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Social and communication patterns that can be detected early in 12-month old infants later diagnosed with an autism spectrum disorder

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SOCIAL AND COMMUNICATION PATTERNS THAT CAN BE DETECTED EARLY IN 12-MONTH OLD INFANTS LATER DIAGNOSED WITH AN AUTISM SPECTRUM DISORDER

By

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BS, University of New Hampshire, 2006

THESIS

Submitted to the University of New Hampshire
In Partial Fulfillment of
the Requirements for the Degree of

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7/23/08
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DEDICATION

This thesis is dedicated to my loving family who has offered me constant support and guidance through some of my greatest challenges. You continue to inspire me to overcome obstacles and taught me to transform them into positive opportunities. Having all of you there to encourage me along the way made achieving my dreams possible and for this I am eternally grateful. We did it!
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ABSTRACT

SOCIAL AND COMMUNICATION PATTERNS THAT CAN BE DETECTED EARLY IN 12-MONTH OLD INFANTS LATER DIAGNOSED WITH AN AUTISM SPECTRUM DISORDER

By

Carolyn C. Winters

University of New Hampshire, September, 2008

The purpose of this project was to determine what social and communication patterns could be detected early in infants who are later diagnosed with an autism spectrum disorder (ASD). Investigators carried out a qualitative analysis collecting descriptive data through retrospective video analysis addressing two main areas of development in infants later diagnosed with ASD: (a) social interactions, and (b) communication and language development. The intent of this research project was to highlight specific social communication behaviors: (1) eye gaze, (2) response to name, (3) communicative forms (both vocalizations and gestures), and (4) communicative intent & function (behavior regulations, social interaction, and joint attention). The following behaviors carried the most relevance surrounding a later autism spectrum diagnosis: lack of overall use of vocalizations, lack of gestures, limited social interactions, and inconsistent or lack of response to name. Based on this investigation, evaluators’ discussion and observations were the most accurate and consistent when predicting an ASD diagnosis in at-risk 12 month-old infants when noting a child’s vocalizations, gestures, and response to name.
INTRODUCTION

Autism is a neurodevelopmental disorder noted as one of the most profound disorders of early childhood. The incidence of autism spectrum disorders is reportedly on the rise; current estimates reflecting this suggest that the disorder affects approximately 1 in 150 children (Center for Disease Control, 2007). Ultimately, this means that every day, 67 children in America are diagnosed with this disorder.

ASD is a developmental disorder of neurobiological origin present from birth or very early in development that is defined by behavioral and developmental features (National Research Council [NRC], 2001). Autism spectrum disorders involves a triad of symptoms: (1) impairments of social interaction, (2) impairments of verbal and nonverbal communication and (3) restricted, repetitive, and stereotyped patterns of behavior, interest and play (American Psychiatric Association [APA], 1994).

While there are strong commonalities (such as social deficits), there is no single behavior or sign that is always typical of an ASD (National Research Council, 2001). Autism spectrum disorders are unique in their pattern of differences, needs, and strengths. They vary in severity, age of onset, and the presence of secondary features (e.g. intellectual disability, epilepsy and specific language delay) (National Research Council [NRC], 2001). Even though diagnostic criteria have been established, the etiology of autism spectrum disorders is still unknown. Currently, early detection and diagnosis of
autism in the first couple of years of life is affected by two factors: limited knowledge regarding early development in children later diagnosed with an autism spectrum disorder and difficulty establishing reliable diagnostic measures and tools.
CHAPTER 1

DEFINING AUTISM SPECTRUM DISORDERS

Autism is a neurodevelopmental disorder defined by differences in social and communication development, along with stereotyped patterns of behavior and play. Autism, along with pervasive developmental disorder-not otherwise specified (PDD-NOS) and Asperger syndrome, is characterized as a pervasive developmental disorder (PDD) within the DSM-IV [American Psychiatric Association (APA), 1994]. In clinical practice the term autism spectrum disorder (ASD) is often used to collectively refer to autism, PDD-NOS, and Asperger syndrome. When the term ASD is used in this paper, it inclusively refers to autism and PDD-NOS. Asperger syndrome was not addressed in this investigation and therefore will not be discussed in this paper.
CHAPTER 2

VALUE OF EARLY DETECTION AND DIAGNOSIS OF AUTISM SPECTRUM DISORDERS

The diagnostic features of ASD should be evident in very young children because they involve skills and abilities that develop in the first few years of life (Wetherby, Woods, Allen, Cleary, Dickinson, & Lord, 2004). Many parents of children later diagnosed with an autism spectrum disorder report concerns about their child’s development during infancy or prior to the age of three. This has caused researchers to explore the possibility and validity of detection and diagnosis before the age of three in this population (Goin & Myers, 2004).

Currently, infants with autism spectrum disorders are rarely diagnosed conclusively before 24 months of age (Elder, Valcante, Groce, Yarandi & Carlton, 2002). These children are not diagnosed with an ASD until 24 months or later because of the difficulty of distinguishing ASD from other childhood disorders (i.e. developmental delays and intellectual disabilities). Factors influencing early detection include the variability of behavior in young children, lack of appropriate referrals by primary care providers to whom parents expressed concern, and/or the family’s lack of knowledge of services.

An early referral is more likely to occur when biological risk factors (e.g. very low birth weight) are present, or when communication differences develop in conjunction
with physical, sensory, or cognitive disabilities (Wetherby et al, 2004). Research has indicated that the absence of typically developing skills, such as protodeclarative pointing, showing of objects, joint attention, affective exchanges, pretend play, and imitation, are strong potential markers of autism in young children. (Baron-Cohen et al. 1996; Lord, 1995).

Currently there are no biological markers for ASD; therefore early detection and diagnosis must be based on behavioral characteristics and features (Filipek, Accardo, Baranek, Cook, Dawson, Gordon, et al, 2000). Developmentally based assessments of cognitive, communicative, and other skills provide information important for both diagnosis and program planning for children on the autism spectrum. According to the National Research Council [NRC] (2001), several principles underlie a comprehensive assessment of a young child with autism: (a) obtaining a thorough medical history, (b) psychological assessment, (c) communicative assessment, (d) medical evaluation, and finally as necessary (e) additional consultation addressing sensorimotor and neuropsychological functioning.

It is widely recognized that the outcomes for children on the autism spectrum are greatly improved with early intervention. Important factors that are necessary for early intervention include: early suspicion, early screening, and early diagnosis (Covert, 2005). Families of children with autism typically receive their initial evaluations in physicians' offices or clinics. (Elder, Valcante, Groce, Yarandi, & Carlton, 2002). Since pediatricians are one of the few professions who have access to the family during a child's infancy, they play a critical and crucial role in the detection and early recognition of ASDs. Educating healthcare professionals, specifically pediatricians, about
developmental precursors of autism continues to be an important step towards successful early detection and diagnosis of ASD.

Parents also need accurate information about their child’s development and difficulties in order to learn how to best care for their child. Early detection may be the key to mitigate long-term familial stress over the uncertainty of what is affecting their child and what might be helpful to their child (Goin & Myers, 2004). With an appropriate diagnosis, parents can receive support and education surrounding ASD, allowing them to make informed decisions on best-care practices for their child.
CHAPTER 3

SOCIAL & COMMUNICATION DEVELOPMENT IN CHILDREN WITH ASD

The focus of this investigation is on the early development of communication and social behaviors in infants later diagnosed with an ASD. Communication is a broad term that includes linguistic, paralinguistic, and pragmatic skills. More specifically, linguistic communication includes phonological, morphological, syntactic, and semantic rule systems. Paralinguistic communication includes proxemics (i.e. space between conversational partners), facial expressions, intonation, and gestures. Pragmatic communication involves discourse skills (e.g. topic maintenance), communicative intentions (e.g. request/protest), and presupposition (e.g. type and style of communication) (Landa, 2007).

Communicative development may be the primary factor deciding the extent to which individuals with ASD can develop relationships with others and participate in daily activities and routines at school (Wetherby et al., 2004). Verbal and nonverbal communications are considered a core deficit in the diagnostic criteria for autism spectrum disorders (American Psychiatric Association [APA], 1994). Differences in social and communication development may be present in children with autism as early as the first year of life, even before first words should occur in typically developing children (Landa, 2007).
The DSM-IV lists four criteria regarding communication impairments in autism:
(1) delay in or total lack of the development of spoken language, (2) difficulty in the
ability to initiate or maintain a conversation, (3) stereotyped or repetitive uses of
language, and (4) lack of varied, spontaneous make-believe play or social imitative play
appropriate to developmental level. Instead of conventional means of communicating,
children with autism may develop idiosyncratic, unconventional or inappropriate
behaviors to communicate, such as self-injurious behavior, aggression, and tantrums
(National Research Council [NRC], 2001). Some individuals with autism develop
echolalic speech. An echolalic utterance is generally an imitated single word label for a
situation or event (National Research Council [NRC], 2001).

Improvements in receptive and expressive communication have been found to
prevent problem behaviors and maintain reductions of these behaviors (National
Research Council [NRC], 2001). Improving and enhancing social and communication
skills for children with ASD involves not only increasing vocal and verbal repertoires,
but also increasing social communication so that children will initiate interactions using
their existing vocabulary (Wetherby et al, 2004).

Vocalizations

Overall, there is great variability in vocal communications in young children with
ASD; children on the spectrum offer a wide range of speech and language abilities.
When compared to children with developmental delays, preschool aged children with an
ASD diagnosis were found to use a comparable proportion of syllables with atypical
phonation (e.g. squeals, growls, and yells) (Sheinkopf, 2000). Parents of children with
autism first have concerns surrounding speech and language delays or difficulties; it is often the reason surrounding an initial referral.

In addition, infants with autism are less likely to direct their vocalizations (e.g. grunts) to others (Chawarska & Volkmar, 2005). The communication development of children on the autism spectrum at 24 and 36 months of age is generally characterized by reduced frequency and diversity of communicative forms, which include complex babbling, gestures, syllables including consonant sounds, words, and word combinations (Wetherby et al, 2004).

**Gestures**

Numerous studies involving young children with ASD have noted differences in their capacity to use both conventional and symbolic gestures. Children with autism who are nonverbal often do not compensate for lack of vocalizations through eye gaze or conventional, physical, or depictive gestures (Chawarska et al, 2007). They predominantly use primitive motoric gestures such as pulling or taking another person’s hand in order to communicate. Children with ASD gestures tend to perform isolated acts that are less often integrated with vocalizations when compared to typically developing prelinguistic children (Wetherby, Prizant & Hutchinson, 1998). In addition, infants with autism typically do not show or share emotions they are experiencing with others (Chawarska et al, 2007). Children with ASD are unlikely to monitor behaviors of others, and follow or respond to nonverbal cues from conversational partners for their attention. Instead of using convention methods of communicating, children with ASD may develop
idiosyncratic, unconventional, or atypical behaviors to communicate, such as self-injurious behavior and aggression.

**Communicative Intent**

Infants with ASD demonstrate differences or impairments relating to function or intent of communication. Children with autism have very restricted means by which to indicate their needs and desires to others. For example, initiation of social communicative acts (e.g. showing, initiating joint attention) which requires integrated attention to social and nonsocial aspects of context, is often impaired relative to requesting (a non-social use of communication) in 24- and 36-month old children with autism (Wetherby & Prutting, 1984, Wetherby et al, 1998). This potentially reduces their ability to be efficient communicators since they lack the flexibility required to partake in the dynamic flow of conversational interactions. In addition, young children with autism are less likely to initiate communication bids with the intention of regulating the behavior of others in order to achieve a desired object or action (Charman, Swettenham, Baron-Cohen, Cox, Baird & Drew, 1997).

**Response to Name**

Children with autism have also shown developmental differences in responding to their name being called. Overall, children with ASD show deficits and inconsistencies in their ability to respond to attention-getting strategies used by caregivers; this is true of children with autism across a wide range of ages (Adrien, Perrot, Hameury, Martineau, Roux, & Savage, 1993; Baranek, 1999; Lord, 1995; Osterling & Dawson, 1994).
Limited response to name continues to be a reoccurring theme in the literature regarding early differences in the development of children with ASD and therefore may be a particularly useful predictor across age groups in young children with autism.

**Imitation**

Imitation is an important skill to acquire in communication development; it creates an opportunity for communicative reciprocity. Imitating another's behavior not only acknowledges their communicative contribution but also confirms attention and promotes additional communicative turns between communicative partners (Landa, 2007). Aside from the socially disengaged echoic behaviors that some exhibit, children with ASD typically do not exhibit spontaneous, meaningful, and socially engaging imitation of conversational partners’ verbal and nonverbal communicative behaviors (Landa, 2007).

**Eye Gaze & Joint Attention**

Early social and communication development are intimately connected. Some of the criteria specified for social impairment are greatly involved in the pragmatic aspects of communication (e.g. nonverbal behaviors such as gaze modulation, facial expressions, body gestures, and social regulatory gestures). Current research has identified joint attention and eye gaze as core social skills that children with ASD have exceptional difficulty acquiring (Wetherby, Prizant, & Schuler, 2000).

Deficits in joint attention reflect difficulty coordinating attention between people and objects. Examples of joint attention include: orienting and attending to a social
partner, shifting gaze between people and objects, sharing affect or emotional states with another person, following the gaze and point of another person, and lastly being able to draw another’s persons attention to objects or events for the purpose of sharing experiences (Wetherby et al, 2004).

Typically developing infants understand by 9-10 months of age that others’ direction of gaze and pointing gestures signal something of importance, and in turn shift their attention to the referenced object thereby establishing a state of joint attention with another. This gaze shift is an important communication skill for children to develop; it allows them to understand that specific words target a particular object (Baron-Cohen, Baldwin & Crowson, 1997).
PREVIOUS STUDIES EXAMINING EARLY MARKERS OF AUTISM

One method several researchers have adopted to identify potential early characteristics of autism is a retrospective approach. Examining early family home videos of infants who were later diagnosed with autism is an example of this retrospective approach. Video recording analysis has several advantages over direct observations. Data can be collected accurately and efficiently, and videotapes can provide a complete record for future reference. Data can also be captured without selection bias. This approach is particularly useful for this type of exploration because results yield consistent and objective data that is not influenced by parents’ recollections (which could be potentially inaccurate). In addition, the information gained through home videotape studies can potentially aid in the identification of young children with autism so that diagnoses can be made earlier and more accurately. In order for early identification to occur, specific behaviors or differences that occur in infants with autism in comparison with typically developing children need to be established.

One study (Osterling & Dawson, 1994) compared first year birthday party videotapes of 11 infants with autism to a control group of 11 typically developing children. The investigators analyzed videotapes for social, affective, joint attention, and communicative behaviors. Results of the study indicated that differences between
typically developing children and children with autism can be identified by 1 year of age. The infants with autism displayed significantly fewer social and joint attention behaviors. Four behaviors correctly classified 10 out of 11 children with autism, and 10 out of 11 typically developing children: (1) pointing, (2) showing objects, (3) looking at others, and (4) orienting to name. The amount of time that a child spent looking at others was the single best predictor of a child’s later diagnosis.

Werner and colleagues (2000) looked at the same videotapes used in Osterling & Dawson’s study (1994), focusing on eye contact & orientation, imitation, affective responsivity, and joint attention behaviors (which included pointing and showing). Results indicated that differences between infants with early onset autism spectrum disorder and typical development can be detected at 8-10 months of age. The strongest finding to emerge from the study was that 8-10-month-old infants were less likely than typically developing infants to orient when their name was called.

Baranek’s (1999) retrospective video study exploring early predictors of autism also showed symptoms are present at 9-12 months. This study confirmed previous research indicating that children with autism show deficits in their ability to respond to attention-getting strategies (e.g. calling child’s name). The consistent findings in these three studies signify that responsiveness to name may be a primary predictor across age groups in young children with autism spectrum disorders.

A study done by Adrien & colleagues (1991) examined social interaction, communication, motility, attention and emotion domains through video analysis. Significant differences were found in behaviors involving social smiles, appropriate facial expression, and appropriate use of gestures. An important finding in the study
indicated that the abnormalities mentioned above increased in intensity and frequency during the second year of life.

Overall, the literature indicates the existence of autistic characteristics in infants younger than 24 months, the approximate age when a confident diagnosis can be made. Evidence supports differences in development that are indeed potentially detectable during the second year of life: 12 to 24 months. Some studies go even further and reveal developmental anomalies present during the first year, or 8-10 months. Various methods (e.g. family home videos, screening devices, parent reports) of obtaining information on the early development of children with autism spectrum disorders yield commonly noted characteristics including: lack of eye contact, affective differences; lack of social skills, gestural differences, unresponsiveness to name, and communication delays.
CHAPTER 5

PRESENT STUDY

The purpose of this project was to determine what social and communication patterns can be detected in 12 month-old infants later diagnosed with an autism spectrum disorder. Early development and behaviors displayed by infants considered to be at risk for autism based on an older sibling’s previous diagnosis were documented. The study was designed to analyze through retrospective video review two main areas of development in infants later diagnosed with an autism spectrum disorder: (a) social interactions, and (b) communication development.

The intent of this research project was to highlight specific social communication behaviors: (1) eye gaze, (2) response to name, (3) communicative forms (both vocalizations and gestures), and (4) communicative intent & function (behavior regulations, social interaction, and joint attention). Focusing on these social communication behaviors may help to reliably predict which children will later be diagnosed with ASD.

Observation of infants at risk for ASD as they engage in daily routines at home with their parents provided an opportunity to better understand the early markers for development of ASD as they manifested in the natural environment. The research question addressed by this project was, “What social and communication patterns can be detected early in children who are later diagnosed with an autism spectrum disorder?”
CHAPTER 6

METHODOLOGY

Participants

Participants in this study included five infants and their caregivers recruited from an ongoing study by Sullivan et al. [in process] looking at early markers of autism. Four of the infants were 12 months of age and one was 15 months of age during videotaping. All five of the infants were considered to be at high risk for the development of ASD based on a diagnosis of ASD in an older sibling. Prior to enrollment of the infants in the study, the older sibling's diagnosis was confirmed by meeting criteria for autism on two standardized measures: (1) The Autism Diagnostic Observation Scale (ADOS-G; Lord, Rutter, Goode, & Heemsbergen, 1989), a semi-structured, play-based assessment and (2) The Autism Diagnostic Inventory-Revised (ADI-R; Lord, Rutter, & LeCouteur, 1994), a structured parent interview. All participants met the following eligibility criteria: (1) no co-morbid diagnosis was present, (2) participants were monolingual English speakers, (3) pregnancies were carried to at least 36 weeks, and (4) participant's birth weight was greater than 2500 grams.

Subsequent to videotaping and prior to the age of 30 months, three of the five participants received a diagnosis of ASD. Two children received an official diagnosis of PDD-NOS, and one child a diagnosis of autism. In these three cases, a local neurologist or pediatrician made the diagnosis. In addition, two of the three children were given the
ADOS-G (Lord, Rutter, Goode, & Heemsbergen, 1989) and ADI-R (Lord, Rutter, & LeCouteur, 1994) and received qualifying scores. The two children participating in the study who do not carry a diagnosis of any ASD are now beyond the age of 30 months and did not receive qualifying scores on either the ADOS-G or ADI-R.

Data Collection

All children were involved in Sullivan et al’s [in process] study at 12 months of age. The focus of this study is a five-minute play interaction where parent-child interaction was analyzed from minutes three to seven on every tape. It should be noted that the first two minutes of interaction were not analyzed in order to maintain coding consistency and eliminate potential bias. This also provided a warm-up period during which children and others being videotaped could grow accustomed to the presence of the camera. To ensure confidentiality, each family was assigned a unique identification code. This code was used to identify the child on all videotapes and data sheets.

The parent-play interaction was videotaped from a single hand held camera that was focused on both the infants’ and caregivers’ faces. In all five videos analyzed, the parent involved in the play interaction was the mother. The parent engaged the child for five minutes of play with a standard set of toys that included: cloth letter blocks, a talking phone, a baby doll with a blanket, bottle, spoon, dish, comb, a textured squeaky ball, an Elmo mirror, a shape sorter with a plastic hammer, and two matching rattles.
**Expert Clinical Judgment**

Videos were analyzed by a total of four coders whom were selected based on having more than 15 years of experience as diagnosticians with the ASD population. The coders ranged from 18 to 30 years of total experience working with children with autism spectrum, with an average of 25 years. In addition, all four coders were part of the Seacoast Child Development Clinic, which is an interdisciplinary team providing family-centered, culturally sensitive evaluation and consultative services for families. The coders’ experience with the Seacoast Child Development Clinic ranged from three to 13 years with an average of 8.5 years. These coders are considered to be experts in the field of autism spectrum disorders based on their extensive experience working with this population.

The coders represented multiple disciplines, including: speech-language pathology (n=2), occupational therapy & family support (n=1), and early childhood education (n=1). All four of the coders held a discipline-specific master’s degree and three coders held a doctoral degree.

**Video Coding Procedures**

All four coders were presented with written instructions prior to viewing tapes. A limited definition of each category was provided. This allowed coders to self-impose and determine what they believed to be critical attributes of each highlighted behavior. The coders then watched the videos. At the end of each five-minute viewing of a videotape, ten minutes were allotted to complete the coding form (see appendix 1).
Coding consisted of viewing the play interactions of all five participants and observing each for highlighted behaviors of: (1) eye gaze, (2) vocalizations, (3) gestures, (4) communicative intents & functions and (5) response to name. Each coder viewed the videotapes and used his/her clinical judgment regarding behaviors (e.g. eye gaze, vocalizations, gestures, communicative intent and response to name) to determine whether or not they predicted the child would be later diagnosed with autism. After all of the coding was complete, coders were surveyed orally as a group about observable social and communicative behaviors they deemed to be relevant regarding the diagnosis of an autism spectrum disorder.

**Data Interpretation**

Data were analyzed in relation to: (1) communication and language, and (2) social interactions of each infant. Following each coder's comments regarding the most relevant behaviors, an analysis was completed to identify prevalent reoccurring themes that are indicative of a diagnosis of autism. Each child’s video produced four completed coding sheets, resulting in a total of twenty completed coding sheets.

The coders’ analyses, including anecdotal comments, were transcribed by the investigator. Next, two graduate students in the University of New Hampshire’s Communication Science and Disorders program, identified reoccurring patterns in the coders’ comments and developed corresponding categories. The students generated categories based on patterns they detected from coders’ comments regarding the presence or absence of highlighted behaviors, and if present, the degree to which they were considered to be relevant when predicting an ASD diagnosis. Inter-rater reliability for
determining whether a behavior was present or absent was calculated using the percent agreement between the two students who independently scored data from the four coders. The mean overall percent agreement between the two examiners was 93% and ranged from 88% to 98% in coding data from the five children.

Data were summarized based on the graduate students' consensus regarding the coders observations of highlighted behaviors (e.g. eye gaze, vocalizations, gestures, communicative intent & response to name). Within each highlighted behavior (e.g. eye gaze) a subset of more specific behaviors (e.g. social eye contact, line of regard, joint attention & shared mutual attention) was determined based on the various coder's discussions of behaviors relevant to a predicted ASD diagnosis. Throughout the summaries, a “1” indicated that a specific behavior was discussed by the expert coders and considered to be present and typical. A “-1” indicated a specific behavior was discussed by a coder and was considered to be absent or not typical. No data was entered when a specific behavior was not discussed at all by a coder. Turning to figures 1-7, children who have a diagnosis of ASD have a (*). This includes children one, three and five. Using these data, a pattern was deemed present when the majority of coders (no less then 3 out of 4) agreed a particular behavior (i.e. eye gaze, vocalizations, gestures, communicative intent & response to name) was either present or absent.
CHAPTER 7

RESULTS

Eye gaze:

When examining eye gaze the following behaviors were considered relevant by the expert coders: (1) social eye contact (eye contact that is maintained for a social purpose), (2) line of regard (object verses person), (3) joint attention (shifting eye gaze); and (4) shared mutual attention. (See Figure 1).

Social eye contact was considered a relevant factor by three coders for three out of five children. Of those three children, expert coders indicated two infants to have an absence and one infant to have a presence of social eye contact. Of the three children with a diagnosis of ASD, coders deemed the absence of eye contact a relevant diagnostic marker for two of them. Social eye contact was considered an important feature by all four coders during the follow-up discussion about early markers of autism. Three out of four coders indicated during the follow-up discussion that social eye contact was an important factor when predicting which children would be later diagnosed with ASD. When reviewing the tapes of the five infants, three of four expert coders observed and noted social eye contact when indicating a prediction of an ASD diagnosis. (See Figure 1)

Line of regard refers to a person’s point of focus based on direction of eye gaze. All of the children (5/5) were judged by the coders to demonstrate a positive line of
regard toward objects. Coders determined that four of the infants had a positive line of regard toward people. For the three children with an ASD diagnosis, one child was reported by expert coders to exhibit line of regard toward people and one child was found by coders to lack line of regard toward people. Line of regard was cited as a primary feature leading to the prediction of autism by three coders during the follow-up discussion. When reviewing the tapes of the five infants, three of the four expert coders observed and noted line of regard when indicating a prediction of an ASD diagnosis. (See Figure 1)

Joint attention is defined as a complete three-point gaze shift from person to object to person (P-O-P) or object-person-object (O-P-O). In this study joint attention was coded when the child utilized a three-point gaze during interaction. Coders noted and agreed on joint attention behaviors for one one child with a diagnosis of ASD who was considered to have positive joint attention. Joint attention was considered a primary feature in predicting the diagnosis of ASD by all of the expert coders during follow-up discussion. However, when reviewing the videotapes only one of the coders actively observed and noted joint attention when predicting an ASD diagnosis. (See Figure 1).

Shared mutual attention is present when the child and caregiver are focused on the same environmental stimulus. Three out of four coders were in agreement for two out of five children where shared attention was present in both children. One of these children was diagnosed with ASD. Shared mutual attention was cited as a primary feature in predicting the diagnosis of ASD by two out of four coders during follow-up discussion. However, when viewing the infants' videotapes only one out of the four coders observed and noted shared mutual attention when predicting a diagnosis of ASD.
Figure 1:

A.
B. Eye Gaze: Child Two

C. Eye Gaze: Child Three
D. Eya Gaze: Child Four

- Coder A
- Coder B
- Coder C
- Coder D

Social Eye Contact | Line of Regard: Object | Line of Regard: Person | Joint Attention | Mutual Attention

Highlighted Behavior

E. Eya Gaze: Child Five

- Coder A
- Coder B
- Coder C
- Coder D

Social Eye Contact | Line of Regard: Object | Line of Regard: Person | Joint Attention | Mutual Attention

Highlighted Behavior
**Vocalizations:**

Behaviors surrounding vocalizations that were noted by at least three out of four coders included overall presence or absence of vocalizations, syllable structure (vowel versus consonant vowels), word approximations, person vs. object directed vocalizations, and affect. (See Figure 2).

At least three of the four coders noted and agreed whether or not vocalizations were typical or atypical for four out of five children. Of these four children, one child’s vocalizations were deemed typical, and three children were given atypical ratings. Two of these latter children were later diagnosed with ASD. All four coders cited a child’s overall vocalizations during discussion as a primary feature leading to the prediction of an autism spectrum disorder. When reviewing the videotapes of the infants, all four expert coders actively noted overall vocalizations when indicating their prediction of an ASD diagnosis. (See Figure 2).

Within the vocalizations category coders also discussed syllable structure. Syllable structure refers to the forms (e.g. consonant/vowel) that make up the syllables within a vocalization. Three of the expert coders agreed on syllable structure for two of the children. For both of these children coders considered syllable structure to be typical for a 12 month-old infant. It should be noted that this category closely coincides with word approximations. Syllable structure was cited by two coders during the follow-up discussion as an important factor regarding the diagnosis of an autism spectrum disorder. When reviewing the tapes of the five infants, two coders observed and noted syllable structure when indicating their prediction of an ASD diagnosis. (See Figure 2)
Word approximations are defined as vocalizations that carry meaning, but do not necessarily match the adult form of the word. Word approximations were noted and agreed upon by three of the expert coders for two of the children. In both cases, the child’s word approximations were considered to be typical; however, one child had a diagnosis of ASD. During discussion, three out of four coders identified that word approximations were predictive factors regarding the diagnosis of ASD. During video observations three coders actively observed and noted word approximations when indicating their prediction of a diagnosis of ASD. (See Figure 2)

When a young child vocalizes for a communicative purpose the child can direct his vocalizations at either a person (e.g. caregiver) or object (e.g. toy). Directed vocalizations were noted by at least three out of four coders who agreed for three out of five children. Among those three children, the child with a diagnosis of ASD was rated as having people directed vocalizations. The coders rated two other children’s vocalizations as object directed. Directed vocalizations were cited by two of four coders during the follow-up discussion. When reviewing the tapes of the five infants, three of the coders actively observed and noted directed vocalizations when indicating a prediction of an ASD diagnosis. (See Figure 2).

When vocalizing a child’s affect can help to express meaning or convey emotions. Affect refers to the rise and fall of a person’s intonation during a vocalization. Three out of four coders noted and agreed that affect of vocalization was a significant behavior for one of the five children. In this single case, the child used his affect to convey pleasure. During the follow-up discussion all four coders cited affect as an important factor when
predicting a diagnosis of ASD. When reviewing the tapes of the five infants, three coders actively observed and noted affect when indicating a prediction of an ASD diagnosis.
Figure 2:

A.

Vocalizations: Child One

Highlighted Behavior

- Vocalization
- Structural V
- Structural CV
- Vocal Approximations
- Stuttered Vowel
- Structural Open
- Post-V
- Structural Nasalized
- Post-R
- Structural Approximation
- Palatal/Onset Approximation

Coder A
Coder B
Coder C
Coder D
D.

Vocalizations: Child Four

Vocalization Structured: CV

Highlighted Behavior

E.

Vocalizations: Child Five

Vocalization Structured: CV

Highlighted Behavior

32
**Gestures**

Gesture related behaviors that were identified by at least three of the four coders included overall typical or atypical use of gestures, types of gesture (e.g. reach, give) and whether the gesture was directed towards a person or object. (See Figure 3).

Three of the expert coders agreed on whether overall gestures were considered to be typical or atypical in two out of five children. Both children had a diagnosis of ASD and were considered to have atypical use of gestures. During the follow-up discussion all four coders noted the overall use of gestures to be an important diagnostic marker in predicting ASD. When reviewing the tapes of the five infants all four coders actively observed and noted overall gestures when indicating a prediction of an ASD diagnosis. (See Figure 3)

At least three out of four coders found an open hand reach to be present and relevant in one out of five children. This child had a diagnosis of ASD. Expert coders also found a give gesture to be present in two out of five children. Neither of these children were later diagnosed with ASD. (See Figure 3).

Three coders noted whether gestures were directed to a person or object in one of five children. This child was not subsequently diagnosed with ASD. During discussion two expert coders mentioned directed gestures as an important diagnostic marker for the prediction of ASD. When reviewing the tapes of the five infants, one coder observed and noted directed gestures when predicting an ASD diagnosis.
Figure 3

A.
B.

Highlighted Behavior

C.

Highlighted Behavior
**Communicative Intent**

Behaviors related to communicative intent that were coded by at least three of the four coders included, (1) overall communicative intent as typical or atypical according to age, (2) type of communicative intent: (a) joint attention (communicative act of caregiver and child), behavior regulation (communicative act of requesting or protesting in order to influence caregiver’s behavior), (c) social interaction (communicating with the intent to draw caregiver’s attention to self), and (3) whether or not communicative act was initiated, or in response to a caregivers comment. (See Figure 4).

Three of four coders noted and agreed on whether a child’s communicative intent was typical or atypical. This child later received a diagnosis of ASD and was considered to have atypical communicative intent for his age by the coders.

Three coders found joint attention to be present and relevant in two out of five cases. One of these children had a diagnosis of ASD while the other did not. There were three communicative intents that the expert coders focused on: behavior regulation, joint attention and social interaction. Expert coders indicated behavior regulation to be present in one out of five children. This child had an ASD diagnosis. Coders indicated social interaction to be absent in two of five children. Both of these children had a later diagnosis of ASD. Three of the coders noted and agreed a communicative act was initiated by one of five children. This child does not carry a diagnosis. Three coders were in agreement regarding a responsive communicative act and in two of five children; both of these children were later diagnosed with ASD. One child was considered to have an absence or lack of responsiveness to caregiver’s communicative acts while the other child was considered to display communicative responsiveness. (See Figure 4).
During discussion all four coders cited a child's communicative intent to be an important diagnostic marker for predicting an ASD diagnosis. Three coders observed and noted communicative intent when reviewing infants videotapes regarding their prediction of ASD.

Figure 4

A.
B. Communicative Intent: Child Two

C. Communicative Intent: Child Three

39
Response to Name:

Only four of the five parent-child interactions presented opportunities for children to respond to their name. The coders noted that in the parent-child interaction that did not present such an opportunity, the parent said the child's name during the sample, however she did not actually call it. Of the four parent-child interactions that did provide opportunities, the coders identified two children who did not respond to their name when clearly given an opportunity to do so. (See Figure 5). Both of these children have a diagnosis of ASD. During discussion all four coders cited response to name to be an important diagnostic marker in predicting ASD. When reviewing the videotapes of the five infants, all of the coders observed and noted response to name when indicating a predicting an ASD diagnosis.
Figure 5

A.

![Graph showing response to name: Child One with data from Coder A, Coder B, Coder C, and Coder D.](image-url)
D.

Response to Name: Child Four

E.

Response to Name: Child Five
**Prediction of Autism Spectrum Disorder**

Expert coders were asked to predict “yes” or “no” whether or not each child would be later diagnosed with ASD. Three out of four coders indicated “no” regarding a prediction of a diagnosis of ASD for the first child although this child was later diagnosed on the spectrum. The coders’ predictions were in 75% agreement with 25% accuracy. This is consistent with parent report of this child not showing any signs until 18-months of age. (See Figure 6A)

Two out four coders indicated “no” regarding a prediction of a diagnosis of ASD for the second child. This child does not have a diagnosis of an autism spectrum disorder, is over the age of 30 months and did not have qualifying scores according to the ADOS and ADI. The coders’ predictions were in 50% agreement with 50% accuracy. (See Figure 6B).

All four coders indicated “yes” regarding a prediction of a diagnosis of ASD for the third child. This child does have a diagnosis of an ASD according to qualifying scores and clinical diagnosis. The coders predicted the diagnosis of ASD for the third child with 100% accuracy and in 100% agreement. (See Figure 6C).

Three out of four coders indicated “no” regarding a prediction of a diagnosis of ASD for the fourth child. This child does not have a diagnosis of an autism spectrum disorder, is over the age of 30 months and did not have qualifying scores according to the ADOS and ADI. The coders’ predictions were in 75% agreement with 75% accuracy. (See Figure 6D).

Three out of four coders indicated “yes” regarding a prediction of a diagnosis of ASD for the fifth child. This child does have a diagnosis of an autism spectrum disorder
according to qualifying scores and a clinical diagnosis. The coders' predictions were in 75% agreement with 75% accuracy. (See Figure 6E).

Overall, at least three out of four coders were in agreement whether or not four out of five children were later diagnosed with ASD. Coders were 75% reliable in predicting a diagnosis of an autism spectrum disorder with 75% accuracy or greater for three of the five children. (See Figure 6)
CHAPTER 8

DISCUSSION

Four coders were asked to observe and code five-minute parent-child interactions focusing on communicative and social behaviors. Initially there were six infants involved in the study. However, one child received a diagnosis of a speech and language disorder, thereby no longer qualifying for the study. Therefore, coders’ observations and coding sheets were used for only the five remaining children.

This study had a surprisingly high number of children whom were later diagnosed with ASD. Three out of the five children received a later diagnosis of an autism spectrum disorder. All five infants were considered to be at-risk for ASD based on a sibling having already been diagnosed. Given the high percentage (60%) of children with ASD in this study, the need for a larger study of infant siblings of children with ASD is evident to further study issues related to reoccurrence risks.

When I asked the coders they stated the following nine communicative and social behaviors as important diagnostic factors regarding the prediction of an ASD: (1) social eye contact, (2) line of regard, (3) joint attention, (4) vocalizations, (5) word approximations, (6) affect, (7) use of gestures, (8) communicative intent, and (9) response to name. A majority of the coders only considered and noted eight of the nine behaviors when predicting a later diagnosis of ASD. (See Figure 7). Although in discussion the
coders identified joint attention (3-point-eye gaze) as an important predictor, only one out of four coders made note of the presence or absence of this behavior when predicting an ASD. This may indicate that joint attention may not be a primary predictive behavior regarding the prediction of an ASD diagnosis in 12-month old infants. However, this could also be due to limitations of the study in regards to the difficulty observing eye gaze when watching a video. Eye contact can be difficult to judge accurately from video since it is sometimes difficult to see all persons simultaneously, and this difficulty may have contributed to inconsistent findings. (Baranek, 1999).

Within the nine suggested predictive behaviors, three behaviors in particular were both discussed as an important diagnostic marker and noted by all four coders when predicting a diagnosis of ASD: (1) overall vocalizations, (2) use of gestures, and (3) response to name. This indicates that professionals who have experience with young children diagnosed with ASD can both recognize the potential diagnostic meaning of these behaviors and reliably distinguish a presence or absence of that behavior in an infant at 12 months of age.

When looking solely at the three children later diagnosed with ASD certain patterns were noted between the coders. These included, (1) limited or absent vocalizations, (2) a positive line of regard toward objects (3) limited or absent use of gestures, (4) absence of social interaction and (5) lack of response to name. Out of the five behaviors stated above, the coders in this study were 100% consistent with at least 75% accuracy for three behaviors: overall use of vocalizations, use of gestures and response to name. The finding of these five behaviors has potential clinical implications regarding evaluations of children considered to be at risk for ASD under the age of two.
However, with such knowledge it is important to recognize that if an infant is not showing any of the discussed behaviors at the age of 12 months it does not necessarily mean that ASD should be disregarded completely. As discussed in this investigation research shows a range of ages for initial onset of behaviors associated with an ASD diagnosis. Even within this study one child who later received a diagnosis of an ASD was not reported to show any signs prior to the age of 18 months.

The present findings support some of the previous studies (Dawson et al. 1998, Baranek, 1999) of early markers of autism in infants considered to be at risk based on a sibling’s diagnosis. This study also validates previous findings (e.g. Adrien et al, 1993; Baranek, 1999; Osterling & Dawson, 1994) regarding the use of retrospective video analysis as an effective tool with which to study young children with autism. This method allows researchers to look at early development in young children often before caregivers and professionals have concerns.

The present investigation has several limitations that limit the interpretation and generalization of the findings. One is that there was a small sample size consisting of only five children. Looking at a small group of children in isolation does not specifically translate into the larger group of children with autism. In addition, there was a lack of a comparison group, such as a group of siblings of children with developmental delays or a control group. It was also noted by the coders that caregivers in the video study were found to use extra compensatory strategies to engage their children more successfully in social interactions. These may be attributed to the fact that all of these caregivers have an older child with a diagnosis of ASD and modified interactions accordingly. Thus these
interactions may not have been representative of typical interactions involving the participating children and their caregivers.

Although coders made multiple comments regarding play interaction, play behaviors were not explicitly included in this study. This study set out to examine communicative and social behaviors that may hold diagnostic value for an ASD diagnosis. Further examination of play behaviors for their diagnostic value is warranted, but is not a part of this project.

This investigation highlights the major communication and social behaviors found in infants considered to be at risk for developing an autism spectrum disorder. The following behaviors carried the most relevance surrounding a later autism spectrum diagnosis, which included a lack of vocalizations, gestures, social interaction, and response to name. Based on this investigation, evaluators are the most consistent and reliable when observing a 12-month old infant's use of vocalizations, gestures and response to name. Therefore, when observing an infant under two years of age with concerns regarding , evaluators might focus on those three particular behaviors in regards to social and communication development.

This paper contributes to a growing body of literature suggesting that there are subtle communication and social differences during the first year of life in children who are later diagnosed with an ASD. Identification of early markers of autism will hopefully assist in decreasing the age at which autism spectrum disorders are diagnosed thereby facilitating earlier intervention. Efforts should be aimed at developing screening tools to identify infants who may be at risk. However, the true benefits of early diagnosis can only occur when appropriate family support, education and intervention are provided
promptly following a diagnosis. Further research should build on gains made in order to study potential social-communication ASD markers in infants during the first year of life.
REFERENCES


Appendix 1

Please comment on your observations of the following behaviors in terms of how they might or might not lead you to predict this child would be diagnosed on the autism spectrum at a future time?

Eye Gaze:

Vocalizations:

Gestures:

Communicative Intents/Functions (behavior regulation, social interaction & joint attention)

Response to Name:

Would you predict this child would later be identified with ASD?

| Yes: | No: |

If you answered YES to the previous question, please comment on any additional behaviors you observed in this video that led you to this conclusion.
Predictive Diagnostic Behaviors of ASD (at 12mo)

Highlighted Behavior

- # of Coders who cited behavior as primary feature leading to prediction of ASD
- # of Coders who observed and noted behavior when reviewing infants' videotapes

**Denoted behaviors indicate Vocalizations, gestures, and response to name has the strongest findings. All four coders cited the three behaviors as important factors for predicting ASD and then all four observed and noted behavior when reviewing the infants' videotapes.**
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IRB #: 4225
Study: Early Markers of Autism
Approval Date: 12-Mar-2008

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved the protocol for your study as Expedited as described in Title 45, Code of Federal Regulations (CFR), Part 46, Subsection 110.

Approval is granted to conduct your study as described in your protocol for one year from the approval date above. At the end of the approval period, you will be asked to submit a report with regard to the involvement of human subjects in this study. If your study is still active, you may request an extension of IRB approval.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the attached document, Responsibilities of Directors of Research Studies Involving Human Subjects. (This document is also available at http://www.unh.edu/osr/compliance/irb.html.) Please read this document carefully before commencing your work involving human subjects.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2003 or Julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie F. Simpson
Manager

cc: File
Calculator, Stephen