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**Publication Date**

2018

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

Improving Joint Engagement and Commenting Language  
in Minimally Verbal Children with ASD

A thesis submitted in partial satisfaction of the  
requirements for the degree of Master of Arts in Education

by

Alison Holbrook

2018

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## ABSTRACT OF THE THESIS

### Improving Joint Engagement and Commenting Language in Minimally Verbal Children with ASD

by

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Master of Arts in Education

University of California, Los Angeles, 2018

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The purpose of this study was to determine if children with ASD receiving an intervention increased in the amount of time they spent in joint engagement (JE) episodes and used more spontaneous comments inside JE than outside JE. Fifty-seven school-aged children, classified as minimally verbal, participated in a 6-month intervention aimed at improving JE and language. We found significant increases in the mean duration of JE episodes. Comparing language inside and outside episodes of JE, children used more language in the context of JE. Results yielded a significant interaction between JE and time on spontaneous comments, indicating growth during episodes of JE. Results of this study emphasize the importance of targeting commenting and JE for minimally verbal children with ASD.

The thesis of Alison Holbrook is approved.

Alison Bailey

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2018

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Individuals with Autism Spectrum Disorder (ASD) face challenges in acquiring language, using social language, and engaging in social interaction. Despite increased access to early intensive intervention, nearly 30% of school-aged children with ASD remain minimally verbal, meaning they use few or no consistent words (Anderson et al., 2007; Tager-Flusberg & Kasari, 2013). Typically, when defining “minimally verbal,” researchers focus on the number of words produced (Tager-Flusberg & Kasari, 2013). However, there are many language domains (e.g., the use of language for various functions, also known as pragmatics) that may be essential to our complete understanding of how “minimally verbal” is defined. Compared to typically developing children, children with ASD differ in pragmatic development (Tager-Flusberg, 1981). Specifically, they may use language to request, while they struggle to use language to comment or share information (Wetherby & Prutting, 1984). The difficulty that many children with ASD face in using commenting language may be in part due to their challenges of engaging in social interaction. Therefore, a goal for intervention with minimally verbal children with ASD should be working on commenting language and social engagement simultaneously.

### **Using Spoken Language**

The development of spoken language for young children with ASD follows a similar trajectory to that of typically developing children moving from “preverbal communication” to “complex language” (Tager-Flusberg et al., 2009). Tager-Flusberg and colleagues (2009) categorize this trajectory into five different developmental phases: preverbal communication, first words, word combinations, sentences, and complex language. Each phase is defined by important mastery criteria for each language domain (e.g., pragmatics and vocabulary). When defining the benchmarks for the language domain of pragmatics, they emphasize the importance of language use with multiple functions. For example, to obtain mastery of pragmatics in the

“first words” phase of spoken language a child must possess language that serves at least two functions, one of which is commenting. The authors provide benchmarks for each phase of language development to help clinicians and researchers define children’s language abilities; however, they emphasize that the “phases are dynamic and overlapping periods that, in reality, have no clear boundaries” (Tager-Flusberg et al., 2009, p. 647).

Children’s difficulty in commenting is one manifestation of social communication delays, a key component of the ASD diagnosis (American Psychiatric Association, 2013). While commenting language often appears very delayed, impacting the pragmatic language domain, children with ASD may use language for other functions such as labeling and requesting (Tager-Flusberg et al., 2009). Indeed, studies find that children with ASD *request* more frequently and often before they use language for socially motivated comments (Wetherby, 1986; Wetherby & Prutting, 1984), supporting the notion that children may have “mixed phase profiles.” That is, they may be at different developmental phases for each domain, such as the “first words” phase in the pragmatics domain and the “word combinations” phase for vocabulary (Tager-Flusberg et al., 2009). Therefore, it is important to both assess and target multiple language domains during interventions for minimally verbal children with ASD, and especially pragmatics since children with ASD struggle most in pragmatic language use.

Despite the fact that children with ASD face challenges in using language to comment, intervention programs in this field primarily focus on requesting using adult mediated interventions (Kaiser, Hancock, & Nietfeld, 2000; Paul, Campbell, Gilbert, & Tsiouri, 2013) or augmentative and alternative communication (AAC) systems (Bondy & Frost, 2001; Reichle & Sigafos, 1991; Sigafos et al., 2004; Schlosser et al. 2007; van der Meer et al., 2013). One of the most prominent AAC systems examined is the Picture Exchange Communication System

(PECS; Bondy & Frost, 1994). The literature on interventions targeting PECS suggests improvement in requesting using PECS, but little to no improvement in spontaneous initiations of comments (Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Howlin, Gordon, Pasco, Wade, & Charman, 2007; Preston & Carter, 2009). Similarly, other AAC systems (e.g., speech generating devices; SGD) also increase requesting using AAC systems, but show little to no improvement in spoken language (Schlosser & Wendt, 2008; Sigafos et al., 2004; van der Meer & Rispoli, 2010). One intervention exception has been tested in which a SGD was added to a blended behavioral social communication and language intervention in which the goal was to increase engagement and communication (Kasari et al., 2014). This study found that the SGD condition significantly increased spontaneous spoken language and commenting language over the intervention without the SGD for minimally verbal 5 to 8 year old children with ASD.

### **Jointly Engaging Others**

For children with ASD, difficulty in social communication may in part be due to the challenges of engaging in social interaction. Episodes of joint engagement (JE) occur when an adult and child coordinate or share attention around an object or event (Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998). Within states of JE, children may display discrete communicative behaviors such as gesturing, commenting, and requesting/protesting. According to the social-pragmatic theory of language development (Tomasello, 1992; Tomasello, 2000), episodes of JE scaffold children's language acquisition by providing a clear referential context for children during social interactions (Tomasello & Farrar, 1986; Tomasello, 1988). This referential context can help children identify and replicate meaningful language used by the adult (Tomasello & Farrar, 1986; Tomasello, 1988).

Research has shown that children with ASD have greater difficulty establishing and maintaining JE and thus spend less total time in episodes of JE than typically developing children (Adamson, Bakeman, Deckner, & Ronski, 2009). The combined challenges in sustaining periods of JE and communicating to share within these interactions, a core characteristic of ASD, has led to targeted interventions. Research has demonstrated that interventionist, caregiver, and teacher-mediated JE based interventions can increase the time children with ASD spend jointly engaged (Kasari, Paparella, Freeman, & Jahromi 2008; Kasari, Gulsrud, Wong, Kwon, & Locke, 2010; Lawton & Kasari, 2012; Chang, Shire, Shih, Gelfand, & Kasari, 2016). In a randomized controlled trial, Kasari and colleagues (2008) found that children with ASD receiving a JE intervention experienced significant gains in expressive language. Moreover, children with the lowest language levels (i.e., fewer than 5 spontaneously initiated words) had the most improved language if they received the intervention focused on JE and joint attention compared to a symbolic play intervention only or control group. Additionally, there is evidence that targeting JE results in significant improvements in engagement for minimally verbal and intellectually disabled children with ASD (Goods, Ishijima, Chang, & Kasari, 2012). These improvements in JE were observed in a context outside of intervention, suggesting generalization of this target skill. Generalization is especially significant because minimally verbal children often struggle to generalize skills learned during intervention to other contexts (Harris, 1975).

Targeting JE within the natural context of play may be one promising avenue for improving engagement and language in minimally verbal children with ASD. Research on language development by Ratner and Bruner (1978) demonstrates that play routines help children and adults engage in JE, which promotes language acquisition. Routines provide limited

repeated language, predictable structure, reversible roles for speaker and listener, opportunities to use language to discuss variation in play, and may minimize child frustration due to the playful nature of such routines. Therefore, JE built around play routines can encourage language use for a variety of different pragmatic functions because it provides a context in which topic maintenance can be achieved. The established relationship between JE and language outcomes for children with ASD makes this an important topic to investigate further.

### **Current Study**

This study is a secondary data analysis in which both treatments in a sequential multiple assignment randomized trial (SMART; Murphy, 2005) were the same base intervention focused on increasing JE and communication. In order to investigate the relationship between JE and language use of minimally verbal children with ASD over the course of intervention we examined the following questions: (a) did children increase in the amount of time they spent in JE episodes (i.e., total duration of episodes and average episode duration) with a therapist during intervention sessions targeting JE; (b) did language (i.e., spontaneous comments, spontaneous requests, and total communicative utterances) occur more inside JE than outside JE, did it increase over time, and did it increase more so during JE episodes than outside JE episodes; and (c) was improvement in spontaneous commenting during JE measured within intervention positively associated with changes in commenting measured outside of the intervention context?

We hypothesized that there would be no significant differences in amount of time spent in JE episodes between intervention groups, and that both groups would have JE increases over time as both groups received treatment that directly targeted JE. We also hypothesized that minimally verbal children would use more language inside episodes of JE and demonstrate greater growth in language inside episodes of JE than outside episodes of JE over the course of

intervention, consistent with the social-pragmatic theory of language development. We anticipated a positive association between the increases in spontaneous comments during JE measured within intervention and increases in comments in another context (i.e., in a language assessment with blinded assessor).

## **Methods**

### **Participant and Family Characteristics**

Participants were selected from the multi-site study, Characterizing Cognition in Nonverbal Individuals with ASD (CCNIA) (Kasari et al., 2014). Sixty-one children met the inclusion criteria and were randomized in the initial study. Of those children, four were missing entry intervention session videos and were excluded from the current study. Therefore, 57 children were included in the analyses in this study.

Children were between the chronological ages of 5 and 8 years old ( $M = 6.36$ ,  $SD = 1.17$ ) at entry and had a clinical diagnosis of an ASD, confirmed by trained research staff using the Autism Diagnostic Observational Schedule (ADOS) Module 1 (Lord, Rutter, DiLavore, & Risi, 2002). The majority of children were male ( $n = 48$ ) from a mix of racial and ethnic backgrounds comprised of White ( $n = 27$ ), African American ( $n = 12$ ), Asian American ( $n = 11$ ), Hispanic ( $n = 3$ ), other/mixed ethnicity ( $n = 3$ ), and non-specified ( $n = 1$ ). The children used an average of 17.09 ( $SD = 14.52$ ) different words during the baseline natural language sample (NLS; Kaiser & Roberts 2011). Nonverbal cognitive scores averaged 4.07 years ( $SD = 1.09$ ) with an average Brief-IQ standard score of 68.68 ( $SD = 19.24$ ). Children participated at three sites (a) University of California, Los Angeles ( $n = 22$ ); (b) Vanderbilt University ( $n = 19$ ); and (c) Kennedy Krieger Institute ( $n = 16$ ). The mothers were primarily college educated.

## **Consent Procedures/Inclusion Criteria**

Children were recruited through community school programs and parent and professional referrals. All children who met inclusion criteria for the study had consent from their caregivers to participate.

Inclusionary criteria for the initial randomized controlled trial included that children must (a) use fewer than twenty spontaneous, functional words during the baseline NLS (Kaiser & Roberts, 2011); (b) have received at least two years of prior intervention; and (c) have obtained an age equivalency score of 24 months or greater for non-verbal cognitive ability or receptive language on the Leiter International Performance Scale-Revised (Leiter-R; Roid & Miller, 1997), Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4: Dunn & Dunn, 2007), or Test of Early Language Development Third Edition (TELD-3; Hresko, Reid, & Hammill, 1999). All types of intervention were included under the requirement that children had at least two years of prior intervention. The reason for this requirement was that children who have not been exposed to early interventions may be different from those who have. Most children begin to receive early interventions at age 3; the study included children 5 to 8, therefore a minimum of two years of intervention was expected. Children with other genetic disorders, sensory disabilities, motor disabilities, seizures, or that had proficient use of a speech generating device (SGD) were excluded from the study.

## **Measures**

Assessors for the following assessments were graduate students and research assistants, supervised by licensed speech and language therapists and psychologists. The assessments were administered in university clinics within a two week window prior to the start of intervention. All assessors were unfamiliar to the children and blinded to child treatment assignment.



**Natural Language Sample (NLS; Kaiser & Roberts, 2011).** This assessment is a videotaped twenty-minute play-based clinician-child interaction using a standardized set of toys. The assessors were unfamiliar to the children and blinded to treatment condition and time. The data were later transcribed using Systematic Analysis of Language Transcripts (SALT; Miller & Iglesias, 2008) conventions and then coded to evaluate spontaneous spoken language skills. At baseline, this assessment was used to derive a measure of language diversity, defined as total spontaneous number of different word roots (SNDW). This assessment was also used to obtain the number of spontaneous comments used during baseline and exit assessments.

**Leiter International Performance Scale-Revised (Leiter-R; Roid & Miller, 1997).** The Leiter-R assesses the nonverbal cognitive abilities for individuals 2 to 20 years old. The assessment does not require verbal instructions or responses, making it a recommended intelligence test for children with ASD (Kasari et al., 2013). Materials are presented on an easel and children respond by placing cards or foam shapes in the appropriate places. The Leiter-R consists of two batteries (i.e., Visualization and Reasoning and Attention and Memory). Four of the ten subtests from the Visualization and Reasoning battery were used to estimate a Brief Intelligence Quotient standard score (BIQ) at baseline. The subtests include the following: Figure Ground, Form Completion, Sequential Order, and Repeated Patterns. The subtests used to derive the BIQ have high internal consistency reliability (Roid, Pomplun, & Martin, 2009).

**Demographic questionnaire.** Caregivers completed a demographic questionnaire providing information about the child and family. Information was collected regarding race/ethnicity, mother's education, child's previous intervention, and current services.

## **Procedures**

**Intervention Design.** The design of the original study was a SMART (Murphy, 2005) design in which children were initially randomized to one of two conditions. Then, at a pre-defined time point, children were re-randomized to maintain the same intervention or change based on their response to initial treatment. All conditions included a naturalistic developmental behavioral intervention, as the base treatment. At both early and later randomization a SGD may have been added. Given the children were school-aged and already had at least two years of early intervention without gaining proficiency in spoken language, a no-treatment condition was not considered. SMART designs involve multiple randomizations, and are conducted to understand the best sequence of intervention for particular children. The underlying premise is that a single intervention will not meet all children's needs; thus they may respond better to a sequence of effective interventions. The original study consisted of two phases. During Phase 1 the children received two sessions per week and during Phase 2 they may have received two to three sessions, with or without a SGD and depending on their response to initial treatment.

**Observational procedure.** The intervention sessions took place at university clinics and were video-recorded. The primary dependent variables and within-subject factors were coded from the therapist-child interactions during the first and last sessions of intervention. The number of sessions included in the analyses ranged from 32 to 60 sessions due to the SMART design; however, 80% of children's exit sessions were either session number 47 or 48. Number of sessions was not significantly related to change in any outcome variables.

Interventionists were trained in a novel intervention (JASP+EMT) (Kasari et al., 2014) that blended elements from Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER) (Kasari et al., 2008; Kasari et al., 2010) and Enhanced Milieu Teaching (EMT)

(Kaiser & Goetz, 1993; Kaiser et al., 2000). JASPER is a developmentally based approach that targets social communication. Responsive interventionists aim to teach JE and play by creating reciprocal interactions around developmentally appropriate play routines. These play routines around toys and activities have a clear sequence of events and active roles for both child and adult. Once routines are established, interventionists encourage play expansions by adding new steps to the routine. EMT is a naturalistic intervention that targets spoken language acquisition through language modeling, expanding, and behavioral prompts. See Table 1 for intervention components.

Children were either randomly assigned to receive JASP+EMT ( $n=28$ ) or JASP+EMT+SGD ( $n=29$ ). Despite the intervention taking place in university clinics, the intervention is considered a naturalistic developmental behavioral intervention since sessions were delivered in a play context with child preferred materials (Schreibman et al., 2015). Participants were assigned therapists (speech clinician, special educator, or child psychologist) who were trained to criterion of 80% over three cases and then supervised, and checked for fidelity over the course of the study. Twenty percent of the sessions were rated for fidelity of treatment implementation, which averaged 94% ( $SD=5\%$ ) for JASP+EMT and 93.69% ( $SD=4\%$ ) for JASP+EMT+SGD.

**Coding procedures for intervention transcripts.** Therapist-child interactions were transcribed using SALT conventions. A 10-minute section (typically minutes 2-12) were transcribed from the first and last sessions of intervention for each participant. Coders verified the transcripts and coded each child utterance on two levels (a) function of utterance: comment, request/protest, other; and (b) spontaneity of vocalization: spontaneous or non-spontaneous. The communicative function was coded using two categories (i.e., comments and requests/protests).

The current study defined a *comment* (i.e., language used for joint attention) as a complete or partially intelligible communicative statement produced by the child for the purpose of sharing information about, calling attention to, or describing an object they have in their possession or an action they are doing. A comment does not elicit a specific desired outcome from the communication partner. A *request/protest* (i.e., language used for behavior regulation) was defined as a complete or partially intelligible communicative statement produced by the child for the purpose of obtaining an object, requesting completion of an action, requiring assistance with an object or action, refusing an object, or stopping an action. Requests/protests elicit a specific desired outcome from the communication partner. Utterances that are not clearly comments or requests were coded as *other*.

Child verbalizations were either coded as spontaneous or non-spontaneous. *Spontaneous utterances* are of particular interest for this study. These were defined as any utterances the child makes that are not prompted by the adult, or directly imitated from the adult's previous statements. Spontaneous utterances do include child responses to strategies used by interventionists to arrange the environment to promote language. Spontaneous utterances can be coded when there is not an adult utterance immediately preceding the child's utterance (i.e., within three seconds), or the child uses an utterance that is different from the adult's previous statement (e.g., the adult says, "block" and then the child says, "stack blocks"). Non-spontaneous utterances include verbalizations that were either complete imitation of adult utterances (e.g., the adult says, "want car" and the child imitates, "want car") or prompted by an adult (e.g., the adult prompts, "say shape" and the child responds, "shape").

*Total communicative utterances* includes all comments and requests that are spoken or produced using a SGD. This variable includes all levels of spontaneity, but excludes scripted and

repetitive language. This means that spontaneous, imitated, and prompted language used for commenting and requesting are included in this variable.

Prelinguistic communication acts are not included in the analyses. Only spoken utterances or utterances using a SGD were coded and analyzed. Language outcomes consisted of spontaneous comments, spontaneous requests, and total communicative utterances. Inter-coder reliability using intra-class correlation coefficient (ICC) was 0.90 for spontaneous comments, 0.89 for spontaneous requests, and 0.96 for total communicative utterances.

**Coding procedures for joint engagement.** Each ten-minute section from the first and last sessions of intervention were watched separately to code for JE. A time sample coding system was used, in which the start time and end time of JE episodes were identified. Start times of episodes of JE were identified when a therapist and child coordinated or shared attention around an object or activity. JE requires both partners to be actively engaged (i.e., in a state of supported JE or coordinated JE; Adamson, et al., 2009). Examples include the following: the therapist and child build a tower out of blocks together; the therapist and child sing “Itsy Bitsy Spider” while playing with toy spiders; and the therapist and child take turns putting dolls in a toy bus. Children are considered outside episodes of JE if they are observed in the following engagement states: the child is not attending to a person, object, or activity (i.e., unengaged); the child is watching the adult play (i.e., onlooking); the child is interacting with the adult without toys (i.e., person engaged); or the child is playing with an object alone (i.e., object engaged; Bakeman & Adamson, 1984; Adamson, et al., 2009).

For the purpose of this study, there are two possible ways an episode of JE ended (a) when the activity or object of focus changed for either or both participants; or (b) the child or adult disengaged from the activity. Brief moments of child or adult disengagement did not end an

episode if the disengaged participant returned to the same activity or object of focus. Episodes of JE were only included if they were a minimum of ten seconds in duration. The two engagement states are mutually exclusive; therefore, throughout the ten-minute section, the child was identified as either jointly engaged (i.e., inside an episode of JE) or not jointly engaged (i.e., outside an episode of JE). From this coding scheme, total duration of JE episodes and average JE episode duration for each child were obtained. Twenty percent of the videos were selected at random across all participants and time points to be coded for inter-coder reliability. The ICC for total duration of JE episodes was 0.85. The ICC for average JE episode duration was 0.71.

**Coding procedures for language and joint engagement.** For this study, child language measures inside and outside episodes of JE are of primary interest. First, the pre-identified start and stop times from the engagement coding were used, and then times were inserted into the correct locations in the session transcripts during a third viewing of the child-therapist interaction. Each transcript was divided into two transcripts, one that included utterances that occurred inside the start and stop JE times and one that contained utterances that were outside the JE times. This combined coding resulted in the following child language measures for the two engagement states (a) spontaneous comments; (b) spontaneous requests; and (c) total communicative utterances.

### **Analytic Approach**

Analyses were performed using SPSS (Version 22). Descriptive statistics were evaluated for JE (i.e., total duration and average episode duration), spontaneous comments, spontaneous requests, and total communicative utterances by time (i.e., entry and exit) to check for the assumptions of normality, homogeneity of variance, linearity, and multicollinearity. As part of the original study, one group received intervention that included a SGD. Since only one group

had the device, we ran descriptive statistics to determine how frequently the children used it to communicate and determine if utterances with the device should be examined separately from spoken language.

First, we evaluated whether there was significant change in JE (i.e, total duration of JE and average JE episode duration) over the course of intervention using paired samples t-tests. We reported the effect sizes (*ES*) by using Cohen's *d* in the results section, where *ES* of 0.20, 0.5, and 0.80 are generally regarded as small, moderate, and large, respectively. Two one-way ANOVA models were used to evaluate if change scores of total duration of JE differed by the following: (a) treatment condition; or (b) site. Two additional one-way ANOVA models were used to examine if change scores of average JE episode duration differed by the following: (a) treatment condition; or (b) site.

Spontaneous comments, spontaneous requests, and total communicative utterances were measured using count (i.e., number of occurrences). To evaluate if spontaneous comments, spontaneous requests, and total communicative utterances occur more inside JE than outside JE, if it increases over time, and if it increases more so during JE episodes than outside JE episodes, generalized estimating equations (GEEs) were used assuming a negative binomial distribution with an unstructured correlation matrix and a log link function. Due to anticipated correlations between longitudinal time points and nonnormality, we used GEEs because they allow adjusting for correlations between observations (Zeger & Liang, 1986) and allow non-Gaussian distributions. Three models were fit, one for each of the following: (a) spontaneous comments; (b) spontaneous requests; and (c) total communicative utterances. Final model predictors include included time (entry versus exit), engagement (inside JE versus outside JE), SNDW, BIQ, age, and total duration of JE episodes. University site, treatment group, time x engagement x site, and

time x engagement x treatment were not significant predictors and were excluded from the final models. For these three models we reported the *ES* by using Cohen's *d* in the results section.

Since the time x engagement x treatment interaction was not significant, data were collapsed across the two treatment groups. Therefore, the current study results are essentially pre-post intervention with all children receiving the same base intervention. Since this was a longitudinal study, spontaneous comments, spontaneous requests, and total communicative utterances were measured at two time points (i.e., entry and exit). Within each time point, each outcome was also measured inside JE and outside JE. Hence, two levels of within subject factors were included in the analyses: (a) time; and (b) engagement.

We are interested to see if children's growth in the use of spontaneous comments during intervention sessions is related to changes of spontaneous comments in another context (i.e., with an unfamiliar adult during an assessment with unfamiliar toys). Multiple linear regression analysis was used to evaluate change in spontaneous comments from pre to post NLS. Predictors included change in spontaneous comments inside JE episodes during intervention sessions, SNDW, BIQ, and change in the total duration of JE episodes. Group and site were excluded because they were not significant predictors. For the regression analysis, we reported the *ES* by using  $\eta_p^2$  in the results section.

## **Results**

### **Preliminary Analyses**

We explored the SGD use in the JASP+EMT+SGD group. At entry we found that 18.21% (*SD* = 25.6%) of verbal utterances were output from the SGD alone, 4.18%



( $SD = 7.62\%$ ) were SGD and spoken language, and 77.61% ( $SD = 28.01\%$ ) were spoken language only. At exit we found that 13.91% ( $SD = 26.76\%$ ) of verbal utterances were output from the SGD alone, 3.4% ( $SD = 11.43\%$ ) were SGD and spoken language, and 82.69% ( $SD = 29.87\%$ ) were spoken language only. On average the SGD use was less than 22.39 % of total utterances during the first session and 17.31% during the last session.

### **Joint Engagement**

At entry the mean duration of JE episode was 148.44 ( $SD = 137.93$ ) and at exit was 233.30 ( $SD = 209.35$ ). We found significant improvements in the mean duration of JE episode,  $t(47) = 2.40, p = .020, ES = .35$ . The mean total duration of JE at entry was 343.38 seconds ( $SD = 163.96$ ) and 399.31 seconds ( $SD = 177.66$ ) at exit. We found that there was no significant change in total duration of JE over the course of the intervention,  $t(47) = 1.68, p = .099, ES = .24$ . As expected, we did not find any differences in mean duration of JE episode by treatment,  $F(1,46) = 1.53, p = .222$ , or site,  $F(2,45) = .31, p = 0.736$ . Additionally, we found that the change in total duration of JE did not differ by treatment,  $F(1,46) = 3.31, p = .075$ , or site,  $F(2,45) = .223, p = .801$ .

### **Language Inside and Outside Joint Engagement**

In terms of spontaneous comments, a significant main effect of JE was found for both time points,  $\chi^2(1) = 30.61, p < .001, ES = .73$ , indicating that children used significantly more spontaneous comments while jointly engaged with their therapist (i.e., inside episodes of JE) than while they were not jointly engaged (i.e., outside episodes of JE; Figure 1). Additionally, a significant interaction of time and JE was obtained,  $\chi^2(1) = 6.44, p = .011, ES = .34$ . This result indicates that spontaneous comments increased significantly more inside episodes of JE than

outside episodes of JE over the course of treatment (Figure 1). Table 2 contains effects for all variables in the final model.

Significant main effects for engagement,  $\chi^2(1) = 13.31, p < .001, ES = .48$ , and time,  $\chi^2(1) = 9.39, p = .002, ES = .41$ , were found for spontaneous requests. The significant main effect for engagement indicates that at both entry and exit children were using more spontaneous requests inside JE episodes than they were using outside JE episodes (Figure 2). The main effect for time suggests that all spontaneous requests, those occurring both inside and outside JE episodes, were increasing over the course of intervention (Figure 2). Table 3 contains effects for all variables in the final model.

For total communicative utterances we found a significant main effect for engagement,  $\chi^2(1) = 46.42, p < .001, ES = .90$ , indicating that at both entry and exit children used significantly more total communicative utterances inside JE episodes than they used outside JE episodes (Figure 3). A significant main effect for time was also found,  $\chi^2(1) = 13.07, p < .001, ES = .48$ , which indicates that total communicative utterances, those occurring both inside and outside JE episodes, were increasing from entry to exit (Figure 3). Table 4 contains effects for all variables in the final model.

### **Changes in Commenting and Language Assessment**

Change in spontaneous comments inside JE during intervention sessions, SNDW, BIQ, and change in the duration of JE episodes significantly predicted 32% of the variability in change in spontaneous comments during the NLS,  $F(4,41) = 4.81, p = .003$ . Children's change in spontaneous comments during the NLS was related to their change in spontaneous comments inside JE during intervention sessions ( $\beta = 1.04, p = .001, ES [\eta_p^2] = .22$ ). Table 5 contains regression coefficients for all variables in the final model.

## **Discussion**

This is a secondary data analysis of a published SMART design in which both interventions focused on JE and commenting language. Since there were no treatment arm differences, the two initial randomized groups were collapsed; therefore, the reported data are pre-post intervention over a 6-month period. This study had three primary findings: (a) mean duration of JE episodes increased over time, while total duration of JE remained stable; (b) language (i.e., spontaneous comments, spontaneous requests, and total communicative utterances) was used more inside episodes of JE than outside episodes of JE, language (i.e., spontaneous comments, spontaneous requests, and total communicative utterances) use increased over time, and spontaneous comments increased more within JE episodes than outside JE episodes; and (c) there was a positive association between the increases in spontaneous comments during JE measured within intervention and increases in comments during a language assessment.

### **Increases in Joint Engagement**

Over the course of intervention targeting JE, the mean duration of JE episodes increased while the total duration of JE remained stable. Increases in JE episode length are consistent with research indicating that mean duration of JE episodes become longer with age (Bakeman & Adamson, 1984). Longer episodes of JE allow for adults to model important language (e.g., commenting) and provide opportunities for children to use more language in a social interaction. Typically developing children are likely to make gains in JE episode length over time (Bakeman & Adamson, 1984), but because children with ASD show deficits in JE (Adamson et al., 2009), it is unlikely that they will naturally demonstrate significant gains in JE without support. In this study, all children received an intervention specifically targeting JE. While there was no control

group that would allow for conclusions regarding causality of treatment effects, it is important to note that there are components of the intervention that have been proven to increase JE (Kasari et al., 2008; Goods et al., 2012; Kasari et al., 2010; Lawton & Kasari, 2012; Chang et al., 2016). Namely, therapists during intervention sessions create play routines to establish episodes of JE, where the dyad is able to play with toys in a repeatable manner, with predictable language, that can be expanded to increase the mean duration of engagement. Therefore, significant gains in JE episode length within a modest time period for school-aged minimally verbal children with ASD are clinically important.

### **Using Language Inside Episodes of Joint Engagement**

Children used more spontaneous comments, spontaneous requests, and total communicative utterances while jointly engaged than while not jointly engaged. This is consistent with research on typically developing children that found spoken language more often occurs inside episodes of JE than outside JE (Tomasello & Farrar, 1986). These data are particularly important because children with ASD have difficulty engaging with others and are delayed in their spoken language. This finding suggests that establishing periods of JE during intervention may be important for minimally verbal children with ASD because it may provide children with important opportunities to learn and practice spoken language in social interactions.

Minimally verbal children with ASD in this study were able to increase their use of spontaneous commenting inside episodes of JE more than when outside JE over a relatively brief (6-month) period of intervention. The increase in commenting language is especially impressive as it is used less frequently by children with ASD (Wetherby & Prutting, 1984) and not described as a common treatment target in effective interventions for minimally verbal children (Pickett et

al., 2009). These findings indicate that it is important for language interventions to specifically target JE to ensure that minimally verbal children are given ample opportunity to use and potentially learn commenting language in social interactions. Future studies should examine the role of including JE as an intervention component – specifically, if JE-targeted interventions result in greater spontaneous commenting than interventions not focused on establishing JE. This would help determine the level of contribution of JE to development of commenting language.

While we found that spontaneous requests and total communicative utterances increased over time, we did not find that they increased more inside JE compared to outside JE over the 6-month period. These findings are consistent with literature documenting that minimally verbal children with ASD can show increases in spoken language and in language for requesting during interventions (Pickett et al., 2009) that do not specifically target JE. While any increases in the use of language for minimally verbal children are seen as positive outcomes, increases in requests may not be enough to help these children overcome pragmatic language deficits. As such, interventions focused on JE may be important for helping minimally verbal children with ASD overcome pragmatic language deficits. JE interventions may support increases in language for a variety of pragmatic functions – including, but not limited to, commenting.

### **Commenting During Intervention and Assessment**

From the session data, we found that children were increasing in their use of spontaneous comments while jointly engaged with their interventionist. These increases were positively associated with increases in spontaneous comments during the NLS, in which the child was assessed by a blinded unfamiliar adult in a novel context. This is significant because it suggests flexibility in the use of commenting, a social communication skill difficult for many with ASD. This analysis cannot determine directionality of the relationship; therefore we unable to conclude

that targeting JE during intervention led to the changes in comments observed during assessments. However, it is important to emphasize that the children enrolled were considered minimally verbal and had received years of prior intervention. Thus, significant changes in areas targeted during the intervention sessions (i.e., commenting and JE), which were related to changes in assessments, should encourage researchers and clinicians to further focus on targeting JE and commenting during interventions for minimally verbal children with ASD. Minimally verbal children can learn to use language for commenting and therefore should be given the opportunity during intervention. One of the best ways to facilitate this language skill may be by targeting JE.

### **Limitations and Future Directions**

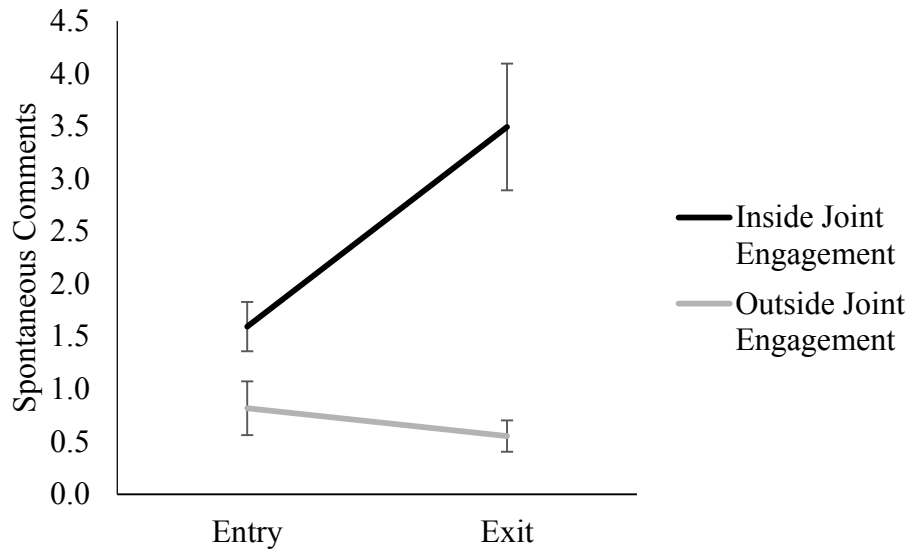
There are some limitations that should be considered when interpreting the results from this study. First, this intervention is described as naturalistic because the sessions were play-based and used child-preferred toys. Sessions in the home or school would have been preferential to clinic-based sessions, and examining the relationship between JE and language in these more natural contexts is an important future direction for our work. Secondly, since both treatment groups received intervention targeting JE, we collapsed groups and did not have data to test if JE mediated the effect of treatment on language outcomes.

The primary goal of this study was to examine if commenting occurred within the context of JE in minimally verbal children with ASD, which appears to be an important yet understudied relationship. While our study found that spontaneous comments, spontaneous requests, and total communicative utterances do in fact occur more frequently during episodes of JE versus outside episodes of JE, we believe there are many directions for future research on this topic. For example, future research could examine if child or adult behaviors (e.g., comments) initiate or

help maintain episodes of JE. Additionally, research could examine JE by coordinated and supported JE states to gain a better understanding of how different types of JE may contribute to the development of commenting language. Most importantly, we believe that future studies should examine two very different types of interventions in order to test the causal effect of targeting JE on increases in JE and spoken language outcomes.

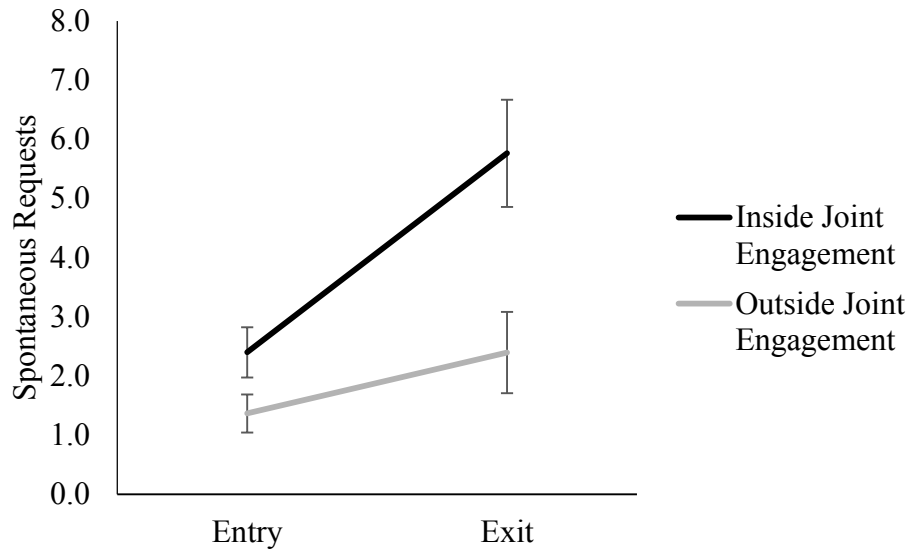
## **Conclusions**

In summary, this study examined the relationship between JE and language (i.e., spontaneous comments, spontaneous requests, and total communicative utterances) in minimally verbal children with ASD. Children used language (i.e., spontaneous comments, spontaneous requests, and total communicative utterances) more when they were jointly engaged with therapist than when they were not. Their spontaneous use of comments increased when inside episodes of JE, not while outside episodes of JE. Children increased in commenting language across contexts, both in sessions as well as during language assessments. These findings suggest that JE may be an important intervention element for the development of language for social purposes and should be targeted during interventions.

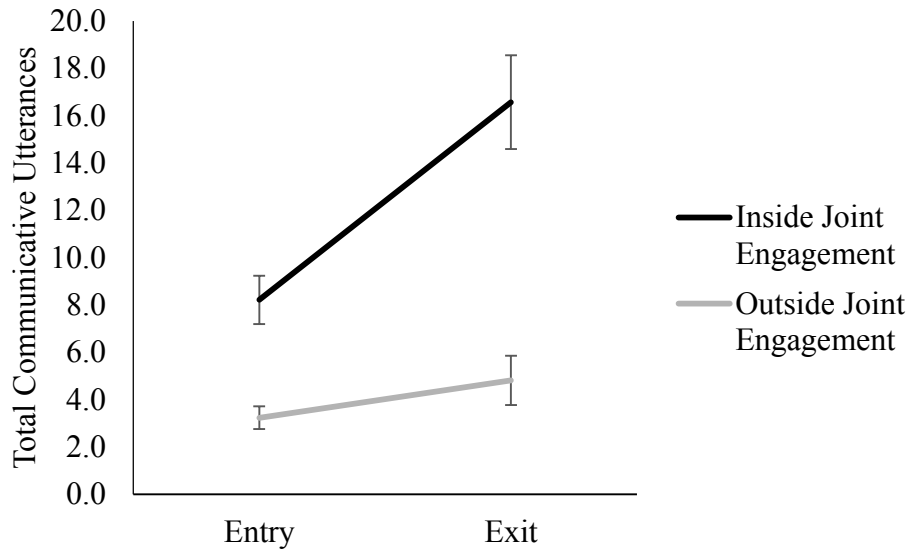


*Figure 1.* Estimated marginal means of spontaneous comments across engagement and time for children who have average nonverbal IQ (Brief IQ = 68.58), vocabulary (spontaneous number of different words = 17.07), and total duration of joint engagement episodes (366.49 seconds). The error bars represent standard error of the mean.





*Figure 2.* Estimated marginal means of spontaneous requests across engagement and time for children who have average nonverbal IQ (Brief IQ = 68.58), vocabulary (spontaneous number of different words = 17.07), and total duration of joint engagement episodes (366.49 seconds). The error bars represent standard error of the mean.



*Figure 3.* Estimated marginal means of total communicative utterances across engagement and time for children who have average nonverbal IQ (Brief IQ = 68.58), vocabulary (spontaneous number of different words = 17.07), and total duration of joint engagement episodes (366.49 seconds). The error bars represent standard error of the mean.

Table 1

*JASP+EMT Intervention Components*

Strategies	Description
Basic strategies	Appropriately matching child's pacing and affect during play; Appropriately applying behavioral strategies when the child is unengaged or dysregulated
Setting up the environment	Setting up the environment to facilitate joint engagement including environmental arrangement, selecting developmentally appropriate toys and placing them within reach and view of the child, and facing the child at eye level
Following child's lead	Following the child's interest during the interaction by imitating and modeling at appropriate times
Establishing play routines	Establishing a clear play routine/sequence of steps that is developmentally appropriate
Expanding play routines	Adding timely and developmentally appropriate steps to existing play routines or following a child's appropriate expansion
Joint attention and requesting skills	Modeling and creating opportunities for requesting and joint attention, & responding to the child's joint attention and requesting bids
Language strategies	Talking at the child's level, leaving space to communicate, responding to the child's communication, and expanding communication
Time delays	Strategies used to elicit child communication (e.g., offering a choice or pausing within a play routine)
Milieu episodes	Prompting language at the child's level in response to child's requests or embedded in play routines
Speech generating device	The device is used in conjunction with adult speech when modeling language or in response to child's communication

*Note.* JASP+EMT= Joint Attention, Symbolic Play, Engagement, and Regulation + Enhanced Milieu Teaching. Adapted from "Preschool Deployment of Evidence-Based Social Communication Intervention: JASPER in the Classroom," by Y.C Chang, S.Y. Shire, W. Shih, C. Gelfand, & C. Kasari, 2016, *Journal of Autism and Developmental Disorders*, 46, p. 2222. Copyright 2016 by the American Psychological Association.

Table 2

*Model Effects for Spontaneous Comments*

Parameter	$\chi^2$	<i>df</i>	<i>p</i>	<i>ES</i>
Intercept	1.78	1	.182	.18
Engagement	30.61	1	<.001	.73
Time	0.78	1	.379	.12
BIQ	3.55	1	.059	.25
SNDW	59.34	1	<.001	1.02
Total JE duration	4.04	1	.044	.27
Engagement x Time	6.44	1	.011	.34

*Note.* ES = effect size; BIQ = Brief Intelligence Quotient; SNDW= spontaneous number of different word roots; JE= joint engagement.

Table 3

*Model Effects for Spontaneous Requests*

Parameter	$\chi^2$	<i>df</i>	<i>p</i>	<i>ES</i>
Intercept	9.81	1	.002	.41
Engagement	13.31	1	<.001	.48
Time	9.39	1	.002	.41
BIQ	2.75	1	.097	.22
SNDW	6.54	1	.011	.34
Total JE duration	0.05	1	.816	.03
Engagement x Time	0.54	1	.464	.10

*Note.* ES= effect size; BIQ = Brief Intelligence Quotient; SNDW= spontaneous number of different word roots; JE= joint engagement.

Table 4

*Model Effects for Total Communicative Utterances*

Parameter	$\chi^2$	<i>df</i>	<i>p</i>	<i>ES</i>
Intercept	30.99	1	<.001	.74
Engagement	46.42	1	<.001	.90
Time	13.07	1	<.001	.48
BIQ	1.41	1	.236	.16
SNDW	40.30	1	<.001	.84
Total JE duration	0.48	1	.489	.09
Engagement x Time	0.90	1	.343	.13

*Note.* ES= effect size; BIQ = Brief Intelligence Quotient; SNDW= spontaneous number of different word roots; JE= joint engagement.

Table 5

*Summary of Regression Analysis for Variables Associated with Changes in Spontaneous Commenting During a Natural Language Sample*

Predictors	<i>B</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Constant	.24	6.34	.038	.970
Change in total JE duration	-.01	.01	-.45	.657
Change in SC inside JE episodes	1.04	.30	3.44	.001
SNDW	.25	.13	1.83	.074
BIQ	-.03	.10	-.27	.792

*Note.* JE = joint engagement; SC = spontaneous comments; SNDW = spontaneous number of different word roots; BIQ = Brief Intelligence Quotient.

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