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The Influence of Social Context on Communication and Restricted and Repetitive Behaviors in Autism

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Abstract

Two of the most salient features of autism spectrum disorder (ASD) are impairments in communication and engagement in restricted and repetitive behaviors (RRBs). The goal of this study was to identify the effects of social context on both the occurrence of RRBs and social language performance in children with ASD. In this study, we defined the social context of a situation based on the primary focus (object or conversation) and the initiator of the interaction (child or experimenter). We performed a frequency count of RRBs as well as a mean length of utterance (MLU) analysis for play tasks with variations in focus and initiator. These measurements indicated that RRBs were lower in object-focused and child-initiated tasks; however, these situations also revealed a lower MLU. MLUs were higher for child-initiated tasks than experimenter-initiated tasks and for conversation tasks than object-focused tasks. These results imply that the type of tasks that are effective in lowering RRBs may not lend themselves to the further development of interpersonal communication skills. In order to develop more effective therapy options, it is important to understand the purpose of RRBs to find effective ways to reduce them while also increasing communication skills.

The Influence of Social Context on Communication and Restricted and Repetitive Behaviors in Autism

Social interactions are complex, ever-present, and crucial for the development of interpersonal relationships; however, autism spectrum disorder (ASD) can hinder the effectiveness of these interactions in building stronger social bonds. ASD is a neurodevelopmental disorder, and one in sixty-eight children are diagnosed with it (CDC, 2013). ASD is characterized in the DSM-V by the core social deficits of social and communicative deficits and restricted and repetitive behaviors (RRBs) (APA, 2013). Symptoms typically become more prevalent around the age of three due to increased social interaction at this age, which means that differences in communication or stereotyped and stigmatized behaviors affect social relationships from a young age. Social and communicative deficits include verbal behaviors (one-sided conversations or lack of conversational language) and nonverbal behaviors (inappropriate eye contact), and RRBs include repetitive speech patterns or motor movements such as rocking or swaying. Additionally, social context may contribute to the presentation of these symptoms due to variations in environment, stimuli, and ambiguity. When these symptoms manifest themselves across the wide spectrum of social interactions, they impair the ability to create and maintain meaningful interpersonal relationships.

The abstract nature of social interactions can cause difficulties for children with ASD and drastically affect their interpersonal relationships. Social interactions are abstract in terms of their fluidity, contextual rules, language use, and subtle social cues from a conversation partner. Children with ASD experience differences from typically developing children in learning abstract rules, which directly impact social functioning in terms of behavior and situational appropriateness (Jones, Webb, Estes, & Dawson, 2013). Without a thorough understanding of the rules that govern social interactions, it is difficult to perform acceptable behaviors, both verbally and nonverbally. Even when children with ASD show an intact knowledge about social rules, they may not be able to apply them correctly in interpersonal interactions (Jameel, Vyas, & Bellesi, 2015). For example, when asked to describe characters in a scenario with either 'clear-cut' or 'ambiguous' social rules, participants with higher scores on the Autism-Spectrum Quotient were less pro-social and less sympathetic towards the characters. In these contexts that were more ambiguous, the children exhibited less emotion and connection with the characters, which could translate into greater difficulty relating to a conversational partner if the social rules of responding are not explicitly clear. Variations in the social context of the situation combine with deficits in communication and the presence of restricted and repetitive behaviors to affect social interactions for children with ASD.

Restricted and repetitive behaviors (RRBs) include actions such as hand flapping, rocking, swaying, teeth grinding, or spinning (Carpenter et al., 2013; Kirby et al., 2015). RRBs are prominent identifying characteristics of ASD on diagnostic scales and can be used to rate symptom severity in individuals with autism. Children with ASD have been proven to demonstrate more repetitive, restrictive, and stereotyped behaviors than both typically developing (TD) peers as well as those with other developmental disabilities (DD). In a study conducted by Ashburner, Bennett, Rodger, & Ziviani (2013), only 2.2% of typically developing children participated in movements that interfered with their daily routines while 70.5% of those children with ASD used these behaviors. RRBs also appear to be more frequent in children with lower language and non-verbal abilities (Harrop, 2013). Because RRBs interrupt typical patterns of interactions (APA, 2013) and are stigmatized negatively, a high prevalence of these behaviors can be extremely detrimental to the building of relationships through interpersonal interactions.

As well as exhibiting more of these behaviors generally, children with ASD also display patterns in participation in RRBs. Kirby, Little, Schultz, & Baranek (2015) used Sensory Interests, Repetitions, and Seeking behaviors (SIRS) as a measurement, which are virtually synonymous with RRBs. Children with ASD engage in more simultaneous SIRS (multiple behaviors at one time) than TD and DD groups. Additionally, children with ASD participate in more posturing (tensing of the body) and sighting behaviors (visual inspection of different objects) than their peers (Kirby et al., 2015). This distinction between the two groups suggest that children with ASD tend to participate in similar patterns of behavior regarding RRBs. While symptom severity does occur on a spectrum and can vary greatly between individuals (Matson, Dempsey, & Fodstad, 2009), the trend in patterns of RRB participation in children with ASD shows that individuals with a certain diagnosis may be more likely to engage in specific types of behaviors. This commonality in individuals with ASD provides evidence that a common neurodevelopmental pathway may control these behaviors and leads to the disorder-specific behavioral characteristics (Kirby et al., 2015).

Restricted, repetitive, and stereotyped behaviors in ASD can be seen early in a child's life and progress as they age; as a child with ASD matures, these behavioral patterns grow in complexity (Kirby et al., 2015). Interestingly, patterns in RRB production that mirror those of older children can be seen in infants, which suggests that behavioral differences become evident as early as 17 months (Matson et al., 2009). These predictable patterns in the types of RRBs that are produced more frequently (posturing and sighting behaviors) that remain consistent over time and follow similar progressions further support the theory that the behaviors can be determined by common neurodevelopmental pathways in diagnosis groups (Kirby et al., 2015; Matson et al., 2009). The recognition of behaviors that are stereotypical of ASD at a young age could lead to a breakthrough in treatments, as the demonstration of RRBs is one of the most apparent and difficult to treat deficits related to ASD (Matson et al., 2009). Additional research is needed to increase our understanding of behavioral patterns in ASD from a young age and could lead to earlier diagnoses and more positive outcomes for children with ASD.

While there is no definitive cause of RRBs, there is evidence that identifies neural adaptation, level of environmental stimulation, arousal, and adaptive functions as factors in RRB participation (Leekam, Prior, & Uljarevic, 2011). This relationship between internal origin and the processing of present stimuli suggests that the environment is a highly influential factor in the occurrence of RRBs, especially with regard to the social contingencies present that vary based on context and environment. RRBs are maintained by both social and nonsocial reinforcement available to them (Rapp & Vollmer, 2005). Social reinforcement includes positive reinforcement, such as praise or attention, and negative reinforcement, such as escape from a difficult task. Nonsocial reinforcement would include automatic positive reinforcement, or sensory stimulation, and automatic negative reinforcement, or escape from an aversive stimulus. There may be a combination of social and nonsocial reinforcement in RRB presentation (Rapp & Vollmer, 2005), but more research is needed to determine how these specific influences affect RRB frequency in different environments. While some RRBs may function to maintain consistency in the environment, like arranging and ordering, others may function as escape or avoidance behaviors to prevent exposure to a negative stimulus or event (Rodriguez, Thompson, Stocco, & Schlichenmeyer, 2013). Environmental variations may alter RRB frequency or presentation, but there is a gap in research that identifies social contexts or manipulations that promote a reduction in RRBs. Current research suggests that exploring the role of environmental factors in RRB production may be beneficial for the development of effective treatment options.

Language development, in terms of word learning, can be broken down into steps based on the cognitive processes associated with each stage. In typically developing children, the child first encodes the new word phonologically, in terms of the relationships of sounds in the word to existing vocabulary, and semantically, or based on word meaning (Gladfelter, 2014). After the initial encoding, the new word is compared to familiar words that have a similar meaning and connections are formed; the multitude and strength of the connections formed is dependent upon the existing vocabulary of the child (Gladfelter, 2014). Once the new word is introduced initially and understood, it is integrated into memory and organized in relation to the existing vocabulary. Retrieval occurs when there are strong semantic representations of words and neural processes that form stronger connections between a cue and an existing target word. Children with ASD, however, show a distinct deficit in semantic encoding, leading to less success in word retrieval than their typically developing peers (Gladfelter, 2014). This difficulty in recalling words with similar semantic meanings may mean that there are weak associations between words within the memory processes of a child with ASD. The lack of word association ability can be attributed to either of two causes: insufficient initial semantic encoding, or the failure to form connections between established words (Gladfelter, 2014). These delays or deficiencies in development can lead to widespread consequences in the child's language use.

Often, a deficit in word retrieval can hinder both future language development as well as the child's social interactions. If a child does not have strong semantic encoding or connections between words in his or her lexicon, then it becomes increasingly more difficult to establish a strong vocabulary over time (Gladfelter, 2014). Without a strong foundation, the child may experience difficulties further developing more complex vocabularies, encoding those meanings and sounds, and retrieving that information when it is needed for expression. Not only does this deficit hinder the further development of language, it also impacts social interactions (Gladfelter, 2014). Conversations often require a flow of language and turn-taking to facilitate an exchange of information; however, children with ASD may have difficulty retrieving the words needed to express themselves or may not have them at all, and that can be both frustrating and discouraging as well as halt the conversation. These interruptions to the typical flow of a conversation can negatively impact social interactions that are based on expressive language.

Expressive language ability can be measured through the smaller components of grammar, syntax, and morphology. Morphemes are the smallest units of sound in a language with meaning. These are broken up into free morphemes, which stand on their own as recognizable words, and bound morphemes, which include prefixes and suffixes. Mean length of utterance (MLU) is a system designed to measure grammatical understanding in children by counting the amount of morphemes per utterance. According to Brown (1973), there are five stages of morphological development that correspond with age; the number of morphemes used per utterance should increase with age due to corresponding growth in language skills. Using this method, there are fourteen grammatical morphemes in our language and children should produce all of them with 90 percent accuracy by 47 months of age (Brown, 1973). Current research has also used MLU as one of the many criterion for defining expressive language abilities in terms of three developmental phases (Tager-Flusberg et al., 2009). These phases in initial language development are: first words, word combinations, and sentences. MLU can be used as an aid in identifying the child's development in terms of these phases as well as in measuring progress after the child reaches the sentences phase.

In children with autism, language development has been positively related to parental MLU and the use of grammatically correct sentences, more so than for children that are typically developing, thus emphasizing the importance of modeling proper grammar and increased MLU in order to encourage growth in morphology from a young age (Sandbank & Yoder, 2015). Initially, increases in verbal language in children with ASD is developed through the use of single-word requests; with further intervention, these requests can be expanded into multi-word utterances over time (Yosick, Muskat, Bowen, Delfs, & Shillingsburg, 2015). These findings in the modeling of MLU and increase in the ability to verbalize requests suggest that children with ASD have the capacity to greatly improve their morphological understanding and demonstration through treatment, thus improving their foundation for interpersonal communication.

Technical delays in language development combine with difficulty understanding abstract concepts like social cues to affect daily interactions. Children with ASD have more difficulty developing conversational language, thus impacting the understanding and use of social skills. Commonly, children with ASD require assistance in developing conversational language because it is directly related to speech and language capacity, reading of social cues, and interpersonal understanding. Many children with ASD do not provide adequate conversational support for their partners, which can be seen through a lack of engagement, clarifying statements, or gestures directed toward their listeners (Morett, 2015). In order to compensate for a deficit in implicit learning of appropriate conversational language usage, scripts can be used to help these children develop these abilities (Charlop & Erickson, 2013). With proper examples and preparation, children with ASD gradually develop foundations for conversational language use and these skills used in social language evolve over time (Charlop & Erickson, 2013).

Language delays or deficits associated with ASD can also be linked to other factors, such as differences in a child's sensory processing mechanisms. Hyporesponsiveness (the lack of an expected response to stimuli) and sensory seeking behaviors (actions that intensify sensory input) are both inversely related to language development in children with ASD (Watson et al., 2013). Related to this, a child who exhibits hyporesponsive or sensory seeking behaviors is more likely to be nonverbal than typically developing peers (Patten et al., 2013; Watson et al., 2013). Abnormal sensory processing is evident before the development of speech, which suggests that inadequate responses to environmental stimuli prevent the child from understanding social communication information from a young age (Patten et al., 2013). In order to better understand this link between sensory processing of the environment and language development, there is a need for additional research that focuses specifically on this relationship.

Communication and RRBs are two of the core social deficits associated with ASD, and the presentation of symptoms in these areas can be affected by the environment, contingencies, or available stimuli. However, there is a gap in existing research regarding which types of social contexts reduce RRBs while also promoting good interpersonal communication. In this study, we will focus on these central issues. First, we are interested in examining which types of tasks result in lower RRB levels, which we believe will be tasks with higher motor engagement and less of a social focus. Second, we will identify which tasks feature a higher MLU count, which indicates greater reciprocal communication. We predict that more social situations without as much motor engagement will foster more communication and result in a higher MLU. Finally, we will compare these variables to existing measures of RRBs, language ability, and clinical diagnosis. While existing research does acknowledge the role of the environment in the production of RRBs, it does not specifically define the social features of situations that reduce RRBs. Additionally, we hope to provide insight into the relationship between RRBs and language across different social contexts.

Method

Participants

Data used throughout this experiment was part of a larger study in which there were 46 participants. The participants with ASD had previously been diagnosed by a licensed clinical psychologist or medical doctor based on DSM-IV_TR criteria (APA, 2000) and diagnosis was confirmed using the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2, Lord et al., 2012). The sample consisted of 41 children were on the autism spectrum, as determined by their ADOS scores, and 5 classified as non-spectrum; for the purpose of this experiment, all of the participant data was analyzed as one group. All demographic data for the participants is depicted in Table 1. The participants performed either an imitation or synchrony task; 24 children diagnosed on the autism spectrum performed an imitation task, and 22 performed a synchrony task.

Measures

ADOS-2. The ADOS-2 is a semi-structured, standardized assessment of communication, social interaction, and play for individuals referred because of possible autism (ADOS-2, Lord et al., 2012). Diagnosis is determined and scores are organized based upon evaluations of Social Affect (SA), Restricted and Repetitive Behaviors (RRBs), and overall scores. The sessions were videotaped and four of the tasks were analyzed for RRBs and MLUs in this study.

Construction task. The construction task consisted of the child building a puzzle with pieces given to him or her by the examiner. The examiner gave the child a few pieces to start, and the child had to ask for more in order to complete the puzzle. Because the experimenter withheld necessary pieces until the child requested them, the activity was experimenter-initiated. While there was a small social component to the task, it was object-focused because it revolved around the child's completion of the puzzle. This task was the shortest in duration of those that were analyzed, typically lasting approximately two to three minutes.

Conversation and reporting task. The conversation and reporting task occurred every time the participant and examiner conversed about a topic other than the immediate context. This event was designed to allow the examiner to observe the child's ability to participate in a cogent conversation, usually about an event or memory, and gain a clearer understanding of the child's general conversational skills. Due to the nature of the task, it occurred more than once in many of the videos in order to obtain a sufficient sample. To control for this, the counts for RRBs and MLU were combined for multiple conversation and reporting tasks in order to obtain the average calculations. This task was initiated by the experimenter and was an inherently social task due to the lack of objects present during the conversations.

Cartoons. In this task, the examiner put out a series of cards that depicted a story with cartoons. The child then narrated the story in his own words while looking at the pictures and recited it to the camera from memory. This task varied in length and was initiated by the child through the completion of the story, and it was socially-focused—the child told the story to the adult and again to the camera without the aid of any objects but the pictures.

Creating a Story. The participants watched the examiner take five objects from a bag and make up a story using those objects. After watching the examiner, the participants made up their own stories with different objects. This task also varied greatly in length depending on the child's behavior during the task, ranging from three minutes to twenty. The child initiated this task because he determined both the objects and the course of his story, with the only boundary being that he must use five objects that are different from those that the experimenter used.

Additionally, this task was object-focused because the child created the stories around the tangible objects chosen and told it while physically using them.

CELF-4. The Clinical Evaluation of Language Fundamentals-4 (CELF-4) (Semel, Wiig, & Secord, 2003) is a standardized language assessment designed for individuals 5 through 21 years of age. The concepts and following directions subscale (C & FD) and the formulated sentences subscale (FS) were administered.

DAS-II. The Differential Abilities Scales, 2nd Edition (DAS-II) was used as a measure of cognitive ability. The general conceptual ability (GCA) score for this test represents verbal, non-verbal, and spatial reasoning ability, and the age of the child determines eligibility for either the Early Years or School Age form.

RBS-R. The Repetitive Behaviors Scale-Revised (RBS-R) is a self-report questionnaire that consists of 44 items and is used to measure repetitive behaviors in individuals with ASD. Parents rated participant behaviors on a scale from low to high severity of problem behaviors, and there are six subscales: Stereotyped Behavior, Self-injurious Behavior, Compulsive Behavior, Routine Behavior, Sameness Behavior, and Restricted Behavior.

Data Coding and Analysis

The four specified tasks representing different social contexts (independent variables) were analyzed in terms of the dependent variables of restricted and repetitive behaviors (RRBs) and mean length of utterance (MLU). RRBs are defined below and were compiled from Harrop (2013), Lampi (2015), and Kirby (2015). After the frequency coding was complete, a ratio of RRBs per second was calculated. The totals for vocal, motor, vocal and motor, and motor and motor RRBs were added in order to compute a total RRB count for each of the four tasks.

Restricted and repetitive behaviors. RRBs were coded as one of four types: vocal, motor, vocal and motor, or motor and motor. Vocal RRBs were operationally defined by utterance, or completed thought, and included undirected whispering, talking to oneself, meaningless sounds, or humming. Motor RRBs were defined by grouping the actions into bouts of behavior on the same premise as vocal RRBs, and these included behaviors such as: fidgeting; hand flapping; unusual posturing; leaving the seat and getting up to move around; placing objects against or touching the chin, lips, or inside of mouth; whole body movements such as spinning, rocking, or pacing; and fiddling with objects in a way that is not productive or necessary to complete a task. Vocal and motor RRBs were coded when the child engaged in both vocal and motor RRBs simultaneously, such as talking to himself while fiddling with objects unproductively. Motor and motor RRBs occurred when the child engaged in two motor RRBs at once, such as rocking while hand flapping.

Mean length of utterance. MLU is defined as the number of morphemes per utterance, and morphemes are the smallest units of speech with meaning that alter a word. MLU should increase with age as language ability develops. In this study, MLU was used to identify a difference in social language usage among the different tasks: a higher MLU indicates more engagement through verbal communication, while a lower MLU implies that the child exhibited less engagement with the examiner. For each task, the number of morphemes was added together and then divided by the total number of utterances in the sample. When there was more than one conversation and reporting task, the total number of morphemes for each task was computed and then divided by the total number of utterances across all of those occurrences in order to control for the difference in conversation and reporting tasks.

Pre-recorded ADOS videos were used in order to evaluate restricted and repetitive behaviors (RRBs) and mean length of utterance (MLU) across different social contexts. Four tasks were selected to represent social contexts based upon both the initiator and focus of each activity. Social context was determined by variation in the two independent variables: the initiator of the task (experimenter or child) and the focus of the task (object or social). In this formation, there were four combinations of these independent variables, thus creating four different experimental groups.

Inter-Rater Reliability

A second rater was trained to recognize and record restricted and repetitive behaviors and independently coded 20 randomly selected videos (43% of the entire sample). Three training videos were used to establish agreement between the two raters, and then the second rater coded the 20 videos used to establish inter-rater reliability. The rater recorded RRB frequency in terms of motor, verbal, motor and motor, and verbal and motor behaviors; after coding for each individual type of RRB, the second rater then combined these counts in order to calculate a composite RRB frequency total for each task. Inter-rater reliability was excellent for the total RRB frequency count. A Pearson correlation was conducted for RRB frequency for all four tasks and was found to be 0.94 (p <0.001).

Results

Frequency of Restricted and Repetitive Behaviors

A 2X2 analysis of variance was conducted with RRB frequency as the dependent variable and the focus and initiator of the tasks as independent variables with two levels. The two levels for the focus of the task were object-focused or conversation-focused, and the two levels for the initiator were child-initiated or examiner-initiated. This revealed main effects of initiator (*F*

(1,38)= 10.80, p= 0.002, η_p^2= 0.221) and focus (F (1,38)= 17.42, p= <0.001, η_p^2= 0.314). There was also a significant interaction between the initiator and focus of the task (F (1,38)= 24.27, p= <0.001, η_p^2= 0.39), meaning that the effect of the focus condition varied with the initiator condition (Figure 1). RRB frequency decreased when the child initiated the task and when the task was object-focused; however, RRBs were consistently high when the experimenter initiated the task. These findings suggest that the focus of the task did not influence RRBs for experimenter-initiated tasks**.** Conversely, the focus of the task did influence RRBs for child-initiated tasks: child-initiated object-focused tasks had much lower RRBs than child-initiated conversation-focused tasks.

Mean Length of Utterance

Another 2X2 ANOVA was conducted with the initiator and focus of the task as independent variables with two levels and the MLU for each of the four tasks as the dependent variable. This resulted in a main effect of the initiator (F (1,38)= 30.55, p= <0.001, η_p^2= 0.446), shown in Figure 2. The MLU increased when the child initiated the task, which indicates more communication at a higher level with the examiner. A lower MLU count suggests less social language used by the child, and this occurred in tasks that were experimenter-initiated. The main effect of the focus of the interaction was also significant (F (1,38)= 22.62, p= <0.001, η_p^2= 0.373), depicted in Figure 3. MLUs were higher for conversation tasks than object-focused tasks, indicating more communication during conversation tasks. The interaction between the focus and initiator of the task was not significant.

Correlations between RRBs, MLU, and Clinical Measures

The means and standard deviations for each of the clinical measures is displayed in Table 1. Correlations were then calculated between the RRBs, MLU, and clinical measures. A grand total for the frequency of RRBs was calculated by creating a new composite ratio for RRBs per minute across all tasks. As depicted in Table 2, there were significant correlations between RRBs and both CELF-4 subtests (-.36 and -.41), all DAS-II subtests (.41, .43, .43, .42, and .43), and the ADOS SA (.37), ADOS RRB (.46), and ADOS Overall (.47). There were negative correlations between the RRB frequency and CELF-4 scores, suggesting that frequent engagement in RRBs was seen in children with lower language scores on the CELF-4. RRB frequency was positively correlated with the DAS-II and ADOS subtests, meaning that children with more frequent RRB engagement were more likely to have received higher scores on these diagnostic measures. A grand total MLU for each child was then computed by averaging each individual total, and correlations were performed against the clinical measures, depicted in Table 3. There were significant negative correlations between MLU and the ADOS SA score (-.38), the ADOS RRB score (-.30), and the ADOS Overall score (-.42). A lower MLU was associated with higher scores on the ADOS subtests and overall score, thus suggesting that children with a lower level of social language use scored higher on these scales than children with a high MLU count across all four tasks.

Discussion

The goal of this study was to investigate the effects of social context on RRB production and communication in children with ASD. Four different social contexts were tested by varying the task initiator (experimenter or child) and focus of the interaction (object or conversation). The results supported our hypothesis that RRBs would be higher when the tasks were conversation focused and experimenter initiated; however, the focus condition appeared to have a greater influence on the frequency of RRB production. The MLU counts were higher in conversation-focused and child-initiated tasks, further supporting our original hypothesis. Ultimately, RRBs were lower in situations that also had lower MLUs.

Tasks that were initiated by the child and object-focused yielded the lowest levels of RRB occurrence. Rapp and Vollmer (2005) suggested that situations with high motor engagement with objects allow individuals with ASD to engage in other, non-problematic behaviors instead of RRBs, which is consistent with the tasks in our study. The object-focused tasks (the construction task and creating a story) had high motor engagement because they emphasized the manipulation of objects, and they featured lower levels of RRBs. Object manipulation is correlated with a reduction in RRBs because it allows an alternative source of automatic reinforcement for the child (Rapp & Vollmer, 2005). This research provides evidence for the nonsocial self-stimulatory function of RRBs because the sensation received from manipulating the object replaces the sensory reinforcement that the child would have experienced from the RRB production.

Additionally, there are extrinsic reinforcers and social contingencies for RRBs that affect the presentation of these behaviors. RRBs can be positively reinforced with attention, and they can also be negatively reinforced through removal of aversive stimuli. Not only can RRBs be used as escape behaviors, but they also function as avoidance behaviors in order to avoid the unwanted stimuli all together (Cunningham & Schreibman, 2008). Interestingly, in this study, both conversation conditions (child-initiated and experimenter-initiated) as well as experimenter-initiated and object-focused tasks all had high levels of RRB occurrence. Experimenter-initiated tasks are inherently social in nature, as are conversations, thus suggesting that RRB engagement increases in social situations regardless of the focus of the task. Because the initiator condition had more of an impact on RRB occurrence, it implies that RRBs occur more frequently in situations that are based on interpersonal communication. Because the most socially-oriented tasks had the highest levels of RRBs, it indicates that these situations could feature aversive environmental conditions or stimuli for these children, thus inducing RRB presentation.

If the purpose of RRBs is better understood, then better therapy options can be developed in order to decrease the frequency. RRB presentation may stem from both social and nonsocial reinforcement and contingencies, but more research into the purposes of RRBs is needed. With a better understanding of the intrinsic and extrinsic functions of RRBs, it would be possible to develop more effective treatment options with more specific targets. In addition, this study focused on the frequency of RRBs rather than the severity. The behaviors present in the analyzed videos were also less severe than behaviors such as self-injurious behaviors. Self-injurious behaviors are potentially reinforced through sensory consequences, or automatic reinforcement, but there are also extrinsic reinforcers that could contribute to their presence across several different contexts (Ahearn, Clark, & Gardenier, 2003). These behaviors may also serve different purposes than less severe RRBs, such as arranging and ordering, which emphasizes the importance of investigating the underlying functions of RRBs across the entire spectrum of behaviors.

While situations that are object-focused and child-initiated may reduce the number of RRBs present, they also lower the MLU. More socially focused tasks (experimenter initiated or child initiated conversations) appear to increase MLU, especially when initiated by the child. When the tasks were focused on objects and initiated by the child, such as in the construction task, the MLU decreases due to the lack of social language usage. A low MLU indicates lower levels of reciprocal communication between the child and experimenter, which translates to less social engagement by the child. Many children with ASD have difficulty providing adequate conversational support for their partners (Morett, 2015), and this was most prominent in the object focused tasks in our study. The low MLU in object-focused tasks could be due, in part, to the tendency of children with ASD to pay more attention to non-social stimuli: when the focus was on constructing a puzzle or using physical objects to create a story, those objects took precedence and the aspects of social interaction were neglected. Research into the social processing patterns associated with ASD has shown that these children are more easily distracted by non-social stimuli than those that are social in nature (Chevallier, 2012), which could have contributed to the lack of social engagement when other stimuli was available. In these instances, the child focused on the objects and did not successfully engage the other person in his or her play; instead of utilizing the task to involve the other person and create greater social bond, the focus was simply on the tangible objects.

Current interventions regarding language acquisition and use in children with autism recommend using shortened speech patterns; however, this may in fact be detrimental for these children (Sandbank & Yoder, 2016). Caregivers of typically developing children use both the child's language output as well as social responses as cues for how to adapt their own language. Because children with autism tend to exhibit less social responsiveness, such as a lack of eye contact, it may contribute to a decrease in parental MLU when addressing them. With decreased exposure to more complex language, children with ASD may develop their own language at a slower rate as a result. Sandbank & Yoder (2016) speculate that there is a limit to caregiver and clinician speech, especially regarding extremely lengthy utterances that may exceed the child's input level, but they should be encouraged to speak in grammatically correct and complete sentences. If this concept is put into practice, then it could prove beneficial in the further development of language abilities in children with ASD. This speculation may add another dimension to our research because the expressive language used by the examiner could have impacted the MLU of the child. The MLU of the children in object-focused tasks was low, which indicates less reciprocal communication; however, these situations also involved more object manipulation. Increased motor engagement could cause a decrease in social responsiveness from the child, thus perpetuating the cycle and lowering the MLU of the examiner. Because exposure to less advanced language could negatively impact the child's own output (Sandbank & Yoder, 2016), it is important to regulate a constant output level of the experimenter so that it does not influence the child's verbal tendencies. This study focused on the difference in MLU between social contexts in which RRBs also varied, but future research should control for this variable or consider this factor in the analysis of MLU in children with ASD. Additionally, future treatment options should emphasize ideal modeling of language by caregivers and clinicians across all contexts in order to maximize expressive language abilities in children with ASD.

While this study does provide insight into the relationship between RRB engagement and interpersonal communication in terms of variations in social context, additional research is needed to confirm these findings. A potential shortcoming of the study is that select tasks did not contain enough utterances to calculate a completely reliable MLU. Conversation and reporting tasks that were short were supplemented in the videos with additional repetitions of the task, and therefore an average MLU could be calculated using the sum of morphemes per utterance in each of the task repetitions; however, the construction task did not occur more than once and was the shortest of all the tasks in duration. Because this task was the shortest and it was object focused—which already presented lower MLU counts—there were no instances in which the children reached 50-100 utterances. MLU can be calculated with less than 50 utterances, but the reliability of MLU as a valid representation of the child's true expressive language use decreases when there are a low number of utterances (Brown, 1973). Due to the brevity of this task, lower MLU counts in object focused tasks may have been partially attributed to a deficit in adequate language samples. Future research should be performed in order to confirm the drastic difference in MLU between the focus and initiator conditions in different social contexts.

Our results offer another perspective for future research and the development of new therapy options with considerations of social context, RRBs, and MLU. The underlying purpose of RRBs should be further investigated to better identify the role of social and nonsocial contingencies in RRB production as well as expressive language patterns across different environments. When children are taught and encouraged to use functional language to communicate (such as, "Help me!"), the amount of RRBs decreases with this alternate way of expression, especially when performing difficult tasks (Cunningham & Shreibman, 2008). Functional language can act as another outlet to express emotions such as frustration, thus expressing the emotion more explicitly to another individual. This tendency provides evidence that fostering verbal communication may serve to decrease problem behaviors while also increasing the quality of interpersonal relationships for children with ASD. Additionally, behavioral interventions can be utilized to encourage multiword utterances, especially in the form of requests. When that happens, more meaningful interactions can occur (Yosick, Muskat, Bowen, Delfs, & Shillingsburg, 2015). Increasing the length of utterances can greatly improve children's functional communication skills and promote alternatives to RRBs while also improving social interactions.

The findings in this study imply that while situations that are object-focused and child-initiated may reduce the number of RRBs present, more socially focused tasks (experimenter initiated or child initiated conversations) may increase MLU. Thus, the type of tasks that are effective in lowering RRBs may not lend themselves to the further development of interpersonal communication skills. Our findings suggest that paying attention to the social context is important to find effective ways to reduce RRBs while also increasing communication skills. In order to develop more beneficial therapy options, it is important to understand the purpose of RRBs and find effective ways to reduce them while also increasing communication skills. Social deficits in ASD affect various areas of interaction, and so treatments must target both verbal and nonverbal behaviors in order to promote successful interpersonal experiences. There is a need for future research into the underlying purpose of RRB engagement in order to provide more accessible treatments that target both motor and language skills, not only on an individual level but also in a way that also fosters the development of interpersonal relationships.

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Table 1

Participant Demographics

		Mean	SD
CA (years)		8	1.49
CA (months)		101.8	17.75
Gender			
	Male	41	
	Female	7	
Ethnicity			
	White	39	
	African American	4	
	Asian	1	
	Multiracial	2	
ADOS			
	SA	9	4.1
	RRB	2.71	1.82
	Overall	11.71	5.03
	Composite	6.6	2.25
CELF			
	FD	7.68	3.71
	FS	8.35	4.27
DAS			
	Verbal	114.63	134.22
	Nonverbal	119.98	133.61
	Spatial	116.85	133.98
	GCA	133.89	133.9
	SNC	118.52	133.73
RBSR		30.1	22.62

Table 2

Correlations between RRB frequency and Clinical Measures

	Total RRBs	
	r	*p*
CELF FD	-.36*	.02
CELF FS	-.41**	.01
DAS Verbal	.41**	.01
DAS Nonverbal	.43**	<.05
DAS Spatial	.43**	<.05
DAS GCA	.42**	<.05
DAS SNC	.43**	<.05
ADOS SA	.37*	.01
ADOS RRB	.46**	<.01
ADOS Overall	.47**	<.01
ADOS Composite	.28	.06
RBSR Total	.06	.71

* Indicates significance at 0.05
** Indicates significance at 0.001

Table 3

Correlations between MLU and Clinical Measures

	Total MLU	
	r	*p*
CELF FD	.18	.25
CELF FS	.31	.05
DAS Verbal	-.17	.25
DAS Nonverbal	-.19	.21
DAS Spatial	-.20	.17
DAS GCA	-.19	.22
DAS SNC	-.20	.19
ADOS SA	-.38*	.01
ADOS RRB	-.30*	.05
ADOS Overall	-.42**	<.01
ADOS Composite	-.27	.07
RBSR Total	-.06	.70

* Indicates significance at 0.05
** Indicates significance at 0.001

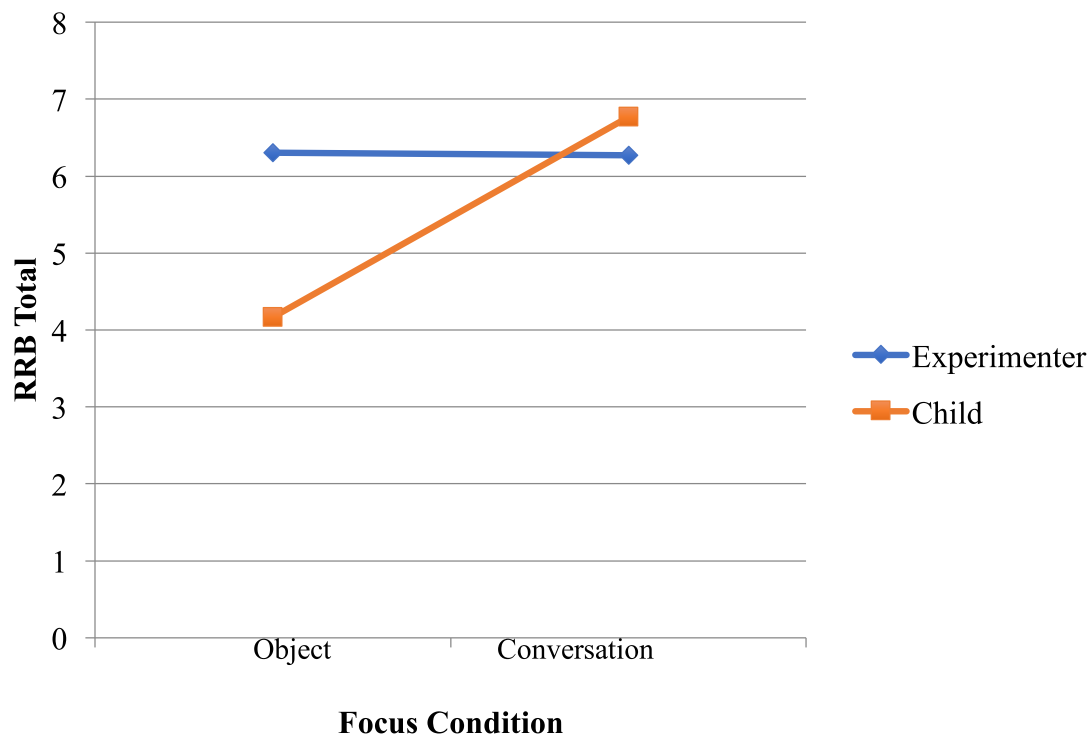

Figure 1. This line chart depicts the interaction between the two independent variables of task focus and initiator of the task. RRB levels are high in both conversation tasks and across both focus conditions for experimenter-initiated tasks. RRB levels were low in object-focused tasks when they were child-initiated.

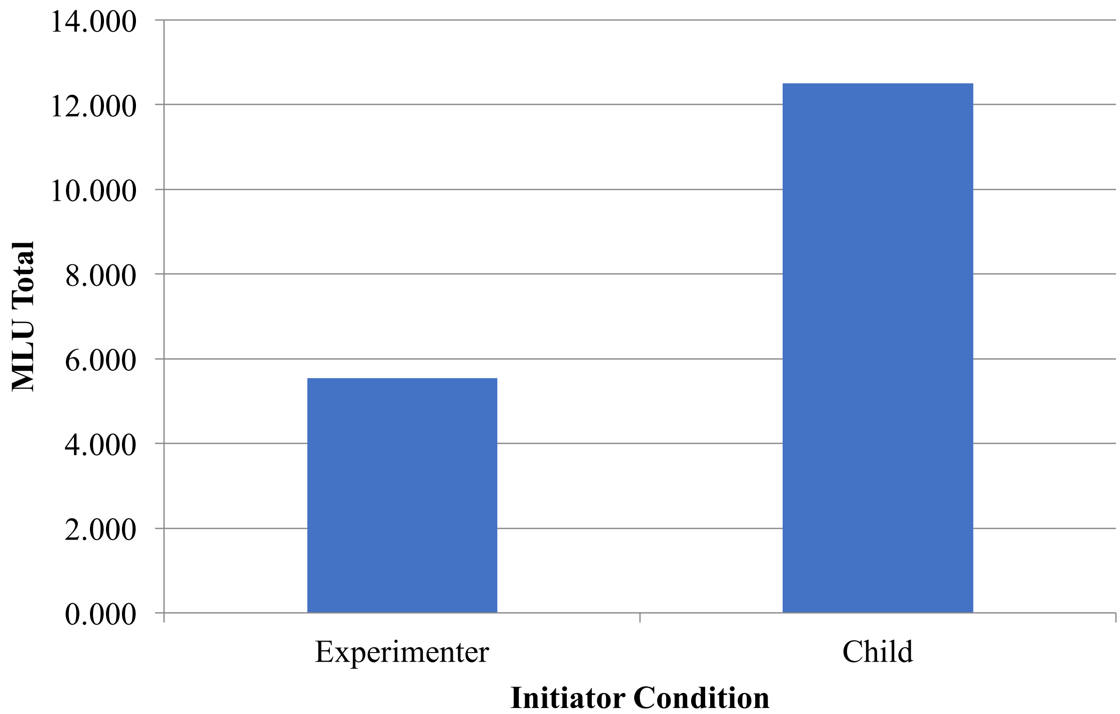

Figure 2. This bar graph depicts the main effect of initiator on MLU. The MLU was higher in child-initiated tasks than in experimenter-initiated tasks.

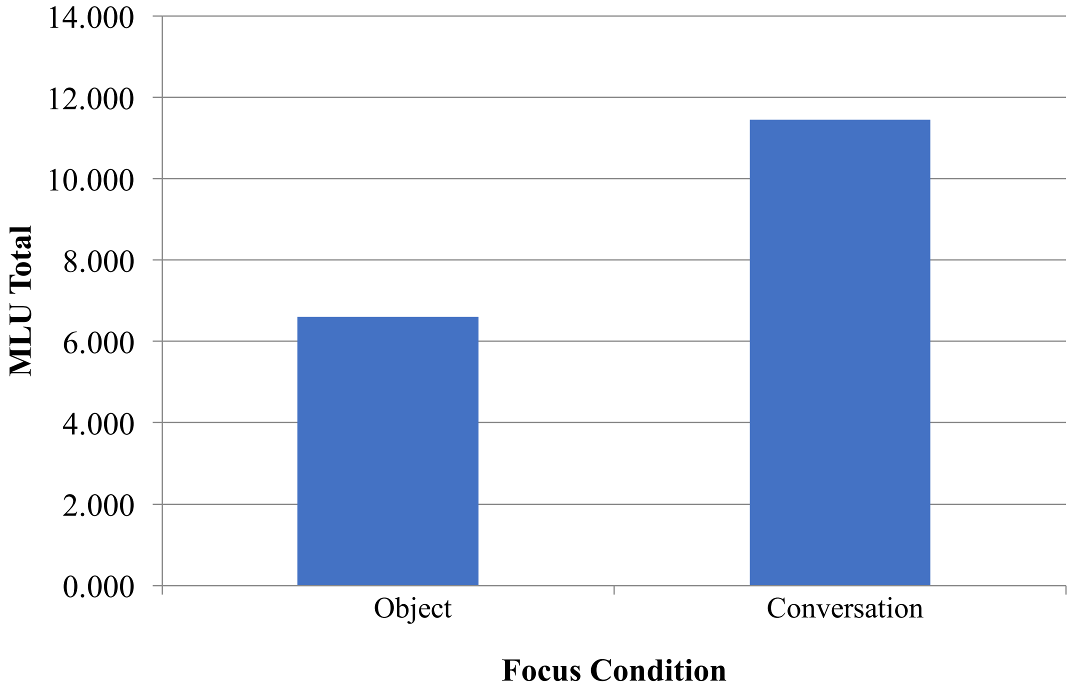

Figure 3. This bar graph depicts the influence of task focus on MLU. Tasks that were conversation-focused had a higher MLU than tasks that were object-focused.