphasize the importance of diagnosing the disorder as early as possible, little is known about the manifestation of symptoms before the age of 3 years. As such, there are very few measures that are able to accomplish this (Matson, 2005; Matson et al., 2008d). One measure designed to achieve this goal, the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT), is designed for use with children aged 17-37 months (Matson et al., 2008d). The aim of the current studies is to use this measure to examine the differential endorsement of communication items between babies and infants diagnosed with autism, those diagnosed with Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS), those who do not have an ASD diagnosis but have some developmental delays, and those who are typically developing. Of note, the terms Autistic Disorder and autism will be used synonymously throughout this paper. The history, diagnostic criteria, core features, and assessment of ASD are discussed, followed by a review of current research on PDD-NOS and communication in infants with an ASD.

History

In 1943, Leo Kanner first gave a detailed description of 11 children (eight boys, three girls) who displayed unique symptoms that could not be explained by any known psychiatric disorder. Kanner noted that, though there were individual differences between the children, the similarities between them suggested a common pathology. All of the children described had severe impairments in socialization and communication and required a strict sameness in their routines. In a follow up paper, Kanner (1944) began referring to this common pathology as "early infantile autism."

Kanner (1943) believed that the fundamental problem was an inability for the children to relate to other people, starting at birth. The children preferred to be left alone and often ignored the presence of other individuals. The children would often choose to play with toys or objects rather than interact with Kanner, or other individuals present. For example, one child was described as showing a complete absence of interest in others, preferring instead to play with objects that could be spun. Kanner differentiated these socialization abnormalities from schizophrenia by stating that the observed children never formed meaningful relationships with the outside world, whereas individuals with schizophrenia typically withdraw from previously meaningful relationships.

A second symptom shared by all 11 children was impairment in communication. Three of the 11 children never developed the ability to speak communicatively. The remaining eight children showed severe impairments and peculiarities in their speech. Much of what was spoken by these children was considered spontaneous, meaningless, and irrelevant to those around them. Additionally, many of the children displayed echolalia, which involves exact repetition of previously heard statements, questions, or songs. This echolalia would be displayed in multiple situations. At times, the children would spontaneously mimic something that had been heard in their past. This indicated that the children could hear and remember what was said to them, thus ruling out deafness or total memory impairment as the cause to their deficits. Additionally, in response to a question, the children would answer by mimicking

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the question, thereby failing to appropriately change pronouns. For example, when asked, "Do you want a cookie?" a child would respond, "Do you want a cookie?" to indicate that they did in fact want a cookie. This failure to correctly use pronouns was found in both immediate and spontaneous echolalia.

A final symptom shared by all 11 children was an obsession with sameness in routine. Kanner (1943) stated, "The child's behavior is governed by an anxiously obsessive desire for the maintenance of sameness" (p. 245). Anything that disrupted this routine would cause severe distress for the children. Kanner (1951) differentiated this type of obsession from ordinary adherence to rituals, by stating that the obsessions are specific to sameness in routine and are forced upon others as well. For example, a child would place a block in the same position every time he entered a room and would become distressed if someone else placed the block in a different position. Additionally, behaviors, such as spinning a top, would be carried out in the exact same manner every time (Kanner, 1943). Many of the children also showed a restricted range of interest, tending to let their daily activities be dominated by that interest. For example, when one child became interested in reflecting light from mirrors, he could not be redirected to any other activity.

After Kanner's original description of early infantile autism, there was much confusion as to the nature of the disorder. One such source of confusion was Kanner's decision to term the syndrome "early infantile autism" (Rutter, 1978). The term autism was actually first used by Swiss psychiatrist Eric Bleuler. Bleuler (1913) used the term autistic thinking to refer to thought that is not based in reality, a symptom of schizophrenia. He described autistic thinking as a departure from logic and reality. Kanner (1965), however, used the term to refer a disorder, not a symptom. He believed that Bleuler's use of the word autism "does not quite account for the status of our patients" (p. 412). This is because Bleuler's use implied a withdrawal from logic and reality, whereas Kanner believed that these children never were connected to reality. Rutter (1968) went into further detail about the confusion in terminology. He settled on using the word "autism" to describe the disorder, while using the words "social withdrawal" to refer to the symptom.

Kanner's use of "early infantile autism" also led to confusion of another nature. Since autism had first been used to describe a symptom of schizophrenia, many people believed autism was synonymous with schizophrenia. As early as 1955, it was accepted by many that autism was a unique disorder; however it was still unclear exactly how it differed from childhood schizophrenia (Eisenberg, 1956). Kanner (1943) made early attempts to differentiate autism from schizophrenia, but later noted the need to further understand the differences between the two disorders (Kanner, 1965). Since that time, many differences have been cited in the literature. Differences include sex ratio (male to female ratio higher in autism than in schizophrenia), family history of schizophrenia (much rarer in children with autism), presence of intellectual disability (much more common in children with autism), presence of hallucinations (very rare in children with autism), and the course of the condition (relatively stable in children with autism) (Rutter, 1968, 1972, 1978; Rutter & Bartak, 1971). Rutter (1972) emphasized the importance in classification, as different classifications imply different needs in treatment.

In addition to differentiating autism from schizophrenia, it was necessary to differentiate the disorder from intellectual disability. Kanner (1943) stated that many of the children had once been diagnosed as being feebleminded; however he stated that they all appeared to have very strong cognitive functioning. This was demonstrated by their expansive vocabulary, memory for events in their past and memory of patterns and sequences. Kanner was incorrect in his belief that all children with autism have average or above average intelligence, as autism is often accompanied by intellectual disability (Rutter, 1968, 1978). However, autism can be clearly differentiated from intellectual disability. Firstly, not all children with autism have intellectual disability (Bender, 1959; Rutter, 1968). Secondly, children with autism have specific cognitive impairments that affect language and coding (Rutter, 1978).

The confusion in terminology and symptomology led to overuse of the diagnosis of early infantile autism (Kanner, 1965; Rutter, 1972). Children with widely varying symptoms were given this diagnosis, as it was unclear how it should be applied. The aforementioned attempts at differentiating autism from other disorders helped decrease overusing the diagnosis of autism (Rutter, 1972).

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Additionally, attempts were made to clearly characterize what symptoms defined autism (Kanner, 1965; Rutter, 1968, 1972, 1978; Rutter & Bartak, 1971). Rutter (1978) defined the key features as being abnormality in social relationships, delays in language development and insistence on sameness. These symptoms were consistent with the original impairments noted by Kanner in 1943. Rutter (1978) additionally noted a required onset before 30 months of age. Rutter's definition of autism had a direct impact on the criteria used in the Diagnostic and Statistical Manual, Third Edition (*DSM-III*).

The *DSM-III* was the first of the Diagnostic and Statistical Manuals to include a category of Pervasive Developmental Disorders (PDDs; American Psychiatric Association [APA], 1980). The *DSM-III* used the term "Infantile Autism" as one of a group of disorders known as PDDs. Additional disorders placed under this term included Residual Infantile Autism, Childhood Onset Pervasive Developmental Disorder, Residual Childhood Onset Pervasive Developmental Disorder, and Atypical Autism. The word "pervasive" was used to point to the fact that the disorder affects all areas of the child's life (Tidmarsh & Volkmar, 2003). Recently, researchers and practitioners have begun referring to PDDs as Autism Spectrum Disorders (ASDs), to indicate the fact that these disorders occur across a spectrum (Matson, Wilkins, Boisjoli, & Smith, 2008b; Wing, 1997). The current paper will use the terms PDD and ASD interchangeably. The revised edition of the *DSM-III* changed the term "Infantile Autism" to "Autistic Disorder," and the term "Atypical Autism" to "Not Otherwise Specified" (Tidmarsh & Volkmar, 2003).

Current Diagnostic Criteria

There are currently two classification systems used in the diagnosis of mental health disorders: The *Diagnostic and Statistical Manual, Fourth Edition, Text Revision* (*DSM-IV-TR*; APA, 2000) and *the International Statistical Classification of Diseases and Health Related Problems, 10th edition* (*ICD-10*; World Health Organization [WHO], 1992). As the two systems are very similar in their descriptions and definitions of PDD, and the *DSM-IV-TR* is more commonly cited in the literature, only the *DSM-IV-TR* will be discussed in this paper (Tidmarsh & Volkmar, 2003).

The *DSM-IV-TR* includes a section referred to as Pervasive Developmental Disorders, which is comprised of five distinct disorders. These disorders are Autistic Disorder, Asperger's Disorder, Rett's Disorder, Childhood Disintegrative Disorder, and Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS). All PDDs are characterized by impairments in social skills, communication skills, and the presence of repetitive, stereotyped behaviors and interests (although, as will be discussed below, not all of these symptoms must be present for a PDD diagnosis). Current *DSM-IV-TR* criteria for Autistic Disorder and PDD-NOS, the two disorders relevant to the current study, will be discussed, followed by a detailed description of the core features.

Autistic Disorder. The *DSM-IV-TR* uses the term Autistic Disorder to describe the syndrome first identified by Kanner as "early infantile autism" (APA, 2000). The disorder is also sometimes known as childhood autism, Kanner's autism, or simply referred to as autism. In order to be given a diagnosis of Autistic Disorder, a child must show qualitative impairments in all three core areas. These core areas are social interaction, communication, and restricted or repetitive behavior, interests, and activities. At least two impairments must be found in the area of social interaction, which includes 1) impairments in use of multiple nonverbal behaviors; 2) failure to develop peer relationships; 3) lack of spontaneous seeking to share enjoyment, interests or achievements; and 4) lack of social or emotional reciprocity. At least one impairment must be found in the area of communication, which includes 1) delay in, or lack of, the development of spoken language; 2) impairment in the ability to initiate or sustain a conversation; 3) stereotyped and repetitive or idiosyncratic language; and 4) lack of spontaneous make-believe play or social imitative play. Finally, at least one impairment must be found in the area of restricted/repetitive behaviors, interests and activities, which includes 1) preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal in intensity or focus; 2) inflexible adherence to specific, nonfunctional routines or rituals; 3) stereotyped and repetitive motor mannerisms; and 4) preoccupation with parts of objects. There must be at least six total impairments

from these categories and an onset of symptoms before age 3. Finally, the symptoms cannot be better accounted for by another PDD diagnosis.

Pervasive Developmental Disorder Not Otherwise Specified. The final disorder found under the title of PDD is Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS). Of the PDDs, PDD-NOS is the most common (Buitelaar & Van der Gaag, 1998; Chakrabarti & Fombonne, 2005; Matson & Boisjoli, 2007; Mayes, Volkmar, Hooks, & Cicchetti, 1993). Unlike the other four PDDs, the *DSM-IV-TR* does not have specific rules for diagnosing PDD-NOS (APA, 2000). The *DSM-IV-TR* says a diagnosis of PDD-NOS should be given when there is pervasive impairment in social interaction, along with either impairments in communication skills or the presence of stereotyped behaviors, interests, and activities. Additionally, the symptoms cannot meet the criteria for a specific PDD, Schizophrenia, Schizotypal Personality Disorder, or Avoidant Personality Disorder (APA, 2000, p.84).

Due to the lack of diagnostic clarity, many authors have tried to determine ways in which to more clearly define PDD-NOS. Buitelaar and Van der Gaag (1998) suggested that PDD-NOS be defined as having four of the five required *DSM-IV* criteria for autism, including one of the social interaction criteria. Tidmarsh and Volkmar (2003) used the term to explain a disorder that does not meet all of the criteria for any of the other four ASD. Additionally, other researchers have attempted to further define the disorder (Buitelaar, Van der Gaag, Klin, & Volkmar, 1999; Lord & Risi, 1998; Matson & Boisjoli, 2007).

Core Features

Social Skills. One of the key deficits found in ASDs is a severe impairment in relating to other people. In Kanner's (1943) original paper, he stated that the primary deficit found in all 11 children was an "inability to relate themselves in the ordinary way to people and situations from the beginning of life" (p. 242). Many other researchers have agreed that the impairments in socialization are the primary feature of ASDs (Sevin, Knight, & Braud, 2007; Volkmar, Cohen, Bregman, Hooks, & Stevenson, 1989;

Walters, Barrett, & Feinstein, 1990). The social impairments of children with an ASD are frequently so severe that their parents suspect the child may be deaf (Eveloff, 1960). These impairments in socialization come in a wide variety of forms. Children with an ASD make fewer initiations with their peers than do typically developing children (Hauck, Fein, Waterhouse, & Feinstein, 1995). Although children with an ASD have been shown to make similar quantities of initiations with adults, they are of much poorer quality, being characterized by ritualistic greetings (Hauck et al., 1995). Children with an ASD have also been shown to have difficulties perceiving complex emotions in others (Golan, Baron-Cohen, Hill, & Rutherford, 2007; Travis & Sigman, 1998). In addition, a well-noted impairment found in many children and infants with an ASD is a lack of joint attention (Charman et al., 1997; Naber et al., 2008). Joint attention refers to the ability for a child to coordinate attention with another person in relation to an object or event (Mundy, 2003). Children with autism show deficits in this ability, especially early in life (Charman et al., 1997; Naber et al., 2008). Another deficit found is in the use of eye-to-eye gaze. Children with an ASD typically do not use eye gaze in the socially meaningful fashion often used by typically developing children (Ruffman, Garnham, & Rideout, 2001; Rutter, 1978). Finally, children with an ASD often have marked impairments in the imitation of others (Charman et al., 1997; Smith & Bryson, 1994).

These socialization impairments lead to difficulties for children with an ASD to develop relationships (Travis & Sigman, 1998). Children with an ASD often have trouble cooperatively playing with other children and fail to make meaningful friendships (Rutter, 1978). Increased severity of the disorder has been linked to the formation of less secure attachments (Naber et al., 2007). Although it was once thought that children with an ASD made no attachments whatsoever, that theory has since been discarded (Travis & Sigman, 1998). Children with an ASD show distress upon being separated from caregivers and behave differently towards caregivers than they would strangers (Sigman & Mundy, 1989). These findings, and others, suggest that some form of attachment has been made. Children with

an ASD additionally show improved relationships with adults around the age of 5 years; however difficulties remain in forming relationships with their peers (Travis & Sigman, 1998).

Communication Skills. Although, as noted above, some researchers believe impairments in social skills are the primary feature of ASDs, others believe that communication skills are the primary deficit (Noens & Van Berckelaer-Onnes, 2005; Rutter, 1968; Rutter & Bartak, 1971). Impairments in communication have been found to be the first cause of parental concern that their child might have a disability (DeGiacomo & Fombonne, 1998; Howlin & Moore, 1997). Approximately 33-50% of children with ASD are never able to functionally speak (Noens & Van Berckelaer-Onnes, 2005; Rutter, 1978). Although those who can speak do use communication to express needs, they rarely use communication to socialize (Folstein, 1999). Additionally, their speech is characterized by a number of abnormalities. Echolalia and delayed repetition of stereotyped phrases are very common (Eveloff, 1960; Noens & Van Berckelaer-Onnes, 2005; Rutter, 1978). Immediate echolalia often occurs because a child did not understand what was said; however delayed echolalia can be used as meaningful communication (Folstein, 1999). Perhaps as a result of this echolalia, children with an ASD often fail to correctly use pronouns (Folstein, 1999; Kanner, 1943; Rutter, 1978). Children with an ASD tend to use speech that is less on topic than do children with other developmental disorders (Tager-Flusberg & Anderson, 1992). A review by Noens and van Berckelaer-Onnes (2005) found that the speech of children with ASD is characterized by abnormal quality of voice, inflection, and stress patterns. Findings on the use of syntax have been mixed, suggesting variability within the communication development of children with ASD. Additionally, children with ASD have difficulties using and forming symbols for communicative purposes (Noens & Van Berckelaer-Onnes, 2005).

In addition to verbal difficulties, children with ASD show marked impairment in non-verbal communication. Children with ASD who do not learn to speak also fail to compensate with non-verbal communication tools, such as pointing, eye contact, or facial expression (Howlin, as cited in Noens & Van Berckelaer-Onnes, 2005). Children with autism have been shown to use non-verbal communication

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less often than other developmentally delayed children (Stone, Ousley, Yoder, Hogan, & Hepburn, 1997). When compared to children with other developmental delays, children with autism are less likely to point to a wanted object, show someone else a wanted object, use eye gaze, or combine multiple forms of communication (e.g., point to something, vocalize and use eye gaze) (Stone et al., 1997). Finally, children with ASD are less likely to imitate or mime others (Rutter, 1978).

On top of expressive difficulties, impairments in communication often include receptive difficulties (Luyster, Kadlec, Carter, & Tager-Flusberg, 2008; Noens & Van Berckelaer-Onnes, 2005). Responses to phrases like "There's mommy" are often impaired in children with ASD (Charman, Drew, Baird, & Baird, 2003b). Comprehension of words and phrases are more delayed than word production (although word production also shows delays; Charman et al., 2003b). Children with autism have failed to show the typical preference for their mother's voice over other voices and general noises in an everyday environment (Klin, 1991).

Repetitive Behaviors and Interests. The final symptom characterizing ASDs is some form of stereotyped behavior or interest, sometimes referred to as a stereotypy. As with the other symptoms of ASDs, this can take a variety of forms. The four main types are attachment to objects, preoccupation, resistance to change, and obsessive rituals (Rutter, 1978; Rutter & Bartak, 1971). Even amongst these categories, there is great variability in the manifestation of stereotypies. Such topographies include sensory behaviors (e.g., licking, sniffing, self-injurious behavior), stereotypical movements (e.g., rocking, hand flapping), insistence on sameness, need for rigid routines, complex motor sequences (e.g., collecting and dispersing items), repetitive use of words or phrases, self-restraint, compulsions, tics, and more (Bodfish, Symons, Parker, & Lewis, 2000; Militerni, Bravaccio, Falco, Fico, & Palermo, 2002; Rutter, 1978). Rutter and Bartak (1971) suggested that stereotyped hand and body movements should not be included as diagnostic criteria as they are also often found in individuals with intellectual disability. However, a more recent study showed that while both groups do exhibit such stereotypies, they are more common and more severe in individuals with autism (Bodfish et al., 2000). Stereotypies

can interfere with children's ability to perform known tasks and learn new ones (Morrison & Rosales-Ruiz, 1997). Children who engage in less repetitive behaviors are more likely to engage in play activities (Honey, Leekam, Turner, & McConachie, 2007). Additionally, severity of repetitive behaviors has been found to be a significant predictor of overall severity of autism (Bodfish et al., 2000).

Repetitive behaviors and interests are specific to the child; however they can change over time (Rutter, 1978). Younger children with autism are more likely to have stereotypies that revolve around sensory stimulation, whereas older children tend to engage in more complex motor sequences (Militerni et al., 2002). Intellectual ability can also affect the type of stereotypy engaged in by the child, as children with higher IQ's are more likely to engage in complex motor sequences, rather than sensory stimulation (Militerni et al., 2002; Rutter, 1978).

Prevalence

The issue of prevalence of autism has recently become an issue of great debate. The Center for Disease Control and Prevention (2009), currently estimates prevalence in the United States to be approximately 1 in every 150 children. This number, and those found by other researchers, represents an increase in prevalence (Wing & Potter, 2002). There has been much discussion as to the reasons for this increase. Many people believe that this represents a true increase in the prevalence of the disorders. A plethora of explanations have been given for this rise, such as yeast infections, gluten, environmental pollutants, antibiotics, mercury, and vaccines. However, none of these explanations have been validated by empirical scientific findings (Herbert, Sharp, & Gaudiano, 2002; Wing & Potter, 2002). The explanation that has created the biggest controversy has been the Measles Mumps Rubella (MMR) vaccine. Many people believe that this vaccine directly causes autism. This belief originated from a work by Wakefield et al. (1998), where twelve children with an ASD were examined due to gastrointestinal problems. Wakefield suggested that the MMR vaccine might have caused the gastrointestinal symptoms, which in turn led to the expression of autistic symptoms. Although he explicitly stated that no causal link was proven, this led to a widespread belief that the MMR vaccine

directly causes autism. This view has been popularized by multiple media outlets, causing many parents to be fearful about giving their children the vaccine (Evans et al., 2001). However, multiple empirical studies have found a lack of evidence for a causal link between the MMR vaccine and autism, and it is now generally accepted within the scientific community that there is no such link (Honda, Shimzu, & Rutter, 2005; Smeeth et al., 2004)

Although the aforementioned factors have failed to provide substantiated explanations for the increase in prevalence, recent research has found many factors that may be contributing. Possible reasons for the growth in prevalence include changes in diagnostic criteria, changes in definitions, different methods used in calculating prevalence, and recognition that autism can be associated with intellectual disability (Williams, Mellis, & Peat, 2005; Wing & Potter, 2002). Wing and Potter (2002) additionally cited increased parental awareness and the development of autism specialists as factors affecting the rate. It has also been suggested that girls with autism have been under diagnosed in the past, and correction of this error has contributed to the increase in prevalence (Ouellette-Kuntz et al., 2007). The final possibility is that there has in fact been an increase in the number of people with autism due to causes unknown at this time. However, until the above factors can be controlled for, it will be impossible to know if the actual prevalence has increased, and if so, by how much.

Assessment

Over the years, there have been many attempts to develop measures that could reliably detect ASDs. Rimland (1964, 1971) was one of the first to make such an attempt, with Diagnostic Forms E-1 and E-2. Form E-1 was first included in a book titled *Infantile Autism* and included seventy-six questions on symptoms, speech characteristics, age of onset, and more (Rimland, 1964). The form was intended for children up to age 7; however, after receiving completed questionnaires, Rimland realized that that major changes in behavior were occurring at about 5 1/2 years of age, consequently obscuring the results (Rimland, 1971). Thus Form E-2 was developed including eighty questions on social interaction, speech and motor abilities, illness development, intelligence, and reaction to sensory stimuli

(Rimland, 1971). Information on this form came from birth through age 5 years. The Rimland checklists were also one among the first to obtain information about behaviors typically associated with autism (Lord & Risi, 1998).

The Autism Behavior Checklist (ABC) was developed to better differentiate autism from other disorders characterized by extremely abnormal behaviors (Krug, Arick, & Almond, 1980; Lord & Risi, 1998). The ABC is comprised of 57 questions that collect information in the following symptom areas: sensory; relating; body and object use; language; social (Krug et al., 1980). Items are answered Yes/No and then assigned weights from 1 thru 4, with higher scores indicating greater impairment (Volkmar et al., 1988). The authors of the scale found it to be high in inter-rater reliability, concurrent validity and criterion validity (Krug et al., 1980). However, more recent studies have found the validity and reliability to be somewhat lower, especially in higher functioning individuals (Sevin, Matson, Coe, Fee, & Sevin, 1991; Volkmar et al., 1988). Due to concerns about reliability and validity, it has been suggested that this measure be used as a screening tool, rather than a diagnostic one (Volkmar et al., 1988).

A more widely used scale, the Childhood Autism Rating Scale (CARS), was developed for use in an outpatient treatment program for children with autism and their families (Schopler, Reichler, DeVellis, & Daly, 1980). The authors developed the CARS, because they felt that no other scale, including Rimland's checklists, was adequate for assessing autism (Schopler et al., 1980). One specific objection was a lack of criteria for use with very young children. The following are the 15 scales that comprise the CARS: impairment in human relationships; imitation; inappropriate affect; bizarre use of body movement and persistence of stereotypes; peculiarities in relating to nonhuman objects; resistance to environmental change; peculiarities of visual responsiveness; peculiarities of auditory responsiveness; near receptor responsiveness; anxiety reaction; verbal communication; nonverbal communication; activity level; intellectual functioning; and general impressions. Each item is scored on a scale from 1thru 4, ranging from normal to severely abnormal, respectively. Reliability of the measure is

considered high, with interrater reliability of .71 and an internal consistency of .94 (Schopler et al., 1980). Additionally, when CARS scores were correlated with independent assessment by a psychiatrist or psychologist, a correlation of $r =.80$ was obtained (Schopler et al., 1980). More recently, researchers have suggested that the reliability may be somewhat lower than initially reported (Sevin et al., 1991). One limitation of the CARS is that it was developed before current *DSM-IV-TR* criteria were established; thus, the CARS does not weigh social deficits as the most significant impairment in autism, as shown in current *DSM-IV-TR* criteria (Lord & Risi, 1998).

Another very commonly used scale is the Autism Diagnostic Interview – Revised (ADI-R; Lord, Rutter, & Couteur, 1994). The ADI-R was created as a revision to the Autism Diagnostic Interview (ADI) to incorporate the latest research in diagnosing autism. Revisions included the addition of items that were more specific to autism (as opposed to other conditions, such as mental retardation) and the ability to be administered to children as young as age 3. Additionally, the ADI-R reflects diagnostic criteria found in the *ICD-10* and the *DSM-IV*. The ADI-R is administered as an interview and consists of the following five sections: opening questions; communication; social development and play; repetitive and restricted behaviors; and general behavior problems. Inter-rater reliability of the measure is considered high, ranging from .62 to .89 (Lord et al., 1994). One strength of the ADI-R is its ability to measure severity within specific domains, thus reducing the chances of a diagnosis based on severe deficits in only one or two core areas (Lord & Risi, 1998). Despite attempts to shorten the ADI-R, it remains lengthy and time consuming to administer. An additional weakness is that it relies solely on parent interviews, not requiring the child to be present during administration. Finally, the ADI-R has been shown to have difficulty differentiating between autism, PDD-NOS and Asperger's Disorder (Cox et al., 1999).

In an attempt to address this weakness, the Autism Diagnostic Observation Schedule (ADOS) was created to standardize observations of social behavior, communication, and play in children suspected having an ASD (Lord et al., 2000). The original ADOS was designed for use alongside the

ADI. The measure has gone under multiple revisions, with the current version being the Autism Diagnostic Observation Schedule – Generic (ADOS-G). The ADOS-G is a 30 minute semi-structured assessment of social interaction, communication, play, and imaginative use of materials for individuals suspected of having an ASD. The ADOS-G places individuals in specific situations that are intended to elicit certain social or communicative responses. Items are typically scored from 0 (no evidence of abnormality related to autism) to 2 (definite evidence), with some items including a code of 3 to indicate abnormalities that were severe enough to interfere with observations. The ADOS-G differs from previous versions, in that it contains four modules designed for individuals with varying levels of expressive language. This change was made in an attempt to avoid overdiagnosing autism for children with poor expressive language. The ADOS-G also was created to include standardization for children with PDD-NOS. The ADOS-G is considered to have excellent inter-rater reliability, internal consistency, and test-retest reliability (Lord et al., 2000). Additionally, the ADOS-G is considered valid for discriminating individuals with autism and PDD-NOS from individuals not on the spectrum. However, the ADOS-G is not able to discriminate between autism and PDD-NOS (Lord et al., 2000). One limitation of the ADOS-G is that it is only able to provide a measure of current functioning, rather than address development across life. Additionally, it requires examiners with extensive training and experience (Lord et al, 2000).

More recently, a set of scales has been developed as a means of differentially diagnosing the ASDs. The Autism Spectrum Disorders-Diagnostic for Adults (ASD-DA) was developed to measure autism, PDD-NOS and Asperger's Disorder in adults with intellectual disabilities (Matson et al., 2008b). Thus, the ASD-DA is one of the first scales developed for use with adults with an ASD. Additional strengths include the ability to differentiate between ASDs and valid use with intellectually disabled adults. The test is comprised of 31 items that are scored as 0 (not different, no impairment) or 1 (different, some impairment). The measure has adequate inter-rater (average kappa coefficient = .30) and test-retest reliability (average kappa coefficient =.39) as well as high internal consistency (.94;

Matson, Wilkins, & González, 2007). A variation of this measure is the Autism Spectrum Disorder-Diagnostic for Children (ASD-DC). Similarly to the ASD-DA, the ASD-DC was developed as a means of measuring autism, PDD-NOS, and Asperger's Disorder; it differs in its design for use with children with or without intellectual disabilities (Matson, Gonzalez, Wilkins, & Rivet, 2008a). The ASD-DC includes 40 items that are scored as 0 (not different, no impairment), 1 (somewhat different, mild impairment), or 2 (very different, severe impairment). Initial tests of reliability showed an internal consistency of .99, an inter-rater reliability of .67 and a test-retest reliability of .77 (Matson et al., 2008a). Additionally, according to *DSM-IV* and *ICD-10* guidelines, the measure correctly identified 91.3% of children as either having or not having an ASD. In addition to the previously mentioned strengths of the ASD-DA and the ASD-DC, they both share additional assets. Firstly, both measures are designed to be completed in 10 minutes or less via an interview with a parent or caregiver (Matson et al., 2008a; Matson et al., 2008b). Secondly, the measures are included in a larger battery of assessments that inquire into comorbid psychopathology and challenging behaviors. These batteries are known as the Autism Spectrum Disorders Adult and Child Battery. Similarly to the ADI-R, one weakness of these measures is the sole use of parent or caregiver interviews. Additionally, as these measures are more recently developed, further studies looking at reliability and validity are warranted.

Early Assessment and Intervention

In recent years, there has been a growing interest in early assessment and intervention for children with ASDs. The importance of early assessment and intervention for children with ASDs has been noted. The view that the earlier a child with an ASD can be identified and treated, the better the long term outcome will be has been shared and supported by many researchers (Corsello, 2005; Fenske, Zalenski, Krantz, & McClannahan, 1985; Harris, Handleman, Gordon, Kristoff, & Fuentes, 1991; Smith, 1999). Additionally, it has been stated that early intervention can aid children with ASD in dealing with many of the difficulties encountered due to their disorder (Matson, 2005). Early intervention can increase the scores of children with autism on standardized intelligence tests, as well as on measures of

language development (Harris et al., 1991). This is not to say that early intervention can increase the children's' IQ, rather it can help increase their scores by methods such as increasing compliance. Early intervention is also related to an increased chance of attending public school and continuing to live with one's biological parents (Fenske et al., 1985). While early intervention is a broad term that can refer to many different practices, elements common to most effective interventions can be deduced. Such elements include a highly supportive environment, predictability of routine, having a functional approach to problem behaviors, and the involvement of family (Dawson & Osterling, 1997). A review of studies on early intervention suggested that children would gain the most benefits when the intervention is begun between 24-48 months of age (Rogers, 1996). Despite the encouraging results of early intervention, there are relatively few measures designed to assess ASDs in this age range (Matson, 2005; Matson et al., 2008d).

Studies have suggested that children with an ASD can be differentiated from typically developing children as early as 12 months of age (Adrien et al., 1993; DeGiacomo & Fombonne, 1998; Mitchell et al., 2006; Osterling & Dawson, 1994; Rogers & DiLalla, 1990; Werner & Dawson, 2005). However, most have found that these differences stabilize and become easier to detect closer to 18-24 months of age (Adrien et al., 1993; Mitchell et al., 2006; Osterling & Dawson, 1994; Werner & Dawson, 2005). Additionally, reliable assessment has been shown to be possible as early as 18 months of age (Baron-Cohen, Allen, & Gillberg, 1992). However, others disagree, saying that early screening for autism is not advisable given the current knowledge base (Williams & Brayne, 2006). A review of the existent literature by Matson et al. (2008c) suggested that there is not likely to be a specific cut-off age for early identification. However, they stress that if intensive intervention is to be given early in life, it is imperative that children be correctly diagnosed. Currently, very few measures are capable of doing this before age 3 years (Matson, 2005; Matson et al., 2008d).

One of the few such measures, the CHecklist for Autism in Toddlers (CHAT), was developed as a screening instrument for children aged 18 months who are considered at risk for autism (Baron-Cohen

et al., 2000). The CHAT is composed of two sections: A) Nine questions asked to parents or caregivers, with an emphasis on pretend play and joint attention; and B) Five items completed by the administrator by direct observation. Each item is answered Yes or No. An advantage of the CHAT is its brevity, taking only 10-15 minutes to administer. The limitation of the scale is its use as a screening tool, rather than a diagnostic one. Additionally, sensitivity of the scale is considered below acceptable levels (Allison et al., 2008; Robins, Fein, Barton, & Green, 2001).

Like most of the scales discussed thus far, the CHAT has undergone a number of revisions. The Modified Checklist for Autism in Toddlers (M-CHAT) was designed to have improved sensitivity, compared to the CHAT (Robins et al., 2001). The M-CHAT includes the original nine questions found in Section A of the CHAT, in addition to 21 additional items designed to identify a broader range of children. Additionally, these items are intended to compensate for the removal of direct observations from the CHAT (Section B). Eventually the 30 questions were reduced to 23, as a functional analysis revealed that 8 items were not as discriminating as others (Robins et al., 2001). The age of screening was also changed from ages 18 months to 24 months, in order to detect children who show regression during this time frame. The M-CHAT has good psychometric properties, with internal reliability at .85 (Robins et al., 2001). Additionally, the M-CHAT accurately classified 33 out of 38 children with autism and 1,188 out of 1,196 children who did not have autism in the normative sample (Robins et al., 2001). Furthermore, the M-CHAT was found to be better than the CHAT at detecting autism without generating as many false positives (Robins et al., 2001). The drawback to the M-CHAT, like the CHAT, is its use for screening purposes, rather than diagnosis (Matson et al., 2008d; Robins et al., 2001). Additionally, it does not have the ability to differentiate between the ASDs.

A more recent update to the CHAT is the Quantitative CHecklist for Autism in Toddlers (Q-CHAT; Allison et al., 2008). The purpose of creating the Q-CHAT was to increase the sensitivity of the CHAT. While the Q-CHAT is different from the M-CHAT, many items are similar in wording. Like the M-CHAT, the Q-CHAT removed the observational section, choosing to keep only the parent report. The

Q-CHAT contains 25 items scored on a scale from 0 to 4 (rather than simply Yes/No), with higher scores representing greater impairment. This allows for greater a range of behavior to be detected. Initial test-retest reliability of the measure was found to be .82 (Allison et al., 2008). As this measure is still very new, full reliability and validity studies have not yet been completed. Until further studies have documented the clinical validity of the measure, the authors do not yet recommend its use as a screening instrument. The Q-CHAT shares the limitations of the M-CHAT, in that it too is used for screening purposes and does not differentiate between ASDs (Allison et al., 2008; Matson et al., 2008d)

Another measure designed for the early identification of autism is the Screening Tool for Autism in Two-Year-Olds (STAT; Stone, Coonrod, & Ousley, 2000). The STAT was developed to address some of the shortcomings of the CHAT, such as ability to differentiate autism from other developmental disorders (Stone et al., 2000). The STAT is composed of 12 items administered during the course of a play interaction. The items include two play items, four imitation items, four directing attention items, and two requesting items, each of which is scored as Pass/Fail. Thus, one strength of the STAT is its use of interactive items that allow the administrator to view behaviors first-hand, rather than relying on parental reports. The downsides to this format include the need for extensively trained administrators and the possibility that existing symptoms will not be observed during the 20 minute session. Initial validity studies showed the measure to have a specificity of .86 and a sensitivity of .83 (Stone et al., 2000), while a more recent study, using newly established cutoff scores, placed these numbers at .85 and .92 respectively (Stone, Coonrod, Turner, & Pozdol, 2004). Interobserver reliability for STAT risk category (high risk for autism vs. low risk for autism) was found to be 1.00, while test-retest reliability was .90 (Stone et al., 2004). One advantage of the STAT is that it can be used for a wider range of ages than the various versions of the CHAT (24-35 months as opposed to 18-24 months). Additionally, like many of the other screening instruments previously described, the STAT is relatively quick and easy to administer. However, like all versions of the CHAT, the STAT is designed as a screening device, not a diagnostic tool. Thus it is not appropriate to make a diagnosis based solely on this measure.

Additionally, the STAT was designed specifically to screen for autism. Therefore, at this time, it is not considered a valid or reliable instrument for detecting PDD-NOS or other ASDs. A final downside to this instrument is its use of a Pass/Fail scoring system, as opposed to the scaled scoring found in the Q-CHAT.

In attempt to address some of the shortcomings of the aforementioned measures, the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT) was developed (Matson et al., 2008d). The BISCUIT is an extension of the previously discussed Autism Spectrum Disorders Child Battery. The BISCUIT is designed for use with children aged 17-37 months who are considered "at risk" for developing an ASD due to developmental delay or a medical condition likely to result in a delay. Unlike the instruments previously discussed in this section, the BISCUIT was designed as a diagnostic tool, rather than a screening tool. Similarly to the Autism Spectrum Disorders Child Battery, the BISCUIT Battery is composed of three distinct parts that assess diagnostic criteria, comborbidity, and challenging behaviors, respectively. Of interest for the current discussion is Part 1, the diagnostic section, containing 62 questions. In a similar fashion to the ASD-DC, BISCUIT-Part 1 items are rated by parents on a 3-point Likert-type scale for how their children compare with typically developing children of the same age. A rating of 0 indicates not different and no impairment; a rating of 1 indicates different and mild impairment; and a rating of 2 indicates very different and severe impairment. Initial studies show the internal reliability of the diagnostic measure to be .97 (Matson et al., 2008d). Item content was successfully established for autism and PDD-NOS, although Asperger's Disorder fell out of the measure. The authors suggested that this was consistent with current research on the age of diagnosis of Asperger's Disorder. Initial findings suggest that the BISCUIT is capable of differentially diagnosing autism from PDD-NOS, although further research is needed to validate this (Matson et al., 2008d; Matson et al., 2009). When differentiating those without a diagnosis versus those with PDD-NOS, an initial study of validity found sensitivity and specificity of the measure to be .847 and .864, respectively (Matson et al., 2009). When differentiating PDD-NOS from autism, sensitivity and specificity were .844

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and .833 respectively (Matson et al., 2009). Additionally, the BISCUIT-Part 1 was found to have an overall correct classification rate of .888 (Matson et al., 2009). If valid differentiation between autism and PDD-NOS is confirmed by future studies, it would represent a major strength of the BISCUIT-Part 1, compared to other measures. An additional strength is its reliability as a diagnostic tool rather than a screening tool. Further strengths include brevity and ease of administration, as well as use of scaled scoring (rather than Pass/Fail or Yes/No). One weakness of the measure is its sole use of parental reports, rather than observations or interactions.

Pervasive Developmental Disorder Not Otherwise Specified

The term Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS) first appeared as a diagnosis in the *DSM-III-Revised*, replacing the previous diagnosis of "atypical autism" (APA, 1987). As mentioned previously, the current classification system, the *DSM-IV-TR*, does not give explicit criteria for diagnosing PDD-NOS (APA, 2000). Because of the ambiguity presented by the *DSM-IV-TR*, there is still no consensus on how to define PDD-NOS (Buitelaar & Van der Gaag, 1998; Buitelaar et al., 1999; Matson & Boisjoli, 2007; Tidmarsh & Volkmar, 2003). Rather than defining what PDD-NOS is, it is more often defined by what it is not (Matson & Boisjoli, 2007; Tidmarsh & Volkmar, 2003). As such, there are currently very few measures that can reliably and validly diagnose PDD-NOS (Matson & Boisjoli, 2007; Matson et al., 2008a; Mayes et al., 1993). Buitelaar and Van der Gaag (1998) suggested four situations that might call for a diagnosis of PDD-NOS: 1) Age of onset before three; 2) Presence of atypical symptoms that do not fit with *DSM-IV* or *ICD-10* criteria; 3) A presentation that just misses the threshold for autism, having less than the 6 symptoms required for a diagnosis of autism; 4) Failing to meet the pattern of criteria for autism (e.g., having no communication symptoms). Although it is difficult to give a clear definition of PDD-NOS, it is clear that individuals who have been diagnosed with PDD-NOS do differ from those with autism. Differences have been found in many areas, such as degree of socialization, language acquisition and daily living skills (Mayes et al., 1993; Walker et al., 2004). Studies that have attempted to uncover these differences will be discussed next.

A study by Buitelaar et al (1999) explored the boundaries of PDD-NOS by looking at *DSM-IV* diagnostic criteria. The study used data from the *DSM-IV* autistic disorder field trial to compare PDD-NOS to autism and to non-ASD disorders (e.g. Attention Deficit Hyperactivity Disorder [ADHD]). The authors compared the disorders by looking the at the *DSM-IV* criteria endorsed for each group. In subjects with "true" autism (defined as having a clinical diagnosis of autism and meeting *DSM-IV/ICD-10* criteria for autistic disorder), all symptoms of autistic disorder occurred with high frequency. Each of the social interaction symptoms were present in approximately 90% or more of the cases,

communication symptoms in approximately 70% or more of the cases, and activities and interests

domains in approximately 60% or more of the cases. Conversely, in PDD-NOS, only 3 symptoms

appeared in at least 60% of cases: lack of reciprocity, failure to develop peer relationships, and

impairment in conversation. Items in the activities and interests domain were rarely endorsed in PDD-

NOS. Stereotyped motor mannerisms were the most commonly endorsed items in this domain,

appearing in only 24% of cases. Overall, all criteria had greater sensitivity in respect to autism than in

respect to PDD-NOS. The criteria that showed the greatest differences in sensitivity were restricted

patterns of interest, lack of varied make-believe play, failure to use nonverbal behavior, and age of onset

criteria. While 100% of the cases of autism had an onset of symptoms before age 3, this was only true in

80% of the cases of PDD-NOS.

Taken as a whole, this study demonstrated a number of ways to differentiate PDD-NOS from

autism, using diagnostic criteria. Most individuals with PDD-NOS have some, but not all, of the

symptoms found in autism. The authors state that these results suggest that PDD-NOS is "basically a

lesser variant of autism with impairments in social interaction as a key characteristic" (Buitelaar et al.,

1999, p. 41).

Pearson et al (2006) compared differences in behavioral and emotional comorbidity in 26

children and adolescents with autism and 25 with PDD-NOS (Pearson et al., 2006). The researchers

compared scores between the groups on the Personality Inventory for Children-Revised (PIC-R), a

parent rating scale that assesses internalizing and externalizing behaviors. When compared with children

with PDD-NOS, the study found that children with autism had greater endorsements for depression,

social withdrawal, atypical behaviors, and social skills problems. On the other hand, children with PDD-

NOS had higher endorsements for family problems. These significant differences came about even

though these scales were often clinically elevated for both groups. So while both groups demonstrate

symptoms in these areas, the severities of symptoms differ between groups. This is consistent with the

notion of PDD-NOS as a less severe form of autism. Further findings from this study showed that over

half of children in both groups showed clinically significant depression. Additionally, over one-third of children in the autism group and one half of children in the PDD-NOS group had clinically significant levels of anxiety.

Mayes et al (1993) aimed to uncover specific clinical features that could be used to discriminate PDD-NOS from autism and other language disorders (Mayes et al., 1993). The authors compiled a list of 80 items from the *DSM-III-R, ICD-10* Draft Research Criteria for childhood autism, the Autism Behavior Checklist, and the Vineland Adaptive Behavior Skills (VABS). Specific items were chosen based on their clinical relevance to the following areas: social problems; communication problems; deviant responses to the environmental; affective symptoms; movement problems; and thought problems. Initial findings by the researchers showed that of the original 80 items, 24 showed reasonable interrater reliability and the ability to discriminate PDD-NOS from the other diagnostic groups (Mayes et al., 1993). The mean age of the children used in each initial group ranged from 6.5-6.9. These 24 items were then administered to a replication sample, including 40 cases per diagnostic group. Average scores for the children with PDD-NOS fell between those of the autism and language disorder groups. Many of the items that distinguished PDD-NOS from autism involved degree of socialization and relatedness, with the PDD-NOS group showing less severe impairments in these areas. Specific discriminating items included choosing solitary activities, abnormal comfort seeking, and lack of social usage of communication. On the other hand, the PDD-NOS group showed more severe impairments in relatedness and need for routines than did the language disorder group. Specific discriminating items included resistance to change, need to maintain sameness, and impaired social relatedness. Finally, the scale for differentiating PDD-NOS from language disorders was more robust than the scale for differentiating PDD-NOS from autism. Thus, more items reliably discriminated PDD-NOS from language disorders than from autism.

In one of the few studies to look at younger children, Charman et al (2003a) conducted a longitudinal study showed that at 42 months of age, children with PDD-NOS had higher receptive and

expressive language scores than did children with autism. The study looked at 18 children who had been identified at 18 months as being at high risk for autism, using the CHAT. A comprehensive assessment at 42 months diagnosed 9 of these children with autism and 9 with PDD-NOS. In the initial session, conducted at age 20 months, all 18 children were assessed on experimental measures of joint attention, play, goal detection, and imitation. Additionally, language skills and nonverbal-IQ estimates were tested during this session. Non-verbal ability and an estimate of non-verbal IQ were measured using specific scales on the Griffith Scale of Infant Development. Additionally, receptive and expressive language abilities were measured using the Reynell Developmental Language Scales. The authors noted that one limitation of this scale was a floor effect when administered at 20 months (Charman et al., 2003a). The children were then seen again at age 42 months, and re-administered the measures of language and IQ.

Results of the study by Charman et al (2003a) showed that, at age 20 months, the PDD-NOS group demonstrated significantly more use of joint attention than the autism group. A non-significant difference was found with respect to play, with the PDD-NOS group somewhat outperforming the autistic group. No differences were found between the two groups with respect to goal detection or imitation. In addition, at age 20 months, increased use of joint attention and imitation was significantly associated with high levels of receptive, but not expressive, language. When reassessed at 42 months of age, participants with a PDD-NOS diagnosis had stronger receptive and expressive language than did those with an autism diagnosis. Due to the aforementioned floor effects, it was not possible to make any similar conclusion at age 20 months. Despite the limitations of this study, it nevertheless provides further insights into differences in communication between young children with autism and those with PDD-NOS.

As a whole, these researchers have showed shown a number of ways to differentiate PDD-NOS from autism and other disorders. Reliable differences have been found in endorsed *DSM-IV* diagnostic criteria, behavioral and emotional comorbidity, degree of socialization, expressive and receptive language and more. While these studies have uncovered important differences, there is still quite a bit of

work to be done. As mentioned previously, there is still no clear definition for PDD-NOS and few

measures are designed to diagnose it (Buitelaar & Van der Gaag, 1998; Buitelaar et al., 1999; Matson &

Boisjoli, 2007; Matson et al., 2008a; Mayes et al., 1993; Tidmarsh & Volkmar, 2003). In order for these

problems to be resolved, further research needs to be conducted in the area.

Infant and Toddler Communication

Impairments in communication are one of the three core impairments found in ASDs. While impaired social skills are currently considered the primary deficit in ASDs, the importance of communication deficits has been stressed by researchers (Noens & Van Berckelaer-Onnes, 2005; Rutter, 1968; Rutter & Bartak, 1971; Sevin et al., 2007; Volkmar et al., 1989; Walters et al., 1990). Parental concerns about possible communication problems often arise very early in a child's life. Parental reports show that delays in language development are often the first sign that a child may have a developmental disorder, with concerns arising on average around 18 months of age (Howlin & Moore, 1997). Others researchers have reported similar numbers, while additionally reporting that approximately 30% of parents recognize abnormal development by age 12 months and 80% by age 24 months (DeGiacomo & Fombonne, 1998; Rogers & DiLalla, 1990). Furthermore, Mitchell et al. (2006) suggested that communication deficits in children with an ASD could be detected as early as 12 months of age. To better understand the communication deficits that exist in individuals with an ASD, it is necessary to understand their communication development in this age range and how it compares to that of typically developing children. A brief discussion will be given on the early development of communication skills in typically developing children and how this compares to those of infants with an ASD.

Typically developing children begin communicating very early in life. A review and subsequent studies by Carpenter, Nagell, Tomasello, Butterworth, and Moore (1998) found that infants show signs of social communication from the first hours of life, quickly learning to engage in more complex behaviors. At around the age of 1 year, infants begin using joint attention, a term that refers to the ability for a child to coordinate attention with another person in relation to an object or event (Carpenter et al., 1998; Mundy, 2003). Joint attention involves a triangle between the child, an adult, and some third object or person to which they share attention (Carpenter et al., 1998). It involves using adults as social reference points, the use of communicative gestures, and helps lead to the growth of verbal communication (Carpenter et al., 1998). The ability to engage in joint attention may arise as early as 9

months of age, but it is not regularly used by typically developing infants until about age 12 to15 months. Infants mimic the behavior of parents from birth, but do not truly begin learning through imitation until about 9 to14 months of age. The ability to understand the meaning of words usually comes towards the end of the first year (Tager-Flusberg, Paul, & Lord, 2005). The first emergence of communicative gestures and vocalizations arrives at about age 10 months, with first words coming around 12 to13 months (Carpenter et al., 1998). In the few months that follow, children begin using these words in reference to another object.

By 18 months of age, the average typically developing child can understand up to 300 words and express approximately 100 words (Tager-Flusberg et al., 2005). This is also the age at which simple sentences are first formed. By age 24 months, the receptive vocabulary includes approximately 900 words, while the expressive vocabulary has increased to approximately 300 words. By 36 months of age, typically developing children have firmly established language skills, with an expressive vocabulary of about 900 words. It has been hypothesized that the development of formal language is closely tied to the emergence of autobiographical memory, which does not form until children are between 4 and 5 years old (Nelson & Fivush, 2004). Nelson and Fivush (2004) explain that language provides a means by which autobiographical information can be expressed, provides skills necessary for organizing and evaluating autobiographical events, and increases children's awareness that memories represent previous events. Children are unable to form memories of past events without language skills that allow them to understand temporal concepts. This may explain why most people have no explicit memories from the first 3-4 years of their lives, a phenomenon often known as childhood or infantile amnesia (Nelson & Fivush, 2004). Thus the development of language and communication skills serves many functions.

The development of communication skills in children with ASDs does not typically follow this course. As mentioned previously approximately 33-50% of children with ASD never are able to functionally speak (Noens & Van Berckelaer-Onnes, 2005; Rutter, 1978). In those who do learn to speak, delays in language acquisition are common. Unfortunately, there is little research on the nature of

these delays, as diagnoses are not typically given until children are 3 to 4 years old (DeGiacomo & Fombonne, 1998; Matson, 2005; Tager-Flusberg et al., 2005). However, as interest in early assessment and intervention has grown, researchers have begun to shed light on this issue; some of these findings will be discussed here.

In one such study, Osterling and Dawson (1994) compared infants with an ASD to typically developing children by looking at home videotapes of 1st year birthday parties. A coding system was developed to record social behaviors (e.g., looking at other's faces, seeking adult contact, imitating behaviors, etc.), joint attention behaviors (e.g., pointing, showing an object to another, alternating gaze between an object and person, etc.), communicative behaviors (e.g., babbling, saying words, using gestures, etc.), and specific autistic behaviors (e.g., self stimulatory behaviors, covering ears, failing to orient to name, etc.). The ASD group displayed significantly fewer social behaviors and use of joint attention behaviors, while displaying significantly more autistic symptoms. Specific behaviors that had significant differences included orienting to name, showing objects to adults, pointing, and looking others in the face. No significant difference was found between the two groups on communicative behaviors. Osterling and Dawson found that 12 months is too early an age to detect significant differences in the communication abilities researched in this study. On the other hand, certain differences can be found between children with an ASD and typically developing children as early as 12 months, in areas such as social behaviors and joint attention (Osterling & Dawson, 1994). Additionally, joint attention is considered by some to fit under both social and communication domains and to serve as a precursor to the acquisition of language skills (Carpenter et al., 1998; Luyster et al., 2008; Osterling & Dawson, 1994). Thus, while specific communication differences were not found at this age, differences related to communication were observed.

While Osterling and Dawson (1994) did not find significant communication differences at 12 months, others have found such differences. Adrien et al. (1993) retroactively looked at home videotapes of 12 children with autism and compared them to those of 12 typically developing children.

The films were taken as early as the first 2 weeks of life, up until the age of 2 years. Behaviors were observed and recorded in the categories of socialization, communication, adaption to environment, tact-tonus-motility, emotional and instinctual reactions, attention, and perception, with note being given to how frequently and intensely they occurred before and after 12 months. Results showed that before 12 months, five behaviors significantly differentiated the autistic group from the control group, two of which resided within the communication domain: lack of a social smile and lack of appropriate facial expressions. After 12 months, additional differentiating symptoms were found in addition to a greater intensity of symptoms. The one additional communication item found was a lack of appropriate gestures and/or expressive postures. Based on these results, Adrien et al. (1993) suggest that infants with autism display significant communication impairments in the first year of life, with more symptoms and severity arising from ages 12 to 24 months.

A study by Mitchell et al. (2006) prospectively took data at 12 months on 97 infants who had an older sibling with an ASD diagnosis. Of these 97 infants, 15 were later given an ASD diagnosis, while the remaining 82 were not. The three groups included in this study were ASD siblings, non-ASD siblings, and a group of 49 low-risk controls. At age 12 months, infants in the ASD sibling group were reported to understand significantly fewer phrases and to produce significantly fewer gestures than both comparison groups. The infants' ability to understand phrases was measured by the appropriateness of responses within a social context, thus tapping into both the communication and socialization domains. The infants with ASD had particular difficulties in their ability to respond to parent-initiated social directives (e.g., "Give it to Mommy"). Impairments in the use of gestures included behaviors such as pointing, giving, shaking/nodding the head, symbolic gestures, and effective use of real objects (e.g., eat with a spoon). No significant differences were found between the three groups for vocabulary comprehension or production at age 12 months. At 18 months of age, the infants with ASD differed significantly from both comparison groups on all variables (Phrase Comprehension, Vocabulary Comprehension, Vocabulary Production, Early Gestures and Late Gestures). Therefore, the findings by

Mitchell et al. (2006) suggest the possibility that impairments in communication skills can be found in infants with autism as early as 12 months of age, with further impairments appearing by 18 months.

In a similar study, Werner and Dawson (2005) were able to find significant impairments in the communication skills of infants later diagnosed with ASD. This study looked retroactively at home videotapes of three groups of children: 1) children with ASD whose parents reported a regression in social/communication skills within the first 3 years (i.e., regressed infants); 2) children with ASD who had impairments before age 1 and did not show regression (i.e., early-onset infants); and 3) typically developing children. While the aim of the study was to better understand the phenomenon of autistic regression, it nevertheless helped to shed light on the communication skills of infants who showed autistic symptoms prior to 12 months of age. Videotapes of the children at ages 12 and 24 months were observed and coded for the presence of behaviors, such as babbling, use of joint attention, eye gaze, etc. At 12 months of age, the early-onset infants used significantly less complex babbling and words than did the regressed infants, with the typical developing infants falling in between the other groups. Early-onset infants were also significantly less likely to use declarative pointing (a form of joint attention). No differences were found in gaze or orienting to name. At age 24 months, both ASD groups used significantly fewer words and word-like vocalizations than the typical developing infants. Additionally, both ASD groups were significantly less likely to use declarative pointing, look at other people, and orient to their name. Werner and Dawson (2005) demonstrate that, at least in early-onset autism, impairments in communication can be detected at 12 months of age. However, similarly to the study by Mitchell et al (2006), these impairments are more pronounced and easier to detect later in life (24 months in this study).

A number of researchers have demonstrated that impairments in communication skills can be found by 36 months of age in toddlers with autism, as this is the age at which diagnoses are typically first given (Charman et al., 2003b; DeGiacomo & Fombonne, 1998; Luyster et al., 2008; Matson, 2005; Tager-Flusberg et al., 2005; Stone et al., 1997). By this age, children with autism show marked delays in

their development of both expressive and receptive vocabularies (Charman et al., 2003b; Luyster et al., 2008). The degree of delay can vary greatly, depending on factors such as cognitive ability (Luyster et al., 2008). A study by Charman et al. (2003b) found that many of the receptive skills found in typically developing infants before age 1 year are often absent in children with autism at age 3 years. For example, children with autism were impaired in their response to phrases like "there's mommy and daddy." Additional delays were found in word production, word comprehension, and phrase comprehension. The study also found that the pattern of emergence of language skills in the autism group did not always follow that of typically developing children. For example, based on their level of word comprehension, children in the autism group were able to produce more words than would be expected by the typical pattern of development. However the authors also pointed to the amount of variability within the sample, noting that some of the children in the autism group had language skills and acquisition patterns comparable to typically developing children.

Stone et al. (1997) found that young children with autism will use significantly less nonverbal gestures and other forms of communication, when compared to developmentally delayed children who do not have autism. Fourteen children with an average age of 32 months showed marked differences in their communication strategies when compared to developmentally delayed controls. The autism group used fewer gestures, made less use of eye gaze, and used fewer complex acts requiring a combination of gestures or a combination of gestures and eye gaze. Additionally, the children with autism were less likely to make requests or direct the examiner's attention to an object. Finally, while 33% of the communicative acts of the developmentally delayed group involved commenting, this was true for less than 1% of the communicative acts of the autistic group.

In summary, with the increased interest in early assessment and intervention in ASD, there has been an increase in the number of studies looking at the skills of infants and toddlers later diagnosed with ASD. While there still is a paucity of information available on this subject, these studies have begun to show the communicative abilities of infants and toddlers later diagnosed with ASD.

Impairments can be found as early as 12 months of age in areas such as use of gestures, comprehension of phrases, use of joint attention, use of a social smile, appropriate facial expressions, and babbling (Adrien et al., 1993; Mitchell et al., 2006; Werner & Dawson, 2005). However, these impairments have not been found consistently at 12 months of age by all researchers (Osterling & Dawson, 1994). By age 18 and 24 months, further impairments have been detected, such as vocabulary comprehension, vocabulary production, use of words, and orientation to name (Adrien et al., 1993; Mitchell et al., 2006; Werner & Dawson, 2005). By age 36 months, broader impairments are detectable, such as use of gestures, eye gaze, expressive and receptive abilities, commenting, and pattern of language development (Charman et al., 2003b; Luyster et al., 2008; Stone et al., 1997). Thus, while impairments can sometimes be detectable by 12 months, it appears that 18 months is approximately the age when these impairments can be found with some regularity. Thus, the ages of approximately 18 through 36 months appear to be the most promising for early detection of communication impairments in infants and toddlers with autism.

One problem with these findings revolves around a crucial methodological issue found in the majority of these studies. For the age ranges of 0 to 24 months, researchers generally utilize either retrospective or prospective data. This is due to the dearth of assessment measures designed for such a young age. Because autism and PDD-NOS diagnoses are not typically given until ages 3 to 4 years, researchers either needed to look back at old home videotapes or to collect data before a diagnosis was ever given. While these strategies provide tremendous insight, it would be preferable to collect data on children who already have a diagnosis of autism or PDD-NOS. As new scales have been developed and researchers and practitioners have become more aware of symptoms before age 3 years, this has become a more viable option.

Purpose

There is a growing consensus that early intervention can greatly aid children diagnosed with ASD (Corsello, 2005; Dawson & Osterling, 1997; Fenske et al., 1985; Harris et al., 1991; Matson, 2005; Rogers, 1996; Smith, 1999). This increased interest in early intervention has necessarily brought about an increased interest in early assessment, as identification of a disorder must occur before treatment can be given. Due to the fact that the age of diagnosis for ASD is typically 3 to 4 years, little is known about the nature of the core deficits (social skills, communication and repetitive interests/behaviors) before this age (DeGiacomo & Fombonne, 1998; Matson, 2005; Tager-Flusberg et al., 2005). To date, few researchers have attempted to detect communication impairments, one of the core deficits, in infants and toddlers (17-37 months) with autism and PDD-NOS. While a handful of researchers have been able to find such deficits, they have mostly relied on the retroactive use of home videotapes. The rationale behind the current studies was to detect these impairments with a newly developed, objective measure designed as a diagnostic tool for this population. The communication factor of the Baby and Infant Screen for Children with aUtIsm Traits - Part 1 (BISCUIT-Part 1) was used to assess the presence of communication impairments in children with diagnoses of autism, PDD-NOS, and non-ASD related developmental delay, as well as in typically developing infants. These diagnoses were given by a licensed doctoral level psychologist with over 30 years of experience in the field of developmental disabilities (Matson, Boisjoli, Hess, & Wilkins, in press-a).

Two studies were conducted assess the presence of communication impairments in children with diagnoses of autism, PDD-NOS, and non-ASD related developmental delay, in addition to typically developing infants. In Study 1, two groups were compared in this study: the ASD group and the typically developing group. A minimum sample size of 20 per group was employed as recommended by Tabachnick & Fidell (1996). Additionally, post-hoc tests confirmed that sufficient power was achieved. Before running the main analysis, a Kolmogrov-Smirnov test of normality showed that the ASD sample was not normally distributed on overall communication impairments, $D(20)=.27$, $p<.001$, while the

34

typically developing sample was also not normally distributed, $D(20)=.50$, $p<.001$; however, based on

the sufficient sample size and a visual inspection of the distributions, parametric statistics were used

(Field, 2005; Tabachnick & Fidell, 1996). Additionally, non-parametric statistics were run on the main

analysis to replicate and confirm the results of the parametric tests. A two-sample, one-way independent

t-test was run to test group differences on overall scores on the communication subscale of the

BISCUIT-Part 1. Group membership served as the independent variable and overall scores on the

communication subscale of the BISCUIT-Part 1 served as the dependent variable.

To further explore where possible differences lay, a multivariate analysis of variance

(MANOVA) was conducted to test the individual communication items, with each of the 6 items serving

as a dependent variable. These items corresponded to item numbers 1 (communication skills), 5 (verbal

communication), 9 (use of language to communicate), 16 (use of language in conversation with others),

24(communicates effectively), and 50 (language development) on the BISCUIT-Part 1. Once again,

group membership (i.e., ASD or typically developing) served as the independent variable for this

analysis. The Pillai-Bartlett test statistic was used, as it is thought to be the most robust to violations of

assumptions, when sample sizes are equal (Olson, 1976). A significant MANOVA was followed by

individual between-subjects Analyses of Variance (ANOVAs) to determine on which items group

differences existed. Bonferroni correctional procedures were used to prevent the inflation of type-I

errors (Field, 2005). Thus $\alpha=.008$ was used for follow-up ANOVAs.

The groups used in this study were selected so that the communication impairments in the ASD

population could be compared to a control group (i.e., the typically developing group). This information

could help parents, practitioners, and researchers know whether the communication skills of infants with

an ASD are significantly different than those of typically developing infants. If significant, this

information could aid in early detection, assessment, and intervention

In Study 2, three groups were compared: autism, PDD-NOS, and non-ASD related

developmentally delayed. Again, a minimum sample size of 20 per group was used and post-hoc power

analyses confirmed that sufficient power was achieved (Tabachnick & Fidell, 1996). Before running the main analysis, a Kolmogrov-Smirnov test of normality showed that the autism sample was not normally distributed on overall communication impairments, $D(220)=.31$, $p<.001$, the PDD-NOS sample was not normally distributed, $D(220)=.22$, $p<.001$, and the non-ASD related, developmentally delayed sample was not normally distributed, $D(220)=.16$, $p<.001$; however, based on the large sample size and a visual inspection of the distributions, parametric statistics were used (Field, 2005; Tabachnick & Fidell, 1996). Again, non-parametric statistics were run on the primary analysis to replicate and confirm the results. Equal sample sizes were used to satisfy the assumption of homogeneity of variance. A one-way between subjects ANOVA was run to test group differences on overall scores on the communication subscale of the BISCUIT-Part 1. Group membership served as the independent variable and overall scores on the communication subscale of the BISUIT-Part 1 served as the dependent variable. A significant ANOVA was followed up with a Bonferroni post hoc test to determine where group differences lay.

As in Study 1, a MANOVA was conducted to test the individual communication items, with each of the 6 items serving as a dependent variable. Group membership served as the independent variable for this analysis. The Pillai-Bartlett test statistic was again used, due to its robustness to violations of assumptions, in the presence of equal sample sizes (Olson, 1976). A significant MANOVA was followed by individual ANOVAs to determine if there were group differences for each item. Bonferroni correctional procedures were used to prevent the inflation of type-I errors (Field, 2005). Again, $\alpha=.008$ was used for follow-up ANOVAs. Bonferroni post hoc tests were then conducted to identify the group differences for any significant ANOVA.

These groups were chosen for comparison, as communication impairments are common among all three groups; however, only autism actually requires communication impairments for a diagnosis. Comparing these groups could give a further break down of communication impairments in infants aged 17-37 months and give information as to how the manifestation of these impairments differs between

diagnoses. This may aid in achieving more accurate and appropriate early detection, assessment, and intervention for each group.

While the two studies compare different groups, they are very related and are included together for a few reasons. Both studies look to answer the basic question of whether communication impairments can be readily identified in infants with ASD and differentiated within ASD and from other populations. The first study exists to provide a control group that comes from an entirely different population (i.e., no developmental delay). The second study then builds upon the first, by making comparisons within the population of developmental delays and breaking down ASD into autism and PDD-NOS. Additionally, the second study employs a much larger sample size, something rarely found in the literature with this population. Therefore, the two studies work hand in hand to test whether the communication impairments found in infants with autism and PDD-NOS differ from one another and from other populations (i.e., non-ASD relate developmentally delayed and typically developing).

Based on the existing literature, predictions were made as to the outcome of the current studies. Communication deficits are one of the defining characteristics of autism, and may be a defining criterion of PDD-NOS, according to *DSM-IV-TR* criteria (APA, 2000). Additionally, parents of children with autism have rated communication deficits as their first sign that something was not quite right (DeGiacomo & Fombonne, 1998). In Study 1, it was predicted that the ASD group would have significantly more communication impairments than would the non-ASD group. In Study 2, it was expected that there would be significant differences based on group membership. Specifically, based on the aforementioned information, it was expected that the infants with a diagnosis of autism would have significantly more communication impairments endorsed than children with non-ASD related developmental delays. Additionally, it was expected that the infants with a diagnosis of autism would have significantly more communication impairments endorsed than those diagnosed with PDD-NOS. Firstly, communication impairments are a required diagnostic criteria for autism, whereas they are a possible diagnostic criteria for PDD-NOS, according to the *DSM-IV-TR* (APA, 2000). Secondly,

Charman et al. (2003) showed that communication impairments are endorsed significantly more in children with autism at 42 months of age when compared with children with PDD-NOS of the same age. It was expected that similar results would be found with the age range of the current study. Finally, it was not anticipated that the PDD-NOS and non-ASD related developmentally delayed groups would differ significantly in communication impairments. The primary reason for referral into the EarlySteps program was due to speech delays. Thus, both of these groups were characterized by the possibility of communication delays and impairments. However, unlike the autism group, this was not a necessity in either of these groups.

<center>**Methods**</center>

Participants

In Study 1, a total of 20 children with no history of developmental delays were recruited and served as the typically developing condition. Previous research has suggested that there should be at least 20 participants per cell for research of this manner, which was satisfied by the current samples (Tabachnick & Fidell, 1996). These children ranged in age from 18-34 months (M=25.55; SD = 5.15). BISCUIT scores were collected from a total of 451 children diagnosed with either autism or PDD-NOS. From this sample, a random sample of 20 children was selected to serve as the ASD condition. This sample included 8 children diagnosed with autism and 12 diagnosed with PDD-NOS and was selected using the random select cases function in SPSS. These children ranged in age from 18-36 months (M=26.00; SD= 5.52). *A priori* chi-square analyses showed that the groups did not differ significantly in gender, $\chi^2(1) =$ .13, p=.72 or in ethnicity, $\chi^2(3) = 6.96$, p=.07. Although non-significant ethnicity differences did exist, it is not believed that these would significantly affect the results. An *a priori* independent t-test showed that the groups did not differ significantly in age, $t(38) = .27$, p=.79. Table 1 below summarizes this demographic information.

Table 1
Demographic Characteristics for Study 1

	Diagnostic Group	
Demographic Characteristics	ASD (n=20)	Typically Developing (n=20)
Age (in months)		
Mean (SD)	26.00 (5.52)	25.55 (5.15)
Range	18-36	18-34
Gender, %		
Male	70%	75%
Female	30%	25%
Race/Ethnicity, %		
Caucasian	45%	80%
African-American	30%	15%
Hispanic	20%	5%
Other	5%	0%

<center>39</center>

In Study 2, the sample of children diagnosed with PDD-NOS was the smallest, with a total of 220 participants. To ensure the robustness of statistical tests, equal sample sizes were used (Field, 2005); therefore a sample size of 220 participants per group was used. This far exceeded the minimum recommended sample size of 20 per cell (Tabachnick & Fidell, 1996). Using the select random cases function in SPSS, random samples were taken from the sample of children diagnosed with autism (N=243) and children with non-ASD developmental delays (N=1035) to fit this sample size. *A priori* chi-square analyses showed that the groups did not differ significantly in gender, $\chi^2(2) = 2.20$, *p*=.33 or ethnicity, $\chi^2(6) = 1.48$, *p*=.96. An *a prior* between-subjects Analysis of Variance (ANOVA) found that the groups did not differ significantly in age, $F(2, 657) = 1.97$, *p*=.14. Demographic variables for all three groups are displayed below in Table 2.

Table 2
Demographic characteristics for Study 2

| Demographic Characteristics | Diagnostic Group | | |
	Autism (n=220)	PDD-NOS (n=220)	Non-ASD Developmentally Delayed (N=220)
Age (in months)			
Mean (SD)	27.22 (4.74)	26.44 (4.77)	26.43 (4.95)
Range	17-36	17-36	18-36
Gender, %			
Male	76.4%	70.9%	70.9%
Female	23.6%	29.1%	29.1%
Race/Ethnicity, %			
Caucasian	51.8%	49.5%	52.3%
African-American	41.4%	42.3%	41.4%
Hispanic	1.8%	1.8%	2.3%
'Other'	5.0%	6.4%	4.1%

Participants for the current study were recruited in two ways. Participants in all conditions, aside from the typically developing condition, were recruited from the State of Louisiana's EarlySteps program. EarlySteps is Louisiana's Early Intervention System under the Individuals with Disabilities Education Act, Part C, which provides services to infants and toddlers and their families from birth to 36

months. Children qualify for these services if they have a developmental delay or a medical condition likely to result in a developmental delay. The children in this program have a wide variety of diagnoses, including, but not limited to, autism, PDD-NOS, cerebral palsy, epilepsy, infant diabetes, blindness, hypoplastic left heart syndrome, asthma, tubular sclerosis, Klinefelter's syndrome, Down's syndrome, and mild intellectual disability (Matson et al., 2008d). Participants from this program were assigned to one of the following three conditions, if they met the specified age range (17-37 months): Autism, PDD-NOS, or developmentally delayed without a history of ASD. A licensed doctoral level psychologist, blind to BISCUIT scores, gave diagnoses of autism and PDD-NOS based on *DSM-IV-TR* criteria, M-CHAT scores, and developmental profiles from the Batelle Developmental Inventory – Second Edition (BDI-2; Matson et al., in press-a). A second doctoral level clinical psychologist independently diagnosed a subset of these participants (*n*=203) to establish inter-rater reliability. Percent agreement for diagnoses was 98.97% (Matson et al., in press-a). Random samples of these participants were selected using the SPSS random select cases function for both studies, as outlined below. In addition to the aforementioned method, children identified as typically developing were recruited from outside the EarlySteps program by members of the doctoral program in clinical psychology at Louisiana State University. These children had no history of developmental delays and fit the specified age range. For all studies, before random sampling, participants were removed if they had missing or miscoded data (e.g., if a participant was given a score of 3 on an item where the response options were 0,1, or 2). This did not affect the overall sample size, as it was determined by the smallest group in each study.

Measures

   Baby and Infant Screen for Children with aUtIsm Traits-Part 1 (BISCUIT-Part 1). The BISCUIT-Part 1 is part of a large battery of assessments, the BISCUIT, (Matson et al., 2008d) which is composed of three distinct parts that assess diagnostic criteria, comborbidity, and challenging behaviors. Of interest for the current studies was Part 1, the diagnostic section, containing 62 questions. Items are rated by parents on a 3-point Likert-type scale (0 = not different/no impairment; 1 = different/mild

impairment; and 2 = very different/severe impairment) with respect to how their child compares with typically developing children of the same age. A factor analysis of the BISCUIT Part 1 found three distinct factors: socialization/nonverbal communication, repetitive behaviors/restricted interest and communication (Matson et al., in press-a). Of importance for the current studies were the items that fall under the factor of communication. Of the 62 diagnostic items, 6 fall under this factor. Example items include "communication skills," "use of language in conversation with others," and "communicates effectively" (see Appendix for full list). This measure has been found to have good internal reliability (r = .97) and to be successful at differentially diagnosing autism from PDD-NOS (Matson et al., 2008d; Matson et al., 2009). Sensitivity and specificity are considered high, at .847 and .864, respectively, when differentiating those without a diagnosis vs. those with PDD-NOS (Matson et al., 2009). When differentiating PDD-NOS from autism, sensitivity and specificity were .844 and .833 respectively (Matson et al, 2009). Additionally, the BISCUIT-Part 1 was found to have an overall correct classification rate of .888 (Matson et al, 2009).

Procedure

For those in the EarlySteps program, personnel whose licensure or certification meets requirements for providing services within the EarlySteps program administered the measure. This includes a wide range of disciplines, including psychology, occupational therapy, physical therapy, social work, and speech-language pathology (Matson et al., 2008d). Before administering the measure, these individuals received training and practice in administering the entire BISCUIT battery. This was to ensure that all measures were administered in a standardized fashion. The BISCUIT-Part 1 was administered alongside other tests and services that are part of the EarlySteps program. The measure was administered in one-to-one interviews with parents/guardians. Current doctoral students in the Louisiana State University clinical psychology program administered the BISCUIT-Part 1 for the typically developing children. These administrations occurred either over the phone or in one-to-one interviews. All current doctoral students have experience administering similar questionnaires and have received

training comparable to that received by EarlySteps assessors in administration of the BISCUIT battery. All informants were the parents or legal guardians of the participating children and provided informed consent. This study received prior approval by the Louisiana State University Institutional Review Board and Louisiana's Office for Citizens with Developmental Disabilities.

Results

Study 1

 SPSS 16.0 was used to conduct all analyses. For the main analysis, a two sample, one-way

independent t-test was run, with group membership entered as the independent variable and overall

scores on the communication subscale of the BISCUIT-Part 1 serving as the dependent variable. The

ASD group (*M*=9.50) had significantly more overall communication impairments than the typically

developing group (*M*=0.30), *t*(38)=14.78, *p*<.001, *d* =4.67. A Kruskal-Wallis test confirmed these

findings, *H*(1)=31.43, *p*<.001. Figure 1 displays the mean endorsement of communication impairments

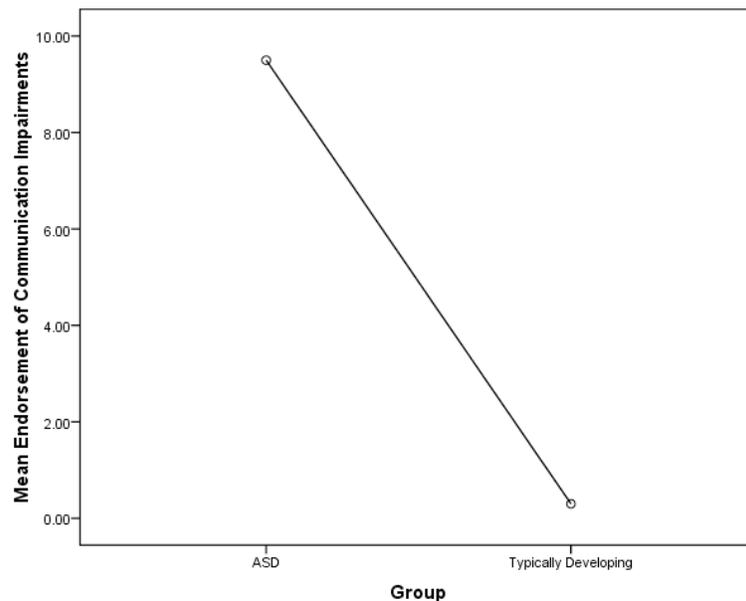per group on the BISCUIT-Part 1.

Figure 1
Mean endorsement of impairments on the communication subscale per group on
the BISCUIT- Part 1

 To further examine in what ways the groups differed, a MANOVA was conducted with each

communication item entered as a dependent variable, and group membership was again entered as the

independent variable. A significant effect of group membership on individual communication item

scores was found, *F*(6,33) = 40.39, *p*<.001, *partial η^2* = .880. Table 3 and Figure 2 show the mean

impairment score for both groups on each individual communication item. Univariate between-subject

tests showed that the ASD group had significantly more communication impairments than the typically developing group on item 1 (Communication skills), $F(1,38)=157.95$, $p<.001$, *partial η^2* = .806; on item 5 (Verbal communication), $F(1,38)=163.91$, $p<.001$, *partial η^2* = .812; on item 9 (Use of language to communicate), $F(1,38)=177.13$, $p<.001$, *partial η^2* = .823; on item 16 (Use of language in conversation with others), $F(1,38)=84.64$, $p<.001$, *partial η^2* = .690; on item 24 (Communicates effectively) $F(1,38)=30.65$, $p<.001$, *partial η^2* = .446; and on item 50 (Language development), $F(1,38)=179.92$, $p<.001$, *partial η^2* = .826. Thus, the groups differed significantly on all items.

Table 3
Mean (*SD*) impairments endorsed per group for item on the communication subscale of the BISCUIT-Part 1

* -	ASD	Typically Developing
Item 1 (Communication skills) *	1.65 (.59)	.00 (.00)
Item 5 (Verbal communication) *	1.75 (.55)	.05 (.22)
Item 9 (Use of language to communicate with others) *	1.70 (.57)	.00 (.00)
Item 16 (Use of language in conversation with others) *	1.40 (.68)	.00 (.00)
Item 24 (Communicates effectively) *	1.20 (.83)	.10 (.31)
Item 50 (Language development) *	1.80 (.41)	.15 (.37)

Denotes item with significantly differential endorsement by groups
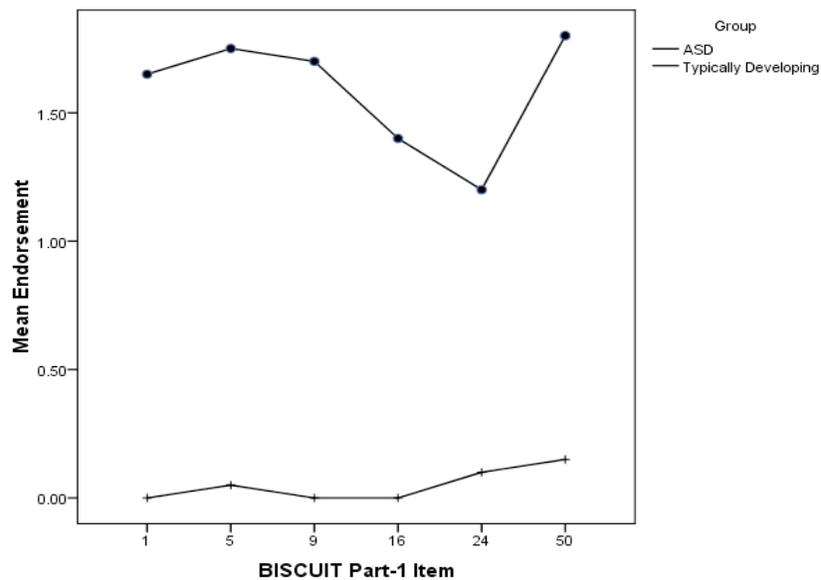

Figure 2
Mean item endorsement on the communication subscale of the BISCUIT-Part 1 for ASD and typically developing infants

Study 2

For the main analysis, a one-way between groups ANOVA was run, with group membership (i.e., autism, PDD-NOS, or non-ASD related developmentally delayed) entered as the independent variable and overall scores on the communication subscale of the BISCUIT-Part 1 serving as the dependent variable. There was a significant effect of group membership on overall scores on the communication subscale of the BISCUIT-Part 1, $F(2,657) = 114.36$, $p < .001$, $partial\ \eta^2 = .258$. A Kruskal-Wallis test confirmed this significant effect, $H(2)=176.78$, $p<.001$. Results of the Bonferroni post-hoc test indicated that there was a significant difference in overall communication impairment between autism ($M=10.48$) and both PDD-NOS ($M=9.23$), $p<.001$ and non-ASD related developmentally delayed ($M=6.25$), $p<.001$. Furthermore, there was a significant difference in overall communication impairment between PDD-NOS and non-ASD related developmentally delayed, $p<.001$. Figure 3 displays the mean endorsement of communication impairments per group on the BISCUIT-Part 1.
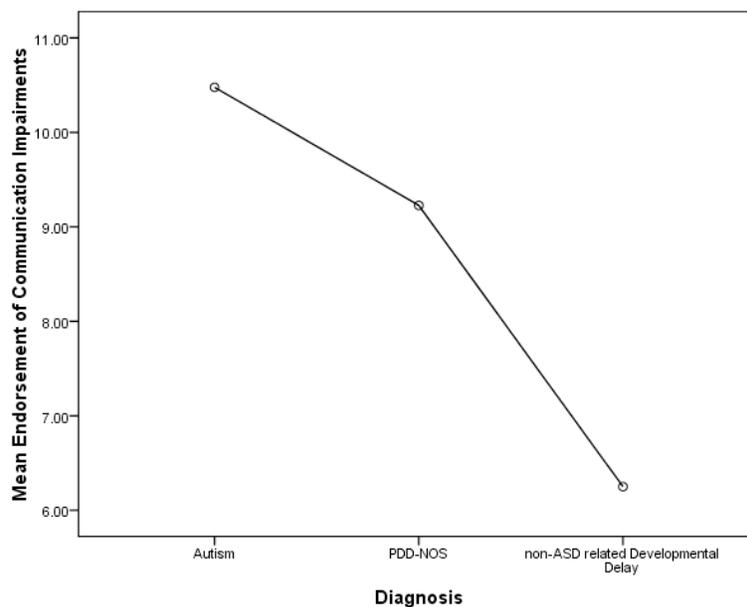

Figure 3
Mean endorsement of impairments on the communication subscale for autism, PDD-NOS, and non-ASD related developmental delay on the BISCUIT- Part 1

Due to significant differences, a MANOVA was conducted to explore on which specific items significant differences existed. Group membership (i.e., autism, PDD-NOS, or non-related ASD developmentally delayed) was entered as the independent variable and each of the six communication items served as the dependent variable. There was a significant effect of group membership on individual communication item scores, $F(12,1306)=20.25$, $p<.001$, *partial* $\eta^2 = .157$. Table 4 and Figure 4 show the mean impairment endorsed for each group on each communication item. Univariate between-subjects tests showed that a significant effect of group membership existed on item 1 (Communication skills), $F(2,657)=52.28$, $p<.001$, *partial* $\eta^2 = .137$; on item 5 (Verbal communication), $F(2,657)=57.71$, $p<.001$, *partial* $\eta^2 = .149$; on item 9 (Use of language to communicate), $F(2,657)=88.02$, $p<.001$, *partial* $\eta^2 = .211$; on item 16 (Use of language in conversation with others), $F(2,657)=87.15$, $p<.001$, *partial* $\eta^2 = .210$; on item 24 (Communicates effectively), $F(2,657)=73.82$, $p<.001$, *partial* $\eta^2 = .183$; and on item 50 (Language development), $F(2,657)=88.28$, $p<.001$, *partial* $\eta^2 = .212$. Thus, a significant effect of group membership was found on all six items.

Bonferroni post-hoc test indicated are as follows: On item 1 (Communication skills), autism differed significantly from both PDD-NOS, $p=.03$ and non-ASD related developmentally delayed, $p<.001$. Additionally, PDD-NOS differed significantly from non-ASD related developmentally delayed, $p<.001$. On item 5 (Verbal communication) showed that non-ASD related developmentally delayed differed significantly from both autism, $p<.001$ and PDD-NOS, $p<.001$. However, autism and PDD-NOS did not differ significantly on this item, $p=.185$. For item 9 (Use of language to communicate) autism differed significantly from both PDD-NOS, $p=.003$ and non-ASD related developmentally delayed, $p<.001$. Additionally, PDD-NOS differed significantly from non-ASD related developmentally delayed, $p<.001$. Results for item 16 (Use of language in conversation with others) showed that autism differed significantly from both PDD-NOS, $p<.001$ and non-ASD related developmentally delayed, $p<.001$. Additionally, PDD-NOS and non-ASD related developmentally delayed differed significantly on this item, $p<.001$. For item 24 (Communicates effectively) autism differed significantly from PDD-

NOS, $p<.001$ and the non-ASD related developmentally delayed group $p<.001$. Additionally, PDD-NOS

and non-ASD related developmentally delayed differed significantly on this item, $p<.001$. Finally,

results for item 50 (Language development) showed that non-ASD related developmentally delayed

differed significantly from both autism, $p<.001$ and PDD-NOS, $p<.001$. However, autism and PDD-

NOS did not differ significantly on this item, $p=.061$.

Table 4
Mean (*SD*) impairments endorsed per group for item on the communication subscale of the BISCUIT-
Part 1

	Autism	PDD-NOS	Non-ASD Related Developmentally Delayed
Item 1 (Communication skills)	1.74 (.52) [b,c]	1.60 (.58) [a,c]	1.19 (.67) [a,b]
Item 5 (Verbal communication)	1.78 (.49) [c]	1.68 (.56) [c]	1.22 (.69) [a,b]
Item 9 (Use of language to communicate with others)	1.76 (.49) [b,c]	1.56 (.62) [a,c]	1.00 (.76) [a,b]
Item 16 (Use of language in conversation with others)	1.73 (.53) [b,c]	1.43 (.75) [a,c]	.86 (.79) [a,b]
Item 24 (Communicates effectively)	1.63 (.62) [b,c]	1.25 (.77) [a,c]	.81 (.72) [a,b]
Item 50 (Language development)	1.84 (.41) [c]	1.71 (.54) [c]	1.18 (.68) [a,b]

[a] Based on post-hoc analyses, significantly different from Autism group ($p<.05$)
[b] Based on post-hoc analyses, significantly different from PDD-NOS group ($p<.05$)
[c] Based on post-hoc analyses, significantly different from Non-ASD Related, Developmentally Delayed group ($p<.05$)
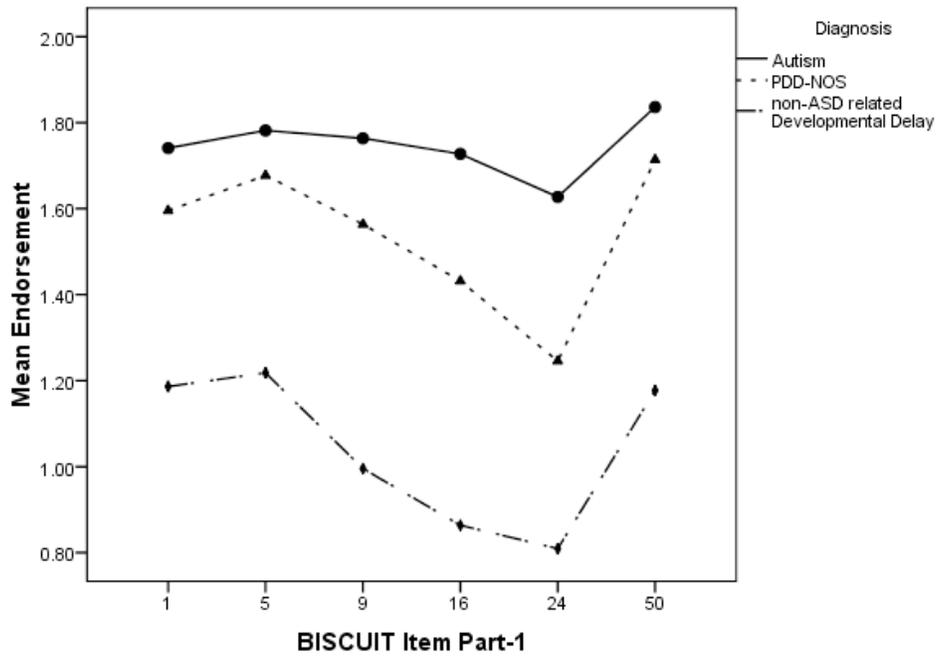
Figure 4
Mean item endorsement on the communication subscale of the BISCUIT-Part 1 for the autism, PDD-NOS, and non-ASD related developmentally delayed groups

Discussion

With the growing interest in early intervention for ASD has come a growing need for early

detection of symptoms and early assessment (Matson, 2005; Matson et al., 2008d). Such interest in earl

intervention has grown, as the earlier a child with an ASD is treated, the better the long-term outcome

may be (Corsello, 2005; Fenske, Zalenski, Krantz, & McClannahan, 1985; Harris, Handleman, Gordon,

Kristoff, & Fuentes, 1991; Matson, 2005; Smith, 1999). While parents begin to show concern that their

children may have a delay at as young as 12 months of age (DeGiacomo & Fombonne, 1998; Mitchell et

al., 2006; Rogers & DiLalla, 1990), diagnoses of ASD are not typically given until children are between

3 and 4 years old (DeGiacomo & Fombonne, 1998; Matson, 2005; Tager-Flusberg et al., 2005). Parental

concern of a possible developmental delay is most frequently in regards to the development of

communication (DeGiacomo & Fombonne, 1998). Approximately 33-50% of children with ASD are

unable to use functional speech (Noens & Van Berckelaer-Onnes, 2005; Rutter, 1978). Despite this, few

researchers have looked at communication impairments in ASD before age 3. The majority of studies

that have been done with this population have relied on the use of retrospective home videotapes, rather

than an objective, validated measure used for diagnostic purposes in real time. The current investigations

aimed to do just that, first comparing the early communication impairments of children with ASD to

typically developing children and then comparing these impairments between autism, PDD-NOS, and

children with developmental delays not related to ASD.

Results of Study 1 supported the main hypothesis. Children with ASD had significantly more

total communication impairments than did typically developing children. This was expected, as

communication impairments are one of the core features of ASD and are one of the first signs to parents

that something might not be right (APA, 2000; DeGiacomo & Fombonne, 1998). Children in Study 1

ranged in age from 18-36 months, with a mean of 25.78 months. These results are in line with previous

research using retrospective home video tapes, which found significant communication impairments in

children with ASD between 18 and 36 months (Adrien et al., 1993; Mitchell et al., 2006; Werner &

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Dawson, 2005). Therefore, Study 1 provides further evidence that the communication impairments found in ASD emerge before 36 months, despite diagnoses not typically being given until 3-4 years (DeGiacomo & Fombonne, 1998; Matson, 2005; Tager-Flusberg et al., 2005). By 18 months, most typically developing children have an expressive vocabulary of approximately 100 words and a receptive vocabulary of approximately 300 words (Carpenter et al., 1998). By 36 months, these numbers are typically both above 900 words (Carpenter et al., 1998). Children with ASD do not follow this same developmental path. Children with ASD were rated as being more significantly impaired in their language development, their communication skills, their verbal communication, and their use of language to communicate with others.

Study 1 provides further evidence that communication deficits can be used to differentiate infants and toddlers with ASD from typically developing infants and toddlers. It is imperative that accurate diagnosis and differentiation occur if children are to receive early intensive intervention (Matson et al., 2008c). This information can help parents and practitioners in correctly diagnosing ASD earlier in life, allowing for early intervention to appropriately take place. While some have argued that early screening and detection is not possible or advisable (Williams & Brayne, 2006), the results of the current study support the ability to differentiate children with ASD even at a young age.

 An inspection of specific items found significant differences between the groups on all communication items. Therefore, significant differences are found across a broad array of aspects of communication. The current findings provide insight into specific impairments that are more frequently and/or severely rated in ASD than in typically developing children.

Two hypotheses in Study 2 were supported, while a third was not. Children with autism had more total communication impairments than did both children with PDD-NOS and non-ASD related developmental delays. While communication impairments are possible in PDD-NOS and non-ASD related developmental delays, they are required for a diagnosis of autism (APA, 2000). Unexpectedly, children with PDD-NOS were found to have significantly more total communication impairments than

were children with non-ASD related developmental delays. While the average child in both of these groups had some degree of communication impairment (M=9.23 in PDD-NOS vs. M=6.25 in non-ASD developmental delays), these impairments were either more frequently or more severely rated in the children with PDD-NOS. As a whole these results further the implications found in Study 1. Similarly to Study 1, the range and mean ages in Study 2 were 17-36 and 26.70, respectively. Given the larger sample size found in this study, this gives even further support to the emergence of communication impairments in children with ASD before 36 months. Moreover, not only can communication impairments be used to differentiate toddlers with ASD and typically developing toddlers, they can also be used to differentiate toddlers with autism, PDD-NOS, and non-ASD related developmentally delays. While all groups expectedly evinced communication impairments, the current results show that it is possible to discriminate between these impairments, even at a young age. This approach will even further aid in the early detection and diagnosis of ASD and implementation of early interventions.

Additionally, the current study should contribute to a better understanding of the differences between autism and PDD-NOS. The current *DSM-IV-TR* definition of PDD-NOS is vague in that there is no established threshold or cut-off point. This fact has prompted researchers to try and establish more concrete criteria for the disorder (APA, 2000; Buitelaar & Van der Gaag, 1998; Buitelaar et al., 1999; Matson & Boisjoli, 2007; Tidmarsh & Volkmar, 2003). Despite the unclear definition of PDD-NOS, a number of researchers have found significant differences between PDD-NOS and autism (Buitelaar et al., 1999; Charman et al., 2003a; Mayes et al., 1993; Pearson et al., 2006; Walker et al., 2004). While the boundaries between the two disorders remains unclear, the current findings add to the aforementioned literature. Within the domain of communication, significant differences exist between PDD-NOS and autism as early as 18-36 months. Further researchers should examine whether these differences hold true for the two other core features, socialization and repetitive behaviors/interests. This will help bring better clarity to the definition and assist in creating more reliable and valid ways to diagnose the disorder (Matson & Boisjoli, 2007; Matson et al., 2008a; Mayes et al., 1993).

In Study 2, only two items did not show significant differences between all groups: autism did not differ significantly from PDD-NOS on item 5 (Verbal communication) or on item 50 (Language Development). It is possible that these items did not show significant differences, as they are somewhat broader than the other items. As all groups averaged some degree of communication impairment, it is possible that these items were not specific enough to highlight differences. Future researchers could examine this possibility. Despite these non-significant findings, the majority of significant findings provide further means to differentiate these populations. Study 2 shows that both global and specific communication impairments can be used to distinguish these groups. Further research should be conducted at the level of individual items, as this could provide more specific ways of differentiating between these populations.

One limitation of the current study was the inability to control for certain extraneous variables, notably intelligence and socioeconomic status (SES). Intelligence was not included in the current study for a handful of reasons. An intellectual disability group was not used, as intellectual disability can be a comorbid disorder found within all three populations. Furthermore, intelligence is not considered to be stable until around ages 7-8 years (Ho, Foch, & Plomin, 1980); therefore it could be misleading to include this information, as it might not hold true over time. SES could also influence the findings of the current study. Toddlers coming from a higher SES may be more likely to receive a superior education and have increased opportunities to learn effective, appropriate communication skills. All participants in Study 2 came from the Louisiana EarlySteps program, which provides free services. It is therefore not expected that differences in SES would have been found had this information been available. Nonetheless, future research should examine this empirically to further strengthen the current results.

Another limitation is the use of convenience sampling for the typically developing group in Study 1. The typically developing children were not a true random sample, as convenience sampling was used. Thus it is possible that this sample is not truly representative of its respective populations. This could be problematic in Study 1, given the small sample size. Even within typically developing

children, there is great variability within development. Future researchers should attempt to use increased sample sizes of typically developing children to increase the likelihood of a more representative sample.

In recent years, there has been increased interest in early intervention for children with ASD. However, before children with an ASD can receive intervention they must be accurately identified and diagnosed with an ASD (Matson et al., 2008c). The current studies have provided parents, researchers, and practitioners with information that can assist in this process. Children with an ASD show significantly more communication impairments than do typically developing children between the ages of 18-34 months. Additionally, children with autism show significantly more communication impairments than do children with PDD-NOS, who in turn have significantly more communication impairments than non-ASD related developmentally delayed children, between the ages of 18-36 months. While communication impairments alone are not sufficient to diagnose a child with an ASD, the current investigations provide information on one of the core features. Therefore future researchers should explore whether these findings extend to the other core features of ASD and if they can be extended to earlier ages. This will give further aid in identifying and assessing children with ASD before 3 years of age, thereby assisting them in receiving much need interventions and services as early as possible.

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Appendix

* - Indicates which factor the item is loaded on

Item	Factor 1 Repetitive Behavior/ Restricted Interests	Factor 2 Socialization/ Nonverbal Communication	Factor 3 Communication
58. Abnormal, repetitive motor movements involving entire body	.*		
41. Use of facial expressions	*		
29. Eye-to-eye gaze	*		
48. Becomes upset if there is a change in routine	*		
42. Abnormal fascination with the movement of spinning objects	*		
27. Restricted interests and activities	*		
39. Interest in a highly restricted set of activities	*		
26. Display a range of socially appropriate facial expressions	*		
8. Maintains eye contact	*		
43. Curiosity with surroundings	*		
4. Engages in repetitive motor movements for no reason	*		
34. Abnormal preoccupation with parts of an object or objects	*		
61. Isolates self	*		
49. Needs reassurance, especially if events don't go as planned	*		

#	Item		
57.	Abnormal, repetitive hand or arm movements	*	
55.	Limited number of interests	*	
6.	Prefers food of a certain texture or smell	*	
38.	Expects others to know their thoughts, experiences, and opinions without communicating them	*	
33.	Sticking to odd routines or rituals that don't have a purpose of make a difference	*	
11.	Reactions to normal, everyday sounds	*	
13.	Reaction to normal, everyday lights	*	
30.	Reaction to sounds and sights	*	
44	Saying words or phrases repetitively	*	
7.	Ability to recognize the emotions of others		*
51.	Responds to others' distress		*
20.	Interest in another person's side of the conversation		*
46.	Understand of appropriate jokes, figures of speech, or sayings		*
18.	Ability to make and keep friends		*
47.	Gives subtle cues or gestures when communicating with others		*
21.	Able to understand the subtle cues or gestures of others		*
22.	Use of too few or too many social gestures		*

19.	Interest in participating in social games, sports, and activities	*	
59.	Development of social relationships	*	
23.	Body posture and/or gestures	*	
28.	Motivated to please others	*	
36.	Reads nonverbal cues of other people	*	
32.	Facial expressions corresponds to environmental events	*	
12.	Responds to others social cues	*	
14.	Peer relationships	*	
52.	Socializes with other children	*	
35.	Plays appropriately with others	*	
62.	Participation in games or other social activities	*	
45.	Make-believe or pretend play	*	
10.	Social interactions with others his/her age	*	
17.	Shares enjoyment, interests, or achievement with others	*	
2.	Intellectual abilities	*	
3.	Age appropriate self-help and adaptive skills	*	
9.	Use of language to communicate		*
1.	Communication skills		*
5.	Verbal communication		*
50.	Language development		*
16.	Use of language in conversations with others		*

24. Communicates effectively *
53. Use of non-verbal communication

Vita

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