ABSTRACT

Title of Thesis: USE OF MULTIMODAL COMMUNICATION IN PLAY INTERACTIONS WITH CHILDREN WITH AUTISM

Avery Rain, Master of Arts, 2020

Thesis directed by: Dr. Nan Bernstein Ratner

Department of Hearing and Speech Sciences

In typical adult-child interaction, adults tend to coordinate gesture and other nonverbal modes of communication with their verbalizations (multimodal communication). This study explored the effectiveness of multimodal communication with young children with autism spectrum disorders (ASD) to encourage child responses. The maternal use of verbal, nonverbal, and multimodal initiations and the subsequent response or lack of response of their child was examined in fifty mother/child video-recorded play interactions. Results indicated that mothers initiated multimodally at similar rates with children with lower and higher expressive language levels. Child response rates to multimodal communication initiations were higher than response rates to verbal-only or nonverbal-only initiations; this finding was consistent across low and high expressive language groups. Additionally, a significant positive correlation was found between maternal wait time after initiation and overall child response rate. These findings have important ramifications for clinical practice and parent training.

USE OF MULTIMODAL COMMUNICATION IN PLAY INTERACTIONS WITH CHILDREN WITH AUTISM SPECTRUM DISORDERS

By

Avery Rain

Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of Master of Arts
in Speech-Language Pathology
2020

Advisory Committee:
Dr. Nan Bernstein Ratner (Advisor)
Dr. Rochelle Newman
Dr. Natasha Cabrera

Acknowledgments

Thank you to Dr. Nan Bernstein Ratner and Sarah Ferrier for their time spent conceptually developing this project over many meetings. A special thank you to Sarah for her uncomplaining dedication in sharing the extensive coding that we decided on in those meetings.

Thank you to the other members of the advisory committee, Dr. Rochelle Newman and Dr. Natasha Cabrera for their suggestions to refine and optimize the aims, methods, and execution of the project.

Thank you to Kayla Cook for tolerating and compensating for my deficits in our home life throughout this project, for proofreading my work better than I do, and for maintaining the sweetest and most unwavering support.

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Introduction

Human communication is multisensory. Verbal speech is accompanied by nonverbal signals, including gestures, facial expressions, proximity, and eye contact, that help the listener interpret a message. When speaking to infants and young children, caregivers spontaneously adapt their verbal input in ways that can facilitate children's affect, attention, and language development (Saint-Georges et al., 2013). This infant-directed speech (IDS), or "motherese," is characterized by exaggerated prosody and intonations, increased pitch, and slowed rate (Kuhl et al., 1997; Stern et al., 1983). Given the multisensory nature of communication, it is unsurprising that caregivers also adjust their gestural input towards young children: "gesturese." Mothers use more concrete deictic gestures (e.g. pointing) with young children than are used in communication with adults (Saint-Georges et al., 2013; Iverson et al., 1999). Moreover, gestures toward young children are used most often in coordination with speech with the intent to emphasize and clarify a verbal message (Saint-Georges et al, 2013; O'Neill et al., 2005). This use of gestures primarily as a supplement to verbal communication leads to a high rate of multimodal communication in IDS. Multimodal motherese helps develop child language by focusing a child's attention, providing visual cues, and highlighting word-referent relationships (Abu-Zhaya et al., 2016; Gogate et al., 2000.) Mothers facilitate their children's communication development though verbal, nonverbal, and multimodal means.

Parental Input to Children with ASD

Communicating with children in a way that facilitates language growth is especially important in the study of children with atypical language development. Autism

spectrum disorder (ASD) is a cluster of developmental disorders characterized by challenges with social skills, repetitive behaviors, and verbal and nonverbal communication. Given that acquiring useful language by the age of five is a strong predictor of positive outcomes in people with ASD, it is of particular importance for the caregivers of children with ASD to communicate in ways that engage and grow their children's language systems (Howlin et al., 2004). If children with ASD are low responders to parent initiations due to the social and communicative deficits of ASD, this in turn may impair parental input, which reinforces social withdrawal and poverty of language input (Cohen et al, 2013). If parents are able to communicate in ways that encourage child responses, however, this leads to increased opportunities for expansion of child utterances and sustained communicative interactions.

Reassuring evidence suggests that parents do tend to interact with children with ASD in similar or even more communicatively enhanced ways than they interact with typically developing children. Studies show that parents of children with ASD provide verbal language input similar to parents of typically developing young children (Wolchik, 1983; Howlin & Rutter, 1989). The conclusions about parental gesture and multimodal input have been more varied. Some studies have shown no differences between the amount and type of gestural and multimodal communication used by parents of children with ASD, developmental delay, and typical development (Özçalışkan et al., 2018). Medeiros & Winter (2014) found that parents used similar overall amounts of gesture with children with ASD and typically developing children, but used more deictic gestures with children with lower linguistic abilities in both groups. Other studies have found that parents use more exaggerated and frequent IDS and gesturese with children with ASD,

and may use IDS for longer into the child with ASD's development (Wan et al, 2019; Cohen et al., 2013). Parents may also use increased nonverbal communication strategies with their children with ASD, such as physical proximity, structure and cue behaviors, and hand-over-hand prompts, compared to parents with typically developing children (Doussard-Roosevelt et al., 2003; Lemanek et al., 1993; Wan et al., 2019). Parents seem to be interacting verbally and nonverbally just as much or more with children with ASD than with typically developing children.

This parental input is crucial, as evidence suggests a strong relationship between parent and child communicative characteristics. Children diagnosed with ASD who heard more caregiver speech in infancy have better language skills later in life (Swanson et al., 2019). Further, longitudinal studies show that the speech of children with ASD and the speech of their parents tend to mirror each other lexically and syntactically (Fusaroli et al., 2019). In both typical development and ASD, amount of parental gesture use toward children correlates with amount of child gesture use, indicating that parents adjust to their child's communication style and/or children learn to use or not use gesture from their parents (Wan et al., 2019). Children with ASD and their parents also tend to use similar proportions of types of gestures (alone and in multimodal communication), emphasizing a learned component to gesture use (Özçalışkan et al., 2018). Child and parent communication are tightly related, suggesting that parental input molds a child's communication capacity, and that parents adjust their communicative input to their child's level.

Given the benefits of parental input, it is important to note that parents of children with ASD can be taught to modify their communication in ways that increase interaction

within the parent-child dyad. In one intervention study, parents were taught verbal responsiveness strategies to increase communication of their children with autism. Even with a short term intervention, the participating parents became more verbally responsive and their children, in turn, showed gains in prompted communication acts (Venker et al., 2012). Other studies have focused on teaching caregivers to increase social scaffolding for their children with ASD to provide increased communication opportunities without being overly directive. This training in socially scaffolding communication opportunities was predictive of later language growth (Wan et al., 2019). Thus, not only does child language development mirror parental input, but parents can be taught to interact with children in ways that increase the child's functional communication.

Effect of Child Language Level

In typical development, caregivers adjust motherese and gesturese based on the child's characteristics. Evidence shows that IDS changes as a child ages: the mean fundamental frequency lowers, exaggeration diminishes, and prosodic contours change (Stern et al., 1983; Liu et al., 2009; Niwano & Sugai, 2002). Parents may also increase the magnitude of features of IDS with children with lower language abilities (Kajikawa et al., 2004; Amano et al., 2006). Evidence suggests that these patterns are evident with child-directed gesture use as well. Mothers use more gesture with younger children, children with lower linguistic ability, and children with lower comprehension (Shatz, 1982; Iverson et al., 1999; Schmidt, 1996). Both verbal and nonverbal maternal input to young children varies as a function of the child's age and language level. These modifications appear to facilitate child comprehension of and response to an adult message, as well as encourage typical language development.

Given the spectrum nature of ASD, there is a wide range of linguistic abilities represented in a given sample of children with ASD. How does parental communicative input change relative to the language level of a child with ASD? If parents of typically developing children adjust their verbal and nonverbal input based on the language needs of their child, and parents of children with ASD tend to provide similar or enhanced levels of verbal and nonverbal input to their children, it follows that parents of children with ASD would adjust their speech, gesture, and other nonverbal communication to accommodate their child's language needs. Some ASD research does support this finding: Konstantareas et al. (1988) found that mothers of children with ASD adjust the types of verbal input they use according to the child's level of functioning. Medeiros & Winter (2014) found that in ASD, as in typical development, parents used more gesture in interactions with children with lower linguistic abilities. Conflicting evidence has shown that parental input and child output are highly correlated in ASD and typical development, which would suggest that parents may use less verbal and nonverbal communication with their children with ASD who have lower language levels (Fusaroli et al., 2019; Wan et al., 2019; Özçalışkan et al., 2018). Understanding the relationship between parental input and the language level of a child with ASD will help characterize the communicative profiles of caregivers across the spectrum of language abilities in ASD and can help to determine appropriate recommendations for intervention.

Multimodal Communication and ASD

In typical development, evidence suggests that coordinated verbal and nonverbal multimodal communication plays an important role in language comprehension and development (Kelly et al., 2009; Baldwin, 1991; Morford & Goldin-Meadow, 1992). The

extent to which multimodal communication is useful in interactions with children with ASD is less clear. Gesture production deficits in children with ASD are well established; the evidence regarding gesture comprehension is less definitive. While some studies have demonstrated deficits in gestural comprehension for all gesture or certain types of gesture (Perrault et al., 2019; Ham et al., 2011; Cossu et al., 2012), conflicting evidence has shown similar patterns of gesture comprehension in ASD and typical development (Dimitrova et al., 2017; Adornetti et al., 2019; Smith & Bryson, 2007.) Many of the studies that have shown no difference have matched children with ASD with typically developing peers based on language level. There may be variation in gesture comprehension in ASD that reflects language level or other child variables that would explain these conflicting results; this concept requires further study.

As the evidence on gestural comprehension is conflicting, it may be helpful to examine the theoretical benefits of using multimodal communication with children with ASD. Some evidence suggests that a visual nonverbal element to communication would facilitate message comprehension in this population. People with autism are strong visuo-spatial thinkers and learners, and visual cues can be beneficial for learning (Quill, 1995, 1997). The inclusion of visual supports is an evidence-based practice for encouraging learning in ASD (Wong et al., 2015). The success of ASD interventions using video modeling suggests that adding a visual component to a stimulus promotes learning (Cihak et al., 2012). Finally, when children with ASD were taught vocabulary through discrete trial training with and without simple supporting gestures, they better retained the information that was presented multimodally (Kurt, 2011). Researchers have argued that the inclusion of a gestural component to a verbal message may help focus a child with

ASD's attention and contextualize the message (Leekam et al., 1998; Presmanes et al., 2007). There is compelling evidence that the inclusion of a nonverbal visual component to a stimulus enhances comprehension and learning in young children with ASD.

Conflicting research also suggests, however, that children with ASD may have trouble integrating stimuli from concurrent visual and audio modalities. These deficits may lead to lower comprehension of multimodal communication than when processing verbalizations or gestures alone. In one study, children with developmental language disorders benefited from the addition of gesture to a joint attention direction, while those with ASD performed more poorly (Loveland & Landry, 1986). This suggests that the addition of a gesture may be distracting rather than helpful for children with ASD. Silverman et al. (2010) found that adding reinforcing gesture to a verbalization facilitated responses in neurotypical people but produced slower reaction times in those with ASD. Bebko et al. (2006) found that, unlike typically developing children, children with ASD do not show a preference for synchronized audio and visual linguistic stimuli over asynchronized stimuli. Researchers hypothesized that children with ASD are slow or unable to detect violations of synchrony because they have trouble integrating visual and audio modalities. These results suggest that multimodal communication may be distracting rather than facilitative for children with ASD. It is unclear whether parental use of multimodal communication would increase or inhibit child responses as compared to verbal initiations or gestural initiations alone.

Summary and Statement of the Problem

A child's communicative characteristics are influenced by interactions and communicative styles of their caregivers; in fact, child language and parent language are

tightly related. Research shows that parental input facilitates aspects of child language development and that parents adjust their communicative input based on their child's language level. In typical development, mothers spontaneously adapt their communication input to their child's age, linguistic abilities, and comprehension level. One such adaptation is the increased pairing of verbalizations with coordinating gestures or other nonverbal communication elements.

Evidence suggests that parents of children with ASD tend to use similar or higher rates of communication and comparable or richer quality of input to their children than parents of typically-developing children. Given the evidence about parental adjustment of input based on child characteristics, we might expect to see increased rates of multimodal communication initiations in parents of children with ASD who have lower language skills than those with children with higher language skills. However, other evidence suggests that the opposite might be true: if child communication mirrors parental communication, perhaps we would see lower rates of multimodal communication with children with lower language function. The present study seeks to compare use of multimodal communication by parents toward young children with ASD with differing levels of linguistic ability.

In typical development, experts agree that multimodal communication serves to facilitate language comprehension and development. It is unclear the extent to which multimodal communication serves the same facilitative functions for children with ASD. Studies of gesture comprehension in ASD have mixed results, with some researchers reporting gestural comprehension deficits in ASD and others obtaining opposite findings. Moreover, some research suggests that nonverbal reiteration of a message benefits the

visual strengths of children with ASD, while other studies have found deficits in simultaneous auditory and visual processing in ASD. The present study investigates multimodal communication use by mothers to their children with ASD to explore the effects of simultaneous verbal and nonverbal messages on child responsiveness.

Research Questions and Hypotheses

In the current study, previously collected language samples from home play interactions of young children with ASD and their mothers were analyzed using CHILDES transcription and CLAN analysis software (MacWhinney, 2000). The samples were coded and analyzed to explore the use of multimodal and unimodal (verbal-only or nonverbal-only) conversational initiations by mothers and how children with ASD respond to these initiations.

Maternal initiations were examined instead of child initiations for two reasons. First, evidence is good that parental input is linked with child language output (Swanson et al., 2019; Fusaroli et al., 2019; Wan et al., 2019). This study seeks to investigate the role of parental input in order to make useful clinical recommendations for the treatment of ASD. Second, child initiations of communication in this sample were rare and mothers tended to make the majority of communication initiations. While it is useful to know under what circumstances young children with autism initiate communication, these instances would have provided a much less robust data set.

The first goal of the study was to analyze the use of multimodal initiations by mothers as it relates to the expressive language level of the child. Given the spectrum of language capabilities in autism, these data will provide insight on the use of multimodal initiations by mothers toward children with ASD whose language skills differ. It was

hypothesized that mothers will use more multimodal initiations to children with ASD who demonstrate a lower language level.

The second goal of this study was to compare the rates of child response to multimodal initiations by mothers as compared to unimodal (verbal-only or nonverbal-only) initiations in mother/child dyads with children with ASD. Additionally, analysis will be performed to see if child response rates to multimodal and unimodal maternal initiations differ as a function of the child's expressive language level. It was hypothesized that children with ASD will respond to more multimodal maternal initiations than the single mode initiations.

In summary, the major research questions of the current study are:

1. Do mothers produce more multimodal initiations toward children with ASD with lower language skills than children with ASD who have higher expressive language abilities?
2. Do children with ASD respond to multimodal communicative bids more often than initiations that are nonverbal-only or verbal-only?

Methods

Experimental Design

This study used data from Dr. Richard Solomon and colleagues' Play and Language for Autistic Youngsters (PLAY) Project Randomized Controlled Trial (RCT) (Solomon et al., 2014). In this RCT, 128 young children (ages 2.5 to 6) previously diagnosed with autism were randomly assigned to intervention and treatment-as-usual groups. The parents of children in the treatment group were coached in PLAY Project techniques to improve parent-child interactions. Treatment lasted for one year. Fifteen-minute parent-child free play interactions were filmed before and after the treatment period for both groups. These interactions were previously transcribed by undergraduate and graduate students at the University of Maryland using Computerized Language Analysis (CLAN) software and transcription system (MacWhinney, 2000). For the present study, play interaction videos collected after the treatment period from both the intervention group and treatment as usual group were used. Post-treatment videos were used under the assumption that parent-child dyads would exhibit more communicative behaviors with an additional year of treatment regardless of what intervention they received. Treatment group during PLAY RCT was not a variable examined in this study.

Participants

Fifty of the participating parent-child dyad post-treatment videos and transcripts were included for transcript analysis in the present study. Of the 128 original dyads in the PLAY RCT, there were 80 participants who had adequate pre-treatment and post-treatment video recordings. Dyads were excluded if one of the video-recorded sessions was unusable (e.g., video quality, caregiver switched between pre- and post- sessions).

These 80 dyads were sorted by mean length of utterance (MLU) in their post-treatment play sample and divided into three groups based on MLU. The 28 children with the lowest MLU were grouped together into a low language group and the 26 children with the highest MLU were grouped together into a high language group. The 26 children with an MLU lying between these two groups were not analyzed. Upon further analysis, the two youngest children in the low language group and the two oldest children in the high language group were omitted to control for age as a confounding variable, resulting in a final sample group of 50 dyads (26 low language and 24 high language).

The 50 children included in the study were previously diagnosed with ASD, confirmed by scores on the *Autism Diagnostic Observation Schedule-Generic (ADOS-G*; Lord et al., 2003*),* and the *Social Communication Questionnaire (SCQ;* Rutter et al., 2003*)*, a parent report measure. Participants ranged in age from 47 months to 84 months at post-intervention, with a mean age of 63.56 months and a standard deviation of 8.79 months. There were 45 males and 5 females included in the sample. Of the 50 child participants, eight (16%) were identified as African-American, Asian, or Hispanic by parent survey. In the 50 dyads, the caregivers were all mothers of the participating child.

The low language and high language group were compared to eliminate confounding differences between groups besides language level. Data did not meet all assumptions of normality and equal variance, so a Mann-Whitney U test was used. Alpha level was set at .05 for these comparisons. No significant differences were found between the low language group and the high language group in regards to age or socioeconomic status (as defined by maternal education and family income.)

Table 1.

Descriptive Statistics by Group

	Count	Gender		Age (months)		MLU (morphemes)		
		Male	Female	M	SD	M	SD	Range
Whole sample	50	45	5	63.56	8.79	2.15	1.31	0-4.14
Low language	26	23	3	62	9.06	1.03	.69	0-2
High language	24	22	2	65.25	8.34	3.36	.45	2.51-4.14

Note: M=Mean. SD=Standard Deviation.

Table 2.

Results of Mann Whitney U Test Comparing Low and High Language Groups

Variable	*U*	*Z*	*p*
Age	231.5	1.56	.12
Maternal Education	199.5	1.46	.15
Family Income	274	.75	.45

Procedure

Post-treatment videos of the 50 included mother-child dyads were coded for interaction using a behavioral coding scheme developed for this project. Two students at the University of Maryland coded seven minutes of each video. In analysis of parent-preschooler conversations during free play, seven- to ten-minute portions of a longer interaction were reliable representatives of the language characteristics of the larger sample (Guo & Eisenberg, 2015). Other sources suggest that even five minutes is enough to reliably represent a larger sample (Paul et al., 2018). Coding a seven-minute portion of each sample provided an optimal balance of reliability and coding efficiency.

Coding was initiated at the beginning of the second minute of each video, and continued until the end of the eighth minute of the video. This eliminated the first minute of the video, cutting out the beginning stages of play in order to capture a representative sample of the ongoing mother-child play interaction. If either the mother or the child was off-camera for over 15 seconds, the coder skipped ahead by one minute from the time that the person went off-camera and resumed coding. Additional minutes were coded at the end of the interaction to replace any skipped minutes. The final result was that every mother-child sample was coded for seven total minutes with neither participant being off-camera for more than 15 seconds.

The seven-minute samples were coded in accordance with a behavioral coding manual developed by the coders and their faculty advisor. The full coding manual is included in the Appendix. The coders noted each initiation of communication from the mother to the child. An initiation was defined as a purposeful behavior that initiates a circle of communication by providing some sort of new information or action inviting a child's response. Each maternal communication initiation was categorized as verbal, gestural/nonverbal, or multimodal (simultaneous verbal and gestural/nonverbal). Verbal communicative behaviors by a mother on a sustained topic were considered new initiations of communication if they provided new content. These behaviors were not considered initiations if they simply repeated the child's utterance. Gestural/nonverbal communication initiations were defined as intentional body movements with or without objects that invited the child's response. This category included gestures, play action initiations, and object interactions.

The child's behavior directly following the mother's initiation of communication was categorized as a response (verbal, gestural/nonverbal, multimodal), no response, or "no wait time." Responses were coded if the child completed a communicative behavior related to the maternal initiation. It should be noted that rejection of an activity counted as a response when it followed the maternal initiation. "No wait time" was coded when the mother quickly initiated communication again without allowing adequate time for the child to reply, which was operationally defined as three seconds from the end of the first maternal communication initiation. This is consistent with literature identifying three seconds as the time interval that best captures contingent responses to communication initiations in mother-child interactions (Van Egeren et al., 2001; Fagan & Doveikis, 2019). For the current study, a mother must have left at least three seconds of time before initiating again for the child's behavior to be coded as non-responsive. Any time the mother initiated again quickly without leaving three seconds for a response, the interaction was coded as "no wait time."

Reference the full coding manual for more detailed explanations and operational definitions used for coding (see Appendix).

Reliability

Twelve percent of videos (N=6) were coded by both trained coders to establish interrater reliability between coders. The reliability videos included participants from the low language and the high language groups. Percent agreement of total counts for maternal communication initiation type and child response type was calculated for each reliability video and Cohen's Kappa was computed. Kappa values for individual reliability videos ranged from .70 to .87, with an average kappa value of .78. In

accordance with the kappa value interpretation set forth in Landis & Koch (1977), this value represents substantial reliability between the two coders.

Given the low incidence of nonverbal-only maternal initiations, a follow-up reliability check was performed to ensure reliability across all types of maternal initiations. Cohen's Kappa for nonverbal maternal initiations ranged from .50 to 1.00, with an average kappa value of .77. While there was a greater range in agreement values for nonverbal initiations of communication, the average kappa value still represents substantial reliability between the two coders (Landis & Koch, 1977).

For the videos coded for reliability, the version coded by the primary graduate researcher on this project was included in data analysis.

Analyses

To address the first research question, the number of maternal initiations that were multimodal was divided by the total number of maternal initiations to find the proportion of multimodal initiations in each dyad's play interaction. The resulting proportions were log-normalized. A two-sample t-test was used to assess whether the mother's rate of multimodal initiations significantly differed by the child's expressive language group (low language, high language, by MLU).

To answer the second research question, child response rates for different types of maternal initiation were compared. Child behaviors directly following a maternal initiation were sorted into three categories: response, non-response, or "no wait time" (initiations where the mother initiated again before the child had adequate time to respond). The total number of responses for each maternal initiation type was a sum of all child verbal, gestural/nonverbal, and multimodal responses. This number of responses

was divided by the total number of maternal initiations in each category (verbal, gestural/nonverbal, multimodal) that included adequate time for the child to respond. In other words, the total number of child responses for each type of maternal initiation was divided by the total number of child responses and non-responses, representing the child's response rate for each type of initiation. Communication interactions in which the child had no wait time were excluded.

Response rates to verbal, nonverbal/gestural, and multimodal initiations of communication were log normalized. The resulting data were compared using a one-way repeated measures analysis of variance (ANOVA). The role of expressive language level in child response rates was examined by including language group as a between factor variable. Following the finding of a significant effect of maternal initiation type, paired t-tests were used to compare child response rates to the three types of maternal initiations.

For hypotheses using a single comparison, an alpha level of .05 was used. For other hypotheses, the Holm-Bonferroni correction was applied to appropriately account for multiple comparisons.

Results

Mothers' Use of Multimodal Initiations

Characteristics of initiations of communication were analyzed across the entire sample and within each language group. Since dyad behaviors were observed for a consistent amount of time for this study between participants, total counts of each type of behavior were used to compare initiations between groups (see Table 3). Data met all assumptions for normality and equal variances. Following application of the Bonferroni correction, the alpha level was set at .17. Mothers initiated significantly more overall with children in the lower language group (range: 55 to 125 times) than mothers did with children in the higher language group (range: 24-85 times). This was consistent across type of initiation (verbal, nonverbal/gestural, and multimodal); mothers of children in the lower language group used more of all types of initiations than did mothers of children in the higher language group (see Figure 1). Mothers had more verbal initiations with children in the low language group (range: 8-71) than mothers did with children in the high language group (range: 5-49 times). Mothers initiated more nonverbally toward their lower language children (range: 0-24 times) than mothers did toward their higher language children (range: 0-26 times). Finally, mothers had more multimodal initiations with low language children (range: 21-74 times) than did mothers with high language children (range: 0-70 times).

Table 3.

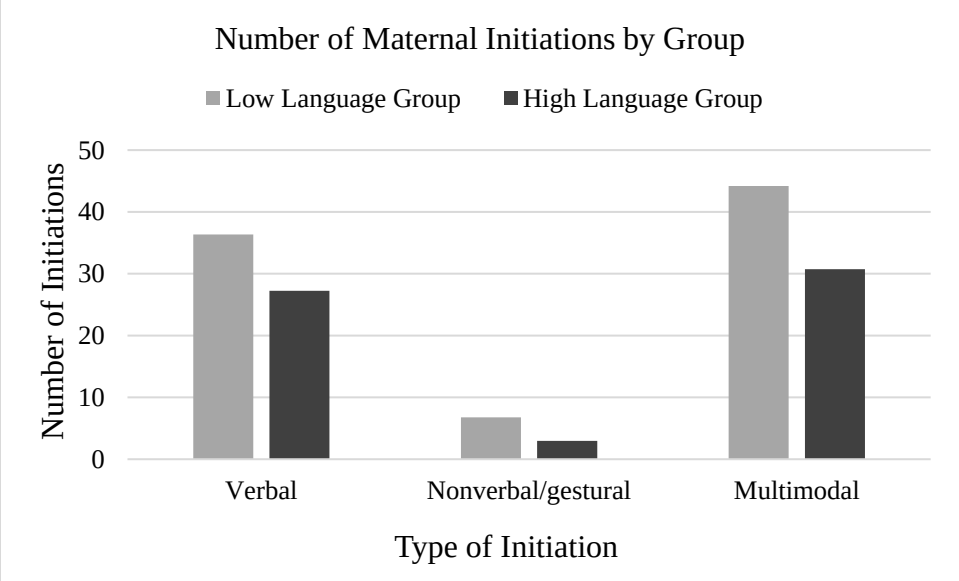
Number of Each Type of Maternal Initiations by Language Group (Two-Sample t-test)

	Low Language		High Language		*t*	*p*
	M	SD	M	SD		
Verbal Initiations	36.35	15.71	27.25	11.62	-2.33	.02*
Nonverbal/Gestural Initiations	6.77	6.15	2.96	5.35	-3.16	<.001*
Multimodal Initiations	44.19	13.93	30.75	16.15	-5.37	<.001*

*$p < .17$

Note: M=Mean. SD=Standard Deviation.

Figure 1.



Note: A comparison of the number of maternal initiations of each type in dyads with children in the low and high language group is shown above. Mothers initiated significantly more with their low language children than mothers did with their high language children across all initiation types: verbal, nonverbal/gestural, and multimodal.

Multimodal initiations were divided by total initiations to find a rate of multimodal maternal initiation for each dyad. The resulting proportions were log normalized for data analysis. Data did not meet all assumptions of normality and equal variance. A Mann-Whitney U test was used to compare the proportion of initiations that were multimodal from mothers in each language group (see Table 4). While the rate of maternal multimodal initiations was slightly higher in dyads with a child in the high language group (range: 0-.92) than in the low language group (range: .28-.72), this difference was not significant. There was no effect of language group on maternal rate of use of multimodal initiations (see Figure 2).

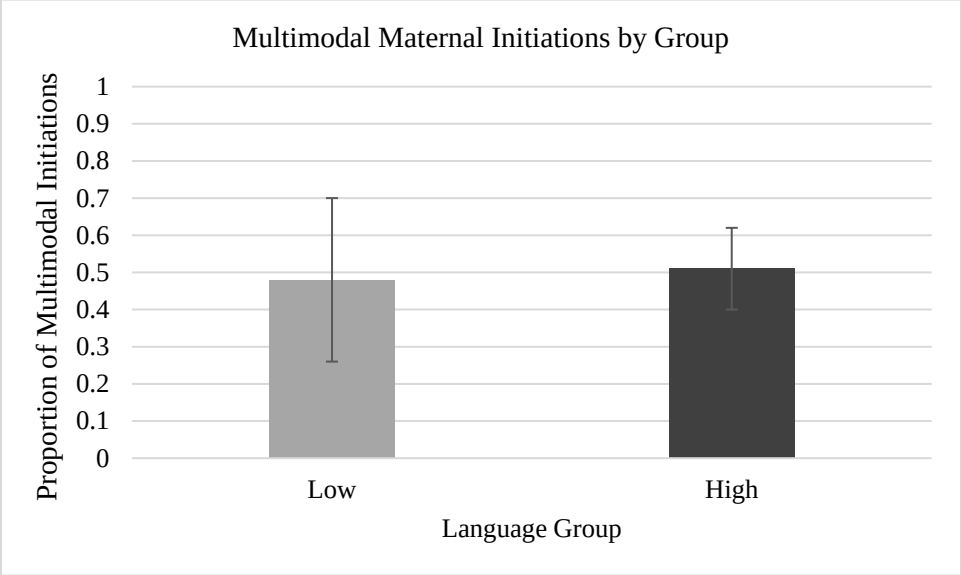
Table 4.

Proportion of Total Initiations that were Multimodal by Language Group (Mann Whitney U test)

	Low Language	High Language	*U*	*Z*	*p*
Mean	.48	.51	301	-.20	.84
Standard Deviation	.22	.11			

*$p<.05$

Figure 2.



Note: This figure shows relative rates of multimodal initiations in low and high language dyads. There was no significant difference between the rates of multimodal communication by mothers with children in the low language group as compared to mothers with children in the high language group.

Child Responses to Multimodal Initiations

Child response rates to maternal initiations of each type (verbal, nonverbal/gestural, multimodal) were log normalized. The resulting data were compared across language group (See Table 5). Data met all assumptions of normality and equal variance. Alpha level was set at p=.05. Comparison with a repeated-measures ANOVA showed a significant effect of language group on response rate: as expected, children in the high language group responded at a significantly higher rate than children in the low language group. There was also a significant effect of maternal initiation type on child response rate, indicating that there was a difference in response rate to at least two types

of maternal initiation. No significant interaction between child language group and maternal initiation type was found.

Table 5.

Effect of Language Group and Initiation Type on Child Response Rates (Repeated Measures ANOVA)

Source	Sum of Squares	DF	Mean Square	F	Significance
Language group	.96	1, 48	.96	20.16	<.001*
Initiation type	1.34	2, 48	.67	24.22	<.001*
Language group*Initiation type	.12	2, 48	.06	2.26	.11

*$p < .05$

The log-normalized child response rates to each type of initiation were further compared using a series of two-sample t-tests (see Table 6). Following application of the Bonferroni correction, the alpha level was set at .013. As already demonstrated, children in the high language group (range: .56-.98) responded at a significantly higher rate overall than children in the lower language group (range: .18-.74). Children in the high language group (range: .15-.92) responded at a significantly higher rate to verbal and multimodal initiations than children in the low language group (range: 0-.43). Children in the high language group (range: .6-1) also responded at a significantly higher rate to multimodal initiation than children in the low language group (range: .15-.88). While the average response rate to nonverbal/gestural initiations was slightly higher for children in the high language group (range: 0-1) than for children in the low language group (range: 0-1), this difference was not statistically significant.

Table 6.

Child Response Rates Overall and by Initiation Type, Sorted by Group (Two-Sample t-test)

	Low Language		High Language		*t*	*p*
	M	SD	M	SD		
Overall	.46	.16	.75	.11	6.75	<.001*
Verbal Initiations	.22	.15	.53	.18	6.50	<.001*
Nonverbal/Gestural Initiations	.36	.33	.51	.46	1.05	.30
Multimodal Initiations	.54	.20	.84	.10	5.97	<.001*

*$p < .013$

Note: M=Mean. SD=Standard Deviation.

The log-normalized response rates to different types of maternal initiation were also compared in a series of pairwise t-tests (see Table 7). Each type of maternal initiation was compared to each other type of initiation in terms of log-normalized child response rate in each language group. Alpha levels were set using the Holm-Bonferroni correction. There was no significant difference between child response rate to verbal and nonverbal/gestural initiations in either language group. Across both language groups, children were significantly more likely to respond to multimodal initiations than verbal initiations, and to multimodal initiations than nonverbal/gestural initiations.

Table 7.

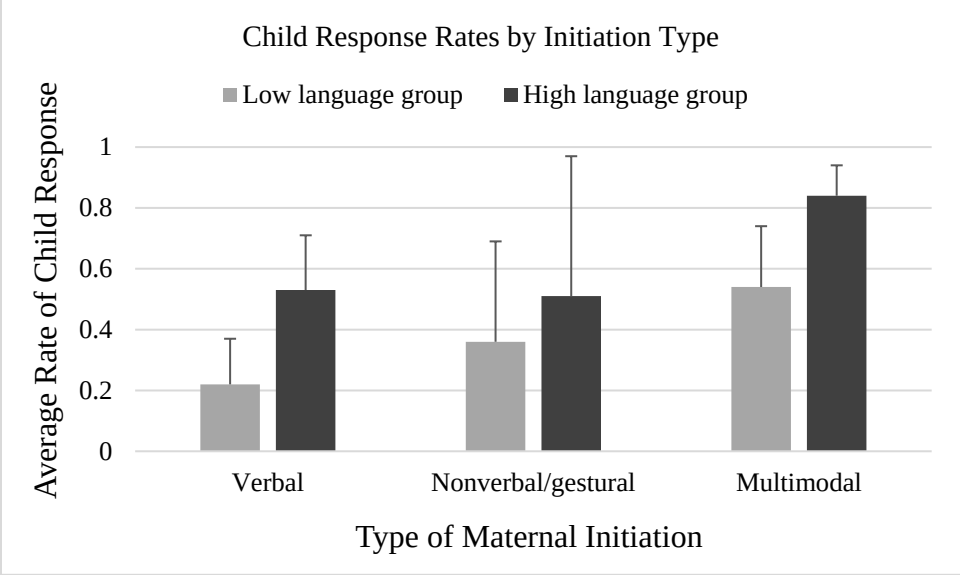
Comparison of Child Response Rates to Different Initiation Types (Paired Sample t-tests)

	Verbal		Nonverbal		Multimodal		*t*	*p*
	M	SD	M	SD	M	SD		
Low Language								
Verbal vs. Nonverbal/Gestural	.22	.15	.36	.33			-1.74	.09
Verbal vs. Multimodal	.22	.15			.54	.20	-7.53	<.001*
Nonverbal/Gestural vs. Multimodal			.36	.33	.54	.20	-3.42	<.01*
High Language								
Verbal vs. Nonverbal/Gestural	.53	.18	.51	.46			.80	.42
Verbal vs. Multimodal	.53	.18			.84	.10	-8.64	<.001*
Nonverbal/Gestural vs. Multimodal			.51	.46	.84	.10	-3.47	<.01*

**Significant following Holm-Bonferroni correction.*

Note: M=Mean. SD=Standard Deviation.

Figure 3.



Note: Child response rates by language group (low language, high language) and maternal initiation type (verbal, nonverbal/gestural, multimodal) are plotted above. Results of a one-way repeated-measures ANOVA indicated a significant effect of language group, with children in the high language group responding at a higher rate than children in the low language group. There was also a significant effect of maternal initiation on child response rates. Results of pairwise t-tests indicated that children in both language groups responded at a significantly higher rate to multimodal initiations than to verbal initiations, and at a higher rate to multimodal initiations than to nonverbal/gestural initiations. The difference in response rate to verbal initiations and nonverbal/gestural initiations was not significant in either language group. Additionally, there was no significant interaction between child language group and maternal initiation type.

Importance of Wait Time

As previously described, maternal initiations that did not allow adequate time for response from the child were assigned a specific code during the initial coding process,

"No Wait Time." Maternal initiations directly followed by a code of No Wait Time were excluded from the total count of initiations used to compute a response rate for each initiation type. The rationale for this exclusion was that an initiation that does not give a child adequate time to respond does not provide not a valid measurement of the child's response to the communication initiation attempt.

A *post-hoc* analysis was run to determine how maternal use of initiations with No Wait Time are related to child response rate in general. Data were log-normalized. The rate of No Wait Time over total initiations and the rate of child response to maternal initiations were both log-normalized. Pearson's *r* was then calculated between the two variables. Following application of the Bonferroni correction, alpha level was set at .017. A significant negative correlation was found between rate of No Wait Time by mothers and rate of child response. As instances of No Wait Time over total initiations increased, child response rate tended to decrease. Significant negative correlations were also found in the low and high language groups (see Table 10, Figure 4).

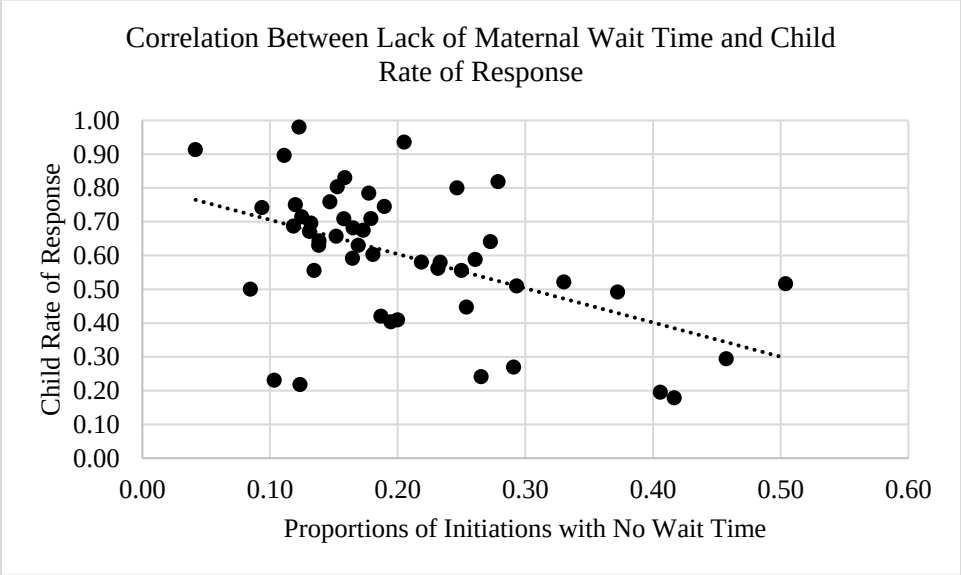
Table 8.

Correlation between Maternal Use of Initiations with No Wait Time and Child Response Rate (Pearson's r)

	r	*p*
Whole Group	-.66	<.001*
Low Language	-.71	<.001*
High Language	-.62	<.001*

*$p < .017$

Figure 4.



Note: Results of a correlation between rate of maternal initiations without sufficient response time and overall child rate of response are shown. A significant negative correlation was found, with child rate of response decreasing as the proportion of maternal no wait time initiations increases.

The dyads were then sorted by the rate of maternal initiations that were followed by no wait time and split into two groups for follow-up analysis: a high wait time group and a low wait time group. The high wait time group had a lower rate of no wait time initiations, while the low wait time group had a higher rate of no wait time initiations. The child overall response rates to maternal initiations (excluding no wait time initiations) were compared across wait time groups using a two-sample t-test. Alpha level was set at .05. Mothers who were sorted into the high wait time group had children who responded at a significantly higher rate (range: .22-.98) than mothers who were sorted into the low wait time group (range: .18-.94) (See Table 9, Figure 5).

Table 9.

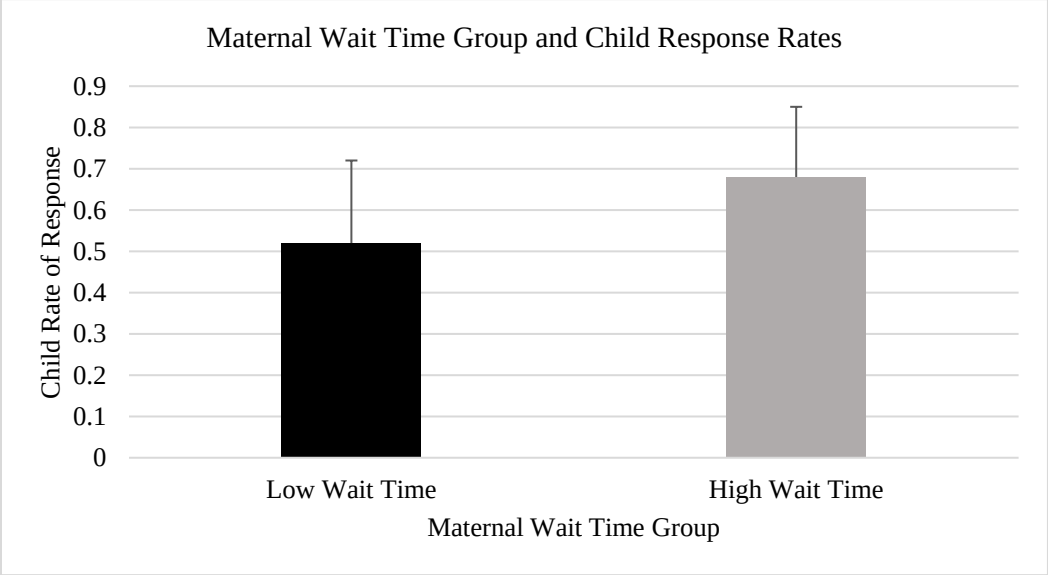
Child Rates of Responses Compared Across Low Wait Time and High Wait Time Groups based on Maternal Rate of No Wait Time (Two-sample t-test)

	Low Wait Time		High Wait Time			
	M	SD	M	SD		
Rate of No Wait Time	.28	.09	.13	.03	*t*	*p*
Child Rate of Response	.52	.20	.68	.17	-2.99	<.01*

**p<.05*

Note: M=Mean. SD=Standard Deviation.

Figure 5.



Note: Dyads were split into a low wait time group and a high wait time group by the overall rate of maternal initiations coded as having no wait time. The overall child response rates were compared across groups. The children of mothers who had high wait time overall (had a lower rate of no wait time initiations) responded at a significantly

higher rate than the children of mothers who had low wait time overall (had a higher rate of no wait time initiations).

Discussion

The purpose of the present study was to investigate the use and effectiveness of multimodal communication initiations by mothers with their children with ASD in order to identify factors that may increase child response rates. Specifically, the rate of use of multimodal communication initiations in interactions between mothers and their children with lower levels of expressive language were compared to the rate of use by mothers and their children with a higher expressive language level. Additionally, child rate of response to multimodal initiations was compared to the rate of response to verbal-only and nonverbal-only initiations. Finally, the rate of maternal initiations without adequate response time was compared to the overall child response rate to identify a trend in the data. The analyses yielded some significant findings that suggest that certain maternal behaviors may contribute to a higher response rate by children with ASD.

The first research question considered the use of maternal multimodal initiations with children of varying expressive language levels. Results indicated that mothers of children with higher expressive language levels made fewer initiations overall than mothers of children with lower expressive language levels. This finding held across all types of initiations: mothers initiated significantly more verbally, nonverbally, and multimodally with children with lower language than with children with higher language. A possible explanation for this finding is that child initiations were higher in the high language group. It is likely that these children in the higher speech group have not only higher expressive language skills, but also are more competent social communicators overall (Howlin et al., 2004; Tager-Flusberg & Kasari, 2013). While child initiations were not formally coded or tallied, it was informally observed that children with higher

expressive language levels tended to initiate more themselves. Thus, the overall number of initiations may have been the same in low language and high language dyads, but in the high language dyads, the child accounted for more of the total load of initiations. If the children in the higher expressive language group had better communicative skills overall, they also may have been able to sustain back and forth reciprocal exchanges for longer than children with lower expressive language. Thus, high language group dyads may have had more conversational continuity and fewer new initiations. Finally, joint engagement skills are strongly associated with expressive language skills in children with ASD (Adamson et al., 2017). As such, the children with lower language skills may have had overall lower amounts of engagement and attention in the play interactions, leading their mothers to initiate more in an attempt to establish engagement with their child.

An examination of the different types of initiations used by mothers revealed that mothers used multimodal initiations at a high rate across language groups. This type of initiation was the most frequently used with both low and high language groups, with verbal initiations used second most frequently by mothers in both groups. Across both groups, mothers used relatively few nonverbal-only initiations. Mothers may think that these initiations are less likely to lead to a child response, and our results suggest that this perception may be correct. It may be that when a mother has an opportunity to initiate nonverbally, she is inclined to pair this initiation with a supporting vocal initiation, making it a multimodal initiation. The relatively higher number of verbal-only initiations indicates that mothers may be more comfortable with this initiation type and believe it sufficient to lead to a child response. She may be less inclined to add a supporting gesture. Overall, these results suggest that mothers of children with ASD tend to use

verbal and multimodal initiations much more often than nonverbal/gestural initiations. Any recommendations to parents of children with ASD regarding multimodal communication initiations should consider that it seems that many parents are already using this type of initiation quite frequently.

Research has shown that parents adjust their communication based on the developmental level of their child (Gutmann & Turnure, 1979; Saint-Georges et al, 2013; O'Neill et al., 2005; Iverson et al., 1999). As multimodal communication is often used more with younger children or children with lower linguistic competence, it was hypothesized that mothers of children with lower-level language skills in our study would use a higher rate of multimodal initiations than mothers of children with higher-level language skills. When maternal multimodal initiations were divided by total maternal initiations to derive a rate of multimodal initiation use, however, results revealed no significant difference in this number between high language and low language dyads. Relative to the total number of initiations, mothers appear to use similar rates of coordinated verbal and nonverbal initiations across expressive language levels. One explanation for this result is that mothers may adjust their use of multimodal communication based on perceived receptive language level rather than expressive language level. Mothers in our study may have used less gesture with a child with higher language comprehension abilities even if they had low verbal output. Mothers may also have adjusted elements of their multimodal communication other than rate of use based on child language level. For example, they may have used less complex co-speech gestures in communication with the lower language group. Finally, both groups of children were not using language at age-appropriate levels; thus, both groups may have

received higher levels of multimodal input than might have been seen in maternal interaction with typically-developing children of the same ages.

The second research area investigated the response rates to initiations and how these rates varied by children's expressive language group and the type of maternal initiation. Both language group and type of initiation had significant effect on child response rates. Unsurprisingly, children in the higher language group had a higher response rate than children in the lower language group overall. The higher expressive language level of this group of children may be reflective of an overall higher level of communication. In general, they engaged more in response to maternal initiations. Children in the higher expressive language group also had a significantly higher response rate to verbal-only initiations and multimodal initiations. Interestingly, there was no significant difference between low- and high-language groups in response to nonverbal-only initiations. It seems that the low verbal communicators are able to comprehend and appear motivated to respond to nonverbal-only initiations at a similar rate to higher verbal communicators. More advanced verbal language is less of an advantage in the communicative competency of a child when the interaction does not involve verbal language. As soon as verbal language is added, in the form of a verbal or multimodal initiation, children with higher language appear to benefit from the verbal information more than children with lower language.

Child response rates also differed significantly by maternal initiation type. In both the low and the high language groups, children responded at higher rates to multimodal initiations than verbal initiations and nonverbal/gestural initiations. There was no significant difference in response rates to verbal initiations and nonverbal/gestural

initiations. These results suggest that a multimodal initiation may be more likely to lead to a response from a child than a single mode initiation. This finding is in line with earlier studies that have found a facilitating effect of nonverbal/gestural communication in coordination with verbal communication for children with ASD (Cihak et al., 2012; Kurt, 2011). The fact that response rates to verbal and nonverbal initiations do not significantly differ suggests that there is no advantage of a specific mode of initiation to this population. Instead, it seems that verbal and nonverbal elements are able to combine effects in some way that increases response rates.

One possible explanation for this multimodal advantage is that a gesture or other visual nonverbal component to the initiation helps focus a child's attention to the verbal message being shared, thus increasing the likelihood of the response. This explanation is consistent with previous research into how caregiver gesture can contextualize a verbalization for children with ASD (Leekam et al., 1998; Presmanes et al., 2007). It is also possible that initiating through two simultaneous modes casts a wider net for the child's attention at that particular moment in time. If a parent initiates in a single perceptual mode (verbal/auditory or nonverbal/visual), the child's auditory system or visual system might be focused elsewhere, and they miss the initiation and do not respond. Multimodal initiations may increase child comprehension by multisensory bombardment of a message. Response is a flawed proxy for comprehension, as it is always possible for the child to comprehend an initiation and still not respond. However, it is possible that multimodal comprehension emphasizes a message in a way that leads to greater child comprehension and thus increases responsivity. Finally, as this is a correlative study, it is possible that there is a third variable that causes both multimodal

initiation and increased response rate. For example, perhaps mothers tend to be more animated and engaged when initiating multimodally than when using a single mode initiation, which in turn might lead to an increased child response rate.

The low and high language groups displayed similar patterns of response to multimodal and unimodal initiations: both groups responded at a higher rate to multimodal than either type of unimodal initiations, and both groups had no significant difference in response rate to verbal-only initiations and nonverbal-only initiations. Based on the earlier results that showed no difference in response rates to nonverbal/gestural initiation between the low and high language groups, we might expect to see a higher response rate to nonverbal/gestural initiations than verbal initiations in the low language group. However, though children in the low language group did respond at a higher rate to nonverbal/gestural initiations than verbal initiations, this was a nonsignificant difference. These findings suggest that there may be some variability in the extent to which children with lower expressive language levels benefit from nonverbal/gestural communication. Though the mean difference in response rates to nonverbal and verbal initiations in the low language group response rate is high, there is also a high standard deviation. Perhaps some children with low verbal language are more likely to respond to nonverbal over verbal communication than other children with low verbal language. There were lower standard deviations for the rates of response to verbal and multimodal initiations, indicating less variation in response rates to these types of initiations. Individual variation in the extent to which visual supplementation facilitates responses could account for the wide range of response rates to these types of initiation. As discussed earlier, researchers disagree about the extent to which gesture comprehension is

affected in ASD; wide individual variation in gesture comprehension is a possible explanation for these varied findings (Perrault et al., 2018; Dimitrova et al., 2017). Further research into gestural comprehension variations is warranted, including the extent to which comprehension of gesture affects the facilitative effects of multimodal communication. While gestural initiations may benefit some lower language level children, a more robust finding of this study is that multimodal initiations were associated with higher response rates across both language levels and the entire sample.

The *post-hoc* analysis performed sought to compare the relationship between mothers who have high rates of rapid consecutive initiations without adequate response time and the overall rate of response of their children. A significant negative correlation was found: as rate of initiations without adequate wait time increased, the child's response rate tended to decrease. Further, when dyads were sorted into groups based on the maternal rate of no wait time initiations, children of mothers who had lower rates of no wait time initiations responded at a significantly higher rate overall than children of mothers who had higher rates of no wait time initiations. This indicates that even when substantial wait time is provided, the children of mothers who frequently do not leave wait time are less likely to respond than the children of mothers who tend to provide adequate wait time.

One interpretation of this result is that children are less likely to respond to initiations if there is never space left for a response. Children with ASD have deficits in social communication, including pragmatic rules like turn-taking. If space is not left in conversational exchanges, they may not know when it is their conversational turn or understand that a response is expected. Research has shown that children with ASD have

increased need for processing time (Hedvall et al., 2013.) Mothers may be waiting what they feel is an appropriate amount of time before initiating again, but children are not able to process the initiation and formulate a response before their mother is initiating again.

It should be noted that this finding is correlational: a high frequency of initiations without wait time does not necessarily cause a low response rate. Alternatively, it is well-established that mothers adjust elements of their communication based on their child's linguistic needs. It is possible that mothers with children with low response rates increase their communication initiation rate and decrease wait time because they know their child's communication pattern (or lack of one) and do not expect a response. However, given adequate wait time, these children with low response rates may show increased integration into the turn-taking pattern of the conversation and/or have adequate processing time to formulate and share a response in the communicative exchange.

Clinical Implications

The results of this study have important implications for the treatment of ASD in the context of parent training as well as direct ASD therapy. Multimodal communication and increased wait time by adults in play interactions may increase the response rates of children with ASD. This increase in response rate is valuable as it increases opportunities for adult expansion of child language and sustained communication interactions. Given the findings that multimodal communication initiations were associated with higher child response rates, it could be beneficial to train parents to purposefully increase this type of communication with their children with ASD. Professionals should be aware, that based on the results of this study, parents are already using this type of communication at a

fairly high rate (at least 50% of the time). This is a benefit because parents already know how to use this type of communication and may only need coaching on how to expand their existing usage.

Another clinical implication of this study is that multimodal initiations are beneficial for children with both lower and higher expressive language levels. Instinctively, parents may be more likely to use supplementary gestures when they speak with children at lower developmental and language levels. These results indicate, however, that maternal use of multimodal communication can increase child response rates regardless of the child's expressive language level, and should be encouraged for parents of children across the language spectrum.

Another finding of this study is that some children with lower language levels may respond at a higher rate to gestural/nonverbal-only than verbal-only initiations. For some children with lower language levels, gesture (in the form of nonverbal-only and multimodal communication) may be particularly useful to increase their responses to communicative initiations by others. In ASD, as in typical development, gesture has been shown to be a bridge to later spoken language development (Luyster et al., 2007; Özçalışkan et al., 2017). It is possible that these children who are high responders to gestural initiations are the children who will later develop more verbal language. Clinically, if there is a child with lower verbal skills who seems to respond particularly well to gestural communication, this should be further emphasized and pursued with this child. Ideally, this will increase the child's communicative range and success, and lead to an increased desire to communicate.

A final clinical implication is the potential role of wait time in increasing child response rates. The negative correlation between frequency of initiations without adequate response time and overall child response rate suggests that parents who do not leave time for their child to respond to their initiations may have an effect on their overall tendency to respond to others. Although this finding is correlational, it makes theoretical sense that a child who is frequently not given time to respond will be less likely to respond even when adequate time is given. Clinically, parents and therapists can be taught to allow adequate time after an initiation. This has the dual purpose of giving the child additional processing time and creating the basic framework of an interchange of communicative turns. With time, a child with ASD may be more motivated and able to respond to an initiation for communication.

Overall, increased multimodal communication initiations and wait time may lead to increased child response rates. The findings of this study suggest that many parents already use these strategies frequently. Clinicians can coach parents to continue or even increase their use of these techniques, as these results suggest that they can be beneficial for encouraging child participation in communication exchanges.

Limitations

While a strength of this study was that it used naturalistic, home-based mother-child interactions, the collection of these interactions required the presence of a researcher videotaping in the home. This fact that they were being observed and videotaped, as well as the presence of another person, may have affected the communication characteristics of the mother and child. Additionally, the very nature of this study as a retrospective behavioral analysis is a limitation, as there was no random

assignment of participants to conditions and behavioral coding schemes are notoriously subjective. However, the strong interrater reliability of the coding scheme and the within-subjects design increases the validity and power of the findings.

Another limitation of this research was that maternal initiations and child responses were coded on a relatively simple scale. Maternal initiations were described as only verbal, nonverbal/gestural, or multimodal, with no measurement of quality or further categorization of type. For example, nonverbal initiations ranged from handing a child a toy to complex representational gestures. Child reactions were coded as absent or present, without any quality ratings. Additionally, multimodal initiations were not categorized into reinforcing (where the nonverbal act emphasizes the same information as the verbalization) or supplemental (where the nonverbal act provides additional information to the verbalization) acts. Informally, the majority of multimodal acts by mothers in this sample were reinforcing. Supplemental multimodal acts are more difficult to understand for typically developing children and children with ASD, so the proportions of supplemental and reinforcing multimodal acts could influence the conclusions drawn about multimodal communication use and effectiveness (Dimitrova et al., 2017). A more in-depth analysis of initiations and response patterns would allow for more detailed and nuanced patterns of communication in these dyads.

Additionally, there was no categorization of mother or child engagement. When participating in a communication interaction, a highly engaged communication partner is likely to behave in different ways than a less engaged partner. For example, a child with high engagement throughout the interaction may be more likely to respond to maternal

initiations regardless of mode. Coding for engagement might reveal more nuanced characteristics of maternal initiations and child response patterns.

Another limitation is that children were sorted into language groups based on expressive language level (by MLU) only. While expressive language was used a proxy for overall language ability, it is possible that sorting the children by receptive language level would have led to different compositions of the high and low language groups. Given that the focus of the study was child responses to communication initiations, grouping the children by high and low receptive language rather than expressive language may have been more appropriate to the research questions.

Another limitation of this study that should be noted is that the families who participated in this study may have differing communication characteristics from families who did not participate in the study. For example, parents who would volunteer to participate in a treatment study may be more frequent initiators of communication than families who did not know about the study or chose not to participate. This may affect the extent to which the results can be generalized to all young children with ASD.

Finally, this study examined mother-child communication samples that were collected after the treatment period for both the intervention group and treatment as usual group. In order to determine the effects of intervention, it would be useful to also examine maternal use of multimodal initiations and wait time and child responses to different types of initiations before the intervention time period and how these factors change following the different interventions. If the change in these maternal and child factors is consistent across different treatment conditions, one can assume that these communication elements generally tend to be addressed in intervention for ASD. If there

are differences in the rate of change following intervention between treatment groups, one might draw useful conclusions about the influence of specific interventions on mother/child communication exchanges.

Conclusion

Given the verbal and nonverbal communication deficits characteristic of ASD, interacting with young children with ASD in ways that promote communicative interaction is paramount. The purpose of this study was to explore the use and effectiveness of multimodal communication in mother-child dyads as a tool to facilitate child responses. Important findings suggest that maternal multimodal initiations encourage child responses; this was evident in children with both low and high expressive language levels. Additionally, the absence of adequate time for response was correlated with lowered child responses, suggesting that maternal wait time following communication initiation may be a factor in child response rates.

Training parents to increase their use of multimodal communication with children with ASD of all linguistic capacities and encouraging the use of adequate wait time between maternal initiations could lead to increased child response rates. In turn, this would provide increased opportunity for adult expansion on child language and sustained communicative interactions. Many mothers are already using these techniques at a high rate. These results of this study support that these communication strategies seem to increase child responses and that their use should be encouraged. Further research directions building on these findings include comparing the effects of different types and qualities of maternal multimodal initiations on the frequency and quality of child responses, examining the role of engagement in response to multimodal initiations, and following the developmental trajectories of young nonverbal children who show increased response rates to nonverbal over verbal initiations of communication.

Appendix

Communication Initiation and Response Codebook

WHEN TO CODE?

Code starting at the first new initiation after the 1-minute mark of the video clip. You will need to use the video file to find that spot in the video. Mark the beginning of the section you're coding with a gem marker on a new line.

@bg: coder's_name

Code for 7 total minutes starting at minute 1. Most of the time, this means you will code from minute 1 to minute 8. If the child and caregiver are off-screen for more than 15 seconds, go back to when they first go off-screen and skip ahead in 1-minute increments until they are both on-screen again. Resume coding from that point and code until you have coded a total of 7 minutes for the video. After 7 minutes have been coded, mark the end of the section you're coding with an ending gem marker.

@eg: coder's_name

WHERE TO CODE?

These codes should be coded on a gestural-proxemics tier (%gpx) below the main line tier in which the communicative act occurs. If the participant does not speak when a communicative act occurs, then the main line tier should be coded with a "0" and the communicative act should be coded below. Below is an example of a parent initiating joint attention by telling the child to "look at the ball" and pointing to the ball (multi-

modal initiation) and the child gesturally responding to the communicative bid by reaching for the ball.

EXAMPLE:

*MOT: look at the ball!

%gpx: $x:IMM

*CHI: 0.

%gpx: $x:RG

%com: child reached for the ball

"$x:" should occur before the code. This helps with searching for codes later during analysis.

WHAT TO CODE?

Throughout the 7-minutes of video, code two things.

1) Code every time the mother initiates an interaction with the child. These initiations can be verbal, gestural, or coordinated verbal and gestural (multimodal).
2) Code what the child does directly after the mother initiates interaction with the child. The codes include verbal response, gestural response, coordinated verbal and gestural (multimodal response), no response/noninteractive response, and no-wait time (when mother initiates again quickly).

CODES

Each initiation by the mother should be categorized using the following codes.

CODE	FUNCTION
IV	Mother initiates communication verbally
IG	Mother initiates communication gesturally
IMM	Mother initiates verbally and gesturally (multimodally)

The child's behavior directly following each initiation should be categorized using the following codes.

CODE	FUNCTION
RV	Child responds to initiation verbally
RG	Child responds to initiation gesturally
RMM	Child responds verbally and gesturally (multimodally)
0W	Child is not given adequate time to respond to initiation before another initiatio
N	Child does not respond and/or engages in non-interactive behavior

NOTES

General

- "If it looks like a duck and sounds like a duck, it probably is a duck." Throughout coding, if you are unsure whether the child should get credit for a response or behavior, then you can be generous. If it looks like the child is trying to communicate, give them credit, even if it's not conventional.
- When coding, it's easy to follow along with the transcript and miss communicative gestures. Make sure you're watching carefully for gestures that are used purposefully to communicate and code for these so the richness of the interaction is captured.
- Apply the same guidelines to parent and child communication acts. Broadly, a child should not get credit for an initiation or response if the same act would be coded as noninteractive if done by the parent. For example, do not code an incidental motor movement as a gestural response just because a child performed it. However, note that the limited language repertoires of the children do tend to make their communication acts more simple.
- When a parent is reading a book to the child, the text from the book should be coded in quotes. Look in the CLAN manual for the specific codes to use. At the beginning of the story, the parent is coded for IV (Initiating Social Interaction), however, if she continues to read the story without any chance for interaction, this is only counted as one initiation. If the parent invites a response, such as pausing for the child to fill in, commenting on the pictures in the story, or asking what the child thinks will happen next, then these would be coded as additional initiations.

If the child responds then it should be coded as a response and if the child does not respond then it should be coded as non-interactive.

- Sometimes the original coder coded lines without verbal acts or communicative gestures. Even if there is a %spa code, make sure you are using this coding scheme for the %gpx tier. If there are no verbal acts or communicative gestures in a line, do not add a %gpx tier.
- When the parent and child are role-playing, behaviors can be coded for the parent and child rather than as the characters they are playing.

Initiating General (MOTHER)

NOTES:

- Every initiation should be followed by either a response (RV, RG, RMM), no response or non-interactive behavior (N), no wait time (0W).
- An initiation should be purposeful and communicative - don't code something as an initiation just because the child responds. If you wouldn't code an initiation if the child didn't respond, then don't code an initiation EVEN IF the child does respond. In this situation, do not code the initiation or the response.
- If there is a video cut such that you can't see the reaction to an initiation, don't code the initiation.

Initiating Verbally (IV) (MOTHER)

This code should be used for a mother's behaviors that verbally initiate communication and open a circle of communication.

EXAMPLES:

- Calling child's name
- Requesting an action
- Directing child's attention to an object, person, or event
- Asking a question

NOTES:

- Sound effects/onomatopoeia count as a verbal initiation.
- If there are two utterances that seem to hang together as one initiation, only put a code after the 2nd utterance. This follows more of a conversational turn style than purely utterance-based exchange.
    - One example of this is if a parent puts a "communicator" (ex: okay, yeah, right) after their main initiation. This should just be coded for one initiation after the 2nd utterance.
    - For example:
        - *MOT: play the piano .
          *MOT: okay?
          %gpx: $x:IV

<u>Initiating Gesturally (IG) (MOTHER)</u>

This code should be used for a mother's behaviors that nonverbally initiate communication and open a circle of communication. To be coded, gestures should be purposeful.

EXAMPLES:

- Directing child's attention to an object, person, or event
- Giving or showing an object to a child
- Initiating a social routine with gestures or facial expression.
- Manipulating an object as part of a social interaction.

NOTES:

- Gestures are generally larger motions that can be clearly coded. Do not code facial expressions and eye gaze alone as gestural initiations.
- Manipulating an object as part of a social routine can be coded as a gestural initiation. However, make sure that the manipulation of the object is communicative, and you're not reading into non-communicative movements.

Initiating Multi-Modally (IMM) (MOTHER)

This code should be used for a mother's behaviors that coordinate verbal and gestural initiation of communication to open a circle of communication. To be coded, gestures should be purposeful. If a verbal and a gestural act are more than 3 seconds (count: one Mississippi, two Mississippi, three Mississippi) apart or have a response from the communication partner between them, they should be coded as separate acts.

EXAMPLES:

- Directing child's attention to an object, person, or event with a gesture and vocalization.
- Asking a question with an accompanying gesture.

NOTES:

- If a mother uses a gesture and verbalizes at the same time, and they don't seem to be related to each other:
    - If they are both clearly communicative, you can code a multi-modal interaction.
    - If they aren't both clearly communicative, only code for the communicative portion (verbal or gestural)
- Manipulating an object as part of a social routine while talking can be coded as a multi-modal initiation. However, make sure that the manipulation of the object is communicative, and you're not reading into non-communicative movements. If a mother is moving when they are talking, it doesn't necessarily make the initiation multi-modal. Pay attention to the communicative intent they are projecting to the communication partner.
- Talking "as a toy" (i.e. speaking as if you were a doll while holding it up) is coded as a multimodal initiation/reaction.
- If a gesture + speech combination is coded as multimodal and the gesture slightly overlaps with the next utterance, but is meant to be paired with the first utterance, don't code the second utterance as multimodal. However, if a sustained gesture lasts across multiple utterances, each act can be coded as multimodal.

Responding (General) (CHILD)

NOTES:

- Every mother's initiation should have a response code, no wait time, or non-interactive code on the next child tier.
- When coding for responses, if the child is following along with the activity, then be generous. So if you are unsure if what the child says or does really follows the activity, but the child seems to be synced up with the parent, then you can consider it a response.

Responding Verbally (RV) (CHILD)

This code should be used for a child's verbal responses to communicative initiations.

EXAMPLES:

- Answering a question
- Imitating or echoing the mother
- Continuing a train of thought from the mother
- Commenting on a mother's initiation of communication

NOTES:

- Verbal rejection of an activity or request should be coded as a response.
- Sound effects/onomatopoeia counts as a response.
- If a child is unintelligible, give them the benefit of the doubt and code for a verbal response IF the mother demonstrates with their response/conversation that they seem to understand. Otherwise, don't give credit for verbal response.

- Purposeful verbal rejection of an activity or request should be coded as a response to communication.

Responding Gesturally (RG) (CHILD)

This code should be used for a child's behaviors that are gestural/nonverbal responses to a mother's communication initiation. To be coded, gestures should be purposeful.

EXAMPLES:

- Performing an action in response to the mother's request
- Imitating the mother's action
- Manipulating an object as part of a social interaction

NOTES:

- Gestures are generally larger motions that can be clearly coded. Do not code facial expressions and eye gaze alone as gestural responses.
- Manipulating an object as part of a social routine can be coded as a gestural response. However, make sure that the manipulation of the object is communicative, and you're not reading into non-communicative movements.
- Purposeful gestural rejection of an activity or request should be coded as a response to communication. This can include throwing, blocking, and purposeful walking away.
- Laughter as a clear response to an initiation can be counted as gestural reaction due to its interactive nonverbal nature.

Responding Multi-Modally (RMM) (CHILD)

This code should be used for a child's behaviors that coordinate a verbalization and a gesture in response to a mother's initiation of communication. To be coded, gestures should be purposeful.

EXAMPLES:

- Responding to a request for action with a gesture and vocalization.
- Answering a question with an accompanying gesture.

NOTES:

- If a child uses a gesture and verbalizes at the same time, and they don't seem to be related to each other:
    - If they are both clearly communicative, you can code a multi-modal response.
    - If they aren't both clearly communicative, only code for the communicative portion (verbal or gestural)
    - If the child is responding to a previous initiation with one mode and starting a new one with another mode (verbal or gestural) simultaneously, only code the mode that is being used to respond to the initiation.
- Manipulating an object as part of a social routine while talking can be coded as a multi-modal response. However, make sure that the manipulation of the object is communicative, and you're not reading into non-communicative movements. If a child is moving when they are talking, it doesn't necessarily make the response multi-modal. Pay attention to the communicative intent they are projecting to the mother.

- Talking “as a toy” (i.e. speaking as if you were a doll while holding it up) is coded as a multimodal response.

Non-Interactive/Non-Responsive Behavior (N) (CHILD)

This code should be used when a child does not respond to a mother’s initiation of communication.

EXAMPLES:

- Ignoring questions, comments, or requests
- Fixating on objects
- Refusing to answer or act
- Not responding

NOTES:

- Don't be afraid to mark when the child is being non-interactive/non-responsive. Remember that typical children often ignore parents and would also show a number of non-interactive behaviors as well. Don't be worried that giving the child a non-interactive will count against the child--we are looking at the child's entire communicative profile and the proportion of these behaviors to other behaviors.
- Purposeful verbal, gestural, or multimodal rejection of an activity or request should be coded as a response to communication. This can include throwing, blocking, purposeful walking away, or verbal rejection.

- If the child interacts with the camera equipment or camera person instead of with the mother after a mother initiates communication, code this behavior as non-interactive/non-responsive.

No Wait Time (0W) (CHILD)

This code should be used on a child tier after a mother's initiation where there is not a wait time of at least 3 seconds (Count: one Mississippi, two Mississippi, three Mississippi) during which the mother is giving the child time to respond before they initiate again. Each initiation like this should have a child tier after it - the main line should read 0, and the %gpx tier is $x:0W.

NOTES:

- If there is close to a 3-second wait time but it's ambiguous, give the mother the benefit of the doubt and code the child as N (see below) if there is no response before the mother initiates again.

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