PREDICTING EXPRESSIVE LANGUAGE ABILITIES FROM EARLY INTENTIONAL COMMUNICATION IN YOUNGER SIBLINGS OF CHILDREN WITH AUTISM SPECTRUM DISORDER

By

Elizabeth Eve Malesa

Thesis

Submitted to the Faculty of the Graduate

School of Vanderbilt University in partial

fulfillment of the requirements for the

degree of

MASTER OF SCIENCE

in

Psychology

May, 2007

Nashville, Tennessee

Approved:

Professor Tedra Walden

Professor Megan Saylor

Professor Paul Yoder

ACKNOWLEDGEMENTS

This thesis was supported by the Developmental Disabilities pre-doctoral training grant through the National Institutes of Health (NRSA, T32 HD07226) and a Peabody Graduate Honors Fellowship, awarded to the author. The data presented in this thesis was collected as part of a grant from the National Institute of Child Health and Development (NICHD # R01 HD043292), awarded to Dr. Wendy Stone (PI), and Drs. Tedra Walden and Paul Yoder (co-PIs).

I am grateful to all members of my committee members for their thoughtful and thorough contributions. Specifically I would like to thank Dr. Tedra Walden for her immense patience which included countless hours of brainstorming and discussion. Furthermore, I would like to Dr. Paul Yoder for his extensive contribution in designing this study. Finally, I would like to thank Dr. Megan Saylor for her comments and for her fresh perspective.

Page

Table Page

CHAPTER I

INTRODUCTION

Review of Critical Literature

Autism spectrum disorder (ASD) is a pervasive neurodevelopmental disorder characterized by impairments in social and communication behavior and a restricted range of activities and interests (APA, 2000). As a spectrum disorder, autism encompasses individuals of varying degrees of intelligence and language ability, and spans vast degrees of severity (Hill & Frith, 2003). Of particular relevance to this paper is the marked impairment of non-verbal intentional communication (i.e. limited use of eye contact and gestures) in ASD, that is identifiable very early on in development.

Though the biological bases of ASD are largely unknown, a number of genetic links have been pinpointed, extending the characteristics associated with an ASD diagnosis to parents and siblings. Family members of individuals with autism often exhibit many of same the traits which define autism, albeit to a lesser degree (e.g. Bailey et al., 1998; Losh et al., 2007; Piven et al., 1997). This milder variant of autism has been referred to as the “broader autism phenotype”, though a precise definition of this broader phenotype remains contended (Losh et al., 2007).

The recurrence rates of ASD in siblings is estimated somewhere between 6-9% (Szatmari, Jones, Zwaigenbaum, & MacLean, 1998; Piven et al., 1997) and 29- 37% (Zwaigenbaum, et al., 2005; Landa & Garrett-Mayer, 2006). A growing number of

prospective studies have capitalized on this recurrence risk of autism in siblings (arguably the most clearly defined high-risk group available) as a means to identify the earliest markers of autism. This body of research has in turn heightened awareness of the heritability of milder variants of autism and is the population of interest in this paper.

In particular, younger siblings of children with autism have been observed to have many of the social-communicative impairments that are present in children with autism, including deficits in language and communication, social engagement and reciprocity, and engagement in repetitive behaviors. When contrasted with siblings of typically developing children (SIBS-TD), siblings of children with autism (SIBS-ASD) have lower levels of eye contact, pointing, showing, requesting, and turn-taking (Goldberg et al., 2005). Furthermore, they demonstrate reduced affective expression (Cassell et al., 2007), less accurate responding to joint attention (Presmanes, Walden, Stone, & Yoder., 2007; Sullivan et al., 2007), less frequent infant-initiated declarative intentional communication (also known as initiating joint attention) (Golderberg et al., 2005; Stone et al., 2007), and less frequent use of gestures (Goldberg et al., 2005; Mitchell et al., 2006; Stone et al., 2007; Toth et al., 2007; Yirmiya et al., 2006). SIBS-ASD have also been noted to have lower levels of adaptive behavior (Toth et al., 2007), delayed language development (Gamliel et al., 2007, Stone et al., 2007, Toth et al., 2007, Yirmiya et al. 2006; Yirmiya et al., 2007; Zwaigenbaum et al., 2005), and increased overall autism symptomatology (Stone et al., 2007).

As Yirmiya and Ozonoff (2007) noted, the findings demonstrating deficits in SIBS-ASD as compared to SIBS-TD are validated by the fact that the various research

groups report similar findings, using different methodologies. Furthermore, one study reported strong agreement between observational measures and parental report (Stone et al., 2007). The current study focuses on the predictive relation between early intentional communication skills and later language, which are thought to be specifically and importantly related (Bates et al., 1989; Mundy, Kasari, Sigman, & Ruskin, 1995; Tomasello, 1988). The predictive relation between the two has not yet been examined in SIBS-ASD and thus is a major objective of this paper. This study also seeks to identify group differences in SIBS-ASD versus SIBS-TD in joint attention and language, domains previously found to be deficient in SIBS-ASD. Furthermore, an examination of specific types of early intention communication (i.e. declaratives versus imperatives) will be conducted, with an expectation that the SIBS-ASD will exhibit a deficit of use of declaratives in comparison to imperatives (defined below).

Intentional Communication/Initiating Joint Attention

As mentioned, early intentional communication deficits are among earliest identifiable traits in autism. These deficits are evident before the development of language and have been shown to be impaired in SIBS-ASD. Intentional communication is defined as a triadic exchange, involving a shared mental focus between two people (Bakeman & Adamson, 1986; Bakeman & Adamson, 1984; Bretherton, 1992), in which the child's gestures, vocalizations, gaze, and facial expressions demonstrate coordinated attention to an object and person (Bates, 1979). Though a vocal component (i.e. vocalization or verbalization) becomes present in

intentional communication as development proceeds, a linguistic component is not required to meet the definition of an act of intentional communication. The literature has been inconsistent when referring to intentional communication (also known as "initiating joint attention"). Some authors use initiating joint attention as it is used here, whereas others have used it to describe interactions such as two people looking at the same object (Bakeman & Adamson call this "onlooking"), or the infant looking at an object with which the adult is visually engaged (because he has learned that looking where an adult is looking often results in interesting sights), or the parent looking where the child is looking (following the child's attentional lead) (Corkum & Moore, 1995) or declarative intentional communication (Mundy). The operational definition for the present study emphasizes that the attentional focus of the two people involved must be truly joint, with both people monitoring each other's attention to the referent (Tomasello, 1995). The term "intentional communication" has been used more consistently than "initiating joint attention" to describe the genre of joint interaction intended here, and it will therefore be used hereafter.

The acquisition of intentional communication skills early in life is crucial for the development of social, language and cognitive abilities (Tomasello, 1995). A child can initiate these interactions using eye contact, alternating looks (referencing), pointing, giving, showing, and/or vocalizing (includes single or multi-word utterances about an object). Communication in infants between 9 and 18 months of age frequently contains these triadic exchanges (Carpenter et al., 1998), which are often prelinguistic in nature. It has been argued (e.g., Tomasello, 1995) that communication in infants does not

become clearly intentional until 12 months of age, the minimum age of participants in this study.

Functions of Intentional Communication

Intentional communication can be characterized in terms of pragmatic function. *Imperative* acts (also called "initiating behavior regulation") describe instances in which the child requests an object that is out of reach, or requests an action with an object. While this form of infant-initiated intentional communication has the purpose of meeting an immediate need or desire (Gomez, Sarria, & Tamarit, 1993), other acts may be intended to share attention or comment to a social partner. These are called *declarative* acts (some have also used the term "initiating joint attention" to describe these) and serve to share awareness or an experience about an object or an event (Mundy, 1995). Declaratives have a social motive (Gomez et al., 1993; Tomasello, 1995) and a frequent purpose of these exchanges is the expression of shared positive affect about an object or event (Kasari, Sigman, Mundy, & Yirmya, 1990; Mundy, Kasari, & Sigman, 1992). The distinction between imperatives and declaratives is important, as they may have different implications for language development (to be explained in further detail below). Additional subsets of intentional communication also exist. One category consists of protests: (i.e. acts used to refuse an undesired object or to command another person to cease undesired actions). Another group of behaviors is called social interactions (Bruner, 1981; Mundy, Sigman, Ungerer, & Sherman, 1987;

Wetherby, Cain, Yonclas, & Walker, 1988) and include greetings, social routines, and teasing, used to attract and maintain another's attention to oneself for affiliative purposes.

The absence or impairment of declarative intentional communication is an early marker and key symptom of ASD (Charman, 2003; Travis & Sigman, 1998), and is one of the best-replicated distinctions between young children with autism and typically developing peers (Mundy & Crowson, 1997; Travis & Sigman, 1998). Declarative intentional communication may be used at a lower frequency, in fewer contexts, and may be used with less flexibility or ease. Furthermore, children with autism have been shown to use a lower proportion of declaratives to other forms of intentional communication, than typically developing children (Mundy, Sigman, & Kasari, 1990; Stone et al., 1997). Impairments in the use of declaratives have also been identified in SIBS-ASD, with SIBS-ASD showing lower motivation to initiate instances of declarative intentional communication with social partners. Specifically, deficits have been observed in SIBS-ASD at 14-19 months of age (Goldberg et al., 2005) and 12-23 months (Stone et al., 1997). The current study examines a subset of sample examined by Stone et al., thus this study seeks to duplicate the deficit in use of declaratives observed in SIBS-ASD using a truncated sample (i.e., only those that were 12-19 months at the initial visit) and with some variations in the measure.

Instead of initiating instances of declarative intentional communication (for the purpose of sharing), children with autism exhibit a specific pattern of intentional communication that is used primarily to regulate another's behavior, such as attempting

to obtain objects or direct the activity of others. Conversely, children with typical development and non-autistic impairments such as Down syndrome express a wide range of intents early in development, including directing another person's attention to self, objects or events, protesting, regulating another person's behavior, and requesting objects, information or activities (Shulman, Bukai, & Tidhar, 2001). This contrast may indicate the importance for considering the purpose of intentional communication acts of individuals with autism and those at-risk for autism. Imperatives reflect the use of another person as means to an end (Gomez, Sarria, & Tamarit, 1993) whereas declaratives share a thought or experience with a social partner (Mundy, 1995). Some studies have noted that children with autism exhibit a different pattern of development than typically developing children in terms of types of intentional communication used, with rates of *imperatives* being seemingly normal (e.g., Sigman & Ruskin, 1999; Mundy, Sigman, & Kasari, 1994), and rates of *declaratives* markedly deficient (e.g., Mundy et al., 1990, Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby, Yonclas, & Bryan, 1989). As one can observe different functional patterns of use of intentional communication before children use words, the evaluation of these differences in various populations may be useful in identification of at-risk infants and toddlers. Therefore, examining initiations of declaratives in comparison to initiations of imperatives in SIBS-ASD could provide important predictive information for early identification of language impairments and/or risk for autism. Siblings of children with autism, who are at increased risk for autism, are expected to exhibit a deficit in engaging in declarative

intentional communication in comparison to their ability to engage in imperative intentional communication.

Early predictors of expressive language

In typically developing children, early declarative communication may predict important aspects of developmental outcome (Mundy & Crowson, 1997). For instance, the acquisition of declarative communication early in life is crucial for the later development of social, language and cognitive abilities (Tomasello, 1995). Travis & Sigman (1998) hypothesized that declaratives may be related to later language acquisition, as they may index a child's awareness of the purpose of communication. Children who are more capable of declaratives may participate in more social exchanges that provide opportunities for language learning. Language has in turn been found to predict long-term outcome in terms of social and academic progress in children with autism (Gillberg, 1991). However, children with ASD are limited in their use of declaratives, and such hallmark deficits of ASD are theorized to have developmental consequences of impairments in declaratives. Therefore, difficulties with declarative intentional communication are likely to be especially important predictors of later impairments in language, social, cognitive, and behavioral outcomes.

Language deficits, a core symptom of ASD and also found in SIBS-ASD (Gamliel et al., 2007, Stone et al., in 2007, Toth et al., 2007, Yirmiya et al. 2006; Yirmiya et al., 2007; Zwaigenbaum et al., 2005) are among the most widely studied outcomes predicted by declarative intentional communication.. This study has examined

expressive language via Lexical Density, a measure of useful speech and particularly face valid metric for children with ASD (Yoder, 2006). Declaratives have been described as having a "special significance" in laying the groundwork for later language (Yoder & Warren, 1999), and several reasons have been postulated as to why they may be particularly predictive of later language acquisition. Yoder, Warren and McCathren (1998), Yoder and Warren (1999), and Stone and Yoder (2001) discussed the following three reasons. First, declaratives may indicate a child's desire for linguistic input from others (Lock et al., 1990), an indication of the child's readiness and receptiveness. Second, declaratives may elicit linguistic input from social partners (Franco et al. 1996), who are given the opportunity to provide a contingent and/or specific verbal response containing vocabulary specific to the child's communication bid. In a sense, the child is facilitating opportunities for the caregiver to give linguistic input. Language learning in children is facilitated when parents follow the child's lead and provide language input contingent on the child's focus of interest (Akhtar, Dunham, & Dunham, 1991; Rocissano & Yatchmink, 1984; Tomasello & Farrar, 1986). Although the caregiver's sensitivity during interactions seems to have a significant impact on the child's linguistic development, the child's own interest in a given activity significantly influences the probability that he/she will initiate or maintain a mutual state of attention (Paparella & Kasari, 2004). Third, declaratives may indicate a particular desire to share mental states or experiences with others (Mundy, 1995), which has been described as the primary motivation to learn to talk (Bloom, 1993). In other words, infants' internal states are potentially expressible in language; infants wish to make them explicit and known to

other persons, hence, language is learned (Bloom, 1993). Along these same lines, Calandrella and Wilcox (2000) proposed that bids for coordinated attention accomplished by declaratives may be motivated by children's desire to acquire language, i.e. a less ambiguous and more conventional form of communication. One implication of these conjectures is that the use of declaratives leads to an increased capability of a child to express himself/herself (i.e. expressive language).

A child's fluency and aptness to use *prelinguistic* intentional communication (particularly declaratives) may play a role in his/her transition to *linguistic* communication (i.e. verbalizations), which has shown to predict later language competency. There is concrete evidence for a positive predictive relation between intentional communication skills and later language ability in several different populations. Declarative abilities have been found to predict later expressive language in children with Down syndrome (Mundy et al., 1995, $R^2 = .15$; Sigman & Ruskin, 1999, $R^2 = .16$, Yoder & Warren, 2004, $R^2 = .35$), general developmental delays (Ulvand & Smith, 1996, $R^2 = .12$; Yoder & Warren, 1998 with 83% correctly identified), typical development (Mundy et al., 1988, $R^2 = .30$; Mundy & Gomez, 1998, $R^2 = .26$) and autism (Bono, Daley, & Sigman, 2004, $R^2 = .24$; McDuffie, Yoder, & Stone, 2005, $R^2 = .26$; Mundy, Sigman, & Kasari, 1990, $R^2 = .37$; Sigman & Ruskin, 1999, $R^2 = .11$). Notably, Mundy, Sigman, and Kasari (1990) found declaratives to be the only significant predictor of language in children with autism ($R^2= .37$, $p<.05$), finding no significant relations for imperatives ($R^2=.0081$, p=n.s.), initial language level ($R^2= .15$, p=non-significant), or IQ ($R^2= .001$, p=n.s.). In the present study, it was expected that use of

declaratives would predict language abilities to a greater extent than use of imperatives in both siblings of children with autism and siblings of children with typical development.

Though several of the aforementioned studies examined the unique contribution of declaratives after controlling for language (Mundy et al., 1995; Yoder et al., 1998; Yoder & Warren, 2004), cognitive delay (McDuffie et al., 2005), and/or motor skills (Ulvund & Smith, 1996; McDuffie et al., 2005) only one examined the unique effect of declaratives after controlling for imperatives. McDuffie (2004) showed that the residual effect for declaratives predicting expressive language remained significant above and beyond the effect of imperatives ($\Delta R^2 = .22$, $t=2.904$, $p<.007$, one-tailed). The nature of this unique predictive relation is particularly relevant in autism and those at risk for autism, as it allows for the discrimination of the contribution of declaratives from that of imperatives in language learning. Declaratives are not only more impaired in autism than imperatives, but this discrepancy also distinguishes children with autism from other populations (Mundy et al., 1986; Mundy et al., 1994). Both declaratives and imperatives are forms of intentional communication, requiring the same triadic structure (described above), however it may be that the different motivational processes involved in using declaratives versus imperatives influence divergent pathways of language learning. Examining the contribution of declaratives while controlling for the influence of imperatives will allow for the identification of the unique variance contributed by declaratives apart from imperatives.

A few other studies have found no evidence for a relation between declaratives and later expressive language. Results of these studies have exhibited evidence

contradictory to the above predictive relation, finding that imperatives but not declaratives predict expressive language in children with Down Syndrome (Smith & von Tetzchner, 1986, R^2 =.24, mean CA: initial: 24 mos, follow-up: 36 mos) and typical development (Mundy et al., 1995, R^2 = .18, mean CA: initial: 15 mos, follow-up: 26 mos). Given that language deficiency is a core feature in children with autism and in children at-risk for autism, declaratives may be a more important antecedent to language than imperatives in these particular populations. The current study is the first to examine the relation between declaratives and later language in SIBS-ASD. It is also the first to examine the unique contribution of declaratives, while controlling for effects of imperatives. Previous studies have found evidence for these relations in autism, however none to date has looked specifically at SIBS-ASD, a group at high-risk for language delays.

Summary

In summary, this study examines overall group differences in terms of declarative and imperative intentional communication, and later expressive language level, measured via Lexical Density, in SIBS-ASD versus SIBS-TD. Furthermore, the predictive relation between early declaratives and later expressive language in these two populations is examined. This study also seeks to determine whether declaratives predict later language after controlling for the variance contributed by imperatives, and whether imperatives predict later language after controlling for the variance contributed by declaratives in both SIBS-ASD and SIBS-TD.

Research Questions

The present study addresses two main sets of research questions: (1) Are there group differences of intentional communication at 12-19 months of age (Time 1), and expressive language measured approximately one year later (20-28 months of age; Time 2) in SIBS-ASD versus SIBS-TD? (2) Does intentional communication predict later language ability for SIBS-ASD and SIBS-TD?

Specific Hypotheses

1) a. SIBS-ASD will exhibit a deficit in engaging in declaratives (i.e. proportion of the trials for which the child capitalized on specific opportunities to engage in declaratives) in comparison to SIBS-TD at Time 1 (T1).

   b. SIBS-ASD will exhibit a deficit in engaging in declaratives in comparison to their ability to engage in imperatives (i.e. proportion of the trials for which the child capitalized on specific opportunities to engage in imperatives) at T1.

   c. SIBS-ASD will exhibit a deficit in expressive language (i.e. Lexical Density) in comparison to SIBS-TD at Time 2 (T2).

2) a. Declaratives at T1 will be significantly related toT2 expressive language (i.e. Lexical Density) in SIBS-ASD and in SIBS-TD.

   b. Declaratives at T1 will predict T2 expressive language after controlling for effects of imperatives.

Exploratory Questions

1) Are there group differences for imperatives (i.e. proportion of the trials for which the child capitalized on specific opportunities to engage in imperatives) in SIBS-ASD versus SIBS-TD at T1?
2) Do SIBS-TD exhibit any differences in terms of their ability to engage in declaratives (i.e. proportion of the trials for which the child capitalized on specific opportunities to engage in declaratives) versus imperatives at T1?
3) Do SIBS-ASD exhibit a deficit in comparison to SIBS-TD in declaratives, after controlling for the variance contributed by imperatives?
4) Are imperatives at T1 related to T2 expressive language (i.e. Lexical Density) in SIBS-ASD? SIBS-TD?
5) Do imperatives at T1 predict T2 expressive language (i.e. Lexical Density) after controlling for effects of declaratives.

CHAPTER II

METHODS

Participants

Participating families were recruited as part of a larger longitudinal sibling study at Vanderbilt University in Nashville, Tennessee. Sixty-eight children participated in the study: 38 younger siblings of children with autism spectrum disorder (SIBS-ASD; 21 males, 17 females) and 25 younger siblings of typically-developing children (SIBS-TD; 17 males, 8 females).

SIBS-ASD were recruited from regional multidisciplinary evaluation and speech-language centers, a statewide birth-to-three service network, autism parent groups, and a university-based autism-specialized service and outreach program. SIBS-ASD met the following inclusion criteria: (1) An older sibling with an autism or PDD-NOS diagnosis, as determined by clinical diagnosis and Autism Diagnostic Observation Schedule (ADOS) classification (Lord et al., 2000); (2) Absence of severe sensory or motor impairments; and (3) Absence of identified metabolic, genetic, or progressive neurological disorders. Of the 38 probands (older siblings of the children who participated in this study), 22 were diagnosed with autism, 15 with PDD-NOS, and 1 with Asperger's syndrome; chronological age at diagnosis ranged from 1 - 6 years (M = 36.2 months, SD = 14.4 months). Participant characteristics and demographics are reported in Table 1

Table 1. *Participant Characteristics and Demographics*.

	SIBS-ASD (*n*=38)	SIBS-TD (*n*=25)
Chronological Age in months at T1		
Mean (SD)	14.03 (2.2)	14.76 (2.2)
Range	12-18	12-19
Chronological Age in months at T2		
Mean (SD)	22.53 (2.4)	22.96 (2.2)
Range	20-28	20-27
Gender		
Male	21 (55%)	17 (68%)
Female	17 (45%)	8 (32%)
Race		
Caucasian	32 (84%)	23 (92%)
African American	4 (11%)	2 (8%)
Other	2 (5%)	0 (0%)
Maternal Education*		
High School or less	4 (11%)	1 (4%)
Partial College	7 (18%)	2 (8%)
College Degree	21 (55%)	11 (44%)
Graduate Degree	6 (16%)	11 (44%)

* denotes a significant difference at p<.05 between groups

SIBS-TD were recruited using birth records and met the following inclusion criteria: (1) A older sibling with typical development; (2) No family history of autism or mental retardation in first degree relatives; (3) Absence of severe sensory or motor impairments; and (4) Absence of identified metabolic, genetic, or progressive neurological disorders.

Procedure

Children first participated in procedures administered for the larger longitudinal research project. After completing these, children were escorted to a new room where they participated in the *Screening Tool for Autism in Two-Year-Olds* (STAT; Stone et al., 2000; 2004), described below. In the current study, children were between 12 to 19 months at their first visit (T1). They returned for a follow-up approximately one year later, where ages ranged from 20 to 28 months (T2). Children participated in the STAT (described below) at both T1 and T2.

Time 1 Variables: Intentional Communication

Children participated in the STAT at both time points. The STAT is an empirically derived, play-based screening instrument for autism. The STAT consists of 12 items assessing play, communication, and imitation. The 12 items were presented in a non-fixed order and in a play-like interaction. Two items were intended to elicit functional play, four involved imitation with objects, and six were designed to elicit prelinguistic intentional communication. Items are scored on a pass/fail basis. At T1, only items

assessing declarative intentional communication and imperative intentional communication items within the STAT were used in analyses. Intentional communication was conceptualized in two distinct categories (i.e., declaratives, imperatives); and each is described in detail below.

Declarative Intentional Communication (*Commenting*):

Operational Definition: A communicative act that serves the function of sharing one's focus of attention with another person. The primary purpose of the communication is to establish a social interaction, rather than to obtain something.

Four items in the STAT are designed to assess this skill: Balloon, Puppet, Bag of Toys, and Noisemaker (see appendix A for greater detail). In all of these items it was observed whether the child indicated his/her awareness of the object or event to the examiner using behaviors such as pointing at an object and looking at the examiner, commenting about an event, or holding up and showing an object.

Since unequal numbers of items were administered to assess declaratives and imperatives (i.e. 4 versus 2), it was necessary to equate the number of opportunities per function as different denominators across functions result in more information residing in the variable with the larger denominator. Thus, only two of the four declarative items had to be selected and it had to be determined which were most likely to elicit declarative acts. Moreover, the four items intended to elicit declaratives were specifically designed and validated for two-year-old children and it was therefore likely that some of the items were not appropriate (i.e. too difficult) for this younger sample

(i.e. 12 to 19 months of age). Of the four items (i.e. Balloon, Puppet, Bag of Toys, and Noisemaker) Balloon and Puppet were eliminated based on the following rationale. The *balloon* often seemed to elicit requests rather than a declaratives. It may be that seeing the balloon is so intrinsically rewarding that both socially and non-socially motivated children may focus their efforts and attention on using the adult as an instrument repeat the action of the deflating balloon, rather than sharing their attention/excitement with the adult. The *noisemaker* did not appear to be the most appropriate item for this particular age group, as it produced a floor effect in both groups. The noisemaker likely elicits some interest from the child (e.g., he/she might orient to the sound), but not enough to motivate him/her to communicate this to the experimenter. The overwhelming amount of novelty that the child is experiencing on his/her visit to the lab may diffuse the desire to be particularly inquisitive about the some of items presented, especially items without visible properties to elicit reactions (i.e. noisemaker). While it is possible a child might express interest and use declaratives in response to this item in a more familiar setting, in the context of the current research paradigm, 90% of children in either group failed to use a declarative for this item. Therefore the Balloon and the Noisemaker were eliminated whereas the Puppet and the Bag of Toys were used in analyses to represent the construct of declarative intentional communication, as they fit this study's definition most consistently.

Imperative Intentional Communication (*Requesting*):

Operational definition: A communicative act that serves the function of getting something from another person. The primary purpose of the communication is to obtain something, rather than to establish a purely social interaction.

Two items in the STAT are designed to assess this skill: Bubbles and Snack (see appendix A). Both involve presenting the child with a desirable object that he/she needs help obtaining. These items are presented in sealed clear plastic containers and the child must request assistance from the experimenter.

Time 2 Variable: Expressive Language (Lexical Density)

At T2, the children participated in the STAT, which was videotaped and coded for Lexical Density. Event coding was used for the Lexical Density measure, counting the number of different, non-imitative vocabulary words used throughout the STAT. The STAT was selected as the measurement context because it is a semi-structured protocol that is playfully conducted, while allowing for similar interaction experience with the examiner, with comparable opportunity for all children to exhibit the desired behaviors. Materials, items, activities and verbal instructions were standard for all children. Items were administered either at a child-sized table with two chairs, or on the floor, depending on child preference. The child's parent was present if necessary; however, the parent was encouraged not to interact with the child. The toys presented were intended to be toys that children might encounter in everyday play activities, and

included a baby doll, teddy bear, spoon, ball, and car. Standardized verbal instructions were scripted to be similar to what an adult may say to a young child when interacting with him/her and attempting to guide the situation; the scripts were intended to elicit particular responses but at the same time seem natural to the child. The experimenter did not help elicit vocabulary words; for example, when presenting the bubbles the experimenter never said the word “bubbles.” This was done to avoid extra prompting resulting from labeling specific objects or activities which could inflate observed Lexical Density. Detailed descriptions of each item, materials used and verbal instructions are available in the STAT manual (Stone & Ousley, 1999, 2003).

Some aspects of the STAT administration varied across children. If a child did not pass an item according to specifications outlined in the STAT manual, up to two additional opportunities (depending on the item) were given. Therefore, the number of trials for each item varied across participants, offering additional opportunities to respond for those who failed to do so on the first trial. A t-test was conducted to ensure that the duration of the STAT did not differ significantly by group, $t(1,61)=1.03$, p=n.s., with an average time of 17.8 minutes (SD=4.2) for SIBS-ASD and 16.69 minutes (SD=3.91) for SIBS-TD. The non-significant difference suggests a comparable administration time and hence comparable time period for presentation of coded behaviors.

Coding

Videotapes were converted to digital format and coded using ProcoderDV software (Tapp, 2003), a software program that enables event coding of digital files made from videotapes.

Lexical density is defined as the number of nonimitative, non-prompted words used in a communication sample, and reflects both talkativeness and productive vocabulary size (Yoder, Warren, & McCathren, 1998). Only non-prompted and non-imitative words are used to ensure that all words are used with fluency. Lexical density is a more optimal measure of the desired outcome variable than the more commonly used parent report, since it does not include words that are infrequently used or used in noncommunicative ways, as parent report measures do (Yoder, 2006).

Number of unique words produced by the child was calculated for the Lexical Density variable. The following criteria were used for a word approximation (adapted from Yoder, 2006): (a) must contain at least one accurate consonant and vowel in the correct position, (b) must have the correct number of syllables (exceptions made for common developmentally appropriate word derivates), and (c) appears in the unabridged English language dictionary. Number of unique words was tallied (note: different word forms such as “want” and “wanted” qualify as one word). Criteria used within the Lexical Density measure is an empirically and theoretically supported. It is designed to reflect useful speech, and is characterized by language that is useful (i.e. communicative, functional, flexible, non-imitative and frequent) (Yoder et al., 1998).

When assessing communicative language abilities in ASD and children at risk for ASD, these aspects of language are of particular importance to isolate in order to disregard echolalic and non-functional speech which is commonly used by this population. Furthermore, past research has used this measure with children with ASD (Yoder, 2006).

Reliability

Coders were trained on the Lexical Density coding system. Coders transcribed tapes, typing the word or phrase used by the child, and recorded all non-imitative, non-prompted words. Inter-observer reliability was estimated from independently coded, randomly selected tapes that comprised at least 20% of the SIBS-ASD and 20% of the SIBS TD sessions. The intra-class correlation coefficients were .97 for SIBS-ASD and .94 for SIBS-TD.

CHAPTER III

RESULTS

Design Overview: designs used are (a) intact group comparison and (b) longitudinal correlational design. Groups were equated on chronological age at T1.

Preliminary Analyses.

Table 2 supplements the information provided in Table 1, completing the descriptive information of variables used to test research questions. Descriptive information about the predictors at T1 and the Lexical Density measure at T2 is provided. T1 predictors (i.e. intentional communication variables) were converted to proportion variables to reflect the proportion of items passed.

Tables 3 and 4 present correlations between variables of interest, within and across groups.

Table 2. *Means and Standard Deviations for Descriptive Variables at Time 1 and Time 2.*

	Group					
Variable	SIBS-ASD (*n*=38)			SIBS-TD (*n*=25)		
	Mean	SD	Range	Mean	SD	Range
Intentional Communication (T1)*						
Declaratives	.24	.30	0-1	.52	.37	0-1
Imperatives	.38	.43	0-1	.56	.42	0-1
Expressive Language (T2)						
Lexical Density	23.74	16.90	0-61	22.60	16.74	2-61

*Intentional Communication variables are operationalized as the proportion of the trials for which the child capitalized on specific opportunities to engage in the particular behavior (i.e. declarative, imperative). The possible Ranges are proportions and therefore 0-1,with possible values of 0, .50, and 1.

Table 3. *Correlations for Predictor and Outcome Variables Across Groups.*

	Imperatives	Lexical Density
Declaratives	.270*	.358**
Imperatives	--	.102

* *p* < .05
** p <.001

Table 4. *Correlations for Predictor and Outcome Variables Within Groups. SIBS-ASD are above diagonal and SIBS-TD are below.*

	Declaratives	Imperatives	Lexical Density
Declaratives	--	**.119**	**.276[a]**
Imperatives	*.322*	--	**-.074**
Lexical Density	*.570***	*.407**	**--**

[a] p <.10
* *p* < .05
** p <.001

Group differences (in SIBS-ASD versus SIBS-TD) in terms of main effects of chronological age, gender, and maternal education were addressed. SIBS-ASD and SIBS-TD were not significantly different in terms of chronological age at T1, t(1,61)= -1.29, p=.20, or T2, t(1,61)=-.73, p=.47, or gender, t(1,61)=1.02, p= .32. Group

differences were found for maternal education, t(1,61)=-2.42, p=.02, with mothers of children in the SIB-TD having received significantly higher levels of education than mothers in the SIB-ASD sample. Socioeconomic status, including level of maternal education, has been shown to be related to measures of child development (i.e. language skills) (Hart & Risley, 1995; Walker, Greenwood, Hart, & Carta, 1994). Since preliminary analyses in the current sample revealed a significant group difference in maternal education, further preliminary analyses were performed to test the relation between maternal education and the variables of interest (i.e. commenting, requesting, Lexical Density). Results revealed that maternal education was not correlated with any of the variables of interest and therefore did not need to be co-varied in subsequent analyses. Non-significant correlation between maternal education and the variables of interest were as follows: r=.19, p=.13 for declaratives; r=.02, p=.89 for imperatives; and r=-.05, p=.70 for Lexical Density.

Main Analyses

Part 1a: Do SIBS-ASD exhibit a deficit in ability to engage in declaratives (i.e. proportion of the trials for which the child capitalized on specific opportunities to engage in declaratives) in relation to SIBS-TD at T1? Are there specific items designed to elicit declaratives that best distinguish SIBS-ASD from SIBS-TD? Are there group differences in terms of ability to engage in imperative intentional communication (i.e. proportion of the trials for which the child capitalized on specific opportunities to engage in imperatives)?

T-tests revealed that SIBS-TD initiated significantly more declaratives than SIBS-ASD, t(1, 61)=-3.34, p=.002, Cohen's d= .83. SIBS-ASD had a mean proportion of .24 (SD=.30) for declaratives, and SIBS-TD had a mean proportion of .52 (SD=.37). These

relatively low proportions are not surprising given that declarative intentional communication is an emerging skill throughout the second year of life in typical development.

Part 1b: Is there a group difference (i.e. SIBS-ASD, SIBS-TD) for imperatives?

Group differences for imperatives were also examined. No significant difference between groups was found for imperatives, t(1,61)=-1.64, p=.11

Part 1c: Do SIBS-ASD exhibit a deficit in engaging in declarative intentional communication in comparison to their ability to engage in imperative intentional communication? Is the hypothesized discrepancy present in SIBS-TD?

To determine whether SIBS-ASD were significantly better at engaging in imperatives than declaratives a paired sample t-test was performed, examining imperatives versus declaratives within the SIB-ASD group. Analyses revealed that SIBS-ASD engaged in significantly more imperatives than declaratives, t(1, 37)=1.81, p=.08, Cohen's d=.38. Given the a-priori directional hypothesis, a p-value of .10 was needed to achieve significance. Thus, discrepancy between SIBS-ASD use of imperatives and declaratives was found.

The presence of discrepancy between imperatives and declaratives was also examined in the SIBS-TD sample. A paired sample t-test within the SIBS-TD sample indicated no significant difference in type of intentional communication, t(1, 24)=.44, p=.66. On average, SIBS-TD initiated imperatives on 56% and declaratives on 52% of

the trials designed to elicit these behaviors. These abilities appear to be roughly equal in the SIBS-TD sample.

Part 1d: Do SIBS-ASD exhibit a deficit in comparison to SIBS-TD in declaratives, after controlling for the variance contributed by imperatives?

ANCOVA were used to examine group differences for declaratives after removing the variance contributed by imperatives with declaratives as the dependant variable, group as the fixed factor, and imperatives as the covariate. Results revealed that groups were significantly different, $F(1,60)=8.84$, $p=.004$, $\eta_p^2=.13$, with SIBS-TD performing at a significantly higher level than SIBS-ASD. The mean proportion was.52 (SD=.37) for SIBS-TD and .24 (SD=.30) for SIBS-ASD.

Part 1e: Do SIBS-ASD exhibit a deficit in comparison to SIBS-TD for expressive language (i.e. Lexical Density), measured at T2?

T-tests did not reveal any significant difference between SIBS-ASD and SIB-TD groups for Lexical Density at T2, $t(1,61)=.25$, $p=.80$, Cohen's d=.09.
The mean number of unique words used was 23.74 (SD=16.76) for SIBS-TD and 22.64 (SD=16.90) for SIBS-ASD. Cohen's d indicates a very small effect size.

Part 2a: Does this study replicate previous findings which indicate a significant positive relation between declarative acts (i.e. proportion of the trials for which the child capitalized on specific opportunities to engage in declaratives) observed at T1 and expressive language (i.e. Lexical Density) observed at T2 in typically developing children (SIBS-TD)? Is this relation present in SIBS-ASD?

Regression analyses revealed that declaratives at T1 were significantly and positively correlated with Lexical Density at T2 for the SIBS-TD, β=.57, p=.003, R^2=.33. This relation was then examined in the SIBS-ASD sample. Regression analyses revealed that the declaratives at T1 were also significantly and positively related to Lexical Density at T2 in the SIBS-ASD, β=.28, p=.09, R^2=.08. It should be noted that a one-tailed test was used in these analyses, requiring a p-value of .10 to achieve significance, as a specific theoretically supported hypothesis of a positive association between declaratives and Lexical Density was given a-priori. The strength of this relation in the SIBS-ASD versus SIBS-TD was also of interest. Therefore a regression with declaratives, group and the group X declaratives interaction was performed. Results revealed this interaction term was significant, β=-.42, p=.04, R^2=.21, which indicates that the relation between declaratives and later language is different for SIBS-ASD than it is for SIBS-TD. In particular, this relation is stronger in SIBS-TD versus SIBS-ASD with β=.57 and β=.28, respectively.

Part 2b: Do declaratives (i.e. proportion of the trials for which the child capitalized on specific opportunities to engage in declaratives) at T1 predict Lexical Density at T2, after controlling for imperatives (i.e. proportion of the trials for which the child capitalized on specific opportunities to engage in imperatives) at T1 in SIBS-TD and in SIBS-ASD?

In order to examine the relation between declaratives and Lexical Density after removing variance contributed by imperatives, declaratives and imperatives were

entered into the same regression model, with imperatives entered first. The prior significant and positive relation found in SIBS-TD and SIBS-ASD remained, β=.49, p=.01, R^2=.38; ΔR^2=.33 and β=.29, p=.08, R^2=.09, ΔR^2=.09, respectively.

To determine whether strength of this relation differed for SIBS-ASD versus SIBS-TD a multiple regression with declaratives, imperatives, group, and the group X declaratives interaction was conducted. Results revealed this interaction term was non-significant, indicating that the relation between declaratives and Lexical Density after removing any of the variance contributed by imperatives is not different between groups, β=-.16, p=.40, ΔR^2=.17.

Part 2c: Do imperatives (i.e. proportion of the trials for which the child capitalized on specific opportunities to engage in imperatives) at T1 predict Lexical Density at T2, after controlling for declaratives (i.e. proportion of the trials for which the child capitalized on specific opportunities to engage in declaratives) at T1 in SIBS-TD and in SIBS-ASD?

As a preliminary question, the relation between imperatives and Lexical density was examined in both groups. A significant relation was found for SIBS-TD, β=.41, p=.04, R^2=.17, but not SIBS-ASD, β= -.44, p=.66, R^2=.01. Next, the relation between imperatives and Lexical Density after removing variance contributed by declaratives was examined via multiple regression, imperatives and declaratives were entered into the same regression model, with declaratives entered first. The prior significant and positive relation found in SIBS-TD was no longer significant after removing the variance contributed by declaratives, β=.24, p=.18, ΔR^2=.38. For the SIBS-ASD, the relation remained non-significant, β=-.11, p=.51, ΔR^2=.09

The difference of the strength of this relation for SIBS-ASD versus SIBS-TD was examined via multiple regression with imperatives, declaratives, group, and the group X imperatives interaction. Results revealed this interaction term was non-significant, indicating that the relation between imperatives and Lexical Density after removing any of the variance contributed by declaratives is not different between groups, β=-.35, p=.12, ΔR^2=.20

Summary of Results

SIBS-ASD were significantly more impaired in their use of declaratives as compared to SIBS-TD, before and after controlling for imperatives. No group differences were found for use of imperatives or expressive language use (i.e. Lexical Density). Furthermore, SIBS-ASD but not SIBS-TD exhibited a significant discrepancy between their use of imperatives versus declaratives, initiating declaratives markedly less adeptly than imperatives.

Declaratives were found to be significantly and positively related to later expressive language in both SIBS-ASD and SIBS-TD, before and after controlling for imperatives. This relation was found to be different for SIBS-ASD versus SIBS-TD, before controlling for imperatives. A relation between imperatives and later expressive language was found for SIBS-TD, but not SIBS-ASD. However this distinction between the 2 groups disappeared after removing the variance contributed by declaratives.

CHAPTER IV

DISCUSSION

Early intentional communication abilities are fundamentally important in a child's early development, as they have significant implications for subsequent developmental sequelae. One salient developmental outcome is language development. The relation between declarative intentional communication and later language is both theoretically and empirically supported in autism and typical development, but has not yet been examined in siblings of children with ASD who are at heightened risk for language and other developmental delays related to ASD. The discussion commences with an examination of the predictive relation between intentional communication and language, and subsequently follows with a separate discussion of group differences in each ability.

The Predictive Relation between Intentional Communication and Expressive Language

The primary purpose of the current study has been to examine the predictive relation between early declarative intentional communication abilities and later expressive language in younger siblings of children with autism spectrum disorders (SIBS-ASD). Declaratives are theorized to be critical for subsequent development of social, language and cognitive abilities (Tomasello, 1995). Specifically, it is believed that the relation between declaratives and later language acquisition exists, given that both indicate a child's awareness of the purpose

of communication (Travis & Sigman, 1998). In line with prior research, this relation is present in our sample of typically developing children (younger siblings of typically developing children; SIBS-TD).

Furthermore, as hypothesized, this relation is also significant in the SIBS-ASD sample. The presence of this relation has been of particular importance as it indicates that one can make predictions regarding language outcomes in SIBS-ASD based on early abilities in declarative intentional communication, which has important implications for earlier identification and intervention. Evidence has also been found showing that the nature of this relation for SIBS-ASD differs significantly from the relation for SIBS-TD. This suggests the possibility of SIBS-ASD and SIBS-TD not following the same trajectory of early declarative abilities to later expressive language, and that SIBS-ASD may learn via different pathways than typically developing children. While the association between early declaratives and later language is significant in both populations, the relation is stronger in SIBS-TD, implying that the significance of early declarative abilities may not be as strong for SIBS-ASD as it is for SIBS-TD.

The next query has been whether declaratives predict language after controlling for the effect of imperatives. Results have extended previous findings in autism (McDuffie 2004), with the relation remaining significant in SIBS-TD and SIBS-ASD. This underlines the role of the development of early declarative intentional communication in the typically developing children and suggests its importance in SIBS-ASD. When examining the unique contribution of declaratives (removing the variance contributed by imperatives), no evidence has been found for a difference in strength of this relation in

SIBS-ASD versus SIBS-TD. This indicates that the unique contribution of declaratives may have a similarly important underlying mechanism in language learning in SIBS-ASD and SIBS-TD. Given that a past study has shown this same evidence for a relation between a unique contribution of declaratives after controlling for imperatives and later expressive language in children with ASD (McDuffie, 2004), one can conjecture a commonality among SIBS-ASD and children with ASD in that the unique contribution of declaratives is a salient predictor for later language. Thus, while it is clear that declaratives possess a distinct importance for language learning in both SIBS-ASD and SIBS-TD the question arises of what possible contributions imperatives may be making in the SIBS-TD.

The relation between early use of imperative intentional communication and later language abilities has also been of interest, though the empirical and theoretical support for this relation is less compelling. This study has found a significant relation between imperatives and later language in the sample of typically developing children (SIBS-TD), but not in SIBS-ASD. This introduces the possibility that SIBS-TD may capitalize on interactions governed by imperatives for language learning, while SIB-ASD may be less apt to do so.

In examining fundamental differences of the relations of declaratives and imperatives relative to later development of speech, it is clear that although both share overt commonalities, clear distinctions exist. In particular, underlying motives to use either form of communication are theoretically distinctive. When a child possesses a drive to engage in more declaratives, he/she generates contexts for social interaction.

More time spent engaged with the adult allows the child to hone his/her language and socialization skills. While imperatives also elicit linguistic mapping, it is possible that for SIBS-ASD and children with ASD, the quality of the interactions within declarative intentional communication is more fundamental to acquiring useful language (i.e. communicative, functional, flexible, non-imitative and frequent) than in typically developing children.

Given the discussed commonalties among imperatives and declaratives, and the significant correlation between the two within the SIBS-TD group in the preliminary analyses, the question has arisen whether imperatives might continue to predict later expressive language after removing any variance contributed by declaratives. Interestingly, once variance contributed by declaratives is removed, the significant relation in SIBS-TD between imperatives and later language is no longer significant. This again underscores the *relative* unimportance of imperatives within the developmental acquisition of language.

Furthermore, it has been postulated that different forms of intentional communication are mediated by different neurological pathways (Mundy 1995; Mundy & Neal, 2001), and may involve different attention regulation, affective, and cognitive processes (Mundy, 1995). Specifically, declaratives and imperatives have been found to be differentially related to measures of frontal brain activity (Mundy et al., 2000; Henderson et al., 2002), attention regulation (Morales et al., 2005), social motivation (Mundy, Kasari, Sigman, 1992; Vaughan et al., 2003), and self-monitoring (Nichols et al., 2005). Various combinations of these wide-ranging influences may differentially

affect the development of declaratives versus imperatives. In other words, convergent as well as divergent processes are involved, reducing common associations to other aspects of development. This may serve to explain why declaratives were found to be the only form of intentional communication to uniquely predict later language production in the typically developing sample, underlining the distinct importance of declaratives in the developmental process of language acquisition. This is not to say that imperatives do not possess any predictive validity for language, but that the early development of declaratives presents itself as a more salient indicator, and is arguably a more tangible precursor for language.

Group Differences in Intentional Communication

Another goal of this paper has been to examine group differences between SIBS-ASD and SIBS-TD on declaratives and imperatives more generally. As found in previous work (Goldberg et al., 2005; Stone et al., 2007), SIBS-ASD are significantly less successful in utilizing declarative intentional communication than SIBS-TD at T1 (12-19 months). A deficit in use of declaratives has been a hallmark feature of the atypical early development in ASD (e.g., Mundy & Sigman, 1989; Mundy, Sigman, Ungerer, & Sherman, 1986; Sigman, 1998), and is commonly utilized as a marker for early identification. This deficit has been presupposed, given prior examination of a portion of this sample (i.e. Stone et al., 2007), however it has needed to be re-examined given variations of the sample and measure. Given that a significant correlation has been found between imperatives and declaratives in the SIBS-TD sample, group

differences in declaratives have been examined while controlling for the effect of imperatives. Removing the effect of imperatives has allowed for an examination of declaratives as an isolated construct. Results have revealed a significant difference between groups, reinforcing the presence of a declarative deficit in SIBS-ASD.

No significant group differences have been found for imperatives. This is consistent with previous research that has children with ASD to be less impaired in the use of imperatives (Loveland & Landry, 1986; Mundy et al., 1986; Sigman, Mundy, Ungerer, & Sherman, 1986; Wetherby & Prutting, 1984). While SIBS-ASD (and children with ASD) may be using imperatives as habitually as SIBS-TD, it is possible that the specific nature of these interactions may not be the equivalent in that, as discussed above, SIBS-ASD may benefit less from these interactions in terms of learning (i.e. language). Specifically, SIBS-ASD may be focusing all of their attention on ensuring that their interactive partner fulfills the instrumental need they are expressing, and may therefore miss out on any supplementary input the caregiver may be providing.

Performance in SIBS-ASD and SIBS-TD on declaratives relative to imperatives has also been examined. A discrepancy in the ability to engage in declaratives in contrast to imperatives has been noted in autism (e.g., Mundy, Sigman, & Kasari, 1990), with a marked deficiency in declaratives relative to imperatives. As hypothesized, this discrepancy has been found in SIBS-ASD, whereas no evidence of a difference in these two skills in SIBS-TD has been present. In the literature, the relation between declaratives and imperatives is well-replicated for typically developing children (e.g., Charman et al., 2000; Mundy & Gomez, 1998; Ulvand & Smith, 1996),

and the current study supports these findings as well. In typically developing children, the presence of this relation suggests the possibility of parallel developmental milestones in the acquisition of these two skills. The SIBS-ASD as a group may be demonstrating a different pattern from that found in typically developing children, with the ability to engage in declaratives lagging behind the ability to engage in imperatives. One possibility is that the ability to initiate intentional communication for imperatives may scaffold the subsequent ability to share attention for the purposes of commenting (i.e. declaratives). Leew (2001) has demonstrated that children with developmental delays who learn to initiate imperatives can learn to use the same behavioral form for the purpose of commenting. Thus, while typically developing children may have the ability to develop these skills concurrently, the SIBS-ASD and children with autism may need to first develop skills in imperatives and subsequently learn to use declaratives.

Group Differences in Expressive Language

A further central question in this study has involved the examination of group differences in expressive language abilities. This was assessed approximately one year after the examination of intentional communication skills; ages ranged from 20 to 28 months. A measure of Lexical Density, the number of unique words produced in a communication sample, assessed expressive language. There was no evidence for expressive language differences in SIBS-ASD versus SIBS-TD using this measure. This is consistent with other studies examining expressive language in these two groups within this age range (e.g., Toth et al., 2007). However, given the replicated relation

between early declaratives and later language, the deficits that SIBS-ASD have in early declarative intentional communication make these children particular vulnerable to subsequent difficulties in language. While the present results do not support this conclusion, it may be that the measure of expressive language was not sensitive enough to discern the differences that exist. It is also possible that the quality and functionality of the language may be different, rather than there being a difference in vocabulary size. For instance, research has also provided evidence of a delay in the development of pragmatic (Tager-Flusberg, 1981; Wetherby & Prutting, 1984; Wilkinson, 1998), phonological, syntactical, and morphological systems in children with autism (Bartolucci, 1982). Not surprisingly, Bartak, Rutter, and Cox (1975) also reported that children with autism differed on functional use of language, in that children with autism have fewer and qualitatively different spontaneous remarks, with an apparent defect in social usage of language. A closer examination of the expressive language skills of SIBS-ASD, particularly related to those aspects of language that have been found to be impaired in children with autism, may provide more insight into the lasting language deficiencies or peculiarities that may relate to or by triggered by a lack of early motivation to engage in declarative intentional communication.

An alternative explanation for the present findings concerning language usage is the possibility SIBS-ASD learn to compensate with alternative mechanisms for language learning. This may allow them to develop language despite their lessened motivation for purely social interactions through the spontaneous use of mechanisms such as

experiential learning, imitation or trial-and-error, rather than through the socially mediated pathways many have theorized exist in typical development.

Limitations

One limitation of this study has been the small number of opportunities given for each intentional communication measure. In the final measures used for analyses (i.e. imperatives and declaratives), there were only two items in each category. Thus, the possible proportion scores for these were: 0, .5, and 1. A more continuous measure might allow for more sensitivity in assessing individual differences in intentional communication skills and making meaningful predictions regarding later language outcomes. As mentioned earlier, the STAT was designed as a screening tool for ASD and not as a specific measure to elicit intentional communication. Future studies could use a more targeted measure to better assess these skills in SIBS-ASD.

Another possible limitation is the nature of the measure of expressive language, or Lexical Density. This particular measure attempts to obtain a naturalistic language sample in a relatively short period of time. Due to the nature of the assessment from which the language sample was obtained, the child's mood or temperament may have skewed language estimates. For instance, a shy child, or a child who was anxious around new people, may have used much less language than he/she is capable of. The Lexical Density measure used in this study assesses talkativeness in addition to language capacity (which was thought to be advantageous for the study's purposes in

some respects). However, this feature may make it less suitable than other measures when accounting for definitive abilities in productive vocabulary size.

Future Recommendations

Given the strong empirical and theoretical relation between early declaratives and later social behavior in SIBS-TD, future studies should use measures of social-communicative skills to examine the predictive relations between early intentional communication abilities and later outcomes in SIBS-ASD. Subtle differences between SIBS-ASD and SIBS-TD may be crucial and influential in the development, even though these differences were not clearly quantifiable with the instruments used in the present study. Therefore, selection of more sensitive and extensive assessments of social-communicative, intentional communication, and expressive language skills may prove to be critical to the detection of important, yet perhaps more subtle differences.

A future study here at Vanderbilt will focus on the predictive relation between early intentional communication and later social and language outcomes in SIBS-ASD at a later stage, as children reach school age. Communication skills become particularly important at this age as children begin to have more interactions with peers and as they must use language at a more sophisticated and flexible level in the classroom. This study will allow us to determine the relative importance of early developmental lags as detected through declarative intentional communication on later social and communicative functioning in younger siblings of children with autism spectrum disorders. Early deficits may have an adverse effect on later development

and functioning and the identification of early markers leads to opportunities for remediation through intervention. In particular, neurodevelopmental theory has indicated that brain plasticity of very young children may allow for an optimal time window for the potential opportunity to overcome neurodevelopmental deficits (Huttenlocher, 1994; Nelson, 2000), and may in turn facilitate optimally beneficial early interventions (Dawson et al., 2000; Mundy & Neal, 2001). Findings will be of foremost significance to parents and educators as they will help to indicate whether children who exhibit a deficit in their use of early use of intentional communication (i.e. declaratives) require early intervention services before school age in order to prevent a cascade of further deficits.

APPENDIX A

Intentional Communication Item Description

	Item	Description	Example
Declaratives	Balloon	The examiner inflates a balloon and then lets it go so that it flies across the room. The examiner maintains neutral affect and waits to see the child's reaction.	**The child may look back and forth between the examiner and the balloon and laugh, or pointing to the balloon and say, "Look".**
	Puppet	The examiner wears an animal puppet on his/her hand while writing some notes. If the child does not react that examiner yawns and scratches his/her head with the hand wearing the puppet. Should the child continue not to respond the examiner will place the puppet on the table in front of the child. The examiner remains neutral until the child responds.	**A child might direct the examiner's attention by saying "Puppy" while looking at the examiner or by pointing to the puppet and smiling at the examiner.**
	Bag of Toys	The examiner gives the child an opaque bag of toys. If needed	**Examples of directing attention behaviors for**

		the examiner will partially reveal the toys inside of the bag. The examiner maintains neutral affect until the child responds.	**this item include holding up and showing toys to the examiner or looking at the examiner while labeling a toy (e.g., "Snake").**
	Noisemaker	Another item involves activating an electronic noisemaker out of the child's view.	**For this item a child might direct the examiner's attention by looking at him/her and saying, "Uh-oh" or by pointing toward the sound with a surprised facial expression.**
Imperatives	Bubbles	The examiner blows soap bubbles and then hands the bubble jar to the child with the lid screwed on tightly.	**The child may give the jar of bubbles to the examiner and vocalize, alternating gaze between the jar of bubbles and the examiner.**
	Food	**The examiner gives the child a sealed, clear plastic jar containing candy and other food treats.**	**For this item, the child may request by holding up the jar of food and vocalize, while alternating gaze between the experimenter and the jar.**

Modified from STAT Manual: Screening Tool for Autism in Two-Year-Olds (Stone, W., & Ousley, O., 1999; 2003).

REFERENCES

Akhtar, N., Dunham, F., & Dunham, P. J. (1991). Directive interactions and early vocabulary development: The role of joint attentional focus. *Journal of Child Language, 18*, 41-49.

American Psychiatric Association, (2000). *Diagnostic and Statistical Manual of Mental Disorders-IV-Text Revision (4th ed., rev.).* Washington DC: Author.

Bailey, A., Palferman, S., Heavey, L., & Le Couteur, A. (1998). Autism: the phenotype in relatives. *Journal of Autism and Developmental Disorders, 28,* 369-392.

Bakeman, R., & Adamson, L. (1984). Coordinating attention to people and objects in the mother-infant and peer-infant interaction. *Child Development, 55,* 1278-1289.

Bakeman, R., & Adamson, L. (1986). Infants' conventionalized acts: Gestures and words with mothers and peers. *Infant Behavior and Development, 9,* 215-230.

Bartak, L., Rutter, M., & Cox, A. (1975). A comparative study of infantile autism and specific developmental receptive language disorder: I. *British Journal of Psychiatry, 126,* 127-145.

Bartolucci, G. (1982). Formal aspects of language in childhood autism. *Advances in Child Behavioral Analysis and Therapy, 2,* 159-185.

Bates, E. (1979). Intentions, conventions, and symbols. In E. Bates, L. Benigni, I. Bretherton, L. Camaioni, & Volterra (Eds.), *The emergence of symbols: Cognition and Communication in infancy* (pp. 33-68). New York: Academic Press.

Bates, E., Thal, D., Whitesell, K., Fenson, L., & Oakes, L. (1989). Integrating language and gesture in infancy. *Developmental Psychology, 25,* 1004-1019.

Bloom (1993). *The transition from infancy to language: Acquiring the power of expression.* New York: Cambridge University Press.

Bono, M., Daley, T., & Sigman, M. (2004). Relations among joint attention, amount of intervention, and language gain in autism. *Journal of Autism and Developmental Disorders, 34,* 495-505.

Bretherton, I. (1992). Social referencing, intentional communication, and the

interfacing of minds in infancy. In S. Feinman (Ed.) *Social referencing and the social construction of reality in infancy* (pp. 57-77). New York: Plenum.

Bruner, J. S. (1981). The social context of language acquisition. *Language and Communication, 1,* 155-178.

Calandrella, A. & Wilcox, J. (2000). Predicting language outcomes for young prelinguistic children with developmental delay. *Journal of Speech, Language, and Hearing Research, 43,* 1061-1071.

Carpenter, M., Nagell, K., Tomasello, M. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs for the Society of Research in Child Development, 63, (4)*, serial no. 255.

Cassell, T. D., Messinger, D. S., Ibanez, L. V., Haltigan, J. D., Acosta, S. I., & Buchman, A. C. (2007). Early social and emotional communication in the infant siblings of children with autism spectrum disorders: An examination of the broad phenotype. *Journal of Autism and Developmental Disorders, 37,* 122-132.

Charman, T. (2003). Why is joint attention a pivotal skill in autism? *Philosophical Transactions of the Royal Society of London Series B-Biological Sciences, 358,* 315-324.

Charman, T., Baron-Cohen, S., Swettenham, J., Baird, J., Cox, A., & Drew, A. (2000). Testing joint attention, imitation, and play as infancy precursors to language and theory of mind. *Cognitive Development, 15 (4),* 481-498.

Corkum V. L., & Moore, C. (1995). Development of joint visual attention in infants. In C. Moore & P. J. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 61-83). Hillsdale, NJ, Erlbaum.

Dawson, G., Ashman, S. B., & Carver. L. J. (2000). The role of early experience in shaping behavioral and brain development and its implications for social policy. *Development and Psychopathology, 12,* 695-712.

Franco, F., Fabia, F., & Butterworth, G. (1996). Pointing and social awareness: Declaring and requesting in the second year. *Journal of Child Language, 23,* 307-336.

Gamliel, I. Yirmiya, N. & Sigman, M. (2007). The development of young siblings of children with autism from 4 to 54 months. *Journal of Autism and Developmental Disorders, 37,* 171-183.

Gilberg, C. (1991). Outcome in autism and autism-like conditions. *Journal of the*

American Academy of Child and Adolescent Psychiatry, 30, 375-382.

Goldberg, W. A., Jarvis, K. L., Osann, K., Laulhere, T. M., Straub, C., Thomas, E., Filipek, P., & Spence, M. A. (2005). Brief report: Early social communication behaviors in the younger siblings of children with autism. *Journal of Autism and Developmental Disorders, 35,* 657-664.

Gomez, J., Sarria, E., & Tamarit, J. (1993). The comparative study of early communication and theories of mind: Ontogeny, phylogeny, and pathology. In S. Baron-Cohen, H. Tager-Flusberg, & D. Cohen (Eds.), *Understanding other minds* (pp. 397-426). Oxford, England: Oxford University Press.

Hart, B., & Risley, T. (1995). Meaningful differences in the everyday experience of young American children. Baltimore, MD: Paul H. Brookes Publishing.

Henderson, L., Yoder, P., Yale, M., & McDuffie, A. (2002). Getting the point: Electrophysiological correlates of protodeclarative pointing. *International Journal of Developmental Neuroscience, 20*, 449-458.

Hill, E. L., & Frith, U. (2003). Understanding autism: insights from mind and brain. *Philosophical Transactions: Biological Sciences, 358*, 281-289.

Huttenlocher, P. R. (1994). Synaptogenesis in Human Cerebral Cortex, in G. Dawson & K. W. Fisher (Eds.). *Human Behavior and the Developing Brain* (pp. 137-152). New York: Guilford Press.

Kasari, C., Sigman, M., Mundy, P., & Yirmiya, N. (1990). Affective sharing in the context of joint attention interactions of normal, autistic, and mentally retarded children. *Journal of Autism and Developmental Disabilities, 20,* 87-100.

Landa, R. & Garrett-Mayer, E. (2006). Development in infants with autism spectrum disorders: A prospective study. *Journal of Child Psychology and Psychiatry, 47,* 629-638.

Leew, S. (2001). *The relationship of prelinguistic milieu training to the increased use of communication forms associated with proto-declaratives.* Unpublished dissertation, Vanderbilt University, Nashville.

Lock, J., Young, A., Service, V., & Chandler, P. (1990). Some observations on the origin of the pointing gesture. In V. Volterra & C. J. Erting (Eds*.), From gesture to language in hearing and deaf children.* Berlin: Springer-Verlag.

Losh, M., Childress, D., Lam, K., & Piven, J. (2007). Defining key features of the broad autism phenotype: a comparison across parents of multiple- and single-incidence

autism families. American Journal of Medical Genetics Part B: Neuropsychiatric Genetics, in press.

Loveland, K., & Landry, S. (1986). Joint attention and language in autism and developmental language delay. *Journal of Autism and Developmental Disorders, 16,* 335-349.

McDuffie, A. (2004).The *relationship of four prelinguistic skills and rapid word-object mapping to vocabulary outcomes in young children with autism.* Unpublished doctoral dissertation, Vanderbilt University, Nashville, TN.

McDuffie, A. Yoder, P., & Stone, W. (2005). Prelinguistic predictors of vocabulary in young children with autism spectrum disorders. *Journal of Speech, Language, Hearing Research, 48,* 1080-1097.

Mitchell, S., Brian, J., Zwaigenbaum, L., Roberts, W., Szatmari, P., Smith, I., & Bryson, S. (2006). Early language and communication development of infants later diagnosed with autism spectrum disorder. (Early Identification). *Journal of Developmental & Behavioral Pediatrics*, 27, 69-78.

Morales, M., Mundy, P., Crowson, M., Neal, R., & Delgado, C. (2005). Individual differences in infant attention skills, joint attention, and emotion regulation behavior. *International Journal of Behavioral Development, 29*, 259-263.

Mundy, P. (1995). Joint attention and social-emotional approach behavior in children with autism. *Development and Psychopathology, 7,* 63-82.

Mundy, P., Card, J., & Fox, N. (2000). EEG correlates of the development of infant joint attention skills. *Developmental Psychobiology, 36,* 325-338.

Mundy, P. & Crowson, M. (1997). Joint attention and early communication: Implications for intervention with autism. *Journal of Autism and Developmental Disorders, 6,* 653-676.

Mundy, P. & Gomez, A. (1998). Individual differences in joint attention skill development in the second year. *Infant Behavior & Development 21(3),* 469-482.

Mundy, P., Kasari, C, & Sigman, M. (1992). Nonverbal communication, affective sharing, and intersubjectivity. *Infant Behavior & Development, 15,* 377-381.

Mundy, P., Kasari, C., Sigman, M., & Ruskin, E. (1995). Nonverbal communication and early language acquisition in children with Down

syndrome and in normally developing children. *Journal of Speech and Hearing Research, 38,* 157-167.

Mundy, P. & Neal, R. (2001). Neural plasticity, joint attention and a transactional social-orienting model of autism. *International Review of Mental Retardation, 23,* 139-168.

Mundy, P. & Sigman, M. (1989). The theoretical implications of joint attention deficit in autism. *Development and Psychopathology, 1,* 173-183.

Mundy, P., Sigman, M., & Kasari, C. (1990). A longitudinal study of joint attention and language development in autistic children. *Journal of Autism and Developmental Disorders, 20,* 115-129.

Mundy, P., Sigman, M., & Kasari, C. (1994). Joint attention, developmental level, and symptom presentation in autism. *Development and Psychopathology, 6,* 389-401.

Mundy, P., Sigman, M., Kasari, C., & Yirmiya, N. (1988). Nonverbal communication skills in Down syndrome children. *Child Development, 59,* 235-249.

Mundy, P. & Sigman, M., Ungerer, J., & Sherman, T. (1986). Defining the social deficits of autism: The contribution of nonverbal communication measures. *Journal of Child Psychology and Psychiatry, 27*, 657-669.

Mundy, P., Sigman, K., Ungerer, J., & Sherman, T. (1987). Nonverbal communication and play correlates of language development in autistic children. *Journal of Autism and Developmental Disorders, 17(3)*, 349-364.

Nelson, K. (2000). Global and functional: Mandler's perceptual and conceptual processes in infancy. *Journal of Cognition and Development, 1,* 49-54.

Nichols, K. E., Fox, N., & Mundy, P. (2005). Joint attention, self-recognition and neurocognitive functioning. *Infancy, 7*, 35-51.

Paparella, T., & Kasari, C. (2004). Joint attention skills and language development in special needs populations. *Infants and Young Children, 17,* 269-280.

Piven, J., Palmer, P., Jacobi, D., Childress, D., & Arndt, S. (1997). Broader autism phenotype: evidence from a family history study of multiple-incidence autism families. *American Journal of Psychiatry, 154,* 185-190.

Presmanes, A. G., Walden, T. A., Stone, W. L., & Yoder, P. J. (2007). Effects of different attentional cues on responding to joint attention in younger siblings of children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 37,* 133-144.

Rocissano, L., & Yatchmink, Y. (1984). Joint attention in mother-toddler interaction: A study of individual variation. *Merrill-Palmer Quarterly, 30*, 11-31.

Shulman, C., Bukai, O., & Tidhar, S. (2001). Communicative intent in autism. In E. Schloper, N. Yirmiya, C. Shulman, & L. Marcus (Eds.) (2001), *The research basis for autism intervention*. New York: Kluwer Academic/Plenum Publishers.

Sigman, M., & Ruskin, E. (1999). Continuity and change in the social competence of children with autism, Down syndrome, and developmental delays. Monographs of the Society for Research in Child Development, 64, (1, Serial No. 256).

Sigman, M., Mundy, P., Sherman, T., & Ungerer, J. (1986). Social interactions of autistic, mentally retarded and normal children and their caregivers. *Journal of child psychology and psychiatry, 27,* 647-656.

Smith, L., & von Tetzchner, S. (1986). Communicative, sensorimotor, and language skills of young children with Down syndrome. *American Journal of Mental Deficiency, 91,* 57-66.

Stone, W., Coonrod, E., & Ousley, O. (2000). Screening tool for autism in two-year-olds (STAT): Development and preliminary data. *Journal of Autism and Developmental Disorders, 30*, 607-612.

Stone, W., Coonrod, E., Turner, L., & Pozdol, S. (2004). Psychometric properties of the STAT for early autism screening. *Journal of Autism and Developmental Disorders, 34*, 691-701.

Stone, W. L., McMahon, C., Yoder, P. J., & Walden, T. A. (2007). Early social-communicative and cognitive development of younger siblings of children with autism spectrum disorders. *Archives of Pediatric and Adolescent Medicine,* 161, 384-390.

Stone, W., & Ousley, O. (1999, 2003). STAT Manual: Screening Tool for Autism In Two-Year-Olds. Unpublished Manuscript, Vanderbilt University.

Stone, W., Ousley, O., Yoder, P., Horgan, K., & Hepburn, S. (1997). Nonverbal

communication in two- and three-year-old children with autism. *Journal of Autism and Developmental Disorders, 27*, 677-695.

Stone, W. & Yoder, P. J. (2001). Predicting spoken language level in children with autism spectrum disorders. *Autism,* 341-361.

Sullivan, M., Finelli, Marvin, A., Garrett-Mayer, E., Bauman, M., & Landa, R. (2007). Response to joint attention in toddlers at risk for autism spectrum disorder: A prospective study. *Journal of Autism and Developmental Disorders, 37,* 37-48.

Szatmari, P., Jones, M. B., Zwaigenbaum, L., & MacLean, J. E. (1998). Genetics of autism: Overview and new directions. *Journal of Autism and Developmental Disorders, 28,* 351-368.

Tager-Flusberg, H. (1981). On the nature of linguistic functioning in early infantile autism. *Journal of Autism and Developmental Disorders, 11(1),* 45-56.

Tapp, J. (2003). Procoder for Digital Video [Computer software]. Nashville, TN: Kennedy Center.

Tomasello, M., (1995). Joint attention as social cognition. In P. Dunham & C. Moore (Eds.)*, Joint attention: Its origins and role in development*. Hillsdale, NJ: Erlbaum.

Tomasello, M. (1988). The role of joint attention process in early language development. *Language Sciences, 10*, 69-88.

Tomasello, M. & Farrar, M. (1986). Joint attention and early language. *Child Development, 57,* 1454-1463.

Toth, K., Dawson, G., Meltzoff, A. N., Greenson, J., & Fein, D. (2007). Early social, imitation, play, and language abilities of young non-autistic siblings of children with autism. *Journal of Autism and Developmental Disorders, 37,* 145-157.

Travis, L. L. & Sigman, M. (1998). Social deficits and interpersonal relationships in autism. *Mental Retardation and Developmental Disabilities, 4,* 65-72.

Ulvand, S. & Smith, L. (1996). The predictive validity of nonverbal communication skills in infants with perinatal hazards. *Infant Behavior and Development, 19*, 441-449.

Vaughan, A., Mundy, P., Block, J., Burnette, C., Delgado, C., Gomez, Y., Meyer, J.,

Neal, R., & Pomares, Y. (2003). Child, caregiver, and temperament contributions to infant joint attention. *Infancy, 4,* 603-616.

Walker, D., Greenwood, C., Hart, B., & Carta, J. (1994). Prediction of school outcomes based on early language production and socioeconomic factors. *Child Development, 65,* 606-621.

Wetherby, A., Cain, D., Yonclas, D., & Walker, V. (1988). Analysis of intentional communication of normal children from the prelinguistic to multiword stage. *Journal of Speech and Hearing Research, 31,* 24-252.

Wetherby, A., & Prutting, C. (1984). Profiles of communicative and cognitive-social abilities in autistic children. *Journal of Speech and Hearing Research, 27,* 364-377.

Wetherby, A. Yonclas, D., & Bryan, A. (1989). Communicative profiles of handicapped preschool children: Implications for early identification. *Journal of Speech and Hearing Disorders, 54*, 148-158.

Wilkinson, K. (1998). Profiles of language and communication skills in autism. *Mental Retardation and Developmental Disabilities, 4,* 73-79.

Yirmiya, N., Gamliel, I., Pilowsky, T., Feldman, R., Baron-Cohen, S., & Sigman, M. (2006). The development of siblings of children with autism at 4 and 14 months: social engagement, communication, and cognition. *Journal of Child Psychology and Psychiatry, 47*, 511-523

Yirmiya, N. & Ozonoff, S. (2007). The very early autism phenotype. *Journal of Autism and Developmental Disorders, 37,* 1-11.

Yoder, P. J. (2006). Predictors of growth in Lexical Density in children with ASD. *American Journal of Speech-Language Pathology, 15(4),* 378-388.

Yoder, P. J., & Warren, S. F. (2004). Early predictors of language in children with and without Down syndrome. *American Journal of Mental Retardation, 109*, 285-300.

Yoder, P. J., & Warren, S. (1998). Maternal responsively predicts the prelinguistic communication intervention that facilitates generalized intentional communication. *Journal of Speech, Language, and Hearing Research, 41(5),* 1207-1219.

Yoder, P. J. & Warren, S. F. (1999). Self-initiated proto-declaratives and proto-imperatives can be facilitated in prelinguistic children with developmental

disabilities. *Journal of Early Intervention, 22,* 337-354.

Yoder, P.J., Warren, S.F., & McCathren, R. B. (1998) Determining spoken language prognosis in children with developmental disabilities. *American Journal of Speech-Language Pathology, 7(4),* 77-87.

Zwaigenbaum, L., Bryson, S., Rogers, T., Roberts, W., Brian, J., & Szatmari. (2005). Behavioral manifestations of autism in the first year of life. I*nternational Journal of Developmental Neuroscience, 23,* 143-152.