THE INFLUENCE OF ADULT SPEECH ON THE LANGUAGE OF CHILDREN WITH ASD: AN EXAMINATION OF MULTIPLE DIMENSIONS OF RESPONSIVENESS IN TWO CONTEXTS

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ABSTRACT

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Adult responsiveness is related to language development both in young typically developing children and in children with ASD, such that parents who use more responsive language with their children have children who develop better language skills. In addition, very young children and children with ASD have an easier time acquiring new object labels when adults follow in to their focus of attention rather than attempting to redirect their attention. One dimension of responsiveness, following in to the child's focus of attention, has been consistently found to promote language learning in children with and without ASD. However, other dimensions of responsiveness, such as degree of demandingness of adult language, have not been examined in detail or have produced inconsistent results. The current studies examined the relationships between two dimensions of adult responsiveness (relationship to the child's focus of attention and degree of demandingness) and child language in children with ASD and typical development. Study 1 used a microanalytic technique to examine conversational turns within a mother-child interaction. This study found that mothers' use of follow-in demanding language was most likely to elicit appropriate expressive language in both children with ASD and children with typical development. For children with ASD, but not children with typical development, mothers' use of orienting cues conferred an additional benefit for expressive language production. Study 2 examined how the same two dimensions of adult language influenced the

acquisition of new expressive and receptive vocabulary in children with ASD and typical development during a brief experimental learning task. Children with typical development were easily able to learn receptive labels in all conditions, while children with ASD tended to mis-map words to their own focus of interest during trials in which the adult's focus of attention was discrepant from their own. Children with ASD showed a trend toward correct receptive mapping with the addition of an orienting cue. During expressive trials, both children with ASD and children with typical development were most likely to map successfully during follow-in trials, and least likely to map successfully during discrepant trials. These findings suggest that following a child's focus of interest may confer language learning benefits for both children with ASD and children with typical development during challenging tasks.

This dissertation is dedicated to my parents, Elizabeth and Michael Meyer, who instilled in me a love of learning and desire to always keep asking questions.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Introduction

Autism spectrum disorders (ASD) are a group of developmental disorders characterized by impairments in social interaction and communication, and restricted and repetitive patterns of behavior or interests (American Psychiatric Association [APA], 2000). Delay in or lack of development of spoken language is a diagnostic criterion for autism (APA, 2000), and epidemiological studies have estimated that 19 to 59% of individuals with autism have no spoken language (Fombonne, 1999). Given the large percentage of individuals with ASD who have language difficulties, a significant amount of research has focused on understanding the relationships between language and other social-communication skills in individuals with ASD (e.g., Charman et al., 2005; Tager-Flusberg, 2000 for review; Mundy, Sigman, Ungerer, & Sherman, 1987; Stone & Yoder, 2001). This research has revealed that early language skills predict a variety of skills later in childhood, including socialization and communication skills (Charman et al., 2005) and that individuals with at least some functional language skills by the age of five have, on average, better long-term outcomes in terms of overall independence and quality of life in adulthood (Gillberg & Steffenburg, 1987; Nordin & Gillberg, 1998). Given the importance of language as a functional skill and the associations between early language skills and later functional outcomes across domains, language is an important treatment target for young children with ASD.

Language is comprised of a wide variety of complex skill sets, including vocabulary, grammar, and social and conversational skills. While children with ASD are delayed in a number of domains of language functioning, the following studies focus primarily on two aspects of early language learning: functional use of expressive speech during naturalistic interactions and

the acquisition of expressive and receptive noun vocabulary. These language targets are important for several reasons. In regard to use of functional expressive speech, delay in expressive language is one of the earliest concerns reported by parents of children with ASD (Coonrod & Stone, 2004) and rate of expressive language production has been used as a proxy for language functioning more broadly in a number of studies examining language interventions for children with ASD (e.g., Ingersoll, Dvortcsak, Whalen, & Sikora, 2005). In addition, Tager-Flusberg et al.'s (2009) recommendations for measuring expressive language in children with ASD note that natural language samples are an important component of measuring expressive language in these children and that they provide unique information about pragmatic language use that is difficult to obtain from standardized or parent-report assessments. In regard to noun vocabulary, this is an important early language skill as vocabulary size during toddlerhood has been found to predict later linguistic and cognitive skills (Marchman & Fernald, 2010), and nouns usually outnumber other parts of speech in children's early lexicons (Gentner, 1982). In addition, parents of preschool-aged children with ASD report that their children have significantly smaller vocabularies than children with other developmental delays (Coonrod & Stone, 2004), indicating that vocabulary is an important skill that is specifically delayed in children with ASD.

The Importance of Responsiveness in Language Development

A large body of research has indicated that parent responsiveness is associated with positive language outcomes for young children. Parent responsiveness has been broadly and variably defined across studies, but has usually included verbal or nonverbal behaviors that maintain or reflect upon a child's current attentional focus and actions. For example, Tamis-

LeMonda, Bornstein, and Baumwell (2001) found that mothers who were more responsive to their 9- and 13-month-old children's vocalizations, social initiations, and play actions during a parent-child interaction had children who achieved language milestones such as first word acquisition and combining words earlier than children of less responsive mothers. Maternal responses that commented on the child's actions (e.g., describing the child's play) and responses that directed the child's behaviors (e.g., giving play directions) both made unique contributions to children's attainment of language milestones. Similarly, Akhtar, Dunham, and Dunham (1991) found that mothers' use of language to give directions to their 13-month-old infants was correlated with better vocabulary skills 9 months later when the directions followed the infant's focus of attention (follow-in language), but not when the directions attempted to redirect the infant's focus of attention (redirecting language). Finally, Landry, Smith, and Swank (2006) found that an intervention designed to increase maternal responsiveness led to increases in children's word use. In particular, mothers who more often maintained their infants' foci of attention and labeled objects in their infants' environments had children whose word use increased more. These studies suggest that a variety of types of maternal responsiveness may be important for promoting language in young typically developing children.

A number of studies have suggested that responsiveness is also associated with better language outcomes for children with a variety of risk factors and disabilities, including children with pre-term birth (Cusson, 2006; Landry et al., 2006), hearing loss (Roberts et al., 1995), and Fragile X syndrome (Warren et al., 2010). Given the severe difficulties in language and social interaction in children with ASD, a number of researchers have also examined the relationship

between parent responsiveness and child language outcomes in young children with ASD. In a longitudinal study, Siller and Sigman (2002; 2008) examined the relationship between maternal responsiveness at age 4 and child language outcomes up to 16 years later in children with ASD. They found that mothers who used more verbalizations that followed their child's focus of attention without attempting to direct the child's behavior (follow-in, non-demanding language) had children with better language skills 10 and 16 years later (Siller & Sigman, 2002). In addition, both mothers' overall use of follow-in language, and use of follow-in non-demanding language made independent contributions to children's rate of language gains over the 4-year period following the initial assessment (Siller & Sigman, 2008). McDuffie and Yoder (2010) used a slightly different metric of parent language, with similar findings. Total number of parent follow-in verbalizations was predictive of child vocabulary gains over the course of 6 months. Within this follow-in category, a greater number of non-demanding parent verbalizations as well as a greater number of demanding parent verbalizations (those that directed the child to perform a particular action with a toy) both predicted child vocabulary gains. These findings are consistent with those of Tamis-LeMonda (2001) regarding the types of maternal language that promote language skills in typically developing children. Taken together, these studies suggest that, over time, parent use of follow-in language may be beneficial for the language skills of young children, particularly children with ASD. While it is clear that language that follows the child's attentional lead promotes child language skills, the exact type of follow-in language (e.g., demanding vs. non-demanding) that is most beneficial is less clear.

Given the apparent benefits of parent responsiveness for the language development of children with ASD, a number of interventions have aimed to train parents in responsiveness-based strategies in order to promote their children's development. Research on these interventions has suggested that changes in parent responsiveness are tied to children's language and communication outcomes. For example, Aldred, Green, and Adams (2004) implemented a parent-mediated social-communication intervention with 28 children with ASD and their families. Parents were taught to become more responsive to their children and were encouraged to use primarily follow-in, non-demanding language with their children during play interactions, describing and commenting on play rather than directing play or asking the child questions. Compared to a treatment-as-usual control group, parents in the treatment group showed increases in synchrony, including increases in comments and statements about their children's play. In turn, children in the treatment group showed decreases in ASD severity scores (particularly in the reciprocal social interaction domain) and made significantly more progress in expressive vocabulary based on parent report and on number of communication acts during a parent-child interaction than children in the control group. A larger study examining the same parent training intervention found similar effects on parent and child behavior during the parent-child interaction as well as on parent-reported child vocabulary (Green et al., 2010). However, they failed to find significant differences between the treatment and control groups for reduction in ASD severity scores or improvements on standardized language measures. McConachie et al. (2005) implemented a different parent-training intervention with families of children with ASD that also included elements designed to increase parent use of non-demanding, follow-in language, by following the child's lead and creating

natural opportunities for the child to communicate. Parents who received training increased their use of these strategies compared to parents in a control group, and their children showed greater increases in parent-reported vocabulary than control group children.

In yet another parent training intervention aimed at parent responsiveness, Kaiser, Hancock, and Nietfeld (2000) taught parents to use Enhanced Milieu Teaching (EMT) with their young children with ASD. This treatment teaches parents to follow-in to their child's interests, but teaches parents to use both non-demanding language (to describe their child's interests and model language) and demanding language (to prompt their child to use specific verbalizations) with their children. They found that parents' use of this intervention increased both the production of specific language targets and the overall complexity and diversity of expressive language by children during treatment sessions (parent-child interactions). Finally, Coolican, Smith, and Bryson (2010) found that training parents to use Pivotal Response Training (PRT), which uses semi-structured prompting for language and other behaviors while following the child's interests, led to increases in children's use of functional verbal utterances during interactions with their parents.

This group of studies indicates that interventions that increase a number of different dimensions of parent responsiveness lead to gains in language for children with ASD. In tandem with naturalistic studies suggesting a relationship between parent responsiveness and child language gains over time, these studies provide further evidence that parent responsiveness may have a causal influence on language development for these children. However, given that multiple aspects of responsiveness, including following the child's lead (follow-in language), commenting on the child's play (non-demanding language), and prompting the child for

language around his interests (demanding language) are usually taught to parents together, these studies are unable to determine which type of responsiveness may be most important for promoting child skills.

Responsive Language and Joint Attention

One reason that responsive language may be important for building language skills in young children with and without disabilities is because it reduces the attention following demands of word learning situations. The ability to follow another person's attention, known as gaze-following or response to joint attention (RJA), begins to emerge very early in typically developing children. There is some evidence that infants as young as 4 months of age show evidence of shifting their gaze in response to an adult's gaze shift (Hood, Willen, & Driver, 1998), and infants begin to follow adults' gaze by turning their heads around 11 or 12 months of age (Carpenter et al., 1998). Infants become increasingly proficient at RJA as they get older. Mundy and Gomes (1998) found that young children (14-17 months old) were able to follow a point and head-turn 72% of the time; children were successful on this task 92% of the time at a follow-up assessment 16 weeks later, suggesting that this skill is well-established by 18-21 months of age in typically developing children.

Correlational studies have suggested that RJA skills are related to language skills in young children. RJA skills are concurrently and prospectively correlated with language skills in children between approximately 6 and 18 months of age (e.g., Morales et al., 2000). For typically developing children, the correlation between RJA skills and language skills disappears around 18 months of age, probably because, by this time, children have reached ceiling levels of performance on simple RJA tasks (e.g., Salley & Dixon, 2007).

A variety of evidence indicates that children with ASD are impaired in their RJA abilities compared to children with other types of disabilities or with typical development. For example, Mundy, Sigman, and Kasari (1990) found that children with ASD were more impaired in their joint attention (a composite variable that included RJA and well as initiating behaviors) than language- and mental-age matched children with intellectual disabilities. This was true both at initial testing (mean age of children with ASD 44.9 months) and follow-up testing one year later. Given these findings, RJA deficits have been included on early ASD screening measures and have been found to differentiate children with ASD from those with other developmental delays as early as 20 months of age (Baron-Cohen et al., 1996).

Although typically developing children appear to reach ceiling levels of performance on RJA tasks around 18 months of age, the RJA deficits of children with ASD persist at least into middle childhood. Leekam, Hunnisett, and Moore (1998) found that a large proportion of older children with ASD (5-12 years old) continued to have difficulties responding to joint attention, particularly children with verbal mental ages below 48 months. In addition, parents of children with ASD in this study reported later onset of gaze-following behavior regardless of the children's current developmental or language level. Several other studies have indicated delayed or deficient RJA skills in children with ASD, corroborating these findings (Landry & Loveland, 1988; Lewy & Dawson, 1992; Loveland & Landry, 1986; Mundy et al., 1986).

As with typically-developing children, RJA skills are both concurrently and prospectively correlated with language skills in children with ASD (e.g., Anderson et al., 2007; Sigman & Ruskin, 1999; Siller & Sigman, 2002). Given the continued variability in RJA skills in children with ASD throughout later childhood, it follows that the correlation between RJA and language skills

continues to exist over a much longer developmental period in children with ASD than in children with typical development. Indeed, correlations between RJA and language measures have been found in children with ASD when RJA skills were measured at ages as old as 5 years (Dawson et al., 2004; Murray et al., 2008; Mundy et al., 1987; Siller & Sigman, 2008). Because parent's use of responsive language reduces attention-following demands during word-learning situations, this type of language may be particularly beneficial for promoting language skills in children with ASD, who have deficits in attention-following skills.

Defining Responsiveness Across Contexts

The existing literature has attempted to examine the effects of responsive language on child language outcomes across multiple contexts (parent-child interactions, treatment studies, and experimental word learning situations). However, one challenge in the existing literature is how to define responsive language across these contexts, and how to determine which aspects of responsive language are most important for promoting child language development.

Parent-child interaction studies have defined responsiveness in a number of different ways. A number of studies have included responsiveness to the child's focus of attention (follow-in versus redirecting language) when coding parental responsiveness (Akhtar et al., 1991; McDuffie & Yoder, 2010; Siller & Sigman, 2002; Tamis-LeMonda et al., 2001), with researchers finding consistently that follow-in language is beneficial for the development of children with and without disabilities. These benefits of follow-in language are likely due to the reduction in attention-following demands for word-learning when follow-in language is used (in comparison to redirecting language). Another dimension of language that has frequently been examined is the degree of demandingness of parent language. While several studies have

looked at different aspects of demandingness, this dimension of language has been defined inconsistently across studies, and results regarding which type of language is most beneficial have been mixed. Some researchers such as Tamis-LeMonda et al. (2001) have broken maternal language down into specific categories (e.g., commenting, praise, asking questions), others have focused on one specific aspect of language, such as play directions (Akhtar et al., 1991), and still others have attempted to categorize language broadly as demanding or non-demanding (McDuffie & Yoder, 2010; Siller & Sigman, 2002). In some cases, parent language acts that appeared to be potentially meaningful to language development, such as asking the child questions that required verbal responses, were excluded from coding schemes as "other language" (McDuffie & Yoder, 2010). Given the possibility that parent language requiring a verbal response might help children to practice emerging verbal skills, this coding decision may have led the researchers to underestimate the importance of some types of demanding language on child language skills.

Clearly defining important dimensions of parent responsiveness has been even more difficult in intervention studies. A number of treatment studies have indicated that increases in parent responsiveness are associated with improvements in child language skills (Aldred et al., 2004; Coolican et al., 2010; Green et al., 2010; Landry et al., 2006). However, the responsive behaviors that were targeted in these interventions and how responsiveness was measured differed widely across studies. Landry et al. (2006) found positive changes in support for infant foci of attention, a dimension that appears to map relatively well onto follow-in language as defined in parent-child interaction studies. However, changes in other dimensions of responsiveness, such as emotional-affective support and contingent responsiveness to the

child's behaviors were also noted, making it difficult to determine which of these aspects of responsiveness were most important for promoting the children's language development. Aldred et al. (2004) and Green et al. (2010) used the PACT (Preschool Autism Communication Trial) intervention with parents of children with ASD. Again, this intervention taught parents a number of types of responsiveness, including following the child's interests to promote shared attention (which appears to map somewhat on to the follow-in language coded in naturalistic studies) and decreasing demands on the child (which may map on to the demandingness dimension of language used in naturalistic studies). It also included a number of behaviors not examined in other studies, such as repetition and elaboration of the child's behavior. Finally, Coolican et al. (2010) taught parents Pivotal Response Training, an intervention in which parents use primarily follow-in language that prompts the child for communication acts (demanding language). While parent fidelity of implementation was related to child language, it is impossible to tell which elements of the intervention promoted child language, given that a number of intervention techniques were taught at the same time. These intervention studies provide important evidence that parent responsiveness is functionally related to child language outcomes, given that training parents in responsive strategies appears to alter the course of child language development. However, responsiveness is defined differently across each intervention, and the design of these studies does not allow for a detailed analysis of which strategies are most related to child language outcomes.

Given the inherent difficulties with connecting specific elements of responsiveness to child language outcomes when using naturalistic parent-child interactions or intervention studies, experimental studies, which afford more control over the relevant variables, may be

able to provide additional insight into this question. Experimental studies of language learning in children with ASD and typical development have defined responsiveness much more clearly and consistently. The primary focus of this research has been on examining one dimension of responsiveness, relationship of adult language to the child's attentional focus. These studies have typically defined follow-in labeling as a label that is uttered while the adult and the child are both gazing upon the labeled object. In contrast, discrepant labeling is defined as a label that is uttered when the child is gazing at one object, but the adult is gazing at a different object. Across studies, researchers have found that very young typically developing children and children with ASD across a variety of age ranges are more adept at learning new word labels under follow-in labeling conditions than under discrepant labeling conditions.

While very young typically developing children tend to attach adults' labels to their own focus of attention (Pruden et al., 2006), by 18 months of age, typically developing children (who are, by this age, relatively adept at RJA) begin to learn how to harness an adult's direction of gaze to learn new words. Moore (1998) demonstrated that 18-month-olds can learn a new word by following an adult's head turn toward the object, when the child was not actively engaged with either object. However, this ability was extinguished when the distracter object (a remote-controlled toy) was made salient by activating it just as the target object was labeled. As children get older, the ability to use social-pragmatic cues, such as gaze direction, to learn new words, appears to increase and solidify. For example, Hollich et al. (2000) found that 19- and 24-month olds both showed evidence of mapping a novel word produced only five times even when the labeled object was less salient than the distracter. Similarly, Baldwin (1991) found that 18- to 19-month old children were able to succeed at learning a new word in both

follow-in (when the adult labeled the focus of the child's attention) and discrepant (when the adult labeled the focus of her own attention) labeling conditions; the discrepant labeling task was identical to a task that 16- to 17-month-old children failed. Baldwin et al. (1996) also found that 18- to 20-month olds were able to correctly map a novel label provided in a follow-in situation, despite the presence of a distracting person (another experimenter talking on the phone) and the label being provided only three times. Finally, Baldwin (1993) found that 19- to 20-month olds were able to succeed at word-learning during a discrepant labeling paradigm, even when a 10-second delay existed between labeling and the children seeing the labeled object. These studies suggest that, by 20 months of age, typically developing children are relatively skilled at using an adult's direction of gaze to learn a new object label, even when the label is provided with relatively subtle cues to the adult's intentions (gaze direction with no additional cues, such as pointing or using a vocalization to redirect the child's attention).

Many fewer studies have been conducted with children with ASD than typically-developing children regarding use of gaze-following for word learning. However, the available studies suggest that children with ASD have considerable difficulty with this skill. Baron-Cohen, Baldwin, and Crowson (1997) tested 7- to 12-year-old children with ASD (average receptive language age 27 months) on whether they could learn novel words under conditions of follow-in and discrepant labeling. Two novel objects were presented to each child. In the follow-in condition, the experimenter gazed upon and labeled the novel object the child was playing with while he attended to it, uttering the label twice. In the discrepant labeling condition, the experimenter gazed upon and labeled the object she was holding two times while the child was gazing upon and playing with the other object. Despite a relatively difficult test of

comprehension (the children had to pick the object out of an array of six objects—the two novel objects used in the training phase, two additional novel objects, and two familiar objects), children with ASD selected the correct object 82% of the time after follow-in labeling, well above chance level and comparable to the performance of language-age matched children with mental handicaps. In contrast, when the experimenter used discrepant labeling, children with ASD selected the correct item only 29% of the time (not significantly different from chance levels), compared to 71% correct selections by the language-matched children with mental handicaps. Notably, every child with ASD who failed the discrepant labeling task chose the toy that he had been attending to during the labeling episode, indicating that the children with ASD mis-mapped the novel word onto the object they were currently attending to, a pattern similar to that seen in typically-developing 10-month-olds. In a second study reported in the same paper, language-matched typically-developing children showed success in both the follow-in and discrepant labeling tasks. Priessler and Carey (2005) replicated Baron-Cohen et al.'s (1997) results using a nearly identical paradigm (with the exception that children only had to choose between four, rather than six, items during the test phase). They found that children with ASD (average age 7.8 years, vocabulary age 23 months) were able to correctly map the novel word in the follow-in condition, but not the discrepant condition; during the discrepant condition, they mis-mapped the novel word to the object they were attending to at the time. In contrast, typically developing 2-year-olds succeeded at both tasks.

The results of these studies lend further support to the idea that the impaired RJA skills of children with ASD are directly interfering with their ability to learn new words. These children appear to have significant difficulty following a speaker's gaze in order to map new

words onto novel objects, compared to both typically developing children and children with mental handicaps. The fact that children with mental handicaps succeeded at this task suggests that the failure of the children with ASD in the discrepant labeling condition was not due to general developmental delay. In addition, the fact that children with ASD succeeded during the follow-in labeling condition in both studies suggests that the task demands were not so difficult that they were unable to succeed at the forced choice task. In fact, Franken, Lewis, and Malone (2010) found that children with ASD were actually more proficient at learning a new object label than children with moderate learning disabilities when the label was provided under a follow-in labeling condition. However, under discrepant labeling conditions (which require gaze following), the children with ASD showed a specific (and ineffective) strategy of mapping the word onto the object that they were currently attending to. As Baron-Cohen et al. (1997) point out, this strategy would inevitably lead to many confusing mapping errors for these children, and slow and laborious word learning. Given that children with ASD appear to have relatively intact skills in some other areas of word learning, such as using cognitive strategies like mutual exclusivity to learn words (Priessler & Carey, 2005), it appears that difficulty using RJA to learn words may be a specifically impaired strategy for children with ASD that contributes to the early language difficulties of these children. It is notable that the children with ASD in both Baron-Cohen et al. (1997) and Priessler and Carey (2005) had surpassed the level of language skill at which typically-developing children would be expected to use gaze-following cues to learn language. This suggests that children with ASD are able to proceed in their language development despite difficulty using this strategy (i.e., their language development is not arrested at 18 months, the age at which typically developing children begin using gaze-

following consistently to learn new words), but that their language development is very slow as a result.

This group of experimental studies clearly demonstrates a benefit of follow-in labeling versus discrepant labeling for vocabulary learning in children with ASD. Unlike the complex and frequently inconsistent definitions of responsiveness found in studies of parent-child interactions, the clear and consistent definitions of follow-in versus discrepant labeling used in these studies have allowed a number of researchers to examine the impact of these language dimensions of word learning in children with ASD, with relatively consistent results across studies. While the consistency and clarity of these definitions of responsiveness are helpful in drawing causal conclusions about the influence of one dimension of adult responsiveness on child vocabulary acquisition, this narrow definition of responsiveness also makes it difficult to draw meaningful parallels between the naturalistic and treatment studies and these experimental studies. The definitions of follow-in and discrepant language used in these studies map somewhat onto those used in more naturalistic studies, but it is likely that parents are using a variety of cues in combination with these gaze behaviors that are not present in experimental situations (e.g., pointing to a toy, using a word or phrase to get the child's attention). In addition, other aspects of responsiveness besides the question of follow-in versus discrepant language have been largely ignored in this literature, despite indications from parent-child interaction and intervention studies that several other dimensions of responsiveness may be important for language learning.

Two Important Dimensions of Responsiveness: Attentional Focus and Degree of Demandingness

Although a number of qualities of parent responsiveness are likely important to child language learning, two dimensions emerge most consistently in the literature to date: relationship of adult language to the child's attentional focus, and degree of demandingness of adult language.

Attentional Focus. The question of relation of the adult's language to the child's attentional focus has been examined across both parent-child interactions and experimental interactions in some detail, with relatively consistent findings that follow-in language appears to promote child language learning, particularly for children with ASD. However, one difference across contexts may be the methods used by parents versus experimenters in attempting to recruit children's attention. Parents, particularly parents of children with ASD who tend to be less socially responsive than other children, may use a variety of strategies to recruit their children's attention during interactions. These may involve verbal or non-verbal behaviors such as using an attention-getting phrase (e.g., "Look" or the child's name), touching the child, or using a gesture. There is some evidence that the addition of redundant cues such as pointing to gaze cues may increase the ability of children at-risk for ASD to follow an adult's focus of attention (Presmanes, Walden, Stone, & Yoder, 2007), indicating that parents of children with ASD who use these types of cues may be successful at helping their child join their focus of attention. In addition, Koegel, Shirotova, and Koegel (2009) found that the use of individualized orienting cues (e.g., a high five or specific phrase) during treatment helped children with ASD to acquire first words during Pivotal Response Training. Finally, a number of parent training programs for children with ASD teach parents to make use of naturalistic strategies for gaining a child's attention without redirecting their focus of attention, such as repeating familiar

routines, taking a turn, or physically blocking the child's play (Aldred et al., 2004; Koegel et al., 1999).

While these types of orienting cues are commonly present in naturalistic parent-child interactions and are taught to parents of children with ASD during treatment, experimental studies of word learning in children with ASD have required these children to follow the experimenter's gaze alone, with little support. Given the reduced social orienting seen in children with ASD (e.g., Adrien et al., 1993; Watson et al., 2007; Zwaigenbaum et al., 2005), this lack of orienting support during experimental paradigms may reduce the chances that children with ASD will be successful in these situations compared to more naturalistic word learning situations.

Degree of Demandingness. Another potentially important aspect of adult responsiveness that has been examined in a number of studies is the degree of demandingness of the adult's language. However, findings regarding the influence of demanding versus non-demanding language on child language skills have been mixed. While Siller and Sigman (2002) found that only follow-in non-demanding language was related to later child language outcomes, McDuffie and Yoder (2010) found that both follow-in demanding language and follow-in non-demanding language promoted increases in child vocabulary for children with ASD. In addition, both studies excluded a potentially important aspect of demanding language, asking questions requiring a verbal response, from their analyses. Parent training programs focused on promoting responsiveness have also differed in their attitudes toward demanding language. While some programs, such as the PACT program (Aldred et al., 2004; Green et al., 2010), have an explicit goal of decreasing parent demands, such as questions and directions,

other programs, such as Pivotal Response Training (Coolican et al., 2010), teach parents how to prompt children for specific language acts. Despite this fundamental difference in attitude toward demanding language, both programs have resulted in increases in child language skills. Gaining more experimental control over this aspect of adult language to clarify the relationship between demanding language and child language outcomes would be helpful. Two studies examining the impact of language interventions for children with ASD that use follow-in language varying in degree of demandingness have suggested that demanding language may confer an advantage over non-demanding language (Ingersoll, 2011; Ingersoll, Meyer, Bonter, & Jelinek, 2012). However, no experimental study of language learning in children with ASD has manipulated this element of adult language.

Demandingness may be an important aspect of responsiveness to examine for a number of reasons. First, making a request of the child may have an effect on the child's attention to the situation. It is possible that, for children with ASD who are low in social motivation, attention may be lower in situations that the child perceives as not requiring a response in comparison to situations that clearly require a response. Second, there is some evidence that, in children with ASD, language skills may generalize more easily from the expressive to the receptive modality than vice versa (Wynn & Smith, 2003). Therefore, adult language that requires a child with ASD to produce a vocal approximation of a new vocabulary word may promote greater generalized learning of this word than parent language that merely labels the object in the hopes that the child will learn the label receptively. Alternatively, different degrees of demandingness could have different effects on expressive versus receptive language acquisition, with the requirement to produce the word facilitating expressive acquisition and

the simple labeling of the word promoting receptive acquisition. A closer examination of the influence of demanding versus non-demanding language on the language use and vocabulary acquisition of children with ASD would help clarify these questions.

Weaknesses of the Current Literature

In reviewing the literature across parent-child interaction and experimental studies of RJA and word learning in children with ASD, a number of weaknesses and needs are evident. First, researchers examining the behavior of children with ASD across contexts must recognize that context is important. The behavior of children with ASD likely differs on a number of important dimensions in interactions with parents versus experimenters. Differences in factors such as child engagement, interest, and motivation may be different across these settings, leading to different relationships between adult language behavior and child learning. The differences in defining adult behavior across these contexts in previous studies makes it difficult to directly compare the effects of adult language on child language behavior across these two contexts. In order to clarify these relationships, it is important to examine the contribution of adult language type to child language behavior across these different contexts, using similar definitions of adult language, in an attempt to identify both commonalities and differences across these different contexts. In addition, each of these contexts provides unique advantages for asking questions about these children's development. A parent-child interaction context provides a window into the child's daily life and the interactions that take place within the parent-child relationship. On the other hand, an experimental context can afford control over a number of factors of adult behavior that are impossible to control in a naturalistic context.

Second, it is important to consider what elements of child language are being examined, as different types of adult language input may promote different types of child language. One important factor to consider in language type is receptive versus expressive language learning and use. Examinations of the effects of parent language have usually used standardized measures of overall language ability or vocabulary as outcome measures, which likely capture some elements of both expressive and receptive language. In contrast, experimental studies of word-learning have focused primarily on the acquisition of receptive labels, usually conducting forced choice trials to measure whether the child is able to correctly choose a named object. In addition, these different types of studies have measured language outcomes over different time courses. While parent-child interaction studies have usually examined language outcomes months or years later, experimental studies of word-learning usually test vocabulary acquisition immediately following a teaching trial. Examination of language learning across contexts using less disparate performance measures may facilitate a truer comparison of the similarities and differences in the effects of adult language type of child language outcomes in these different settings.

One final factor that may be important in considering how different types of adult language influence child language learning is the use of orienting cues by adults. Given the difficulties of children with ASD in responding to joint attention, parents of these children may routinely use orienting cues in an attempt to elicit their children's attention. However, this element of parent language has not been examined in studies of parent-child interactions to date. In experimental studies of word learning, experimenters have not provided additional orienting cues (besides the adult's gaze behavior) in an attempt to help the children with ASD

succeed at learning words when the adult is using redirecting language. Therefore, these types of experimental learning tasks may lack external validity due to the differences from parent behavior, and it is unknown whether these types of cues would help children with ASD succeed at these vocabulary learning tasks.

Goals of the Following Studies

Given the differences in defining the construct of responsiveness both across studies and across contexts (parent-child interactions versus experimental studies) in previous research, it is difficult to draw firm conclusions about the impact of two dimensions of adult language, relation to child's attentional focus and degree of demandingness, on the language learning of children with ASD. In attempting to clarify which types of adult language best promote child language for children with ASD, it would be helpful to examine these two dimensions of responsiveness when defined similarly across these two contexts. The goal of these studies is to examine these two dimensions of adult language during both a parent-child interaction and an experimental word learning situation in order to determine: 1) which types of language are most beneficial for child language learning and use, 2) whether these two dimensions of responsiveness interact with one another in predicting child language outcomes, 3) whether these dimensions of language have differing effects across contexts, and 4) whether these dimensions of language have different effects across language modality (expressive versus receptive).

Study 1: The Influence of Maternal Responsiveness on the Expressive Language Production of Children with ASD

Introduction

A large body of research has indicated that parent responsiveness is associated with positive language outcomes for young children with both typical and atypical development. Parent responsiveness has been broadly and variably defined across studies, but has usually included verbal and/or nonverbal behaviors that maintain or reflect upon a child's current attentional focus and actions. A number of studies have found that parents who more often follow and respond to the attentional foci of their typically-developing infants (e.g., Akhtar, Dunham, & Dunham, 1991; Tamis-LeMonda, Bornstein, & Baumwell, 2001) have children who develop language more quickly. In addition, studies examining responsiveness in parents of children with ASD have found that mothers who use language related to their children's current focus of attention have children who make greater progress in their language skills during a periods of 6 months (McDuffie, Yoder, & Stone, 2010) to 16 years (Siller & Sigman, 2002).

Benefits of Follow-In Language in ASD

Adults' use of language that relates to a child's current focus of attention (hereafter called "follow-in" language to be consistent with several previous studies) may be important for building language skills in young children with and without disabilities because it reduces the attention-following demands of word learning situations. The ability to follow another person's attention, known as gaze following or response to joint attention (RJA), begins to emerge very early in typically developing children. There is some evidence that infants as young as 4

months-of-age show indications of shifting their gaze in response to an adult's gaze shift (Hood, Willen, & Driver, 1998), and this skill is well-established in typically developing children by 18-21 months of age (Mundy & Gomes, 1998). Correlational studies have suggested that RJA skills are related to language skills in young typically developing children (e.g., Morales et al., 2000) as well as children with ASD (e.g., Anderson et al., 2007; Sigman & Ruskin, 1999; Siller & Sigman, 2002). For typically developing children, the correlation between RJA skills and language skills disappears around 18 months of age, possibly because, by this time, children have reached ceiling levels of performance on simple RJA tasks (e.g., Salley & Dixon, 2007). However, a variety of evidence indicates that children with ASD are impaired in their RJA abilities compared to children with other types of disabilities or with typical development (e.g., Mundy, Sigman, & Kasari, 1990) and that these deficits may persist into middle childhood for many of these children (Leekam, Hunnisett, & Moore, 1998). Given the connections between early RJA skills and later language skills and the RJA deficits seen in children with ASD, adults' use of responsive language may be particularly important for promoting language skills in children with ASD.

Orienting Cues as Support for Attention Following

This body of research suggests that follow-in language may be particularly beneficial for children with ASD. However, it is clear that in everyday situations adults are not able to follow children's attention at all times. This may be particularly true for children with ASD, who may be frequently unengaged with meaningful activities and may provide few high-quality attentional leads for parents to follow. In addition, even when adults follow-in to the attention focus of a child with ASD, the child may nevertheless have difficulty including their interaction partner in this exchange (e.g., Lewy & Dawson, 1992). Given that children with ASD tend to be

poor at following others' attention, it is likely that parents and other adults frequently use orienting cues (e.g., saying "look" or the child's name, touching the child, withholding a desired item) to help the child attend to important stimuli in their environment. However, the types of orienting cues that mothers use to support their children's attention, and how children respond to these cues, have rarely been examined in detail. There is some evidence that researchers' use of redundant orienting cues such as pointing to gaze cues may increase the ability of children at-risk for ASD to follow an adult's focus of attention (Presmanes, Walden, Stone, & Yoder, 2007), and Siller and Sigman (2002) found that mothers' use of synchronized indicating behaviors (handing the child a toy he is interested in, pointing to a toy the child is playing with) were associated with gains in initiating joint attention over time. However, these studies have not examined whether the use of orienting cues helps children with ASD to verbally respond to their parents' redirections within the immediate play context. Therefore, examining which maternal behaviors may support children's use of language during mother-child interactions may be helpful when considering how mothers can best support their child's language acquisition.

Parent Demandingness and Child Language Acquisition

Another potentially important aspect of adult responsiveness that has been examined in a number of studies is the degree of demandingness of the adult's language (i.e., whether the adult is asking the child to perform an action or simply commenting on the child's activity). However, findings regarding the influence of demanding versus non-demanding language on child language skills have been mixed. While Siller and Sigman (2002) found that only follow-in non-demanding language was related to later child language outcomes, McDuffie and Yoder

(2010) found that both demanding and non-demanding language promoted increases in child vocabulary for children with ASD when it followed the child's attentional lead. In addition, neither study examined the *types* of demands parents used in detail (e.g., language prompts, play directions, etc.), and therefore the studies may have been unable to detect a benefit associated with less frequent types of demands, such as language prompts or questions requiring a verbal response. Parent training programs focused on promoting responsiveness have also differed in their attitudes toward demanding language. Research on these interventions has suggested that changes in parent responsiveness are tied to children's language and communication outcomes (e.g., Aldred, Green, and Adams, 2004; Coolican, Smith, and Bryson, 2010; Green et al., 2010; Kaiser, Hancock, and Nietfeld, 2000; McConachie et al., 2005). However, different interventions have targeted different elements of responsiveness, including use of both demanding and non-demanding language, with beneficial effects found across a number of treatment models. A closer examination of the influence of demanding versus non-demanding language on the language use of children with ASD would help clarify these issues.

Weaknesses of Longitudinal Research Designs

A number of longitudinal studies have suggested that responsive parent language may promote child language over periods of 6 months up to 16 years in children with ASD (McDuffie & Yoder, 2010; Siller & Sigman, 2002; 2008). However, the correlational nature of this research makes it difficult to draw firm conclusions regarding the effects of parent language style on later child language. While previous studies have attempted to control for a number of factors such as ASD severity, initial language delay, and child engagement, it is likely that a number of

child factors not easily measured by standardized testing contribute to parent behavior during play sessions and to growth in child skills over time.

In addition, because these longitudinal studies only examine changes in behavior over time, it is difficult to draw conclusions about the mechanism of these changes or the how parent behavior influences child behavior from moment to moment within a single interaction. Parent-child interactions are by nature a transactional rather than a one-way process. Transactional models of child development suggest that both parents and children make meaningful contributions to the child's attainments in various areas of development, including language development (Sameroff & Fiese, 2000). While the parent may be able to facilitate a child's language development by responding contingently to the child's focus of attention and providing relevant language around this focus, the child must also participate in this process by providing meaningful attentional leads for the parent to follow (McDuffie & Yoder, 2010). Given the social interaction difficulties of children with ASD, they are likely to provide fewer or lower quality attentional leads for a parent to follow, making it more difficult for a parent to provide meaningful and responsive feedback to the child during interactions. It is impossible to capture these complex interactive processes using longitudinal correlational designs. Knowing what is happening from moment to moment within the interactions of children with ASD and their mothers may be able to provide additional insight into the mechanisms by which different types of maternal language improve child language over time.

Study Goals

No published study to date has examined the effects of different types of maternal language on the immediate use of appropriate expressive language (within the same

conversational turn) of children with ASD. This study aimed to examine how two dimensions of maternal language, relationship to child focus of attention (follow-in versus redirecting) and degree of demandingness (demanding versus non-demanding), influenced the immediate use of appropriate expressive language of children with ASD and children with typical development within a naturalistic mother-child play session. Further, demanding language was broken down into a number of potentially meaningful categories of behavior, including play directions and language prompts to determine whether one particular type of demanding language was more beneficial than another. Additional orienting cues (e.g., calling the child's name, touching the child, blocking the child's play) used by mothers in conjunction with their language were also examined to determine whether the use of these cues had an impact of child language use. Finally, relationships between individual child characteristics (e.g., language skills, joint attention skills) and the types of language that were most beneficial for these children were examined to explore whether particular types of maternal language were more beneficial for children with certain skill profiles. This fine-grained analysis of parent and child language behavior will add to the existing longitudinal and treatment literature by clarifying whether the types of language that appear to promote language gains in children with ASD over time are the same as the types of language that promote child language within the immediate conversational context.

Methods

Participants

Participants were 28 children with ASD (24 males, 4 females) and 16 children with typical development (9 males, 7 females) and their mothers. Participants with ASD were

selected from a pool of 47 children with ASD (41 males, 6 females) between the ages of 25 and 93 months and their mothers who were recruited from local agencies and professionals serving young children with ASD (e.g., early intervention programs, pediatricians, parent support groups) as part of several intervention studies. All children with ASD met the cut-off for autism or autism spectrum on the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) administered at the research laboratory prior to the start of the study. Nineteen children with ASD were excluded from analyses because of technical difficulties with sound on the video recordings (4), because the child did not use any appropriate language during the ten-minute interaction (11), because the parent spoke a language other than English during the video (1), because both parents participated in the parent-child interaction simultaneously (1), or because two children in the same family participated (2); in these cases, the child who used more language during the video was retained in the sample and the other child was excluded).

Participants with typical development were selected from a pool of 17 children with typical development (9 males, 8 females) between the ages of 16 and 29 months and their mothers. Typically developing participants were recruited such that their chronological ages approximately matched the language age equivalent scores of the children with ASD included in the sample. Participants were recruited from a pool of families who expressed interest in participating in child development research during recruitment fairs in community locations likely to attract families (e.g., farmer's markets, parks, malls). Children were excluded from participation if parents reported a history of developmental difficulties, including language delays, or if the child had an immediate family member (parent, sibling) with an autism spectrum disorder. All children were screened for developmental concerns using the

Communication and Symbolic Behavior Scales-Developmental Profile Infant-Toddler Checklist (CSBS-DP; Wetherby & Prizant, 2002) and scored in the "No Concern" range in all areas. One mother-child dyad in the typically developing group was excluded from analyses because the child did not use any appropriate language during the ten-minute interaction. The two samples did not differ significantly in nonverbal mental age. However, the typically developing group scored higher than the children with ASD on measures of language, vocabulary, and joint attention skills. Characteristics of the participants included in the final sample are reported in Table 1.

Assessment Procedure

Each child participated in a 10-minute videotaped semi-structured play session with his or her mother. Each mother-child dyad was provided with a standard set of age-appropriate toys, including a baby doll, a kitchen set, a car ramp, blocks, and a musical ring-stacking toy. Mothers were asked to play with their children as they usually would. They were instructed to focus on helping their children to demonstrate their language/communication skills during the first five minutes of the interaction, and helping their children to use their play skills (all typically developing children and 22 children with ASD) or their social engagement skills (6 children with ASD) during the second five minutes of the interaction[1].

[1] Instructions for play interaction were changed slightly due to procedural changes in a larger study that children were participants in. Independent-samples t-tests were conducted comparing difference scores for all major language categories and language sub-categories between groups receiving different instructions. Significant differences were found only for the redirecting demanding language category, with the mean difference being slightly lower for the social engagement instruction group. Given that this was the only significant difference, and the direction of effect was the same across groups for this category, groups were collapsed for all analyses.

Children were also administered the Preschool Language Scales, 4th Edition (Zimmerman et al., 2002) to measure language skills, the Bayley Scales of Infant Development (Bayley, 2005) Cognitive scale to measure non-verbal cognitive skills, and the Early Social Communication Scales (Seibert et al., 1982) to measure joint attention skills. Mothers were asked to complete the MacArthur-Bates Communicative Development Inventory (Fenson et al., 1994) to measure vocabulary size.

Table 1

Study 1: Participant Characteristics

	ASD			Typical		
	N	Mean	SD	N	Mean	SD
Age (Months)	28	48.36*	13.06	16	24.06	4.31
Cognitive Age Equivalent (Bayley, Months)	26	26.62	6.61	16	26.13	4.44
Auditory Comprehension Age Equivalent (PLS-4, Months)	28	22.96*	9.04	16	32.06	8.27
Expressive Language Age Equivalent (PLS-4, Months)	28	24.82*	5.67	16	31.63	6.70
Total Language Age Equivalent (PLS-4, Months)	28	23.36*	6.75	16	31.19	7.40
Number of Words Produced (CDI)	27	219.81*	188.41	16	358.06	197.34
Number of Joint Attention Initiations (ESCS)	28	3.82*	4.65	15	13.00	10.25
Percentage Responses to Joint Attention (ESCS)	28	66.50*	27.25	15	97.93	6.15

*Significantly different from typical group, $p < .05$

Videotape Analysis

Each videotaped mother-child interaction was coded using a microanalytic technique to identify what type(s) of maternal language promoted child expressive language use during the

session. Child language points (points in the video when the child used appropriate language) and control points (points in the video at regular 30-second intervals) were identified throughout the video, and the maternal utterance that most immediately preceded the child language or control point was identified and categorized on a number of dimensions. If a particular maternal language type was more likely to precede child points than control points, this type of maternal language was interpreted as encouraging child language use. If a particular maternal language type was more likely to precede control points than child language points, this type of maternal language was interpreted as discouraging child language use. See Wimpory, Hobson, and Nash, 2007 for a more detailed description of analysis procedures.

Identifying Child Language Points. The 10-minute videotaped play sessions were coded by trained undergraduate and graduate research assistants in two passes. Each videotape was first coded to identify instances of appropriate verbal utterances made by the child (child language points). An appropriate verbal utterance was defined as one or more recognizable words that were appropriate to the current situation or conversation. Instances of verbal echoing that were appropriate responses to a maternal utterance (e.g., mother says, “Do you want the baby?” and child responds “Baby”) were coded as appropriate language the first time. If the child repeated the same word or phrase within a 10-second period, or if the echoed portion of the response was not appropriate to context (e.g., mother says, “What do you want?” and child responds, “What do you want?”), it was not scored as appropriate language. See Table 2 for detailed scoring definitions.

Table 2

Researcher Scoring Definitions for Child Language Events

Appropriate Language	Child uses speech that was spontaneous or preceded by a verbal model, question, or gestural prompt. Must be in context and meaningful. Recognizable word approximations used in context or as a request are scored as appropriate language. Echoing used as a request or object label is scored as appropriate the first time. If the child continues to echo the word, this is inappropriate language. Singing or repeating scripts is only considered appropriate if it somehow relates to the context of the interaction or is part of collaborative play with the parent.
Inappropriate Language	The child uses language that is echolalic, non-meaningful, or out-of-context. Repetitive use of the same word or phrase is only scored once unless at least 5 seconds elapses between repetitions.

Identifying Control Points. An additional 20 points were identified at 30-second intervals throughout the 10-minute videotape (regardless of whether a child language point occurred at this time), with the first interval at 15 seconds into the video, the second at 45 seconds, and so forth every 30 seconds throughout the video (control points). Control points were used to control for differences in language style across individual mothers.

Identifying Maternal Utterances. After child language points and control points were identified throughout the 10-minute video, a second coder used this log of child language and control points to identify and categorize maternal language events preceding these points. In order to identify each maternal language point, the coder moved backwards in the videotape from each child language or control point to identify the maternal utterance that occurred immediately preceding the identified point in the video. The maternal utterance that occurred closest in time to the child language point or control point was used, going back up to 10 seconds to identify a maternal utterance. If the mother did not make any verbal utterance in

the ten seconds preceding the child language or control point, this point was coded as “no actions” and excluded from further analyses.

Categorizing Maternal Utterances. After maternal utterances were identified, the coder then categorized each maternal utterance on two independent dimensions: relation to child focus of attention, and degree of demandingess. This coding procedure produced four broad categories of parent language: follow-in demanding, follow-in non-demanding, redirecting demanding, and redirecting non-demanding, as well as a number of sub-categories based on additional coding of maternal language within redirecting and demanding language categories (detailed below). See Table 3 for detailed scoring definitions.

Table 3

Researcher Scoring Definitions for Maternal Language Categories

Relationship to Child Focus of Attention	Each maternal utterance should be coded as either follow-in or redirecting. Each utterance should also be coded for whether or not an orienting cue was used. These categories are defined in detail below.
Follow-In Language	Any maternal utterance that is related to the toy or activity that the child is already engaged in. Follow-in language may: describe the child's current focus of attention, add something to the child's current play, encourage or praise the child's current behavior, tell the child what to do with a toy he is already interested in, or prompt the child to answer a question about or request a toy he is already interested in.
Redirecting Language	Any maternal utterance that refers to something that is not the child's current focus of attention. Redirecting language may: attempt to shift the child's focus from the current toy or activity to a new toy or activity, introduce a new focus of attention when child is unengaged, tell the child to do an action unrelated to his current focus of attention, refer to a different toy or activity than the child is currently interested in, redirect the child's behavior (e.g., telling child to sit down, stop doing that, etc.), refer to something that is irrelevant to the child's current focus of interest, or tell the child to look at or pay attention to something different than their current focus of interest.
Orienting Cue	Any verbal or non-verbal maternal behavior used specifically to assist in recruiting the child's attention. Verbal behaviors may include saying the child's name, the word "look," or another attention-getting phrase. Non-verbal behaviors may include touching the child, blocking the child's play, or taking the child's toy.

Table 3 (cont'd)

Degree of Demandingness	Each maternal utterance should be coded as either demanding or non-demanding. Further, each demanding utterance should be coded as a verbal prompt, a play prompt, or an other behavior prompt. These categories are defined in detail below.
Non-Demanding Language	Any maternal utterance that does not require any action on the child's part, but simply describes the current situation, including the parent's or child's behavior. Non-demanding language may include: object, action, or attribute labels, sound effects, singing songs or rhymes, praising the child, or non-specific comments on the child or the situation.
Demanding Language	Any maternal utterance that asks the child to answer a question, perform a behavior, say something, do something, or stop doing something. Demanding langue may include: modeling an object label while withholding the object from the child, asking a question, directing or redirecting the child's behavior, or using a cloze procedure to prompt a child to say a word (ready, set, …[pause]; one, two, three….[pause]; I want….[pause]).
Verbal Prompt	Any demanding maternal utterance that prompts the child to say a word or phrase by modeling the word, asking a question, or using a cloze procedure.
Play Prompt	Any demanding maternal utterance that prompts the child to complete an action with a toy.
Other Behavior Prompt	Any demanding maternal utterance that prompts the child to perform a behavior that is neither a verbal behavior nor a play behavior.

Relationship to child focus of attention. Each maternal utterance was first coded for whether it followed or redirected the child's current focus of attention. The child's focus of attention was identified as the object that the child was looking at or touching, or a non-object-based activity that the child was performing at the start of the identified maternal utterance. If the maternal utterance was related to the child's current focus of attention in any way (e.g.,

commenting on the child's activity, asking the child to do a different play action around the same activity, asking the child a question about the activity, praising the child's current behavior) the utterance was coded as "follow-in." If the maternal utterance attempted to change or redirect the child's current focus of attention or behavior (e.g., drawing the child's attention to a new toy, asking the child to look at something different, asking the child a question about a different activity, scolding or redirecting the child's behavior), was irrelevant to the child's current focus of attention (e.g., talking about what they would do later at home, directing unrelated comments to oneself or another adult in the room), or attempted to introduce a new focus of attention when the child was unengaged with toys, the utterance was coded as "redirecting." All instances of maternal language were further categorized by whether or not one or more orienting cues were used by the mother (e.g., touching the child, taking a toy from the child, saying the child's name or another attention-getting word, using a gesture) in order to help her child attend to her speech.

Degree of Demandingess. Each identified parent utterance was further coded as "demanding" or "non-demanding." Demanding parent utterances were those that asked the child to perform some behavior. These utterances included asking specific or general questions, including rhetorical questions (e.g., "What color is that?," "Do you like these toys?," "What should we do now?,") , giving directions or suggestions (e.g., "Let's play with the dolly," "Stack the blocks," "Give me that"), re-directions of child behavior (e.g., "Stop that," "No"), prompting the child to use language, (e.g., modeling the word "baby" while withholding the baby from the child, telling the child, "Say block"), and any other parent utterance that asked the child a question or requested that the child perform a behavior. Demanding utterances were further

categorized by what behavior they were designed to elicit. These utterances were grouped into one of three categories: verbal prompts (any question or direction that directly or indirectly requested the child to use language), play prompts (any question or direction that asked the child to do a play action), or other behavioral prompts. A single utterance could be placed into more than one category if more than one type of response would be appropriate. For example, if the mother asked the child, "Do you want to put the baby to bed?" this would be coded as both a language prompt (because an appropriate response would be to say either "yes" or "no") and also as a play prompt (because an appropriate response would be to put a blanket over the baby). Breaking demanding language down into these sub-categories allowed an analysis of what specific types of maternal language contributed to child language use, and also allowed analyses that were more consistent with previous research on the effects of maternal language use on the language development of children with ASD (e.g., Siller & Sigman, 2002; McDuffie & Yoder, 2010). Non-demanding parent utterances were those that commented on the situation without making a request of the child or asking the child a question. These included labeling objects or action in the environment, (e.g., "Baby," "It fell!"), describing or narrating the child's or parent's play (e.g., "We're stacking blocks," "You have the baby," "Mommy has the red one"), using sound effects or exclamations (e.g., "Vroom vroom," "Whee," "Uh oh!"), and using non-specific vocalizations (those directed to self or another adult) or praising the child.

Reliability

Thirty-two percent of mother-child interaction videotapes were coded for child language and maternal language by a second observer to check reliability. Percent agreement

(Agreements/Agreements + Disagreements) was 81% for child language. Cohen's kappa was .61 for relationship to child focus of attention, .71 for degree of demandingness, .67 for use of orienting cues, .73 for language prompts, .62 for play prompts, and .66 for other behavior prompts. These kappa values indicate good agreement (Landis & Koch, 1977).

Data Transformation

First, child language and control points, as well as the types of maternal utterances that preceded each point, were identified. Data was then tallied separately for each child to determine how many maternal vocalizations of each type preceded control points and how many maternal vocalizations of each type preceded child language points for each mother-child dyad. In order to account for the fact that most children had a different number of child language points than control points (with some children having more control points, and some children having more child language points), and that the number of child language points varied across children, the number of maternal vocalizations of each type that preceded child language points and control points were converted into percentages. This was accomplished for child language points by dividing the number of maternal language points of a particular type that preceded child language points by the total number of child language points, and for control points by dividing the number of maternal language points of a particular type that preceded control points by the total number of control points. When breaking down language by number of orienting cues used, percentages for follow-in and redirecting points were calculated separately. For example, when calculating the sub-category of follow-in maternal language with no orienting cues, the number of *follow-in* child points and *follow-in* control

points for each individual child were used as the denominators, rather than the *overall* number of child and control points.

Results

Preliminary Analyses

All analyses were conducted using the Statistical Package for the Social Sciences (SPSS) software, Version 19.0. Because the typically developing group had a higher mean expressive language age equivalent on the PLS-4 than the ASD group and these scores were correlated with a number of variables in the ASD sample, PLS-4 expressive language age equivalents were used as a covariate in all analyses. PLS-4 scores were centered to account for the fact that the mean PLS-4 score was significantly greater than zero (van Breukelen & van Dijk, 2007). In addition, because mothers were given different instructions during the first half of the mother-child interaction (i.e., target language and communication skills) and the second half of the interaction (i.e., target play/social engagement skills), we conducted all analyses separately for the first and second halves of the interaction. When results did not differ across the first and second halves of the interaction, analyses were reported using the full ten minutes of the mother-child interaction. When results differed across halves of the interaction, results were reported separately for the first and second half.

Child Language Use

The total number of child language points during the 10-minute play interaction ranged from 2 to 74 (M = 25.5, SD = 18.3) for children with ASD and from 5 to 89 (M = 51.3, SD = 27.6) for typically developing children. After statistically controlling for expressive language level on

the PLS-4, there was a trend toward children with typical development speaking more frequently than children with ASD, $F(1, 41) = 3.28$, $p = .077$.

Maternal Language Use

In the ASD sample, a total of 17 child language points from 8 mother-child interactions (2.4% of all child language points) and a total of 9 control points from 7 mother-child interactions (1.6% of all control points) were excluded from maternal language analyses due to no maternal language utterances occurring in the 10 seconds preceding the child language or control point. In the typical sample, a total of 8 child language points from 6 mother-child interactions (0.9% of all child language points) and a total of 5 control points from 3 mother-child interactions (1.6% of all control points) were excluded from maternal language analyses due to no maternal language utterances occurring in the 10 seconds preceding the child language or control point.

Baseline rates of mothers' use of each type of language (language preceding control points) were compared between the ASD and typically-developing samples using one-way ANCOVAs with ASD status as a between-subjects factor. These analyses indicated that, during the second half of the interaction only (in which mothers were asked to target play/social engagement skills), mothers of children with ASD accompanied follow-in language with an orienting cue significantly more often than mothers of children with typical development (ASD: $M = 52.29\%$, $SD = 26.20\%$; Typical: $M = 24.05\%$, $SD = 19.54\%$), $p < .05$. No other differences were detected between groups. Baseline rates of each type of maternal language behavior are reported in Table 4 and represented in Figures 1 and 2.

Table 4

Baseline Frequencies of Maternal Language

	ASD		Typical	
	Mean %	Std. Dev.	Mean %	Std. Dev.
Follow-In[a]	77.34	15.10	85.45	10.56
Redirecting[a]	22.66	15.10	14.55	10.56
Demanding[a]	54.98	15.47	57.18	13.55
Non-Demanding[a]	45.02	15.47	42.82	13.55
Follow-In				
Demanding[a]	38.47	15.87	45.51	11.37
Non-Demanding[a]	38.87	16.43	39.94	14.09
Redirecting				
Demanding[a]	16.51	9.03	11.66	7.62
Non-Demanding[a]	6.15	7.39	2.88	4.50
Follow-In				
No Orienting Cues[b]	44.78*	18.34	70.88	12.24
1+ Orienting Cues[b]	55.22*	18.34	29.12	12.24
Redirecting				
No Orienting Cues[c]	33.25	27.30	26.67	19.29
1+ Orienting Cues[c]	66.75	27.30	73.33	19.29
Demanding[e]				
Verbal Prompts[d]	49.80	18.50	59.80	25.35
Play Prompts[d]	29.13	15.74	28.52	22.00
Other Prompts[d]	21.07	16.21	12.82	9.75

*$p \leq .05$, controlling for PLS-4 Expressive Age Equivalent

[a]Percentage of all points

[b]Percentage of Follow-In points

[c]Percentage of Redirecting points

[d]Percentage of Demanding points

[e]Total may exceed 100% as categories are not mutually exclusive

Figure 1

Baseline Frequencies of Maternal Language Types

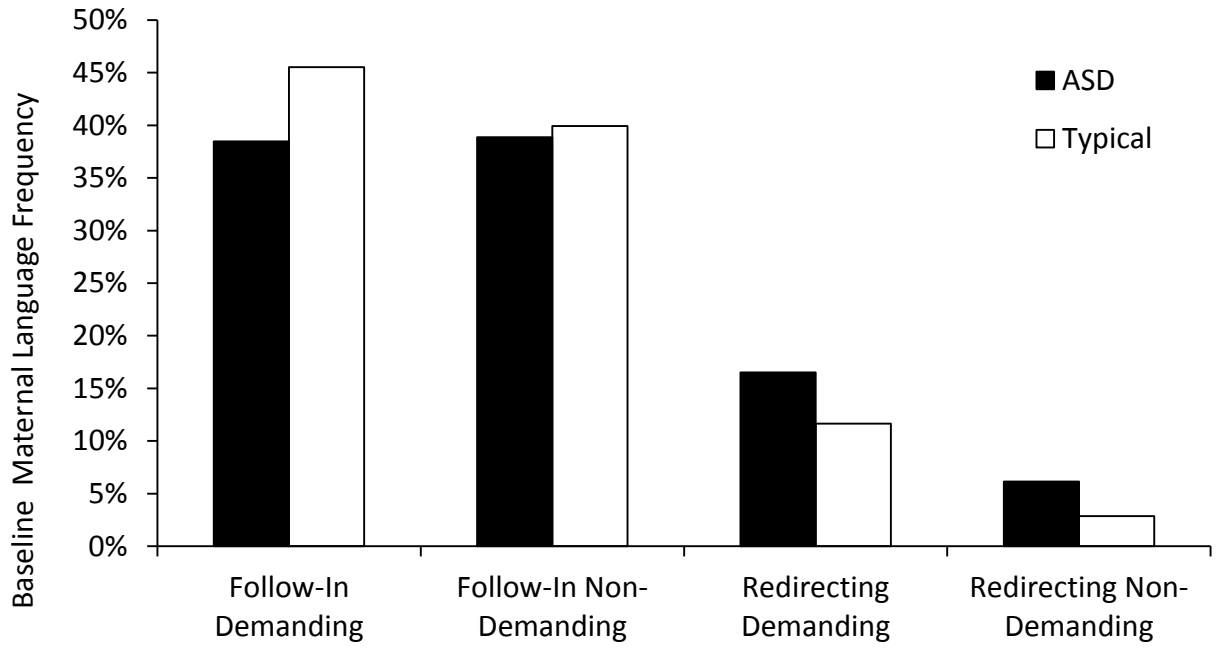
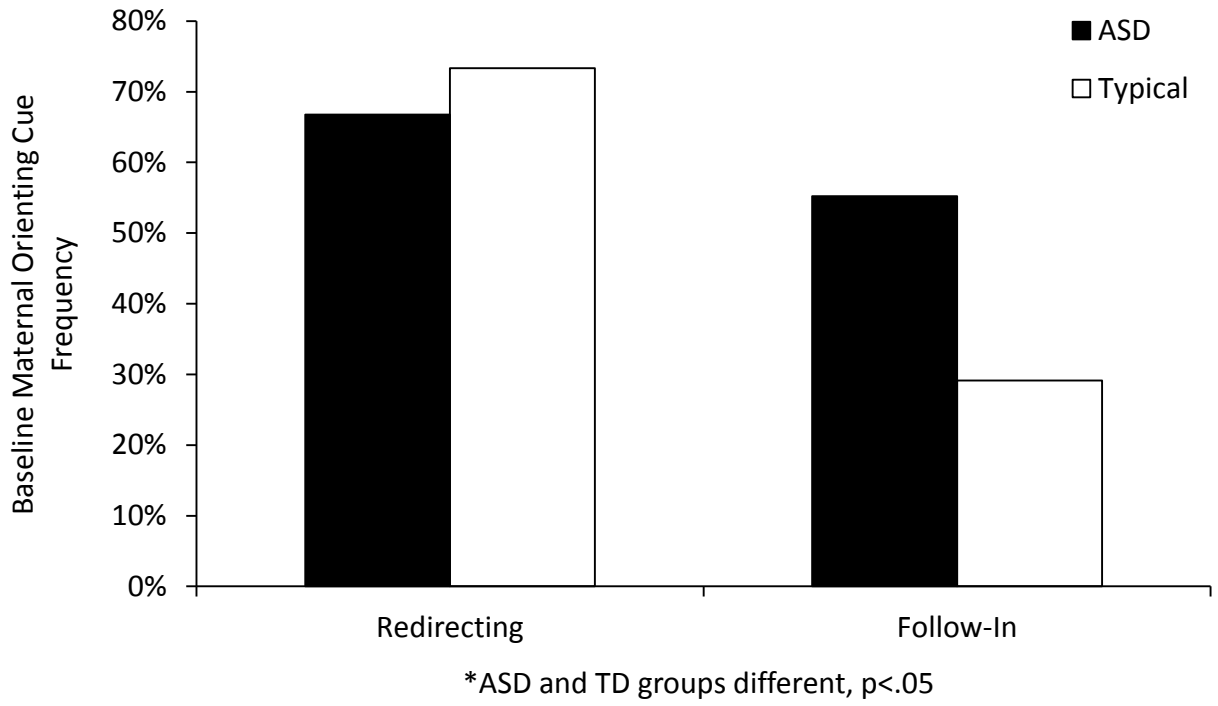


Figure 2

Baseline Frequencies of Orienting Cues



Types of Maternal Language that Promote Child Language Use

Following these preliminary analyses, we conducted a 2 x 2 x 2 mixed model ANCOVA with relationship to child's focus of attention (follow-in versus redirecting) and degree of demandingness (demanding versus non-demanding) as within-subjects factors, ASD status as a between-subjects factor, and PLS-4 scores as a covariate. For both within-subjects factors, the difference scores between percentage occurrence before child points versus control points was used for this analysis. Results of this analysis differed slightly between halves of the video, so the analysis for each half is reported separately.

During the first half of the interaction (in which mothers were asked to target language/communication skills), the ANCOVA indicated main effects of degree of demandingness, F (1,39)=14.352, p = .001, and relationship to child's attention, F (1,39)=6.883, p < .05, such that follow-in language and demanding language were more likely to precede child language than control points. A significant interaction between degree of demandingness and relationship to child's focus of attention was also detected, F (1,39)=11.618, p < .01. Follow-up paired samples t-tests comparing means for each of the four language categories using a Bonferroni correction indicated significant differences between the follow-in demanding condition and all three other conditions (p<.001), suggesting that the main effects were primarily driven by a benefit of follow-in demanding maternal language compared to all other types of maternal language. During the second half of the interaction (in which mothers were asked to target play/social engagement skills), the ANCOVA again indicated a main effect of degree of demandingness, F (1,38)=9.066, p < .01, such that demanding language was more likely to occur before child language points. However, no main effect of relationship to child's attention was detected, F (1,38)=0.338, p = n.s. As in the first half of the play session, a significant interaction between degree of demandingness and relationship to child's focus of attention was also detected, F (1,38)=4.418, p < .05. Finally, an interaction between degree of demandingness and ASD status was detected F (1,38)=5.090, p < .05. Follow-up pairwise comparisons to examine the demand x attention interaction using paired samples t-tests with Bonferroni corrections indicated significant differences between the follow-in demanding condition and the follow-in non-demanding condition (p<.01) and between the follow-in demanding condition and the redirecting non-demanding condition (p<.01). To further examine

the demand x ASD interaction, a one-way ANCOVA with difference score for demanding language as the dependent variable and ASD status as a between-subjects factor was used to compare children with and without ASD on their response to demanding language. These comparisons indicated that the ASD group benefited more from demanding language than the typically developing group, F (1,38)=5.090, $p < .05$. See Figure 3 for a graphical representation of interactions. See Table 5 for full ANCOVA results.

Figure 3

Interaction Between Degree of Demandingness and Relationship to Child's Focus of Attention

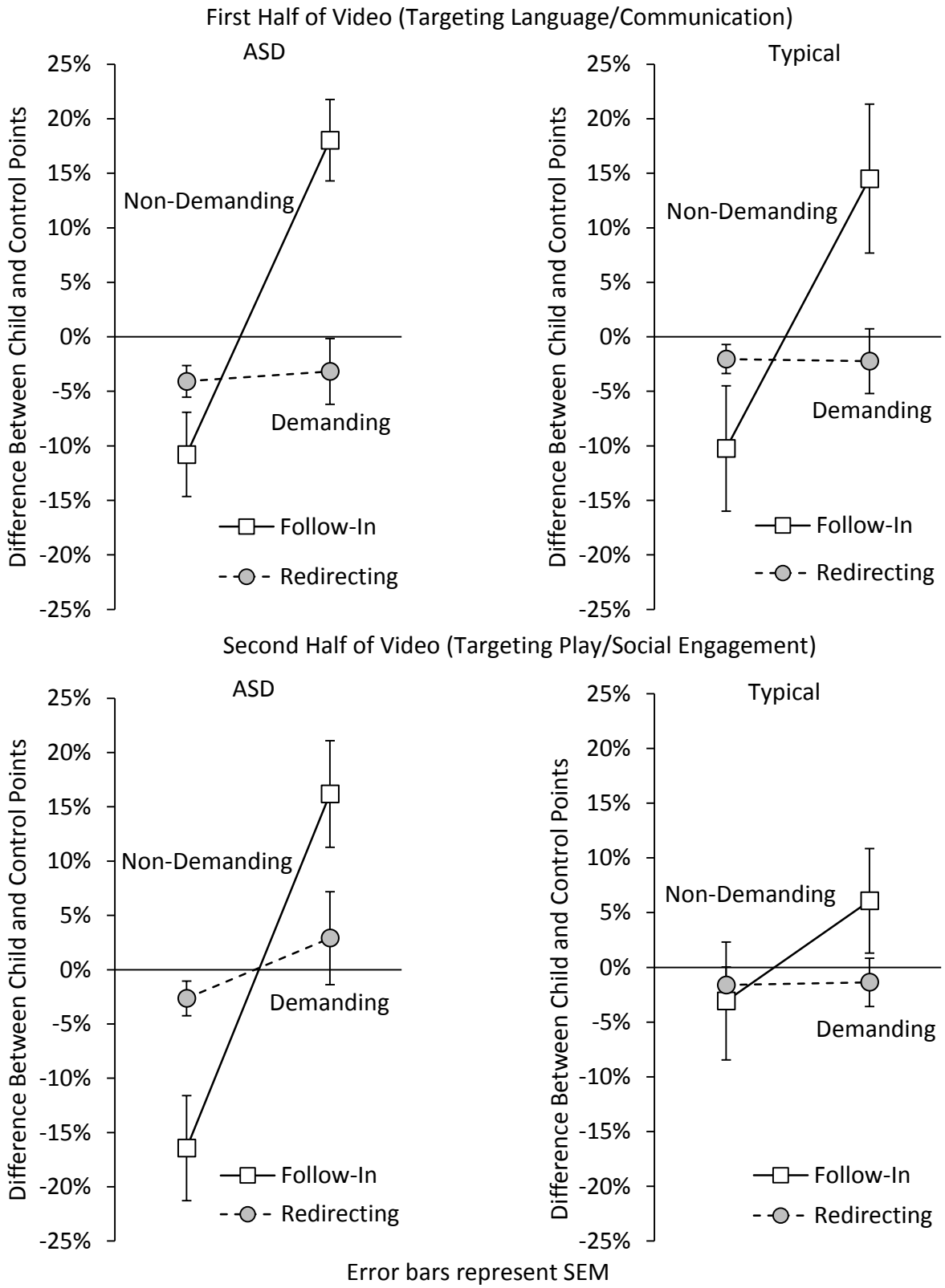


Table 5

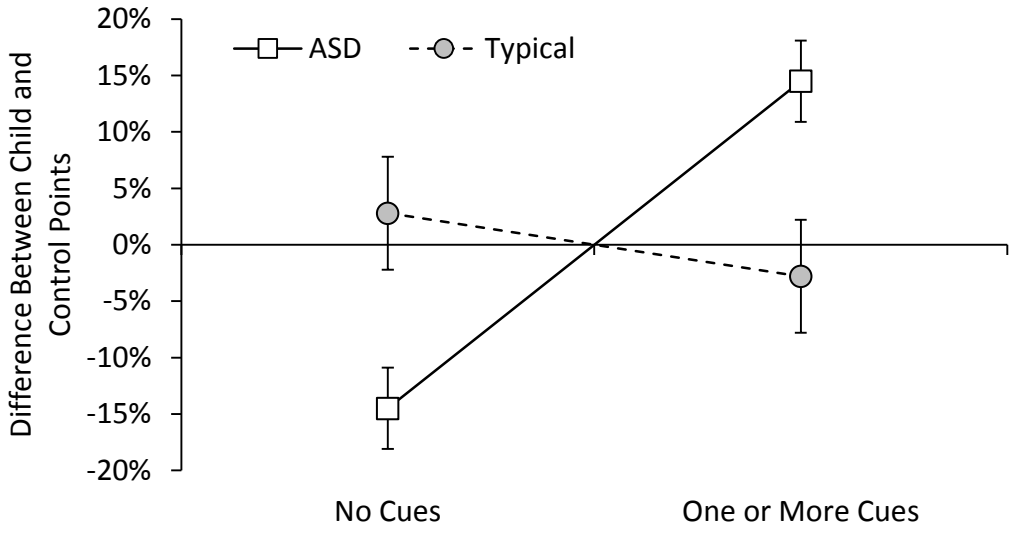
Results of ANCOVA

	Video Segment	F	df	P	Partial η^2
Main Effects					
Relationship to Child's Focus of Attention	1 (Language)	6.88	1, 39	.012*	.150
	2 (Play/Social)	0.34	1,38	.564	.009
Degree of Demandingness	1 (Language)	14.35	1, 39	.001*	.269
	2 (Play/Social)	9.07	1,38	.005*	.193
Two-Way Interactions					
Attention*PLS-4 Expressive	1 (Language)	0.57	1, 39	.456	.014
	2 (Play/Social)	0.56	1,38	.460	.014
Attention*ASD Status	1 (Language)	0.05	1, 39	.819	.001
	2 (Play/Social)	0.60	1,38	.443	.016
Demandingness*PLS-4 Expressive	1 (Language)	0.19	1, 39	.662	.005
	2 (Play/Social)	0.97	1,38	.330	.025
Demandingness*ASD Status	1 (Language)	0.29	1, 39	.594	.007
	2 (Play/Social)	5.09	1,38	.030*	.118
Attention*Demandingness	1 (Language)	11.62	1, 39	.002*	.230
	2 (Play/Social)	4.42	1,38	.042*	.104
Three-Way Interactions					
Attention*Demandingness*PLS-4 Expressive	1 (Language)	1.08	1, 39	.306	.027
	2 (Play/Social)	2.43	1,38	.127	.060
Attention * Demandingness * ASD Status	1 (Language)	0.44	1, 39	.509	.011
	2 (Play/Social)	3.46	1,38	.071	.083

To examine whether children's likelihood of verbally responding differed by mothers' use of orienting cues, we conducted a 2 x 2 x 2 mixed model ANCOVA with use of orienting cues (zero versus one or more) and relationship to child's focus of attention (follow-in versus redirecting) as within-subjects factors and ASD status as a between-subjects factor. This ANCOVA detected a significant two-way interaction between number of cues and ASD status, $F(1, 34) = 7.087$, $p < .05$, such that children with ASD benefited more from mothers' use of orienting cues than children with typical development. See Figure 4.

Figure 4

Difference Scores by Use of Orienting Cues



Significant Cues x ASD interaction, p<.05
Error bars represent SEM

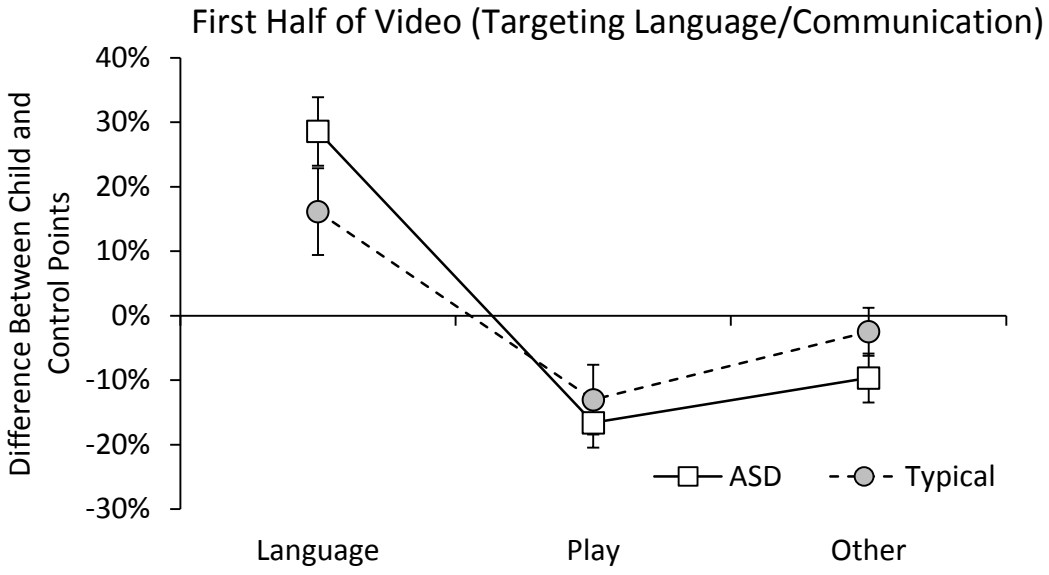
To examine whether children's likelihood of verbally responding differed by the type of prompt mothers used we conducted a 3 x 2 x 2 mixed model ANCOVA with type of prompt (language, play, other) and relationship to child's focus of attention (follow-in versus redirecting) as within-subjects factors and ASD status as a between-subjects factor. For the first half of the video (in which language was targeted), this ANCOVA detected a significant main effect of prompt type $F(2, 48) = 12.508$, $p < .001$. Follow-up pairwise comparisons using paired samples t-tests with Bonferroni corrections indicated differences between language prompts and play prompts, $p<.01$, and between language prompts and other prompts, $p<.01$, such that language prompts were more likely to precede child language use. During the second half of the

video, no significant main effects or interactions between the main variables were detected.

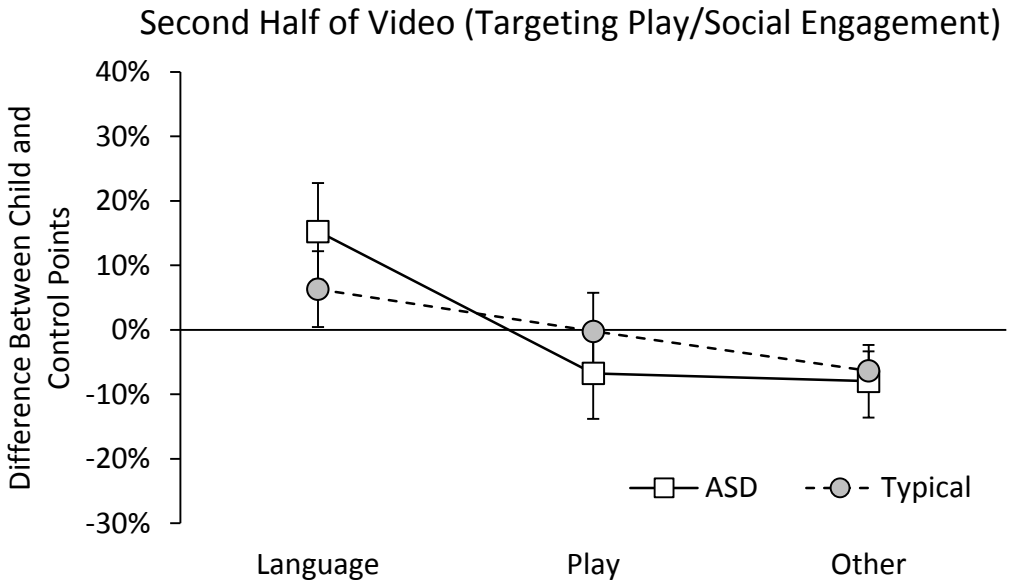
See Figure 5.

Figure 5

Difference Scores by Prompt Type



Significant differences found between language-play and language-other pairs.
Error bars represent SEM.



No significant differences between conditions.
Error bars represent SEM.

Exploratory Analyses

A series of exploratory correlational analyses were conducted to examine relationships between child characteristics on standardized assessments and the types of maternal language that encouraged language use in individual children. Child characteristics included number of joint attention initiations (IJA) and percent of responses to joint attention bids (RJA) on the ESCS, expressive, receptive, and total language age equivalents on the PLS-4, cognitive age equivalents on the Bayley, and productive vocabulary on the CDI. Bivariate correlations were conducted between these factors and child language-control point difference scores for each of the main maternal language categories (follow-in demanding, follow-in non-demanding, redirecting demanding, redirecting non-demanding) and maternal language sub-categories (redirecting no orienting cues, follow-in no orienting cues, language prompts, play prompts, other prompts). Because patterns of correlations differed in the ASD and typically developing groups, correlations are reported separately for each group. In the typically developing group, this analysis found a significant positive correlation between scores on the Bayley and difference scores for follow-in demanding language, $r(16) = .64$, $p < .01$, and a significant negative correlation between Bayley scores and difference scores for follow-in non-demanding language, $r(16) = -.68$, $p < .01$, indicating that typically developing children with higher scores on a non-verbal assessment benefited more from follow-in demanding language and less from follow-in non-demanding language than children with lower non-verbal scores. No other correlations were found between demographic variables and difference scores in the typically developing sample.

In the ASD sample, this analysis found a significant negative correlation between RJA and difference scores for follow-in demanding language, suggesting that children with better RJA skills benefited relatively less from follow-in demanding language than children with poorer RJA skills, $r(28) = -.40$, $p < .05$. A negative correlation was also detected between IJA and difference scores for follow-in language with no orienting cues, $r(28) = -.39$, $p < .05$, indicating that children who initiated joint attention less often were more likely to respond to this type of language. Expressive language scores on the PLS-4 were found to be negatively correlated with difference scores for redirecting language with no orienting cues, $r(24) = -.41$, $p < .05$, indicating that children with poorer expressive language skills were more likely to respond to redirecting language that did not include orienting cues than were children with better expressive language skills. Finally, receptive, expressive, and total language scores on the PLS-4 and vocabulary size on the CDI were negatively correlated with language prompt difference scores, indicating that children with better receptive ($r(28) = -.38$, $p < .05$), expressive ($r(28) = -.53$, $p < .01$), and total($r(28) = -.48$, $p < .05$) language skills and larger expressive vocabularies, $r(27) = -.52$, $p < .01$, benefited relatively less from mothers' use of language prompts than children with poorer language skills.

Discussion

This study examined what types of maternal language were most likely to precede instances of child language in children with ASD and typical development during a brief naturalistic mother-child play interaction. When a particular type of maternal language was more likely to precede child language than control points, this type of language was interpreted as *promoting* child language use. On the contrary, when a particular type of maternal language

was more likely to precede control points than child language points, this type of language was interpreted as *discouraging* child language use. Two main dimensions of maternal language, relationship to the child's focus of attention (follow-in versus redirecting) and degree of demandingness (demanding versus non-demanding) were examined, along with sub-categories of language based on whether mothers used an orienting cue to help the child attend and based on what type of behaviors (language, play, other) mothers were encouraging their children to use.

Maternal Language Styles

Overall, maternal language patterns were similar in mothers of children with ASD and children with typical development. Mothers in both groups used primarily follow-in language, suggesting that, in our sample, mothers were adept at identifying and joining their children's current interests. Given that our sample consisted largely of highly-educated, middle-to-upper income mothers, a group that has generally been found to be highly responsive to their children, this finding is unsurprising (e.g., Feiring & Lewis, 1981; Richman, Miller, & LeVine, 1992). The finding of similar language patterns in mothers of children with ASD and children with typical development is also consistent with previous research suggesting similar levels of responsiveness across these groups (Siller & Sigman, 2002). In both groups, mothers' follow-in language was split relatively evenly between demanding and non-demanding language, indicating that mothers frequently comment on their children's current play as well as make requests about their children's play. Mothers of children with ASD did use orienting cues to support their children's attention somewhat more frequently than mothers of children with typical development. This may be because children with ASD have a more difficult time

switching attention between an object and a person during play than do children with typical development (Swettenham et al., 1998). Mothers of children with ASD may notice and attempt to compensate for this difficulty by using additional cues to help their children attend to them during play.

Types of Maternal Language that Promote Child Language Use

For both children with ASD and children with typical development, mothers' use of follow-in demanding language was most likely to promote child language use when mothers were asked to target their child's language/communication skills. For children with ASD, this benefit for follow-in demanding language remained pronounced during the section of the interaction during which mothers targeted play/social engagement skills as well. This finding that children in both groups benefited from mothers' use of follow-in demanding language is consistent with the naturalistic behavioral intervention philosophy, which embeds prompts for specific behaviors within interactions that follow the child's interests (e.g., Koegel & Koegel, 2006). It is also partially consistent with McDuffie & Yoder's (2010) longitudinal findings that follow-in directives promoted child language growth.

However, this finding stands in contrast to some of the previous longitudinal work in this area. In particular, Siller and Sigman (2002; 2008) found that, over time, children with ASD whose mothers were more likely to use follow-in *non-demanding* language showed the most language growth. Similarly, McDuffie and Yoder (2010) also found that follow-in comments promoted language growth over time (although follow-in directives also made a positive contribution to child language growth in their study). On the contrary, the present study found that follow-in non-demanding language was *least* likely to be followed by child language

compared to the other maternal language categories. There are a number of possible explanations for this discrepancy in findings. First, a closer examination of the specific types of prompts that promoted child language use may provide some insight. In the present study, the benefit for follow-in demanding language was driven primarily by mothers' use of specific prompts for language behaviors. On the contrary, mothers' prompts for non-language behaviors actually discouraged children's use of language. In Siller and Sigman's (2002; 2008) longitudinal work, all types of maternal demands were grouped together. Given that mothers in their study were instructed simply to play "as they normally would" with "any toy they would like to use," (rather than specifically asked to target skills, as in the current study), it is possible that the majority of mothers' demanding language consisted of prompts for non-language behaviors. If this was the case (that mothers' demanding language was focused on non-language behaviors), our findings regarding demanding language (that follow-in demanding play and other prompts discouraged child language) would be more consistent with Siller and Sigman's findings. The instructions given to parents during interactions with their children may influence parents' behavior significantly. Therefore, these results should be replicated using parent-child interactions in which parents are given more open-ended instructions.

It is also possible that the design of the current study enabled it to better take into account both child and parent factors influencing the conversational context than previous longitudinal studies. An interaction between a parent and child is complex, with parent behavior and child behavior influencing one another continuously throughout the interaction. The design of the current study anchored mothers' behaviors to children's language behaviors as they occurred throughout the interaction, allowing the analyses to better account for both mothers' and

children's reciprocal influences during the interaction. While previous longitudinal studies have attempted to control for the child's influence his mother's behavior by controlling for child factors such as amount of time engaged in toy-based attention or child's standardized test scores at the time of the interaction, the complex nature of parent-child interactions makes it nearly impossible to adequately control for all child variables that might influence his parent's behavior during a play session. This opens up the possibility of significant confounds in longitudinal research, as child factors at time 1 (e.g., social relatedness, quality of attention leads provided) may influence both parent behavior at time 1 and child skill growth over time. By anchoring mothers' language behaviors to time periods that *immediately* precede children's language behaviors, the design of the current study may be able to better parse out the influence of parent behavior on child language behavior, rather than vice versa.

While the current study may have more power to detect relationships between parent and child behavior during the immediate conversational context, this design is not able to predict long-term growth in child skills. It is possible that differences in results between the present study and past longitudinal studies are because different mechanisms are at work over time than in the immediate conversational context. This study found that follow-in demanding language, particularly prompts for language behaviors, encouraged children to verbally respond. This type of verbal rehearsal may help children with ASD improve their language over time. However, in addition to rehearsing words and phrases already in their verbal repertoire, children likely also require exposure to new vocabulary, grammar, and concepts to advance their language skills. It is possible that mothers are more likely to include language concepts their children have not yet mastered when simply commenting on their children's activities

than when encouraging their child to use language, knowing that their child is unlikely to be able to use this language at the present time. In this case, both maternal demanding language (that helps children to rehearse their language skills) and non-demanding language (that exposes children to new language forms and functions) are necessary to promote child language growth over time. This explanation is consistent with McDuffie and Yoder's (2010) finding that both of these maternal language types promote language growth over a period of six months in children with ASD. Future studies should examine what types of maternal language promote child language both within the immediate conversational context and over time within the same sample of children and parents, to clarify whether similar or different mechanisms are at work in the short-term versus long-term context and what combination of demanding and non-demanding language is most helpful for children's language development.

The Influence of Orienting Cues

Although the types of language that promoted language use for children with ASD and children with typical development were largely similar, one notable difference did emerge between groups. For children with ASD, but not children with typical development, mothers' use of orienting cues in conjunction with their language helped children to verbally respond. This finding builds on previous literature regarding the benefits of orienting cues for children with ASD. Despite the consistent finding that children with ASD are impaired in their ability to utilize orienting cues such as pointing or having their name called (e.g., Dawson et al., 1998) to establish joint attention with an adult, some literature has found that the adding orienting cues to support attending may help children at-risk for ASD to visually attend to an adult's focus of attention (Presmanes et al., 2007). In addition, Koegel et al. (2009) found that adding an

individualized orienting cue (e.g., a high five or specific phrase) to traditional pivotal response treatment helped non-responders acquire first words. The present study found that mothers' use of orienting cues during a naturalistic play session increased the likelihood of a child with ASD verbally responding, but had no impact of the likelihood of children with typical development verbally responding. This finding supports the existing literature about the use of orienting cues in ASD, indicating that the types of orienting cues mother use spontaneously during play interactions with their children with ASD are facilitating meaningful language use in these children. Additionally, our exploratory analyses detected a negative correlation between RJA skills and follow-in demanding language in the ASD group, suggesting that follow-in demanding language was particularly beneficial for children with poor RJA skills. This finding extends the previous literature by pointing to a group of children (those with poor RJA skills) who may be less likely to respond to orienting cues and therefore may particularly benefit from language that makes demands related to their current focus of attention. Children with typical development were largely at ceiling levels in their RJA skills. Therefore, the fact that orienting cues were not beneficial (but also not detrimental) for children with typical development makes sense, as these children were likely more adept at following their mothers' attention and responding whether or not their mothers used orienting cues.

Future Directions

This study found that, overall, follow-in demanding language was most likely to promote language use in both children with ASD and children with typical development. This suggests that similar learning processes may be at work for children with ASD and children with typical development with similar language skills. This lends support to developmental models of

language acquisition in ASD, which suggest that children with ASD may learn language in similar ways to typically developing children with similar skill profiles. However, given the small sample size in our typically developing group, low statistical power may have hindered our ability to detect group differences. Future studies should examine this question with a larger group of children to clarify similarities and differences between children with ASD and children with typical development.

This study's finding that follow-in non-demanding language is most beneficial for the language use of children with ASD stands in contrast to previous longitudinal studies (Siller & Sigman, 2002; 2008) that have indicated that follow-in non-demanding language is most beneficial for child language growth over time. Given the discrepancies between this study's findings and the longitudinal literature, future studies that examine the types of maternal language that promote child language both within the immediate conversational context and over time in the same sample of children would be useful to help clarify the reasons for these differences.

In addition, the majority of mothers in this sample followed their children's attention the majority of the time, and balanced demanding and non-demanding language fairly evenly. This makes it difficult to generalize these findings to a sample of mothers with more heterogeneous interaction patterns with their children. For example, this study found that follow-in demanding language was most beneficial for child language use. However, mothers only used demanding language, on average, about half the time. It is possible that there is an "ideal" balance between demanding and non-demanding language that many of these mothers fell into, and it may not be true that "more is better" as most mothers used both demanding and non-

demanding language fairly equally. Future studies should attempt to include mothers with a wider range of language patterns; recruiting a sample from a wider range of socioeconomic and educational backgrounds may facilitate this goal.

Finally, this study examined only one particular child skill within the play session—instances of appropriate language use. It is possible that examining child language in a more nuanced way (e.g., grammatical constructions, vocabulary usage, mean length of utterance) might further illuminate patterns in mother-child conversation. For example, certain types of demands may be more likely to elicit particular language forms than others. In addition, examining children's use of other skills, such as play skills or social responses may also provide additional information. While prompts for behaviors other than language did not encourage child language use in this sample, it is possible that these prompts encouraged the use of other types of skills, such as more advanced play skills or joint attention skills. Future studies that examine the influence of responsiveness in maternal speech of a number of skills may further clarify the relationships between particular types of maternal demands and child behavior across skill sets.

Conclusions

In this study, both children with ASD and children with typical development were most likely to verbally respond when mothers used language that followed the child's current focus of attention and placed a demand on the child to use language. For children with ASD, mothers' accompaniment of their language with at least one orienting cue also facilitated verbal responding. These findings are consistent with the naturalistic behavioral intervention philosophy, which prompts for skill use within the context of a child's interest. Future studies should examine the types of maternal language use that promote language both within the

conversational context and over time to better understand how maternal responsiveness functions in both the immediate and long-term context.

Study 2: Fast-Mapping of Receptive and Expressive Noun Labels

Introduction

Autism spectrum disorders (ASD) are a group of developmental disorders characterized by impairments in social interaction and communication, and restricted and repetitive patterns of behavior or interests (American Psychiatric Association [APA], 2000). Delay in or lack of development of oral language is a diagnostic criterion for autism (APA, 2000). Epidemiological studies have estimated that 19 to 59% of individuals with autism have no spoken language (Fombonne, 1999). While children with ASD tend to be delayed in a number of aspects of early language development, parents of preschool-aged children with ASD report that their children have significantly smaller vocabularies than children with other developmental delays (Coonrod & Stone, 2004), indicating that vocabulary is an important early language skill that is specifically delayed in children with ASD.

Fast-Mapping and Joint Attention

Typically developing toddlers are able to pick up new vocabulary words quickly, often learning new words after only a few exposures. This ability is known as "fast-mapping" (Carey & Bartlett, 1978). By 18 months of age, children with typical development are able to use a speaker's direction of gaze to correctly attach a novel label to an object that an adult is looking at, even if the adult's direction of gaze is discrepant from their own (e.g., Baldwin, 1991; 1993). Under the same conditions, sixteen- to seventeen-month-olds tend to respond randomly, failing to map the new word to either their own or the adult's focus of attention (Baldwin,

1991). On the contrary, ten-month-old children tend to incorrectly attach the label to their own focus of attention (mis-map), rather than the adult's focus of attention (Pruden et al., 2006).

This developmental progression in the ability to use an adult's focus of attention to fast-map new words is likely related to the parallel development of children's joint attention abilities. The ability to follow another person's attention, known as gaze-following or response to joint attention (RJA), begins to emerge very early in typically developing children, and there is some evidence that infants as young as 4 months of age show evidence of shifting their gaze in response to an adult's gaze shift (Hood, Willen, & Driver, 1998). Infants become increasingly proficient at RJA as they get older, and this skill appears to hit near-ceiling levels by 18-21 months of age (Mundy and Gomes, 1998). Notably, toddlers' ability to use an adult's direction of gaze to fast-map new words comes on-line around the same time that RJA skills hit ceiling levels.

A variety of evidence indicates that children with ASD are impaired in their RJA abilities compared to children with other types of disabilities or with typical development. For example, Mundy, Sigman, and Kasari (1990) found that children with ASD were more impaired in their joint attention (a composite variable that included RJA and well as initiating behaviors) than language- and mental-age matched children with intellectual disabilities. This was true both at initial testing (mean age of children with ASD 44.9 months) and follow-up testing one year later. While typically developing children appear to reach ceiling levels of performance on RJA tasks around 18 months of age, the RJA deficits of children with ASD persist at least into middle childhood. Leekam, Hunnisett, and Moore (1998) found that a large proportion of older children with ASD (5-12 years old) continued to have difficulties responding to joint attention,

particularly children with verbal mental ages below 48 months. In addition, parents of children with ASD in this study reported later onset of gaze-following behavior regardless of the children's current developmental or language level. Several other studies have indicated delayed or deficient RJA skills in children with ASD, corroborating these findings (Landry & Loveland, 1988; Lewy & Dawson, 1992; Loveland & Landry, 1986; Mundy et al., 1986).

Joint Attention and Fast-Mapping in Children with ASD

Several studies of fast-mapping in children with ASD suggest that these difficulties with joint attention lead to difficulties harnessing more mature strategies to fast-map new words. Baron-Cohen, Baldwin, and Crowson (1997) tested 7- to 12-year-old children with ASD (average receptive language age 27 months) on whether they could learn novel words under conditions of follow-in and discrepant labeling. Two novel objects were presented to each child. In the follow-in condition, the experimenter gazed upon and labeled the novel object the child was playing with while he attended to it, uttering the label twice. In the discrepant condition, the experimenter gazed upon and labeled the object she was holding two times while the child was gazing upon and playing with the other object. Despite a relatively difficult test of comprehension (the children had to pick the object out of an array of six objects—the two novel objects used in the training phase, two additional novel objects, and two familiar objects), children with ASD selected the correct object 82% of the time after follow-in labeling, well above chance level and comparable to the performance of language-age matched children with mental handicaps. In contrast, when the experimenter used discrepant labeling, children with ASD selected the correct item only 29% of the time (not significantly different from chance levels), compared to 71% correct selections by the language-matched children with mental

handicaps. Notably, every child with ASD who failed the discrepant labeling task chose the toy that he or she had been attending to during the labeling episode, indicating that the children with ASD mis-mapped the novel word onto the object they were currently attending to, a pattern similar to that seen in typically-developing 10-month-olds. In a second study reported in the same paper, language-matched typically developing children showed success in both the follow-in and discrepant labeling tasks.

Priessler and Carey (2005) replicated Baron-Cohen et al.'s (1997) results using a nearly identical paradigm (with the exception that children only had to choose between four, rather than six, items during the test phase). They found that children with ASD (average age 7.8 years, vocabulary age 23 months) were able to correctly map the novel word in the follow-in condition, but not the discrepant condition; during the discrepant condition, they mis-mapped the novel word to the object they were attending to at the time. In contrast, typically developing 2-year-olds succeeded at both tasks.

It is notable that the word learning strategies used by children with ASD in these studies are characteristic of those used by typically-developing 10-month-olds (Pruden et al., 2006), and that, by 18 months of age, typically developing children begin to succeed at these word learning tasks. However, the children with ASD included in these studies had language ages well above those that would be expected for children using these types of immature word learning strategies (average language ages were around 24 months). This suggests that children with ASD are able to proceed in their language development despite difficulty learning words when adults use discrepant labeling (i.e., their language development is not arrested at 18 months,

the age at which typically developing children begin using gaze-following to learn new words), but that their language development may be slow as a result.

Supporting Language Learning in Children with ASD

The fact that children with ASD do proceed in their language development despite failing to learn words in these gaze-following tasks suggests that the experimental paradigms that have been used with children with ASD may be missing important factors that are allowing these children to succeed at vocabulary learning in their natural environments (i.e., home or therapeutic settings). Therefore, an examination of the literature on elements important for promoting child language during parent-child or therapist-child interactions may provide insight into additional factors important for increasing the word-learning success of children with ASD that might be useful to examine in more controlled experimental settings.

Use of Orienting Cues. One possibility is that parents and therapists provide children with ASD more support in matching their focus of interest to the adult's focus of interest during word learning situations than is provided in the current experimental paradigms. Although one way that parents and therapists may support this joint attention is by following the child's focus of interest, adults may also use other strategies to support joint attention to an object. For example, Wimpory, Hobson, and Nash (2007) found that adults' engagement in familiar social routines promoted episodes of social engagement in young children with ASD. Presmanes et al. (2007) found that children at risk for ASD benefited from redundant cues, such as pointing paired with gaze, in following an adult's attention. In addition, Koegel et al. (2009) found that children with ASD who did not initially have a positive treatment response improved their responding after the introduction of individualized orienting cues (e.g., giving a high five) to

help gain the child's attention before teaching episodes. Finally, structured behavioral approaches have been successful in teaching children language skills after first recruiting their attention using cues such as saying, "look at me" (Lovaas, 1977). These findings suggest that, in a number of settings in which children with ASD successfully learn language, the use of orienting cues may facilitate the acquisition of new language skills. It is possible that children with ASD are able to successfully navigate word learning situations that require them to switch attention, but only if the adult provides additional support to aid the child in switching his attention.

Use of Demanding Language. Another factor that may influence the word learning success of children with ASD is the use of demanding language, (i.e., prompting a response) during word learning situations. A number of successful treatments for teaching language to children with ASD (e.g., discrete trial training, milieu teaching, pivotal response training) make use of behavioral prompting strategies to help children with ASD increase their expressive and receptive vocabulary skills. In addition to pressing children for a specific response, the use of prompting may also help children with ASD to tune-in to the relevant aspects of the learning situation. This suggests that increasing the demandingness of word-learning situations by asking children to produce the label might increase their success at learning new words. In addition, if prompting the child to produce a language label aids in their learning of the expressive label, this may generalize to receptive learning as well. For children with ASD, this generalization from expressive to receptive language may be easier than generalization in the other direction (Wynn & Smith, 2003). Alternatively, different degrees of demandingness could have different effects on expressive versus receptive language acquisition, with the

requirement to produce the word facilitating expressive acquisition and the simple labeling of the word promoting receptive acquisition. A closer examination of the influence of demanding versus non-demanding language on the language use and vocabulary acquisition of children with ASD would help clarify these questions.

Goals of the Current Study

The current study seeks to extend previous research on the word learning skills of children with ASD and typical development by examining how a number of factors that may support the word learning of children with ASD in parent-child interactions and treatment contexts affect their word learning in a brief experimental context. First, in addition to testing the follow-in and discrepant conditions used in previous studies, this study adds an additional discrepant condition that includes an orienting cue (saying "look" or the child's name) in an attempt to recruit the child's attention to the adult's focus of interest (called the "orienting cue" condition in this study). Examining the learning patterns of children with ASD in this additional condition may help to clarify how much support children with ASD need to acquire new object labels under conditions of discrepant labeling. Second, this study will examine whether adding prompts for a child to verbally produce a word label aids children with ASD in acquiring new labels across these three trial types (follow-in, discrepant, orienting cue). Finally, this study will include both receptive and expressive acquisition trials in order to test whether children with ASD and typical development are able to acquire both receptive and expressive object labels across these conditions. This will provide consistency with previous studies and will allow us to examine whether different elements of adult language differentially affect

expressive versus receptive vocabulary learning, and whether the elements of adult language that promote learning differ across children with ASD and typical development.

Methods

Participants

Fourteen children with ASD (13 males, 1 female) and fifteen children with typical development (7 males, 8 females) participated in this study. Participants with ASD were recruited from local agencies and professionals serving young children with ASD (e.g., early intervention programs, pediatricians, parent support groups). Some participants were part of a number of larger studies examining the effectiveness of treatments for improving early social-communication skills in young children with ASD. Children with ASD had a diagnosis of autism or Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) based on DSM-IV criteria (APA, 2000) and all children met the cutoff for "autism" or "autism spectrum" on the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000), administered during a laboratory visit. Children with ASD were recruited based on language skills (with approximate target being 18-48 month age-equivalent on the PLS-4) and ranged in chronological age from 38 to 97 months. A number of previous studies examining similar questions in children with ASD and typical development have not matched subjects on gender (Priessler & Carey, 2005; Franken, Lewis, & Malone, 2010), and at least one study utilizing similar procedures with a large group of typically developing toddlers did not show effects of gender on performance (Baldwin, 1991); therefore, subjects were not matched on gender.

Participants with typical development were recruited from a pool of families who expressed interest in participating in child development research during recruitment fairs in

community locations likely to attract families (e.g., farmer's markets, parks, malls). Children were excluded from participation if parents reported a history of developmental difficulties, including language delays or if the child had an immediate family member (parent, sibling) with an autism spectrum disorder. All children were screened for developmental concerns using the Communication and Symbolic Behavior Scales-Developmental Profile Infant-Toddler Checklist (CSBS-DP; Wetherby & Prizant, 2002) and scored in the "No Concern" range in all areas. Children with typical development ranged in age from 16 to 29 months. Children with typical development were recruited such that their language skills approximately matched the language skills of the children in the ASD sample.

Measures

All measures used in this study have been shown to have adequate reliability and validity. Measures included the following:

Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000). Children with ASD were administered the ADOS, a semi-structured observational assessment of ASD symptoms, to confirm ASD diagnosis. Eleven children were administered Module 1 (for children with single words) and three children were administered Module 2 (for children with phrase speech). Ten children with ASD met the cutoff for "autism" and the remaining four met the cutoff for "autism spectrum." Because children in the sample were administered different modules of the ADOS, raw scores on the ADOS were converted to severity scores using Gotham, Pickles, and Lord's (2009) scaling procedure. The average ADOS severity score was 6.08 of out a possible 10, *SD* = 1.50, indicating an average severity level at the mild end of the "autism" range (scores of 4-5 indicate "ASD" and scores of 6-10 indicate "autism").

Preschool Language Scales, 4th Edition (PLS-4; Zimmerman et al., 2002). All children were administered the PLS-4. The PLS-4 is a standardized assessment of receptive and expressive language skills. The PLS-4 generates expressive, receptive, and total language scores. The PLS-4 total language age equivalent of each child with ASD was matched within 5 months with a child with typical development. PLS-4 developmental age equivalents for auditory comprehension (t (27) = .76, p = n.s.), expressive language (t (27) = 1.40, p = n.s.), and total language (t (27) = 1.04, p = n.s.) were not significantly different between the ASD and typically developing groups.

MacArthur-Bates Communicative Development Inventory (CDI; Fenson et al., 1994). Mothers were asked to complete the CDI to approximate the children's current expressive vocabulary. The CDI consists of a checklist of words commonly present in the vocabularies of young children. Mothers are asked to indicate the words that their child is able to produce. Children with typical development did not differ from children with ASD in the size of their productive vocabularies, t (25) = 0.79, p = n.s.

Bayley Scales of Infant Development, 3rd Edition Cognitive Subscale (Bayley, 2005). All children were administered the Bayley cognitive scales to estimate non-verbal problem solving skills. The Bayley is a structured play-based assessment during which children are required to complete a number of items involving puzzles, matching, and other simple problem-solving tasks. Because children with typical development tended to attain higher age equivalent scores on the PLS-4 than the Bayley and we attempted to match PLS-4 scores between groups, age equivalent scores on the Bayley were slightly higher in the ASD group (*Mean Age Equivalent* =

29.08, *SD* = 4.77) than the typically developing group (*Mean Age Equivalent* = 25.60, *SD* = 4.05), $t(26) = -2.087$, $p < .05$.

Early Social Communication Scales (ESCS; Seibert et al., 1982). All children completed the ESCS, a semi-structured interaction designed to elicit social communication behaviors, with the examiner. Instances of children initiating joint attention and percentage correct responding to joint attention were scored from video. Children with typical development initiated joint attention, t (27) = 4.54, $p < .001$, and responded to joint attention, t (27) = 3.852, $p < .01$, significantly more often than children with ASD during this assessment. See Table 6 for participant characteristics.

Table 6

Study 2: Participant Characteristics

	ASD			Typical		
	N	Mean	SD	N	Mean	SD
Age (Months)	14	61.57*	17.86	15	23.53	4.03
Cognitive Age Equivalent (Bayley)	13	29.08*	4.77	15	25.60	4.05
Auditory Comprehension Age Equivalent (PLS-4)	14	28.36	10.94	15	31.00	7.60
Expressive Language Age Equivalent (PLS-4)	14	27.86	6.02	15	30.93	5.75
Total Language Age Equivalent (PLS-4)	14	27.36	8.03	15	30.13	6.36
Number of Words Produced (CDI)	12	302.2	176.8	15	360.1	198.4
Number of Joint Attention Initiations (ESCS)	14	3.07*	3.05	15	11.47	6.25
Percentage Responses to Joint Attention (ESCS)	14	75.71*	20.74	15	97.33	6.37

*Significantly different from typical group, p < .05

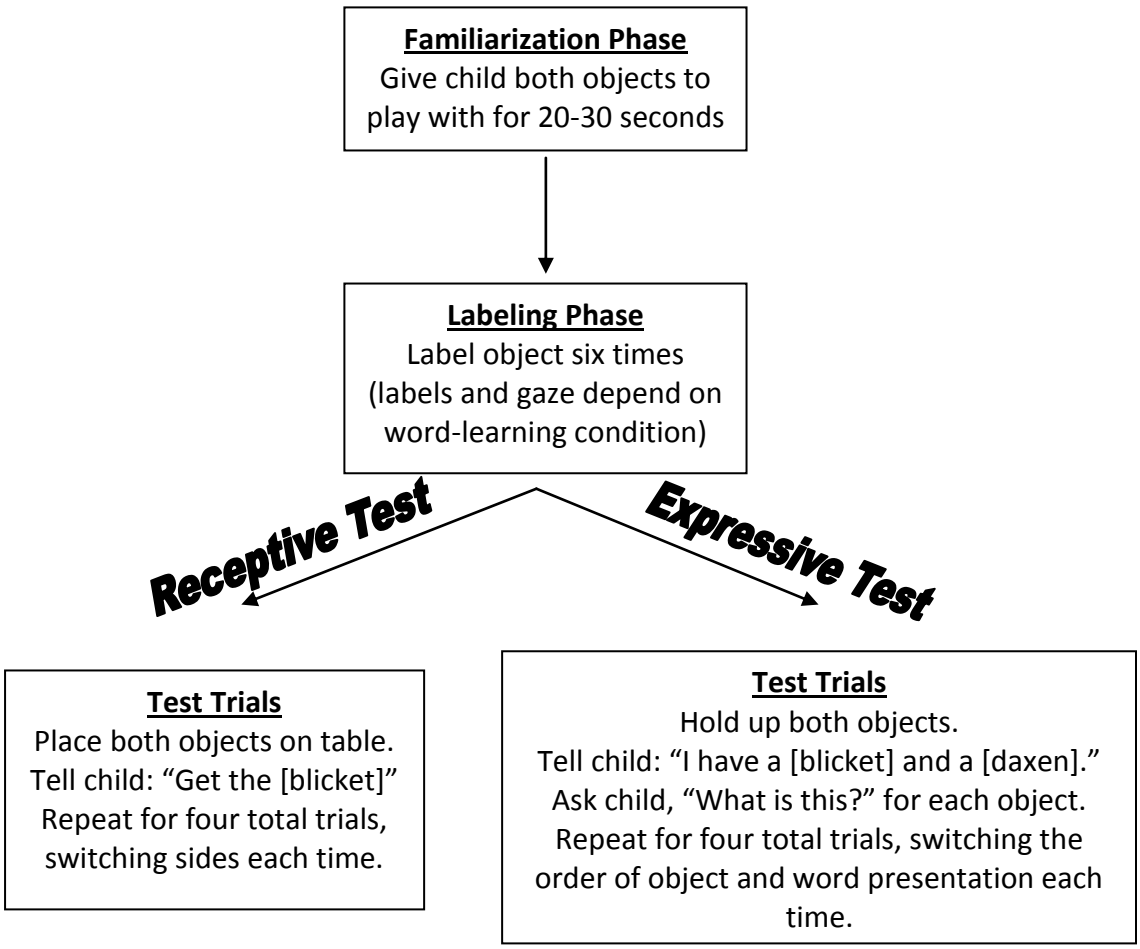
Procedure

Each child was tested individually in a quiet room either at the MSU Autism Laboratory, at their school, or at their home. Children completed the standardized assessments described above, as well as a fast-mapping task.

***Fast-mapping task*.** All children participated in a fast-mapping task designed to measure their ability to acquire novel receptive and expressive vocabulary after brief exposures to novel words paired with novel referents. Children participated in 12 fast-mapping trials: 6 expressive language trials and 6 receptive language trials, across a number of different word-learning conditions. Children were seated in a booster seat or on a parent's lap across the table from the examiner. Parents were asked not to repeat any of the words the experimenter used or direct the child's attention during the task. If the child was not seated on the parent's lap, the parent was asked to sit slightly behind the child to avoid giving the child visual cues about the correct answers to the task. The procedure was completed in one to three testing sessions, depending on the child's attention and compliance. If a child began fussing, throwing toys off the table, refusing to respond, or protesting, the procedure was discontinued at the end of the current trial and continued after a break or another task. In addition, 4 extra sets of toys were available for substitution if the child was not interested in the toys presented on a given trial. A total of 3 expressive trials and zero receptive trials from 2 children with ASD were missing due to child noncompliance with procedures. The total fast-mapping procedure lasted approximately 20-30 minutes. Each trial consisted of four phases: familiarization, labeling, and test trials. See Figure 6 for a visual representation of the task procedures.

Figure 6.

Fast-mapping task procedure



Fast-mapping procedures.

Familiarization phase. At the beginning of each trial, the child was presented with two novel objects (small toys or interesting objects that the child was unlikely to have a pre-existing label for). Photographs and brief descriptions of the objects used are included in Appendix A. Object pairs were pre-determined to match objects on approximate size and saliency, and to ensure the paired objects were easily discriminable from one another. The child was allowed to

play freely with the two novel objects for approximately 20 to 30 seconds. The experimenter then took both objects from the child and placed them briefly out of sight underneath the table.

Labeling phase. After a few seconds, the experimenter returned one of the objects to the child (the child's toy), telling him, "You can play with this one." The experimenter held the other object face up on her palm (the experimenter's toy), slightly to one side of her body, throughout the trial. The experimenter then labeled one of the objects six times over the course of approximately 30 to 40 seconds. After the toy was labeled six times, the experimenter removed both toys from the child's sight, placing them under the table for approximately five seconds. Twenty-six different two-syllable novel words were used to label the objects. As many words as possible were chosen that contained early-emerging initial phonemes while still allowing word pairs that did not contain the same first or second sound (e.g., nona and nellit would not be paired, callen and tillen would not be paired). This resulted in 21 of 26 words that contained initial sounds (e.g., n, m, d, g) that begin to be mastered by the age of 2 years in typically-developing children (The Talking Child, 2003).

Test trials: Receptive. After receptive labeling trials, the experimenter placed both toys on the table, arms' length apart, within the child's reach and told the child "Get the [novel word]." She repeated this request up to three times if the child did not respond. If the child failed to choose either object or chose both objects, the experimenter held out her hand to the child, palm up, and told the child, "Give me the [novel word]." After the child chose a toy, the experimenter provided non-specific encouragement such as "Thank you for getting a toy" regardless of which toy the child chose. This was repeated for a total for four trials, switching

the side that the target object appeared on each time. The children's choices were coded from video. The first toy the child touched was coded as the child's choice, and the child's choices were converted into a percentage correct. If the child did not make a clear choice on at least three out of four trials, the trial was excluded from analyses. One trial from a child with ASD was excluded due to the child not making enough clear choices.

Test trials: Expressive. For expressive trials, after the experimenter removed both toys from the table at the end of the labeling phase, she held up both toys in front of the child and told the child, "I have a [novel word] and a [distracter word]." She then offered the child one of the toys and asked, "What is this?" She repeated the question up to four times, withholding the toy from the child until he produced a label (whether it was correct or incorrect). Once the child produced a label for the first toy, the experimenter held up the distracter toy and repeated the initial statement, "I have a [novel word] and a [distracter word]. What is this?" This procedure was repeated three times, for a total of four trials. The order of presentation of the two objects and the order in which the experimenter said the target word and the distracter word were counterbalanced during each trial. Children's responses were coded from video. The child's first recognizable production of the target word in response to either object, or production of either word in response to the target object was coded as the child's response. If the child responded with the same word to both objects or the child did not produce a recognizable production of either word this was coded as no/indiscriminate responding.

Word-learning conditions. Children were tested for their acquisition of novel expressive and receptive labels for novel objects across six different word-learning conditions. The conditions varied on two dimensions: follow-in versus discrepant labeling (with or without

orienting cue) and demanding versus non-demanding language. During follow-in trials, the experimenter gazed at and labeled the child's toy while the child was looking at it. During discrepant trials, the experimenter gazed at and labeled her own toy while the child was gazing at his toy. During non-demanding trials, the experimenter labeled the toy without asking the child to produce the label. During demanding trials, the experimenter labeled the toy three times, then asked the child to produce the label three times. See Table 7 for the specific language used to label the toys during each trial type.

Table 7

Labeling procedures for each word-learning condition

		Follow-In	Discrepant	Orienting Cue
Non-Demanding	Child Gaze during label initiation	Child's toy	Child's toy	Child's toy
	Toy labeled by experimenter	Child's toy	Experimenter's toy	Experimenter's toy
	Experimenter utterances ([Blicket] indicates one of a number of novel words used to label objects)	1. It's a [blicket] 2. [Blicket] 3. Ooh, a [blicket] 4. [Blicket] 5. That's a [blicket] 6. A [blicket]	1. It's a [blicket] 2. [Blicket] 3. Ooh, a [blicket] 4. [Blicket] 5. That's a [blicket] 6. A [blicket]	1. Look, [name], it's a [blicket] 2. Look, I have a [blicket] 3. [Name], a [blicket] 4. Look at my [blicket] 5. Look, [name], [blicket] 6. [Name], a [blicket]
Demanding	Child gaze during label initiation	Child's toy	Child's toy	Child's toy
	Experimenter gaze during label	Child's toy	Experimenter's toy	Experimenter's toy
	Experimenter utterances ([Blicket] indicates one of a number of novel words used to label objects)	1. It's a [blicket] 2. [Blicket] 3. Ooh, a [blicket] 4. Tell me [blicket] 5. Say [blicket] 6. Can you say [blicket]?	1. It's a [blicket] 2. [Blicket] 3. Ooh, a [blicket] 4. Tell me [blicket] 5. Say [blicket] 6. Can you say [blicket]?	1. Look, [name, it's a [blicket] 2. Look, I have a [blicket] 3. [Name], a [blicket] 4. Look! Tell me [blicket] 5. [Name], say [blicket] 6. [Name], can you say [blicket]?

Counterbalancing and randomization. The order of the six word-learning conditions, which word was used to label each object pair, and which object pair was used with each trial type were randomized and were different for each participant in a group. The toys that were paired together were kept consistent across children. Which toy was the child's toy versus the experimenter's toy, and which toy was the labeled toy in the pair were partially

counterbalanced across participants because the odd number of participants did not allow for full counterbalancing. Receptive and expressive test trials were alternated, with a receptive test trial always occurring first. Each child with ASD was matched with a typically-developing child who received trials in the same order and with the same toy-word combinations.

Results

Data Transformation. For receptive and expressive trials, each child's responses for each trial were converted into a single score of 1, 0, or -1. A score of 1 represented correct mapping, in which the child demonstrated learning of the correct label for the target object. A score of -1 represented mis-mapping, in which the child incorrectly learned the target word as a label for the distracter object. A score of zero indicated no learning of a word-object association.

For receptive trials, the child's choices during the 4 forced-choice trials (in which the experimenter placed both toys on the table and asked the child to choose the labeled object by name) were converted in a percentage correct. Scores above 50% were assigned a score of 1, scores of 50% were assigned a score of 0, and scores below 50% were assigned a score of -1. For expressive trials, a score of 1 was assigned if the child's first response was to use the target word for the target object. A score of -1 was assigned if the child's first response was to use the distracter word for the target object or to use the target word for the distracter object. A score of 0 was assigned if the child failed to respond, or labeled both objects using the target or distracter word on the same trial. To examine performance across related conditions, composite conditions were created for follow-in, discrepant, and orienting cue categories by averaging the scores for demanding and non-demanding conditions within each category.

Composite conditions for demanding and non-demanding categories were created by averaging the scores for follow-in, discrepant, and orienting cue conditions within each of these categories.

Reliability. Thirty-three percent of videotapes of expressive and receptive choice trials were coded by a second observer to check reliability. Exact agreement was 97% for receptive trials and 97% for expressive trials.

Receptive Trials. All analyses were conducted using the Statistical Package for the Social Sciences (SPSS), Version 19.0. To examine whether each group of children performed above chance on their acquisition of receptive labels during the six different word-learning trials, a series of single-sample t-tests was performed separately for the two groups. These t-tests revealed that children with typical development performed above chance in all six word-learning conditions as well as all five composites ($p < .05$), indicating that they correctly mapped the novel words to the labeled novel objects. However, children with ASD performed significantly different from chance only in the discrepant demanding condition, during which they performed below chance, $p < .05$, indicating that they mis-mapped the novel words to their own focus of attention during the discrepant demanding condition. See Table 8 for detailed results of all comparisons.

Table 8

Receptive Trials Comparisons to Chance Responding

	ASD (n = 14)		Typical (n = 15)	
	t	p-value	t	p-value
Follow-In Composite	-1.58	.139	4.68	<.001*
Orienting Composite	1.10	.292	5.10	<.001*
Discrepant Composite	-1.88	.082	4.00	.001*
Demanding Composite	-1.71	.110	4.77	<.001*
Non-Demanding Composite	0.00	1.00	4.96	<.001*
Follow-In				
Demanding	-1.30	.218	2.78	.015*
Non-Demanding	-0.62	.547	2.48	.027*
Orienting				
Demanding	1.30	.218	2.78	.015*
Non-Demanding	0.29	.775	6.21	<.001*
Discrepant				
Demanding	-2.88	.013*	2.17	.048*
Non-Demanding	0.32	.752	3.15	.007*

*Different from chance, p < .05

To examine whether children with ASD and children with typical development differed significantly in their response patterns in each condition, a multivariate ANOVA was performed, entering the six word-learning conditions (follow-in demanding, follow-in non-demanding, orienting demanding, orienting non-demanding, discrepant demanding, discrepant non-demanding) as dependent variables and ASD status as an independent variable. Significant effects of ASD status were found for the discrepant demanding, $F(1, 27) = 11.99$, $p < .01$, $\eta_p^2 = .31$, orienting non-demanding, $F(1, 27) = 6.179$, $p < .05$, $\eta_p^2 = .19$, follow-in demanding, $F(1, 27) = 7.91$, $p < .01$, $\eta_p^2 = .23$, and follow-in non-demanding conditions, $F(1, 27) = 4.597$, $p < .05$, η_p^2

= .15, indicating that children with typical development were more likely than children with ASD to correctly map the novel words in each of these conditions. Significant differences were also found between groups for the discrepant composite, F (1, 27) = 17.94, $p < .01$, $\eta_p^2 = .40$, the follow-in composite, F (1, 27) = 5.03, $p < .05$, $\eta_p^2 = .16$, and the orienting composite, F (1, 27) = 17.94, $p < .01$, $\eta_p^2 = .40$, indicating that children with typical development were more likely than children with ASD to correctly map the novel words regardless of the adult's focus of attention. Finally, significant differences between groups were found for the non-demanding composite, F(1, 27) = 15.58, $p < .01$, $\eta_p^2 = .37$, and the demanding composite, F(1, 27) = 21,71, $p < .001$, $\eta_p^2 = .45$, indicating that children with typical development were more likely than children with ASD to correctly map the novel words regardless of whether the adult made a demand to produce the word.

Finally, we conducted a 3 x 2 x 2 mixed model ANOVA with relationship to child's focus of attention (follow-in, discrepant, orienting cue) and degree of demandingness (demanding versus non-demanding) as within-subjects factors and ASD status as a between-subjects factor. This ANOVA revealed a significant main effect of ASD status, F (1, 27) = 34.14, $p < .001$, $\eta_p^2 = .56$, such that children with ASD performed more poorly than children with typical development. There was also a marginally significant main effect of attention, F(2,54) = 2.44, $p = .096$, $\eta_p^2 = .08$, such that children performed better in the orienting cue conditions than the follow-in or discrepant conditions. No main effects of demandingness and no interactions between any of the independent variables were found.

Expressive Trials. To examine whether each group of children performed above chance on their acquisition of expressive labels during the six different word-learning trials, a series of single-sample t-tests were performed separately for the two groups. These t-tests revealed that children with typical development performed above chance only in the follow-in demanding condition, t (14) = 2.45, $p < .05$. Children with typical development also performed above chance in the follow-in composite, t (14) = 2.58, $p < .05$. Children without ASD did not perform significantly different from chance in any condition or composite. To examine whether children with ASD and children with typical development differed significantly in their response patterns in each condition, a multivariate ANOVA was performed, entering the six word-learning conditions as dependent variables and ASD status as an independent variable. Children with ASD did not significantly differ in their performance from typically developing children in any of the six conditions or five composites.

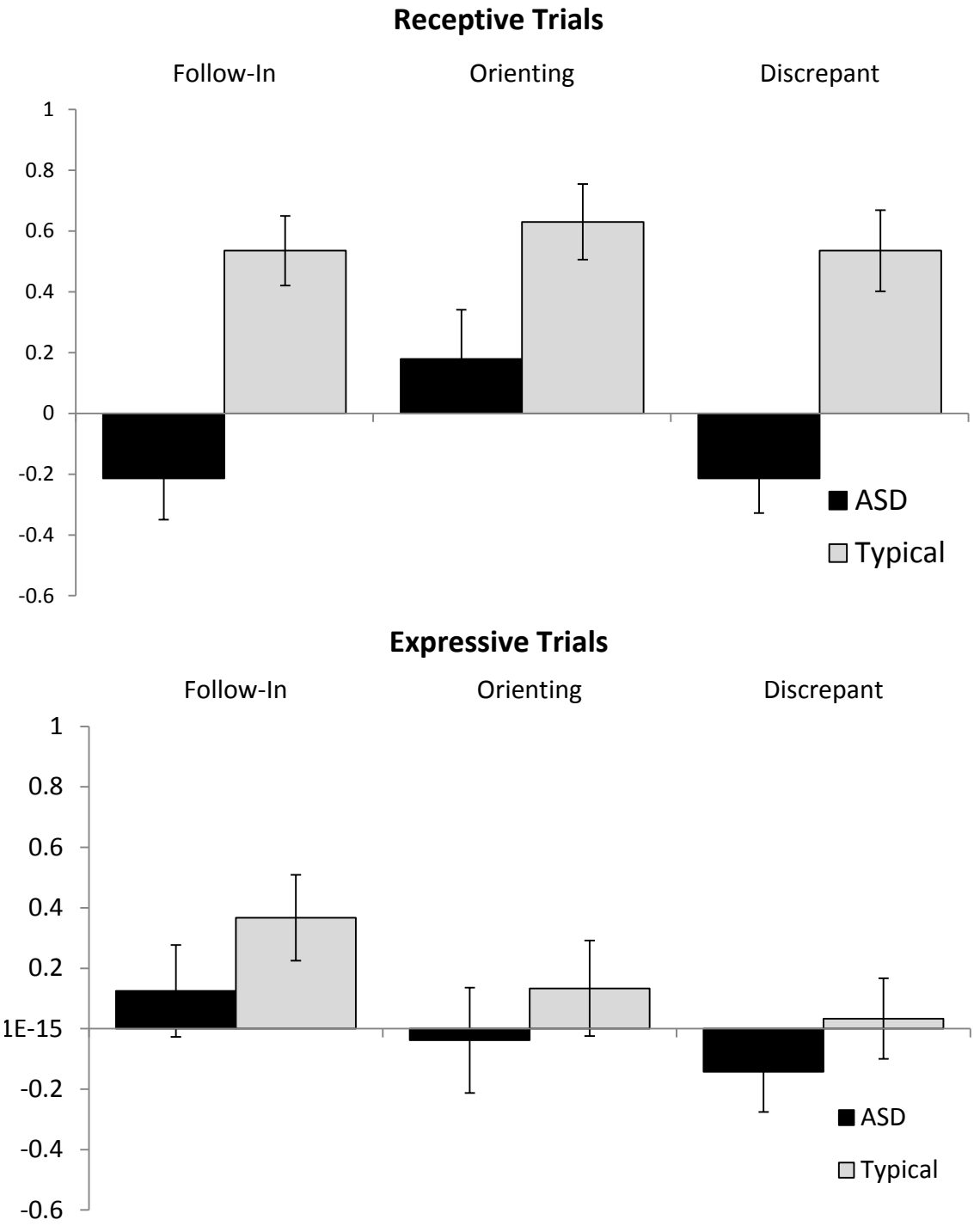
Finally, we conducted a 3 x 2 x 2 mixed model ANOVA with relationship to child's focus of attention (follow-in, discrepant, orienting cue) and degree of demandingness (demanding versus non-demanding) as within-subjects factors and ASD status as a between-subjects factor. This ANOVA revealed a marginally significant effect of attention, $F(2, 50) = 2.46$, $p < .096$, $\eta_p^2 = .09$, such that children performed better in the follow-in condition than the discrepant or orienting cue conditions. No significant main effects of degree of demandingess or ASD status or significant interactions were detected.

Receptive-Expressive Comparisons. To examine whether children performed significantly better on receptive versus expressive trials, we performed a 3 x 2 x 2 x 2 mixed-model ANOVA with relationship to child's focus of attention (follow-in, discrepant, orienting

cue) degree of demandingness (demanding versus non-demanding), and trial modality (expressive versus receptive) as within-subjects factors and ASD status as a between-subjects factor. This ANOVA revealed a significant effect of ASD status, F (1, 25) = 18.27, $p < .001$, η_p^2 = .42, such that children with typical development performed better than children with ASD, and a marginally significant main effect of modality, F (1, 25) = 3.58, $p = .07$, $\eta_p^2 = .13$, such that children were more likely to be successful at receptive than expressive trials. These main effects were qualified by a significant modality x ASD interaction, F (1, 25) = 6.37, $p < .05$, $\eta_p^2 = .20$, such that children with typical development out-performed children with ASD more strongly on receptive than expressive trials. See Figure 7 for a graphical representation of results.

Figure 7

Study 2: Mean performance for receptive and expressive trials



Error bars represent SEM

Exploratory Analyses. To examine whether language skills and joint attention skills were associated with performance on fast-mapping trials, a series of bivariate correlations were conducted to explore relationships between demographic variables (PLS-4 receptive and expressive language age equivalents, IJA, RJA) and the expressive and receptive fast-mapping composites (follow-in, orienting, discrepant, demanding, non-demanding). Because children with ASD and children with typical development showed different patterns of responding during the fast-mapping task, these correlations were conducted separately for each group. For children with ASD, RJA was negatively correlated with the orienting composite on receptive trials (r (12) = -.58, p < 05), and positively correlated with the demanding composite on expressive trials (r (11) = .62, p < 05). This indicates that children with better RJA skills were less likely to respond correctly when an orienting cue was given, a surprising finding (given that our test of RJA required children to follow one type of orienting cue, a pointing gesture). RJA was not correlated with any composite in children with typical development. For children with ASD, PLS-4 scores were negatively correlated with the discrepant composite on expressive trials (r (14) = -.62, p < 05) and with the orienting composite on receptive trials (r (14) = -.66, p < 05). On the contrary, for children with typical development, PLS-4 expressive scores were positively correlated with the discrepant composites for both expressive (r (15) = .55, p < 05) and receptive (r (15) = .56, p < 05) trials, and with the demanding composite on expressive trials (r (15) = .71, p < 01). This suggests that children with typical development were more likely to succeed at discrepant trials (both expressive and receptive) and demanding trials when they had better language skills. However, children with ASD were less likely to respond correctly when they had better language skills. It is possible that children with ASD who had better

language skills were more likely to form a word-object association, but this association was likely to be mis-mapped during discrepant or orienting cue trials, resulting in a negative correlation.

Discussion

Receptive Vocabulary Task

As expected, children with typical development succeeded at correctly fast-mapping new words across all conditions in the receptive vocabulary task. This is consistent with previous findings that, by the age of 18-20 months, children with typical development are able to accurately fast-map new words by following the speaker's direction of gaze (Baldwin et al., 1996). However, children with ASD in this study did not perform as expected on this task. In previous studies examining fast-mapping in children with ASD, this group was able to accurately fast-map new words under conditions of follow-in labeling (Baron-Cohen et al., 1997; Preissler & Carey, 2005). However, in the current study, children with ASD did not succeed in accurately fast-mapping words during the follow-in conditions. One possible explanation for this failure to map (and trend toward mis-mapping) may be due to the task demands of the follow-in labeling phase. During the teaching portion of each follow-in trial, the child was allowed to play with one toy (the target toy) while the experimenter held the other toy (the distracter toy). Given that the children had more exposure to the target toy than the distracter toy during the labeling phase, it is possible that a novelty preference led some children with ASD to choose the distracter toy during these trials. Participants with ASD in previous studies of fast-mapping have been older than the participants in this study; it is possible that the younger children in the present sample were less used to structured response tasks and therefore less able to

overcome this novelty bias than children in previous fast-mapping studies. Children with typical development may have been more motivated by the social demands of the choice phase and therefore more likely to overcome this novelty preference.

Although children with ASD did not show the expected pattern of correct mapping during the follow-in trials, they did show a trend toward mis-mapping during the discrepant composite (which likely would reach significance with a slightly larger sample), and during the discrepant demanding condition, children with ASD performed significantly below chance (mis-mapping the word). This is consistent with previous studies indicating that children with ASD tend to mis-map words to their own focus of attention when the adult's gaze during labeling is discrepant from their own. Importantly, a novelty preference during these trials would bias children towards *correct mapping*, suggesting that the finding of mis-mapping during the discrepant condition is not accounted for by this factor.

While children with ASD showed a trend toward mis-mapping in the discrepant composite, they demonstrated a trend towards correct mapping during the orienting cue composite. This finding suggests that the use of a simple verbal orienting cue (saying "look" or the child's name prior to labeling the object) helped children with ASD to form a correct word-object association, and overcome the tendency to mis-map seen in the discrepant condition (which was identical with the exception of the addition of the verbal orienting cues). This finding opens an important avenue for exploration, as previous studies of fast-mapping have provided no orienting support beyond a relatively subtle gaze cue. If children with ASD are able to overcome their tendency to mis-map during the discrepant condition, this would suggest that the use of orienting cues when teaching language to children with ASD is likely to be

helpful in preventing incorrect word-object mappings and teaching new vocabulary more effectively. Future studies should attempt to replicate this finding with a larger sample of children with ASD and using a choice procedure less prone to novelty bias. It may also be valuable to examine whether other types of orienting cues (e.g., pointing, holding up the object in front of the child to elicit attention) also help children with ASD to fast-map under discrepant conditions.

Expressive Vocabulary Task

In contrast to the consistently accurate performance of children with typical development on the receptive vocabulary task, the expressive vocabulary task proved difficult even for typically developing children. Children with typical development performed above chance on the expressive vocabulary task only in the follow-in demanding condition and the follow-in composite. During orienting cue and discrepant trials, children with typical development did not perform significantly different from chance. Children with ASD did not perform significantly different from chance in any condition or composite in the expressive vocabulary task. Overall, children with ASD had a low rate of consistent responding in this task, making it difficult to compare performance across conditions in a meaningful way for this group. In addition, an ANOVA examining differences between expressive and receptive trials indicated that children performed better on receptive than expressive trials, and that this was particularly true for the typically-developing group.

The finding that an expressive mapping task is more difficult for children with typical development than a receptive mapping task is consistent with studies of early language development, which indicate that children often understand words that they are not yet able to

say (e.g., Fenson et al., 1994). However, previous studies of fast-mapping in young children have not directly compared expressive and receptive learning. The findings of the current study suggest that, in the language age range examined (15-30 months), receptive mapping is well-solidified, but expressive mapping is not yet solidified. Interestingly, children with typical development were most likely to make correct mappings during follow-in trials, and were less likely to form correct mappings during orienting cue or discrepant trials, which were not significantly different from chance. This suggests that the developmental progression of fast-mapping of expressive labels parallels that seen in receptive learning, in which mapping during follow-in trials comes on-line before mapping in discrepant trials (Carpenter et al., 1998), but occurs later in development. In particular, young children with typical development are able to begin forming correct word-object associations during follow-in trials around the age of 12 months, but are not consistently able to form correct word-object associations during discrepant trials until approximately 18-20 months (Carpenter et al., 1998). Previous studies have argued that this developmental progression is closely tied to the development of skills in responding to joint attention, as children with typical development reach ceiling performance on RJA skills around 18-20 months of age.

It is interesting to note that children with typical development in this study performed almost universally at ceiling levels on an RJA task and were able to harness their RJA skills to learn receptive labels under discrepant conditions. They were also able to acquire expressive labels under follow-in conditions. However, as a group, they were not able to follow an adult's attention to learn an expressive label (even though they were able to follow attention to learn a receptive label). These findings cannot be explained by children's RJA abilities alone, as they

were able to use RJA to learn receptive labels under discrepant conditions. Difficulty acquiring and using expressive labels is also unable to completely explain this finding, as the children were able to learn expressive labels during follow-in trials. It is possible that, during a more challenging task (expressive labeling, rather than receptive), following an adult's attention was more taxing to children's information processing capacities, and they were unable to harness both these skills simultaneously. Future research should examine the developmental trajectory of expressive fast-mapping to determine when these skills come on-line in typically developing children and what accounts for the developmental lag in the ability to expressively fast-map under discrepant labeling conditions.

To more closely examine patterns of expressive fast-mapping in children with ASD and children with typical development, expressive fast-mapping tasks should be examined in a larger sample of children encompassing a wider range of language skills and chronological ages. Previous studies of fast-mapping in children with ASD have examined a sample with similar language levels, but significantly higher chronological ages, than this sample. It is possible that the younger children tested in the current study had difficulty with the attention or information processing demands of the fast-mapping task, making this task more difficult for the younger children despite similar language levels to children in previous studies. In the sample of children with typical development, the expressive task proved difficult for most children, particularly during the discrepant and orienting cue conditions. Testing a wider age range of children in this task to determine at what age children are able to succeed at this vocabulary task and the developmental progression of expressive fast-mapping skills would add to the significant existing literature on the developmental progression of receptive fast-mapping skills and

provide insight into whether children undergo a similar developmental trajectory for both expressive and receptive fast-mapping skills.

Conclusions

This study examined fast-mapping of both receptive and expressive noun labels in children with ASD and typical development. For children with ASD, patterns in the receptive fast-mapping task suggested that use of a verbal orienting cue helped these children to avoid mapping errors and map new words correctly when the adult's focus of attention did not match their own. Children with typical development were successful across all conditions during receptive mapping trials, but struggled to correctly map words in all but the follow-in conditions during expressive trials. Future studies should further examine how the use of orienting cues may facilitate fast-mapping in children with ASD and should use larger sample sizes and a wider age range of children to further examine developmental patterns in fast-mapping of expressive labels.

General Discussion

These two studies examined how two dimensions of responsiveness in adult speech, a) relationship to the child's focus of attention and b) degree of demandingess, influenced the language use and acquisition of young children with ASD and typical development. Language skills were examined in two different contexts. A micro-analysis of mothers' and children's language use during a naturalistic interaction was used to examine how mother's language responsiveness influenced their children's expressive language use within a single conversational turn. An experimental fast-mapping paradigm was used to examine how similar elements of responsiveness in an experimenter's speech influenced expressive and receptive vocabulary acquisition.

Degree of Demandingness

Across both studies, degree of demandingness was categorized dichotomously as demanding or non-demanding. Demanding language in the fast-mapping study consisted of only prompts for language; the analysis of mother-child interactions categorized demanding language by prompt type (language, play, or other). The micro-analysis of mother-child interactions revealed that degree of demandingness had a significant influence on child language use, such that mothers' demands were much more likely to elicit child language than mothers' non-demanding language. This was true for both children with ASD and children with typical development. This effect was driven primarily by mothers' use of prompts for language skills; prompts for play or other skills that did not encourage child language use. On the contrary, during the fast-mapping task, no significant effects of degree of demandingness were found in either the ASD group or the typically developing group during receptive or expressive

trials. It is possible that demanding language confers the most benefit when children are being asked to rehearse or produce already learned language skills (e.g., parents asking children to use words or phrases they know the child has already learned), rather than when they are first learning a new word. It is also possible that children are more likely to respond consistently when demands are presented by a familiar caregiver rather than an unfamiliar experimenter. However, given the low rate of consistent responding on expressive trials during the fast-mapping task, especially for children with ASD, it is unclear whether the use of demanding language would influence word-learning in children with ASD who were better able to complete this task. Given the strong benefit found for demanding language during the mother-child interactions, this question should be explored further with a sample of children who are older or who have better language skills to clarify the utility of demanding language during word-learning episodes. In addition, examining whether demanding language continues to be beneficial during play interactions when the interaction partner is an unfamiliar experimenter (rather than a parent) may also clarify the reasons for these different findings across studies.

Relationship to Child's Focus of Attention

The second dimension of responsiveness examined in these studies was relationship to the child's focus of attention (follow-in versus redirecting/discrepant). During mother-child interactions, mothers' follow-in language was more likely to be followed by child speech, but only when the follow-in language was also demanding. That is, follow-in demanding language (i.e., questions or demands about the child's current activity) was likely to elicit child speech, but follow-in non-demanding language (i.e., comments about the child's current activity) was not. This was true for both children with ASD and children with typical development. While this

finding is consistent with the naturalistic behavioral treatment philosophy, in which children are prompted to use language around their current foci of interest, it is inconsistent with findings from some previous longitudinal studies. In particular, Siller and Sigman (2002; 2008) found that parents who used more follow-in non-demanding language with their 4-year-olds with ASD were more likely to have children who made greater language gains over the course of 16 years. McDuffie and Yoder (2010) also found that parents' use of follow-in non-demanding language was positively related to child vocabulary gains over the course of 6 months. In contrast to these longitudinal findings, the present study found that follow-in non-demanding language actually appeared to discourage child language use within a conversational turn. These differences in findings may be due to the fact that previous studies examined language growth longitudinally over the course of 6 months to 16 years, while the present study examined immediate language use within a single conversational turn. It is possible that different elements of maternal language responsiveness promote language growth over time than promote language use in the immediate context. In addition, previous studies have used standardized measures of language skill, such as overall expressive/receptive language level or parent-reported vocabulary size, while the current study examined children's use of language during a less structured mother-child interaction. It is possible that children's language *skill* and language *use* are related differently to parent responsiveness. Future research should further explore these questions by examining the influence of parent responsiveness on children's language both in the immediate context and over time in the same sample of children.

During the fast-mapping study, the use of follow-in language also appeared to confer some benefit for word learning for typically developing children. During the expressive

language task, typically developing children showed a trend toward more accurate performance during follow-in trials than during discrepant trials, with orienting trials falling between these two.

Given the RJA deficits often seen in children with ASD (and demonstrated by children with ASD on the joint attention assessments in this study), it is unsurprising that the use of follow-in language would confer a benefit for this group. However, the children with typical development in both studies performed at near-ceiling levels on a basic RJA task, indicating that attention-following was well-established in this sample (as would be expected in this age group). Nevertheless, children with typical development appeared to benefit from the use of follow-in language both during the mother-child interaction and the fast-mapping task. This suggests that, even once RJA skills are well-established, adults' use of follow-in strategies help children to display expressive language skills. This finding is contrary to the theory that RJA skills and language skills become disconnected by around 20 months of age, due to ceiling levels of RJA performance in children with typical development (Salley & Dixon, 2007). Future research should examine ways in which following a child's focus of attention may be beneficial for language development even after RJA skills are well-established.

Use of Orienting Cues

To more closely examine strategies that adults may use to facilitate children's attending to relevant social cues during language opportunities, we also examined how adults' use of orienting cues (e.g., saying "look," touching the child, withholding a toy) influenced children's language during these two studies. During mother-child interactions, mothers' use of orienting cues was beneficial for children with ASD. Children with ASD were more likely to verbally

respond when the mother used an orienting cue. However, mothers' use of orienting cues did not have a positive impact on language use for children with typical development. During the fast-mapping study, children with ASD showed a trend toward benefiting from an adult's orienting cues during both receptive and expressive trials. Children with typical development showed a trend toward benefiting from these cues during expressive trials. Children with typical development showed consistently good performance across all trial types on receptive trials. This suggests that orienting cues may help children with ASD to attend to and use language more effectively during both structured and unstructured interactions. This is consistent with a behavioral treatment philosophy that stresses first using a specific cue to gain a child's attention before teaching a new skill. In addition, children with typical development may also benefit from these cues during challenging tasks, such as expressive vocabulary acquisition. These trends suggest that potential benefits of orienting cues for word learning should be examined in more detail in children with ASD as well as for children with typical development during difficult tasks.

Clinical Implications

The findings of these studies have several clinical implications for promoting language learning and use in children with ASD. First, findings across studies indicated that adults' use of follow-in language was most likely to promote language learning. In a naturalistic context (but not in an experimental context), this effect was specific to follow-in demanding language. However, previous findings (e.g., Siller & Sigman, 2002; 2008) have indicated potential long-term benefits of follow-in non-demanding language for children's language growth. Taken together, these findings suggest that blended developmental/naturalistic behavioral

interventions that follow the child's focus of interest and utilize a combination of non-demanding and demanding language may be most beneficial for the language acquisition of children with ASD. In addition, the current studies indicated that the use of orienting cues helped children with ASD to learn and use language across contexts. These findings suggest that using orienting cues to help children with ASD attend during play and learning situations aids their vocabulary learning and language use and that is may be helpful for parents, teachers, and therapists to use orienting cues when teaching language to children with ASD to help the children attend to the most relevant aspects of the learning situation.

Conclusions

These studies highlight several important similarities and differences in how children with ASD and typical development respond to adults' language across contexts. During a mother-child interaction, children with ASD and children with typical development showed similar patterns of response to maternal speech, with mothers' follow-in demanding language most likely to encourage child speech. However, children with ASD benefited from mothers' use of orienting cues, while children with typical development did not require these cues.

During the fast-mapping procedure, this pattern of follow-in speech being more beneficial for child language was also partially demonstrated, with children in both groups showing trends towards benefits for follow-in speech during expressive trials. In these expressive trials (the most challenging task for typically-developing children), orienting cues may have conferred some benefit for learning for both groups, suggesting that orienting cues may be helpful in some language learning tasks, even after RJA skills are well-established. More research should examine these questions in a larger sample with a wider age-range of children

to examine how developmental trends in children's responses of these dimensions of adult's speech emerge over the course of development

Figure 8

Toys used during word learning task. For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation.

1. Rubber brush with bendable arms and legs, approximately 4 inches tall.

2. Scrub brush with hard plastic top and flexible plastic bristles.

3. Metal carabeaner covered with flower finish.

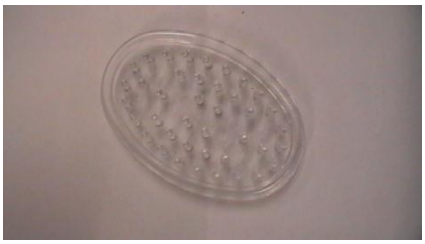
4. Wood and plastic child's game.

Figure 8 (cont'd)

5. Metal tea strainer.

6. Plastic child's toy; flexes at joints but remains connected in a single piece.

7. Flexible clear plastic soap dish.



8. Soft plastic teething toy for infants.

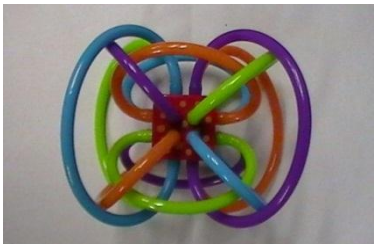


Figure 8 (cont'd)

9. Wooden rattle with metal bell inside.

10. Plush infant toy with squeaker inside.

11. Stretchy rubber child's toy.

12. Hard (pink handle) and flexible (yellow top) plastic toy.

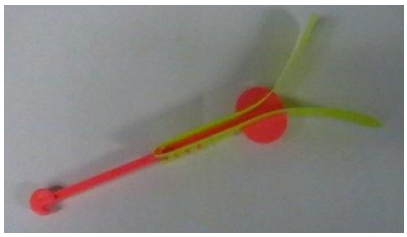


Figure 8 (cont'd)

13. Stamp roller, made of hard plastic (handle) and foam (roller).

14. Fuzzy paint roller.

15. Spinning hard plastic flower and connected streamers.

16. Flexible cloth tube.

17. Painting tool with hard plastic handle and foam bristles.

Figure 8 (cont'd)

18. Metal napkin ring with attached ribbons.

19. Ball clacker toy, made of hard plastic.

20. Hard plastic picture frame ornament.

21. Small square of faux fur.

Figure 8 (cont'd)

22. Small squishy ball with animal face.

23. Infant teething toy.

24. Rubber egg boiler.

25. Easy-grip crayon toy.

Figure 8 (cont'd)

26. Metal jaw harp.

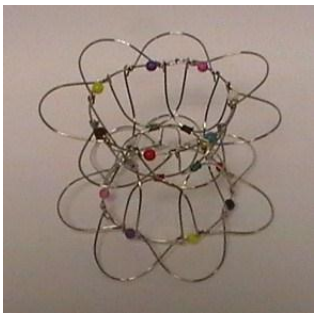
27. Small cloth finger puppet.

28. Wooden bead toy for infants.

29. Rubber bracelet with attached beads.

Figure 8 (cont'd)

30. Wire toy that flexes at joints to make different shapes.



31. Infant feeding aid. Plastic and rubber handle and attached mesh. Beads inside mesh netting.

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