Communicative Repair Requests Produced by Typically-Developing Preschoolers and Preschoolers with Autism Spectrum Disorder

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Dedication

For my dad.

Abstract

Purpose:

Communicative repair requests are a critical social communication skill. Communicative repair requests are important because they provide evidence that the listener (a) is attending the speaker's communicative bids, (b) is monitoring her own comprehension, (c) has strategies for repairing communicative breakdowns, and (d) has skills to successfully repair (Dollaghan, 1987). There were two primary aims of the current project, addressed through two studies. The first aim was to examine 4-year-old children's productions of communicative repair requests as a function of type of insufficient communicative opportunity, either obligatory or non-obligatory, and to examine the relationship between repair requests and performance on a theory of mind (ToM) task. The second aim of the project was to pilot the experimental task (i.e., shared book reading task) among children with autism spectrum disorder (ASD) and to collect preliminary, descriptive data on repair requests among this population.

Method:

Study One: Twenty-five typically-developing (TD) 4-year-old children participated. Participants completed two standardized, norm-referenced assessments of their expressive and receptive communication skills and IQ. Participants also completed a criterion-referenced measure of their theory of mind development (ToM task) and a shared book reading task. The shared book reading task served as the experimental medium in which different insufficient communicative opportunities (i.e., obligatory and

non-obligatory) were presented. Participants' responses were coded according to a pre-established coding scheme.

Study Two: Six children with ASD and with expressive and receptive communication skills and IQ within an average range participated and completed the protocol implemented in Study One.

Results:

Study One: Participants produced a greater number of repair requests following obligatory compared to non-obligatory communicative opportunities. There were no differences in total repair requests between participants who passed or failed the ToM task.

Study Two: The shared book reading task was a feasible method for examining repair requests among 4-year-old children with ASD whose expressive and receptive communication abilities and IQ were within an average range. Descriptive results suggest that participants with ASD who passed the ToM task produced a greater number of repair requests compared to those who failed the ToM task.

Conclusion:

The function of the adult's utterance (i.e., the insufficient utterance that creates an opportunity for a child to repair) is an influential variable in the production of repair requests. One potential explanation is that the obligatory communicative opportunities may have carried a stronger social expectation to respond in a particular way (i.e., requests for information carry the expectation that the responder will provide information); thus, these types of opportunities may have been more likely to be repaired

compared to non-obligatory opportunities. Non-obligatory opportunities allowed more degrees of freedom to whether and how the child responded. Among preschool-age children, the shared book reading task is a naturalistic medium that facilitates the examination of repair requests with a high degree of external and ecological validity. The shared book reading task was a feasible method for examining repair requests among preschool-age children with ASD.

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Chapter 1

Introduction

Communicative breakdown may be defined as an interruption in the successful exchange of information between communicative partners (i.e., speaker/listener). Breakdowns may occur when a message is not understood or responded to (see Wetherby, Alexander, & Prizant, 1998). Unrepaired communication breakdowns may restrict learning opportunities by limiting the amount of control a child is able to exert within their social environment (Halle, Brady, & Drasgow, 2004) and by compounding the amount of misunderstanding as the social interaction progresses (Abedutto et al., 2008). Consequences of breakdowns are mitigated by communicative repair.

Communicative repair behaviors are exemplars of early emerging pragmatic skills that facilitate the identification of breakdowns and allow partners to adjust their original communicative act. This, in turn, has a propensity to increase the likelihood that the interaction will progress (Brinton, Fujiki, Loeb, & Winkler, 1986). Within communicative repair, requests for clarification are a "clear indication" that a communication breakdown has occurred (Halle, et al., 2004; p. 44). For example, adults may ask, "What did you say?" after failing to understand a child's unintelligible utterance. Children may also request repair by asking, "What?" after failing to comprehend their social partner's message.

Typically-developing children begin to produce requests for communicative repair between ages 2 and 3 years (Aviezer, 2003; Pea, 1982; Revelle, Wellman, &

Karabenick, 1985). This development continues throughout the early school years (Beal & Belgrad, 1990; Bonitatibus, 1988; Flavell, Speer, Green, August, & Whitehurst, 1981; Morisseau, Davies, & Mathews, 2013; Patterson, O'Brien, Kister, Carter, & Kotsonis, 1981). There is some evidence to suggest a lack of a developmental effect in children's productions of repair requests (Walters & Chapman, 2000) and there remain many unexplored variables that may influence our understanding of children's repair requests. These include the function of the adult's utterance preceding the repair request as well as how a child's perspective-taking (i.e., theory of mind development) may influence the initiation of repair requests.

Among those with neurodevelopmental disabilities, communicative repair has often been cited as a challenge (e.g., Brady, McLean, McLean, & Johnston, 1995; Calculator & Delaney, 1986; Fujiki & Brinton, 1993; Longhurst & Berry, 1975; Reichle, 1997; Wetherby et al., 1998). Communicative repair requests are important because they provide evidence that the listener (a) is attending the speaker's communicative bids, (b) is monitoring her own comprehension, (c) has strategies for repairing communicative breakdowns, and (d) has skills to successfully repair (Dollaghan, 1987). Communication repair requests have been studied in children with neurodevelopmental disabilities, including children with intellectual disability, Down syndrome, Williams syndrome, and fragile X syndrome (e.g., Abbeduto, Davies, Solesby, & Furman, 1991; Abbeduto, Short-Meyerson, Benson, & Dolish, 1997; Abbeduto et al., 2008; John, Rowe, & Mervis, 2009; Skwerer, Ammerman, & Tager-Flusberg, 2013; Thurman, Kover, Brown, Harvey & Abbeduto, 2017). Very few studies have examined repair requests among children with

autism spectrum disorder (ASD; Martin, Barstein, Hornickel, Matherly, Durante, & Losh, 2017).

Children with ASD are at a high risk for experiencing breakdowns in communication even with familiar partners (Keen, 2003) given difficulties with social communication, weaknesses in joint attention (Osterling & Dawson, 1994), underlying deficits of theory of mind (Baron-Cohen, Leslie, & Frith, 1985), and a propensity to use idiosyncratic communicative forms (e.g., Carr & Kemp, 1989; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997). Given the inherent challenges with perspective-taking and social initiation among children with ASD (see Baron-Cohen et al., 1985; Jameel, Vyas, Bellesi, Roberts, & Channon, 2014; Mundy & Stella, 2000; Waterman, Sobesky, Silvern, Aoki, & McCaulay, 1981; Weiss & Harris, 2001), it seems reasonable to hypothesize that children with ASD may have difficulty initiating requests for communicative repair. Similar hypotheses have been offered in studies examining conversational abilities (but not requests for repair) of children with ASD (e.g., Capps, Kehres, & Sigman, 1998; Tager-Flusberg, 1996; Tager-Flusberg & Anderson, 1991). Children who struggle to take the perspective of their social partner during conversation may experience negative interpersonal consequences (Nilsen & Fecica, 2011). Increased understanding of requests for repair will allow researchers and interventionists to engineer intervention approaches tailored to these potential communication weaknesses. Children with ASD who are able to engage in communicative repair when they do not understand their social partner will increase their educational and social learning opportunities as well as their participation in daily life.

Our understanding of communicative repair has focused primarily on how children respond to an adult's intentional creation of a communication breakdown (e.g., if an adult fails to comply with a child's request for a specific toy [or provides the wrong toy] or the adult request for clarification after a child's utterance). Less attention has focused on how children initiate communicative repair requests when presented with an insufficient communicative opportunity (e.g., when an adult provides ambiguous instructions). Moreover, the majority of investigations related to typically-developing (e.g., Flavell et al., 1981; Morisseau et al., 2013; Revelle et al., 1985; Walters & Chapman, 2000) and atypically-developing (e.g., Abbeduto et al., 2008; Abbeduto et al., 1997; Brinton & Fujiki, 1982; Dollaghan & Kaston, 1986; Ezell & Goldstein, 1991; John et al., 2009; Skwerer et al., 2013) children's communicative repair requests have relied on tasks presented via an obligatory communicative opportunity in which the speaker's message contains inadequate information. For example, participants are asked to follow verbal directions in which the content is degraded (e.g., examiner states, "Put the (cough) in the cup.") or ambiguous (e.g., examiner states "Bring me the cup" in the presence of multiple cups). Very few studies (see Webber, Fey, & Disher, 1984) have examined non-obligatory communicative opportunities that do not necessarily require that the participant respond to the examiner (e.g., "I like the blue one" when there are multiple blue items in an array). Non-obligatory opportunities allow more degrees of freedom for the child's response, for example, a child may request repair (i.e., "Which blue one?" or "This blue one?"), may maintain the interaction by mirroring the examiner's utterance

(i.e., “I the blue one, too!”), may change the topic without repairing (i.e., “I like the red truck!”), or may attempt to infer the reference without repairing.

A child may be more likely to receive feedback when she fails to initiate a communicative repair following an obligatory communicative opportunity (e.g., after an adult requests action or information) compared to doing the same following a non-obligatory communicative opportunity (e.g., after an adult provides information; Webber et al., 1984) because there is a stronger social expectation to respond. Moreover, failure to respond to a comment (as a result of a communication breakdown, for example) has less of a detrimental effect compared to failure to respond to a request for action (Fey, War-Leeper, Webber, & Disher, 1988). There is little empirical evidence related to how obligatory compared to non-obligatory communicative opportunities differentially influence the likelihood of communicative repair requests.

Tomasello (1999) suggested that a child’s experience with communication breakdowns provides an opportunity to understand discourse from a perspective different from their own (i.e., their social partner’s perspective) and may facilitate the development of theory of mind and other social knowledge. Communicative repair has been linked to theory of mind development (Feldman & Kalmar, 1996). In order for repair requests to be successful (i.e., to mitigate or eliminate the misunderstanding within the interaction), a speaker may have to craft their repair based on their understanding of their social partner’s knowledge. That is, the repairer may have to understand the conversation and account for their social partner’s perspective (which may differ from their own). Thus,

children's abilities to understand another person's perspective (i.e., theory of mind development) may be an important variable in their production of repair requests.

Theory of mind is the ability to assign mental states to oneself and to others and to use knowledge of mental states to predict others' behavior (Premack & Woodruff, 1978). Mental states are not directly observable and may include beliefs, preferences, and intentions. As children develop theory of mind they begin to understand that the world may be experienced differently by two people (Korkmaz, 2011). Among TD children, empirical evidence suggests a positive link between performance on theory of mind assessments and their use of prosocial behaviors during real time interactions with others (for a review, see, Repacholi & Slaughter, 2003). Feldman and Kalmar (1996; as cited by Bosco & Gabbatore, 2016) first described the link between theory of mind and the ability to engage in communicative repair. They noted speakers might consider their conversation partner's knowledge and intentions and adjust their own accordingly. There are a few studies suggesting a relationship between performance on theory of mind tasks and TD children's ability to recognize and repair communication breakdowns (Bosco, Bucciarelli, & Bara, 2006; Bosco & Gabbatore, 2016; Sidera, Perpiña, Serrano, & Rostan; 2016), yet the relationship between theory of mind abilities and children's productions of repair request remains unclear.

Among children with neurodevelopmental disabilities, there is limited and mixed evidence related to theory of mind and repair requests, with some evidence suggesting a link (John et al., 2009) and some evidence failing to demonstrate a relationship (Abbeduto et al., 2008). Few studies examining repair requests among children with ASD

have included measures indexing theory of mind abilities, although among children with ASD, difficulty with theory of mind tasks has been shown to relate to difficulty with social interactions with language abilities moderating this relationship (Peterson, Slaughter, Moore, & Wellman, 2016). The link between performance on theory of mind tasks and communicative repair requests remains unclear for both TD children and children with ASD who have primary weaknesses in social communication.

There were two primary aims of the current project and these aims were addressed through two studies. The first aim was to examine 4-year-old children's productions of repair requests as a function of type of insufficient communicative opportunity, either obligatory or non-obligatory, and to examine the relationship between repair requests and performance on a theory of mind task (ToM task). The majority of investigations related to TD children's communicative repair requests (e.g., Flavell et al., 1981; Morisseau et al., 2013 Revelle et al., 1985; Walters & Chapman, 2000) have relied on tasks presented via an obligatory communicative opportunity (i.e., requests for action or information) in which the speaker's message contains inadequate information. Yet, there is very limited evidence related to the relationship between the function of the communicative opportunity presented (i.e., obligatory as in requests for action or information versus non-obligatory as in provisions of information) and the likelihood of TD children producing communicative repair requests. There is also limited evidence related to the relationship between the production of communicative repair requests and theory of mind development among TD children. Thus, the first aim provides evidence to further our understanding of communicative repair requests among TD children.

Given the novelty of the task implemented with TD children to address the first aim, it is important to determine the feasibility of implementing the task among children with ASD given their unique social-behavioral profile. The second aim of the project was to pilot the experimental task among children with ASD and to collect preliminary, descriptive data on repair requests among this population. There are few studies specifically examining repair requests among children with ASD (see Martin et al., 2017). A demonstration of the task's feasibility would serve as a logical next step for future studies directly comparing TD children and children with ASD.

Chapter 2 provides a review of literature relevant to the current study. First, taxonomies of communicative repair requests are described. This is followed by a review studies that have examined repair requests produced by TD children, a description of theory of mind development and the theoretical and empirically-established relationship between theory of mind and TD children's use of communicative repair requests. Second, studies are reviewed that have examined repair in children with ASD. Given the limited evidence related children with ASD, there will be a focus on studies that have examined repair requests produced by children with documented neurodevelopmental disabilities whose cognitive, linguistic and social communication profiles put them at risk for experiencing breakdowns in communication and whose repair request abilities may inform our understanding of children with ASD given shared characteristics. This section will also include an examination of the link between theory of mind development and repair requests among children with neurodevelopmental disabilities. Chapter 3 describes the specific aims of the current project, addressed through two studies. Chapter 4

describes Study One including the participants, method, results, discussion, limitations, and future directions. Chapter 5 describes Study Two including participants, method, results, discussion, limitations, and future directions. Chapter 6 presents an overall conclusion for the project.

Chapter 2

Literature Review

Repair Request Taxonomies and Nomenclature

Generally, studies that examine communicative repair requests describe a broad response class of spoken behaviors (i.e., behaviors that are topographically different, but produce the same effect). Each member of the "communicative repair request response class" provides an overt signal that a breakdown has occurred and continues the interaction. Examples include: (a) general requests for clarification (e.g., "What?"), (b) specific requests for clarification (e.g., "Which green one?"), (c) statements specifying insufficiency or correcting an error (e.g., "Not the dog, you mean the cat.") and (d) general statements indicating lack of comprehension (e.g., "I don't understand.").

A common hierarchy of different repair request behaviors has not been adopted across studies. Porter and Conti-Ramsden (1987) described McTear's (1985) hierarchy of clarification request strategies that progress from those that are more ambiguous (e.g., non-specific request for repetition, for example, "What?" or "Huh?") to those that are the least ambiguous (e.g., You mean + specific request for confirmation, for example, "Do you like the black dog?" "You mean the brown dog?"). Other investigators have collapsed various repair behaviors into one broad category. For example, Abbeduto et al. (2008) described five different verbal repair behaviors (i.e., request for confirmation, request for definition, request for specific information, statement of existence, statement of non-existence) and collapsed them for analysis into one general category (i.e., non-comprehension signals).

Beyond the absence of an established hierarchy of repair behaviors, researchers vary in their use of terminology, with some studies describing *non-comprehension signals* and other studies describing *clarification requests*. Broadly, a communicative repair request provides an overt signal that a breakdown has occurred (Dollaghan, 1987). Initiating requests for communicative repair requires that children engage in two behaviors. First, children must engage in comprehension monitoring, or the metacognitive skill in which they reflect on their understanding (i.e., their basic comprehension) of their partner's utterance (Dollaghan, 1987). Second, when they do not understand, they must signal this to their social partner to begin the process of communicative repair (Dollaghan, 1987). Comprehension monitoring refers to the ability to detect and address breakdowns in one's own understanding of language (Dollaghan, 1987; Markman, 1979). During comprehension monitoring, children must discriminate when they do and do not understand their social partner's communication. Thus, comprehension monitoring is the process by which persons think about their own understanding. During a social exchange, comprehension monitoring allows children to detect parts of the verbal and non-verbal communication act that they may not understand and then act. The term *non-comprehension signaling* connotes the process of comprehension monitoring, in which children reflect on their own understanding of their partner's utterance. This paper will use the term *repair requests* to encompass signals of non-comprehension and clarification requests.

Studies addressing communicative repair have focused either on how children *initiate* (i.e., produce unprompted) repair requests or how they *respond* to their social

partner's repair request. Children's responses to adults' repair requests have received more attention in the communication repair literature. This project focuses on how children produce unprompted repair requests. The next section will review how studies have typically examined children's productions of unprompted repair requests.

Initiating Requests for Communicative Repair

Generally, studies designed to examine children's productions of repair requests have relied on structured tasks (e.g., referential communication tasks, direction-following activities, cooperative games) or unstructured language-sampling tasks. In structured tasks, the researcher is in a speaker-role and the child is in a listener-role. This paradigm provides opportunities for children to listen to the researcher's spoken message (typically requests for action, such as, "Put the spoon under the box.") and produce unprompted repair requests when there is an insufficient information resulting in a communication breakdown (e.g., "Put the spoon under the box" [when there is a fork but no spoon available in an array of objects]). In unstructured language sampling tasks, the researchers may vary the social partner interacting with the participants (e.g., caregiver, peer, or clinician). In language sampling tasks, opportunities to request repair are generally not systematically implemented but instead occur naturally following a communication breakdown. For example, during a play-based task between an adult and a child, the adult may request information from the child (e.g., "What is your car doing?") and the child may not have comprehended the adult and may initiate a communicative repair via a request for repetition (e.g., "What?").

Repair Requests Among Typically-Developing Children. Typically-developing (TD) children demonstrate some ability to both monitor their comprehension and request communicative repair between age 2 and 3 years (Aviezer, 2003; Pea, 1982; Revelle et al., 1985) with skill development continuing throughout the early school years (Beal & Belgrad, 1990; Bonitatibus, 1988; Patterson et al., 1981). Revelle et al. (1985) examined repair requests of 3- and 4-year-old TD children, noting that by 4 years of age, children "demonstrate appropriate and discriminative comprehension monitoring" (p. 662). In this study, the researcher engaged the participants using two structured, play-based tasks; one in which they played together in a sandbox and the other created a tea party. Experimental opportunities occurred when the researcher requested that the participant bring specific items to the researcher (i.e., "Bring me the teacup."). Problematic requests included one of three types: referential ambiguity (i.e., several available objects could potentially fulfill the examiner's request), unintelligibility (i.e., examiner yawned while naming the referent in the request), and memory overload (i.e., examiner requested a list of 5 items for the child to bring). The researcher also implemented control requests that were non-problematic and described as "easy to comprehend and comply with" (p. 656). A total of 36 opportunities (18 problematic and 18 control) were implemented across the two structured tasks. Results revealed that 4-year-old children produced repair requests significantly more frequently than 3-year-old children for each of the three types of problematic requests. Moreover, compared to 3-year-olds, 4-year-olds were significantly more likely to produce problem-focused responses (i.e., repair requests that highlighted the nature of the ambiguity, for example,

"Which one?") following ambiguous examiner requests. Both groups produced significantly more problem-focused responses following the unintelligible examiner requests compared to the control requests.

Flavell et al. (1981) compared 6- and 9-year-old children in their detection of inadequate, ambiguous, inconsistent, and overly complex information. During a structured activity in which participants were assembling a specific block construction, the researchers presented spoken instructions. Inadequate instructions contained an unknown key word or a key word that had been masked by a noise (e.g., examiner cough). Ambiguous instructions contained an unclear referent, which allowed the participants to construct more than one possibility with their materials. Inconsistent messages contained contradictory information. Overly complex instructions were complete (meaning they could have been executed with the materials and language provided) but placed a high demand on the participants' memory because the instructions were very long. The study demonstrated that 9-year-old children were significantly more likely to detect inadequate, ambiguous, inconsistent, and overly complex instructions compared to the 6-year-old children. In addition to the group level differences in detection, the older children were more likely to verbally *respond* and pause after detecting an issue in the information provided to them than the younger children.

Morisseau et al. (2013) investigated the responses that 3- and 5-year-old children produced after hearing over- and under-informative verbal directives compared to optimal verbal directives. An adult examiner directed participants to locate one object from an array of 15 that were arranged on a 4 x 4 grid and place it in the empty grid

location. The investigators examined children's spoken requests for clarification, non-spoken responses (i.e., direct gaze toward examiner after an under-informative directive), and response times. There were significant differences between younger and older children in the total number of communicative repair requests they produced. On average, the younger children requested clarification verbally and/or nonverbally following 25% of under-informative opportunities; whereas, the older children requested clarification for 50% of under-informative opportunities. The 3-year-olds did not demonstrate significant differences in their reaction times after hearing over-informative directives compared to optimal directives. The 5-year-olds demonstrated significantly longer reaction times after hearing over-informative directives compared to optimal directives. Morisseau et al. noted that the 5-year-olds may have demonstrated longer reaction times after hearing over-informative directives because their expectations about how much information was needed to locate a specific item were violated. The 5-year-olds expected directions to be informative and the inclusion of redundant information was enough to slow their reaction time. It is possible that the 3-year-olds did not have sufficiently strong expectations about how informative their social partner's message should have been. Available evidence suggests that comprehension monitoring and initiating requests for communicative repair are skills that emerge as early as 3 years of age and continue to develop as children's communication and cognitive skills become more sophisticated.

Variables Affecting the Production of Repair Requests. The available literature suggests that our understanding of the developmental trajectory of comprehension monitoring and requests for communicative repair appears to be

influenced by the task in which these skills are assessed (Dollaghan, 1987; Revelle et al., 1985). A few studies have highlighted different variables' influence on the likelihood of repair requests, including the type of insufficient information, the social setting in which the information is presented, the relationship between social partners, and the function of the utterance that precedes the communicative repair request.

Type of insufficient information. Markman (1979) reported that school age children detected approximately 50% of the actual inconsistencies in a partner's provision of information. Markman examined 8- to 12-year-old children's comprehension monitoring by measuring their ability detect inconsistencies in non-fiction stories presented verbally. Children were divided into a younger group (mean age = 8 years; 8 months) and an older group (mean age = 12 years; 0 months). The stories contained either implicit or explicit contradictory information. For example, in the implicit condition, the story would describe fish that live in very deep water where there is no light and they know their food by its color. In the explicit condition, a similar story was presented with additional cues, for example, "fish need light in order to see" and "when it is dark fish cannot see" (p. 646).

There was a significant difference between the explicit and implicit conditions. Results revealed that participants in both the younger age group and the older age group demonstrated difficulty detecting both implicit and explicit contradictions, with about 80% of children failing to detect an inconsistency in the implicit condition, and 50% in the explicit condition. When the researchers provided a spoken prompt (i.e., "There is something tricky about these essays") prior to reading the story, the older children

improved their performance. The older group performed significantly better than the younger group (and this difference was statistically significant) with about 12% of the older group failing to detect an inconsistency in each of the explicit and implicit conditions, while 75% of the younger children failed to detect inconsistency in the implicit condition and 50% of younger children failing to detect an inconsistency in the explicit condition.

Beyond information that contains explicit versus implicit contradictions, children's repair responses to other types of insufficient information have also been studied. Walters and Chapman (2000) examined children's spoken clarification requests following inadequate instructions that contained inadequate content, an inadequate signal, or were overly complex. An example of inadequate content was, "Put the spoon in the bowl," in which one of the referents was absent. An example of inadequate signal was, "Put the (cough) in the cup," in which there was an interruption to the acoustic signal. An example of an overly complex experimental opportunity was, "Do these things in the order I say them, but wait until I finish talking. First, put the girl in the car; then put the spoon in the cup, then pick up the box; then the car; then the spoon; and then the cup," (p. 54). Participants were 3-, 6-, and 9-year-old children who listened to the pre-recorded verbal instructions and were asked to complete the instructions using small objects. An examiner indicated that participants could ask questions if they did not understand. If children requested clarification from the examiner, the examiner indicated that the talker "must have missed some information."

No statistically significant group differences were observed in the average number of spoken queries produced by 3-year-olds, 6-year-olds and 9-year-olds across the three types of insufficient messages, suggesting the lack of a developmental effect. Across age groups, inadequate content messages were most frequently queried compared to complex/lengthy or distorted content messages. Walters and Chapman (2000) suggested that "sociability with adults" (p. 53) might have accounted for differences in comprehension monitoring and requests for communicative repair across learners. The authors did not further operationalize this potential social variable. They also suggested that requesting clarification following pre-recorded audio messages (as was used in this study) is likely different from requesting clarification during a face-to-face interaction. A limitation of this study was that the investigators did not directly examine the influence of the children's social competence or mode of presentation (e.g., were participants more likely to request repair when instructions were presented by a familiar versus unfamiliar adult or when instructions were presented via a recording versus during a real-time interaction with an adult) on participants' performance.

Social context. McDevitt (1990) highlighted the influence that social context variables (e.g., relationship between social partners or the setting in which interaction occurs) may have on children's performance in tasks designed to measure their comprehension monitoring skills. In this study, both 7- and 9-year-old TD children were more likely to report inconsistencies in short, nonfiction pre-recorded vignettes when they watched an adult compared to a child presenting the information. Participants were assigned to either the adult-speaker condition or the child-speaker condition. Participants

listened to 10 short passages read by either an adult female (adult-speaker condition) or 9-year-old female (child-speaker condition). Five of the passages contained inconsistencies in the message (e.g., "Corn can be served in many ways. Everyone I know likes some kind of corn. Some people steam corn and mix it with butter. Others mix it with flour and eggs to make bread, or make it into popcorn for a snack. Corn has lots of vitamins, but the people I know don't like to eat corn;" p. 357). Five of the stories did not contain inconsistent information and served as a control measure. After listening to two presentations of the story, the researcher asked the participant if there was anything that was "hard to understand" or "that they didn't like." Dependent measures included: the number of stories for which participants detected an inconsistency and indicated the specific problem. For example, a child would have to indicate that in the story about corn, first the speaker said that everyone likes corn but then she said that people she knows don't like to eat corn.

Additionally, the researchers included a measure of how the participants' mothers provided communicative feedback to their children. The participants' mothers listened to short stories that described a hypothetical situation in which their child struggles to understand how to do something. The researchers then prompted the mothers to describe how they might support their child in this situation. The responses were coded for: (a) directing the child's attention to the specific communication exchange, (b) suggesting a strategy for resolving their confusion, (c) intervening for the child, and (d) not intervening and allowing child to work through confusion independently.

Results revealed that both 7- and 9-year old children were more likely to report

inconsistencies in the information when presented by an adult speaker compared to a child speaker. There were no statistically significant age group differences in rate of detection of inconsistent messages. McDevitt noted that children may be more reluctant to report inconsistencies in a peer's message (child-speaker condition) or more forgiving of peer mistakes (and thus not indicate an inconsistency). The novelty of listening to a child speaker present a nonfiction story may have also been a factor, perhaps children have more experience listening to adults provide information about how something works.

Requests for communicative repair may also be a function of the relationship between the conversational partners and their communicative competence. Adults and familiar social partners may provide language scaffolding thus reducing the potential for breakdowns to occur. For example, if a preschool-age child's social partner is a less familiar or less skillful communicator (i.e., a younger sibling or child), there may be a greater number of opportunities to request repair.

Function of social partner's communicative utterance. The function of the adult's utterance may also be an influential variable in examining repair requests. The majority of repair request studies have relied on adult/researcher utterances that are requests for action, information, or objects. The function of these utterances creates an obligatory opportunity for the child to respond. There is little evidence examining children's repair requests following adult utterances that are comments or provision of information. The function of these utterances renders the child's response to be non-obligatory because a response is not required or expected.

Webber et al. (1984) reported that TD children aged 3 to 9 years old queried their adult social partner after she had produced a comment with an ambiguous referent during an interaction. In this study, participants were presented with 10 experimental communicative bids during unstructured play. Seven of the communicative bids were non-obligatory and contained an ambiguous referent. For example, "I have a *liki* at home." Three of the bids were questions and were considered to place a social expectation on the child to respond. Like the comments, the questions contained an ambiguous referent, for example, "Do you know that story?" Webber et al. noted that participants at ages 3, 5, 7 and 9 years produced repair requests following the ambiguous information for at least 50% of opportunities. This provides some evidence that children across a wide age range may produce requests for communicative repair in non-obligatory communicative contexts. The authors did not report analyses related to differences based on participants' age. More broadly, there is little published information from the Webber et al. (1984) study regarding more specific methodological details and analyses; thus, the results must be cautiously interpreted. Despite the lack of specific published details, the study has been included in the literature review given the limited available evidence related to repair requests following non-obligatory opportunities.

Perspective-taking abilities may be influential in children's ability to engage in communicative repair requests. In order for repair requests to be successful (i.e., to mitigate or eliminate the misunderstanding within the interaction), a speaker may have to craft their repair based on their understanding of their social partner's knowledge. That is, the repairer may have to understand the conversation and account for their social

partner's perspective (which may differ from their own). Communicative repair has been linked to theory of mind development (Feldman & Kalmar, 1996). The next section of this literature review will focus on the link between theory of mind and social communicative behavior, with a particular focus on repair requests as theory of mind development may be an important factor affecting communicative repair requests.

Theory of Mind, Repair Requests, and Typically-Developing Children

Theory of mind is the ability to assign mental states to oneself and to others and to use knowledge of mental states to predict others' behavior (Premack & Woodruff, 1978). Mental states are not directly observable and may include beliefs, preferences, and intentions. Research related to theory of mind development has received much attention in the developmental psychology literature over the past 40 years (for reviews see Flavell, 2000; Flavell; 2004; Repacholi & Slaughter, 2003). Among preschool age children, researchers have documented development in visual perception, attention, understanding emotions and desires, and continued engagement in pretend-based play as factors closely linked to the theory of mind development (Flavell, 2000).

Theory of mind tasks are often categorized as first-order belief tasks or second-order (and higher) belief tasks. First-order belief tasks ostensibly assess a child's understanding of what other people think about reality. Second-order belief tasks assess a child's understanding of a person's beliefs about another person's beliefs about reality (Perner & Wimmer, 1985). Children begin to pass second-order belief tasks in their early school years (e.g., Perner & Wimmer; 1985). Various criterion-referenced assessments of theory of mind have been developed, including the location-change false belief task (e.g.,

Wimmer & Perner, 1983; Baron-Cohen et al., 1985), the unexpected-contents false belief task (e.g., Hogrefe, Wimmer, & Perner, 1986), and evaluation of lies and jokes task (e.g., Sullivan, Winner, & Hopfield, 1995). The location-change false belief task (sometimes referred to as the "Sally-Ann" task; Barron-Cohen et al., 1985) utilizes a puppet show format with two main characters who are playing with toys. One character hides a toy and then leaves the scene, and then the second character moves the toy to a new location. When the first character returns, children are asked if the first character knows where the toy is and where the character will look for the toy. Stronger theory of mind skills are attributed to children who are able to indicate that the first character will not know where the toy has been hidden.

The unexpected-contents false belief task (sometimes called the "Smarties" task; Hogrefe et al., 1986) invites children to watch an examiner hold a familiar container (e.g., a crayon or candy box) that has been filled with unexpected contents (e.g., crayon or candy box filled with paper clips). The examiner asks the child what the child thinks is in the box, then reveals that the box contains something different from what the child predicted. Finally, the examiner asks the child if a caregiver (not present) will know what is inside the container and what their caregiver will state is inside. Stronger theory of mind skills are attributed to children who indicate that their caregiver will not know the unexpected contents (as they have not yet seen them as the child has) and will state that the expected item (e.g., crayons or candy).

The lies and jokes task asks children to evaluate whether a child character's statement (e.g., "I did a good job eating my peas.") is a lie or a sarcastic joke, based on an

adult character's knowledge (Steele, Joseph, & Tager-Flusberg, 2003). Stronger theory of mind skills are attributed to children who are able to able justify whether the child character's statement was a lie or a sarcastic joke based on whether the child character knows the adult character's knowledge of the truth.

Among TD children, empirical evidence suggests a positive link between performance on theory of mind assessments and real-time social behavior (for a review, see, Repacholi & Slaughter, 2003). For example, Watson, Nixon, Wilson, and Capage (1999) demonstrated that 3- to 6-year-old children's false belief understanding predicted teachers' ratings of "the extent to which children engaged in social interactions with peers," (p., 387), after controlling for age, language comprehension, and overall talkativeness with peers. Flavell (2004) broadly noted that children who have more advanced understanding about others' minds tend to experience more successful social relationships.

With respect to repair requests, Feldman and Kalmar (1996; as cited by Bosco & Gabbatore, 2016) first described the link between theory of mind and the ability to engage in communicative repair in discourse. They noted speakers might consider their conversation partner's knowledge and intentions and adjust their own accordingly. When misunderstandings and requests for clarification (i.e., repairs) occur, a child is presented with an opportunity to understand discourse from more than one perspective because a request for repair is a signal that one social partner understands the content of the discourse differently from the other social partner. Tomasello (1999) suggested that a child's experience with this type of discourse (i.e., a misunderstanding and later repair)

facilitates the development of theory of mind (and other social knowledge), as a child must reconcile two different perspectives.

Recent studies rooted in Cognitive Pragmatics suggest a positive relationship between TD children's development of theory of mind and their abilities to recognize and repair communication failures (see Bosco et al., 2006; Bosco & Gabbatore, 2016). Work in this area has focused on communication failures from the speaker's perspective. Typically, in these studies, the researcher creates opportunities for children to identify when communication failures have occurred (i.e., the children watch a short video-recorded interaction between two people) and to indicate how the speaker depicted in the video-recorded interaction might repair their initial utterance.

Bosco and Gabbatore (2016) found that theory of mind task performance had a positive relationship with TD children's ability recognize communication failures in a structured task. In this study, children aged 3 years; 6 months to 8 years; 5 months watched 15 s video clips of people engaged in a short conversation. For example, the speaker asks her conversational partner, "Do you want to take a walk" but a loud bus is passing near them. The conversational partner says, "What did you say?" Researchers asked the participants whether the listener had understood what the speaker said (i.e., was there a communication failure). If the child indicated that a failure had occurred, the researcher prompted the child to describe how the speaker might respond to the communication failure. Results indicated that children were more successful identifying communication successes compared to failures. Older children were more likely to correctly recognize communication failures compared to younger children. However, this

developmental trend was only seen through children who were 6 years; 6 months. A limitation of this study is that it examined repair "offline," in that participants are not required to recognize communication failures as participants in an interaction, rather, as an observer. This type of task may be fundamentally different from repairing a communication breakdown during a real-time interaction.

Sidera et al. (2016) found a positive relationship between performance on a battery of theory of mind assessments and the requests for clarification produced by TD 6- to 10-year-old children during a cooperative referential communication task. This study utilized a barrier task in which participants gave verbal instructions to a peer so she could construct a specific model using toy building blocks. Opportunities for participants to request clarification were not programmed into the task, rather they arose naturally based on the clarity of the message provided by the participant giving directions. Although this type of referential task required children to use requests for clarification in real time (compared to the recognition task used by Bosco & Gabbatore, 2016), the structured, goal-directed nature of the task may have been less socially demanding than an unstructured social interaction with nuanced social rules. Thus, there is some emerging evidence that suggests a relationship between performance on theory of mind tasks and TD children's ability to recognize and repair communication breakdowns (Bosco et al., 2006; Bosco & Gabbatore, 2016; Sidera et al., 2016).

One population that demonstrates weaknesses in perspective-taking abilities and is at risk for communication breakdowns is children with ASD (Keen, 2003). The next section will review the literature related to repair requests among children with ASD.

Given the limited evidence in this area, repair requests among children with other neurodevelopmental disabilities who are also at risk for experiencing communication breakdowns (i.e., intellectual disability, fragile X syndrome, Williams syndrome, Down syndrome, and language impairments) will be reviewed. Given shared cognitive, linguistic and social communication profiles, the repair request abilities of these populations may inform our understanding of children with ASD. Finally, theory of mind development among children with ASD and the relationship between theory of mind and repair requests will be discussed.

Repair Requests Among Children with ASD

Ultimately, learning more about repair requests in TD children will inform both assessment and intervention procedures with persons who are potentially at risk for developing these skills. Consequently, considering the range of learners who may be candidates for assessment scrutiny is warranted.

In populations with developmental disabilities, the ability to consistently engage in requests for and/or responses to queries for communicative repair has often been cited as a challenge (e.g., Brady et al., 1995; Calculator & Delaney, 1986; Fujiki & Brinton, 1993; Longhurst & Berry, 1975; Reichle, 1997; Wetherby et al., 1998). The communicative repair literature has focused on: (a) children with intellectual disability (for a review see Hatton, 1998), (b) Fragile X syndrome (e.g., Hagerman & Hagerman, 2000; Losh, Martin, Klusek, Hogan-Brown, & Sideris, 2012), (c) Williams syndrome (WS; e.g., Stojanovik, Perkins, & Howard, 2006), (d) Down syndrome (DS; Rice, Warren, & Betz, 2005), and (e) language impairments. Very limited evidence exists

related to communicative repair requests produced by children with ASD. Martin et al. (2017) examined the production of repair requests among children and adolescents with fragile X syndrome (FXS-O, *n* = 38), fragile X syndrome and ASD (FXS-ASD, *n* = 53), ASD (*n* = 33), DS (*n* = 37) and typical development (TD, *n* = 41). The average ages for each of the groups ranged from 6 years; 1 month (TD males) to 12 years; 12 years; 6 months (DS males). Researchers measured participants' nonverbal cognitive skills using the Leiter-Revised (Leiter-R*;* Roid & Miller, 1997) and receptive language abilities using the Peabody Picture Vocabulary Test – 3rd Edition (Dunn & Dunn, 1997). Receptive vocabulary mean age ranged from 5 years; 10 months (DS females) to 9 years; 5 months (FXS-O females). Nonverbal mental age ranged from 5 years; 1 month (FXS-ASD males) to 7 years; 6 months (ASD-O males). The researchers also administered the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DeLavore, & Risi, 2001) to confirm or rule-out ASD diagnosis. Mean ADOS severity scores were 7.8 (ASD-O), 6.8 (FXS-ASD males), 6.4 (FXS-ASD females), 1.8 (FXS-O males), 1.9 (FXS-O females), 1.4 (DS males), 1.6 (DS females), 1.7 (TD males), and 1.4 (TD females).

Participants completed a referential communication task (modified from Abbeduto et al., 2008) in which they listened to verbally presented directives and were instructed to select an image (from an array of four images) and place it in a particular location on a visual scene display. Directions were one of four types, informative (six opportunities), incompatible (four opportunities), unfamiliar referent (four opportunities) and ambiguous referent (four opportunities). See earlier description of Abbeduto et al. (2008) for examples of each type of opportunity. The task was video recorded and

participants' behaviors were coded using a pre-established scheme that included seven types of spoken repair requests (e.g., request for confirmation, requests for specific information, statement of uncertainty) and one type of non-spoken repair request (i.e., gestures/facial expressions such as shrugging shoulders while making eye contact with researcher).

Researchers measured the total number of repair requests during the task. Controlling for receptive language abilities and nonverbal cognition, results revealed that the FXS-ASD male group produced significantly fewer repair requests than the FXS-O male, ASD-O male, and TD male groups across the three types of insufficient instruction types. Moreover, among both FXS-ASD male and FXS-O male groups, elevated ADOS scores (increased severity) were associated with fewer repair requests. The DS male group produced significantly fewer repair requests than TD male and ASD-O male group (across insufficient direction types) but did not differ from FXS-ASD male group. The ASD-O male group produced a significantly greater number of repair requests than the FXS-ASD male group and the DS male group and were similar to the TD male group in total number of repair requests.

Among the female groups, results suggest a similar pattern: the FXS-ASD female group and the DS female group produced significantly fewer repair requests compared to the TD female group. There were no significant differences between the FXS-O female group and the TD group. No significant differences were found between males and females across diagnostic categories suggesting that production of repair requests is not expressed differentially between males and females (after controlling for non-verbal

cognitive and receptive language skills). The authors noted the discrete nature of the production of repair requests as a pragmatic skill. They concluded that additional research is needed to more fully understand differences between males and females across special populations with respect to additional and more complex, nuanced social communication skills. The authors indicated that although receptive language and nonverbal cognitive skills were controlled, the groups that requested repair similarly to TD group (i.e., ASD-O, FXS-O) had higher nonverbal cognitive and receptive language skills compared to the FXS-ASD and DS groups (who demonstrated significantly reduced rates of repair requesting). Limitations to the study include the lack of an expressive language measure. The authors highlighted the need to examine repair requests in more naturalistic contexts which may be "more sensitive for assessing group differences and clinical needs." But the results indicate that repair requests represent a social communication weakness for boys with FXS-ASD, and that for children with ASD-O or FXS-O, higher receptive language and non-verbal cognitive skills may relate to repair request abilities similar to TD children.

As previously noted, there is limited evidence related to children with ASD, thus, the subsequent sections focus on studies that have examined repair requests produced by children with documented neurodevelopmental disabilities whose cognitive, linguistic and social communication profiles put them at risk for experiencing breakdowns in communication and whose repair request abilities may inform our understanding of children with ASD given shared characteristics. These populations include: children with

intellectual disability (ID), Down syndrome (DS), fragile X syndrome (FXS), Williams syndrome (WS), and language impairments (LI).

Children with intellectual disabilities, Down syndrome, and fragile X syndrome. Recent estimates suggest that approximately 30% of children with ASD experience an intellectual disability (ID; IQ ≤ 70) and approximately 25% fall within a borderline range for intellectual disability (IQ between 71-85; Christensen et al., 2016). Thus, understanding evidence related to how children with ID, including children with DS, may inform our understanding of communicative repair requests among children with ASD. Studies examining children with FXS have been included given the documented overlap in behavioral phenotype with children with ASD, including difficulties with pragmatic language and theory of mind (Losh et al., 2012) and significant difficulties with social communication (see Hagerman & Hagerman, 2000). Correspondingly, a high rate of children with FXS who meet diagnostic criteria for ASD (up to an estimated 74% of males and 45% of females; see Klusek, Martin, & Losh, 2014 for a review).

There is a modest literature of studies directly assessing the communicative repair requests of persons who experience intellectual disabilities, including children with FXS and DS. The results of these studies present a mixed picture with respect to production of repair requests. Some evidence suggests that children with ID produce fewer repair requests than peers matched on mental age (Abbeduto et al., 1991; Abbeduto et al., 2008); however, other studies have not revealed significant group differences (Abbeduto et al., 1997; Abbeduto et al., 1998). A few studies in this area have also examined the

influence of participant level variables (e.g., IQ, expressive language, and receptive language) on the production of repair requests, however, the results present an unclear picture. Abbeduto et al. (1997) compared children and adolescents with ID (n = 16) and TD children matched on mental age (n = 16) on their production of repair requests during a structured task. Participants ranged in ages from 5-10 years in the TD group (mean age = 6 years; 11 months) and 9-20 years (mean age = 15 years; 7 months) for those with ID. Participants completed a direction-following task in which they manipulated a small car on a map as they listened to instructions presented via speakers. Children participated in two conditions; one in which the speaker who was providing the instructions was a child and one in which the speaker was an adult. In both conditions, the instructions were one of three types: ambiguous, incompatible, or informative. Ambiguous instructions included more than one potential referent (e.g., "Go to the house on the red road" when there was more than one red road on the map). Incompatible instructions included a color or shape that was not present on the map (e.g., "Go to the house on the yellow road" in the absence of a yellow road on the map). Informative instructions were complete and able to be successfully carried out without additional information. Ambiguous and incompatible instructions were designed as opportunities for participants to produce repair requests.

Results revealed no statistically significant differences between the groups in the total number of requests for repair across the two types of insufficient instructions and two different speakers. The participants were significantly more likely to produce repair requests following incompatible directions compared to ambiguous directions. However,

the groups differed in how they requested repair, with TD children more likely to draw attention to the way in which the directions were insufficient (e.g., "There isn't a blue road.") compared to children with ID who tended to signal the need for more information (e.g., "Which blue road?"). Abbeduto et al. (1997) also demonstrated that receptive language skills (as indexed by Test for Reception of Grammar score) was the best predictor of successful productions of repair requests.

Other studies of repair requests have shown similar results with respect to receptive language but have revealed between group differences in total number of repairs produced. Abbeduto et al. (2008) compared adolescents and young adults with FXS (n = 18), adolescents and young adults with DS (n = 22) and TD children (n = 17) matched according to mental age on their productions of repair requests during a referential communication task. The participants with FXS did not have a co-morbid diagnosis of ASD. Average mental age (measured by Stanford-Binet Intelligence Test – 4th Edition; Thorndike, Hagen, & Sattler, 1986) ranged from 4 years; 6 months (TD group) to 5 years; 4 months (DS group). Expressive language skills (measured using the Oral Expression Scale of the Oral and Written Language Scales; Carrow-Woolfolk, 1995) ranged from age equivalencies of 4 years; 6 months (DS group) to 8 years; 0 months (FXS group). Average receptive language (indexed by the Test for Auditory Comprehension of Language-3rd Edition (TACL-3; Carrow-Woolfolk, 1999) ranged from age equivalencies of 5 years; 6 months (DS group) to 6 years; 9 months for (FXS group).

During the referential communication task of Abbeduto et al., participants were directed to move magnetic pictures on an easel board that contained a visual scene (e.g.,

"Put the seashell on the beach"). Instructions were designed to be opportunities to request repair, including incompatible content, ambiguous content or a novel label/referent (e.g., the instructions contained a word that was likely to be unfamiliar/novel to the participants, for example, "Place the azure balloon in the sky." p., 219). Results revealed statistically significant differences between the FXS and DS groups and the TD group. Participants with FXS and DS were observed to produce repair requests significantly less frequently than children matched on mental age. On average, participants in the FXS and DS groups produced repair requests for 30% of opportunities; whereas, TD/MA-matched children produced repair requests for 70% of opportunities. Males with FXS requested repair significantly less frequently than females. Across the three groups, participants requested repair most frequently following incompatible instructions compared to instructions that were ambiguous or contained a novel referent. Following ambiguous and unfamiliar/novel-referent instructions, children with FXS and DS requested repair significantly less frequently than the TD children. Following incompatible instructions, there were no statistically significant between group differences the frequency of repair requests. Across the three groups, receptive language abilities were significantly and positively related to the production of repair requests. Expressive language abilities, nonverbal cognitive skills and performance on a theory of mind assessment were not significantly related to the production of repair requests.

In a longitudinal study, Thurman et al. (2017) examined repair requests produced by 36 male children with FXS, 16 female children with FXS, and 46 TD children matched on non-verbal mental age. The TD group mean chronological age (CA) was 4

years; 7 months, FXS male group mean CA was 12 years; 9 months, and FXS female group mean CA was 12 years; 1 month. At the first time-point, the mean IQ standard scores (based on Leiter-R*)* for the TD group was 116.35 (*SD* = 15.58), for the male FXS group was 46.44 (*SD* = 9.11) and for the female FXS group was 69.00 (*SD* = 15.69). The groups did not demonstrate statistically significant differences in the range of their non-verbal IQ growth scores over the course of the study.

The authors utilized a referential communication task (modeled after Abbeduto et al., 2008) to provide opportunities for participants to request communicative repair. Results demonstrated that children with FXS requested repair across significantly fewer opportunities than TD children matched on non-verbal mental age. Moreover, Thurman et al. demonstrated that TD children demonstrated growth over time; producing, on average, one additional repair request per year over a 4-year period. However, the rate of change over time for males with FXS did not differ significantly from zero. Results also suggested non-verbal IQ to be a significant, unique contributor to the production of repair requests. Receptive language abilities (as indexed by Peabody Picture Vocabulary Test-3rd edition; Dunn & Dunn, 1997) were not a significant contributor to the predictive model.

The aforementioned studies presented mixed results regarding the relationship between participant level variables such as IQ, and receptive and expressive language, and the production of repair requests. Evidence suggests the absence of a significant link between cognitive status and repair requesting among children with ID (Abbeduto et al., 1991; Abbeduto et al., 1998; Abbeduto et al., 2008).

There is some evidence suggesting a link between expressive language and repair requesting among children with ID (Abbeduto et al., 1998). However, in Abbeduto et al. (1997) and Abbeduto et al. (2008) expressive language skills were not a significant predictor of repair requesting for children with ID or their TD peers matched by mental age.

Results from Abbeduto et al. (1997) and Abbeduto et al. (2008) suggest that receptive language abilities are an influential variable in the production of repair requests among children with ID, including children DS and FXS who also have ID. However, other studies have failed to demonstrate the link between receptive language abilities and repair requests among children with ID (i.e., Abbeduto et al., 1991; Abbeduto et al., 1998; Thurman et al., 2017). There do not appear to be key methodological differences (for example, in the type of task that was implemented) that would potentially elucidate these mixed findings. Thus, there remains work to be done to fully understand the influence of participant level variables on the production of repair requests among children with ID.

In addition to examining repair requests among children with ID, it may also be useful to describe repair requests among children with WS. Similar to children with ASD, children with WS experience pragmatic difficulties, including responding appropriately to their social partner's questions and providing sufficient information to maintain a conversation (see Stojanovik, Perkins, & Howard, 2006) as well as delayed theory of mind development (Tager-Flusberg & Sullivan, 2000) and difficulties with social relationships (e.g., Sullivan, Winner, & Tager-Flusberg, 2003).

Children with Williams syndrome. Evidence suggests that children with WS request repair (John et al., 2009) and that children with WS may not differ from their peers matched on verbal mental age in the number of repair requests produced, although they may produce fewer repair requests than their peers matched on chronological age (Skwerer et al., 2013). John et al. (2009) examined the communicative repair requests of 57 children with WS (mean age = 9 years; 2 months). The participants' Kaufman Brief Intelligence Test (KBIT; Kaufman & Kaufman, 1990) mean IQ score was 72.93 (range: 47-110) and Peabody Picture Vocabulary Test-3rd Edition (PPVT; Dunn & Dunn, 2004) mean score was 81.96 (range: 50-115). In addition to the standardized language and cognitive testing, the participants completed a first-order false belief theory of mind task and this was scored as Pass/Fail. Sixteen (34%) of the participants passed the theory of mind task. The participants completed a referential communication task (modeled after Abbeduto et al., 2008). During the task, the researcher presented both informative and insufficient verbal instructions. Three types of insufficient instructions were implemented: impossible, ambiguous, and unfamiliar referent. The researchers recorded whether the participant verbally signaled whether there was something wrong with the instructions.

Results revealed that children with WS signaled there was a problem for 45% of insufficient instructions and were significantly more likely to request repair after hearing impossible instructions, followed by instructions containing an unfamiliar word, followed by ambiguous instructions. Performance on the theory of mind assessment was significantly and positively related to participants' spoken signaling of a problematic

message. Participants' KBIT IQ and PPVT scores were significantly related to their repair requests following impossible instructions, but not for ambiguous or those containing an unfamiliar referent. Limitations of this study include lack of a standardized, norm-referenced measure of expressive language ability and no comparison group of TD children.

Skwerer et al. (2013) examined the verbal clarification requests produced by children with WS (mean CA = 8 years; 6 months) and included two comparison groups, a group of TD children matched on verbal mental age (mean CA = 5 years; 3 months) and a group matched on chronological age (mean CA = 8 years; 0 months). Participants completed a referential communication task in which the researcher provided 16 directives that instructed the participant how to build a small scene using small toy objects. Half of the directives contained a non-unique/ambiguous referent, providing an opportunity for the participants to request clarification. The task was played in two waves, with the sufficient and insufficient opportunities distributed between the two waves. This allowed the researchers to examine potential within-participant learning effects.

Researchers measured both verbal requests for clarification and non-verbal requests for confirmation (i.e., holding up a potential referent and looking at the examiner). Results revealed significant differences in the frequency of clarification requests, such that children with WS requested clarification less frequently than the group matched on chronological age. There were no differences between the children with WS and children matched on verbal mental age. Both TD comparison groups used more

verbal requests for clarification compared to WS group; the children with WS used more nonverbal confirmation strategies. Evidence suggests that although children with WS request repair (John et al., 2009) and may not differ from their peers matched on verbal mental age in the number of repair requests produced (Skwerer et al., 2013), they demonstrate delays relative to their same-age peers and produce less sophisticated repair strategies (Skwerer et al., 2013). Taken together, these results suggest repair requests represent an area of social communicative weakness for children with WS, despite their relatively high social motivation. In addition to examining repair requests among children with WS, it is also helpful to describe repair requests among children with language impairments given shared pragmatic and structural language challenges similar to children with ASD.

Children with language impairments. Language impairment (LI; also referred to as specific language impairment [SLI] or primary language impairment [PLI]) has been generally diagnosed based on the presence of language deficits (within one or more language domains) in otherwise TD children (see Schwartz, 2009), although difficulties with attention, processing speed, and memory have been empirically documented (for a review, see Windsor & Kohnert, 2009) suggesting broader neurodevelopmental differences. Children with specific language impairment have been shown to demonstrate poor social skills (e.g., Fujiki, Brinton, & Todd, 1996) and difficulties participating in ongoing interactions (Brinton, Fujiki, Spencer & Robinson, 1997) and their social pragmatic weaknesses are not entirely accounted for by structural language challenges (Marton, Abramoff, & Rosenzweig, 2005). Given shared social communicative

weaknesses, understanding repair requests among children with language impairments (LI) may further contextualize repair requests among children with ASD.

Observational studies suggest that children with LI with language impairments tend to produce fewer requests for clarification in both dyadic play-based interactions with peers (Brinton & Fujiki, 1982) and child-adult structured play-based interactions (Lee, Kahmi and Nelson, 1983). Brinton and Fujiki (1982) examined the use of requests for clarification produced during 20-min play-based interactions between peer dyads. Dyads were composed of either two TD children or two children with language difficulties. Participants (n = 12) ranged in ages from 5 years; 6 months to 6 years; 0 months and were partnered with a language-similar peer to form a dyad. Children with language difficulties were described as delayed by at least one year on the Carrow Elicited Language Inventory (Carrow, 1974) with additional syntactic difficulties during spontaneous language production. Standardized and/or criterion-referenced (e.g., mean length of utterance [MLU], cognitive and comprehension) scores were not presented. Participants in the TD dyads produced three times as many requests for clarification compared to the dyads that had children with language difficulties. This outcome suggested that TD children were more likely to initiate repairs during play-based activities with peers than children with LI.

Although there is some evidence suggesting children with LI demonstrate weaknesses in repair requests (Brinton & Fujiki, 1982; Leinonen & Letts, 1997; Merrison & Merrison, 2005), a number of studies have not found differences between children with language impairments and their same-age peers (Fey & Leonard, 1984) or their younger

peers matched on language abilities (Leonard, 1986). Fey and Leonard (1984) examined the request repairs of children with SLI in conversations with three different social partners. Participants included six, 4- to 6-year-old children (mean age = 5 years; 4 months) who demonstrated average cognitive skills and expressive language skills were at or below the 10th percentile based on their Developmental Sentence Score (Lee, 1974). Average MLU for the SLI group was 4.44 (range: 3.49 – 5.36). Six TD age-matched peers (mean age = 5 years; 1 month) and six TD language-matched children (mean age = 3 years; 1 month) also participated. The average MLU was 6.66 for the age-matched group and 4.62 for the language-matched children. Participants completed three unstructured, play-based interactions with three separate social partners: an adult partner, a similar-aged peer, and a toddler partner. The interactions took place in a small playroom that contained a standard set of toys. Each interaction lasted 12 – 31 min, a range that allowed the researchers to derive 50 socially directed, self-initiated utterances from each partner from each interaction. Results revealed no statistically significant differences between the SLI group and age-matched peers in the proportion of partner utterances followed by requests for repair. Moreover, the two groups demonstrated a similar pattern across their conversations with the three social partners, and this interaction effect was statistically significant; both children with SLI and age-matched peers produced the greatest proportion of requests for repairs following utterances produced by their toddler partner. Their proportion of requests for repairs was smallest following utterances produced by their adult partner. Given difficulties with the younger, language-matched children participating in the interactions, three participants were

excluded from analyses and statistical comparisons that included this group were not performed. Limited descriptive data were presented. The descriptive results suggest that the language-matched children produced a greater number of repair requests compared to the two other groups, however, the authors note these data were heavily skewed by one participant who produced repair request following approximately 30% of his social partner's utterances. The language-matched children produced a greater proportion of repair requests during the interaction with the toddler partners compared to the adult partner.

Leonard (1986) examined the replies TD children aged 1 year; 5 months to 1 year; 11 months (n = 10) and children with LI aged 2 years;10 months to 3 years; 6 months (n = 10) produce following adults' interrogative (i.e., questions) and non-interrogative (i.e., comments) utterances. The LI group demonstrated nonverbal IQ standard scores at or above 85 on the Leiter International Performance Scale (Arthur, 1952), expressive language at least 1 year below their chronological age as indexed by the Verbal Ability subtest of the Preschool Language Scale (PLS; Zimmerman, Steiner, & Evatt, 1969), and receptive language abilities approximately 6 months below their chronological age based on the Auditory Comprehension subtest of the PLS. Leonard found that children with LI produced a greater number of requests for clarification during unstructured interactions with a familiar adult compared to the number of requests for clarification produced by TD younger peers who were matched on expressive language ability. Data were analyzed descriptively. Descriptive results revealed that TD children used a greater proportion of imitative utterances following adults' interrogative utterances compared to children with

LI. Children with LI were observed to use a wider variety of utterance types (i.e., affirmations, expansion) following adults' non-interrogative utterances, a greater proportion of requests for clarification (following both adults' questions and comments), and were more likely to respond to adults' utterances even when a verbal response was not required (e.g., expanding upon an adult's utterance).

It is important to note a primary limitation of the observational studies of repair requests among children with LI (e.g., Brinton & Fujiki, 1982; Fey & Leonard, 1984; Leonard, 1986; Porter & Conti-Ramsden, 1987). These studies did not directly examine the conditions related to the production of requests for communicative repair. From the published evidence of observational studies, it is difficult to draw cross-study conclusions given differences in contextual variables that may influence repair requests. For example, in Brinton and Fujiki (1982), the dyads consisted of pairs of children from the same kindergarten classroom, thus they may be considered familiar social partners (at a minimum have likely had experience interacting with one another) while the dyads utilized by Fey and Leonard (1984) consisted of unfamiliar social partners.

In summary, there is a modest literature of studies directly assessing the communicative repair requests among children with neurodevelopmental disabilities. Given the limited evidence related to children with ASD, the previous sections have focused on children with ID, including FXS and DS, WS, and language impairments given shared challenges with social communication and risk for experiencing communication breakdowns. The results of these studies present a mixed picture with respect to production of repair requests. Some evidence suggests that children with ID,

including DS and FXS, produce fewer repair requests than peers matched by mental age (Abbeduto et al., 1991; Abbeduto et al., 2008); however, other studies have not revealed significant group differences in total repairs (Abbeduto et al., 1997; Abbeduto et al., 1998), but suggest qualitative differences in the types of repair request strategies that children with ID produce (Abbeduto et al., 1997).

Evidence suggests that children with WS request repair (John et al., 2009) and that children with WS may not differ from their peers matched on verbal mental age in the number of repair requests produced, although they may produce fewer repair requests than their peers matched on chronological age (Skwerer et al., 2013).

Among children with language impairments, the evidence is mixed, with some studies suggesting that children with language impairments tend to produce fewer and less sophisticated repair requests than TD peers (i.e., Brinton & Fujiki, 1982; Leinonen & Letts, 1997; Merrison & Merrison, 2005), while other studies have not found differences between children with language impairments and their same-age peers (Fey & Leonard, 1984) or their younger peers matched on language abilities (Leonard, 1986).

In light of this mixed evidence, and the limited available data specific to children with ASD, there remains work to be done to fully understand repair requests among children with neurodevelopmental disabilities. Just as in the literature related to TD children, this includes a more comprehensive understanding of how potentially influential participant level variables, for example, theory of mind development, influence the likelihood of the production of repair requests. Thus, the next section will review: theory of mind development among children with ASD, the empirically established link between

theory of mind development and real-time social interactions (e.g., Peterson et al., 2016), and the potential link between theory of mind development and repair requests among children with neurodevelopmental disabilities, including children with ASD.

Theory of Mind, Repair Requests, and Children with ASD

Children with ASD demonstrate weakness in their theory of mind and these weaknesses have been used to help explain the behavioral and communicative profiles of children with ASD (seminal work by Baron-Cohen et al., 1985, see also Baron-Cohen, Tager-Flusberg, & Cohen, 1994). To date, consensus has not been established regarding a unified theory that explains the social-behavioral phenotype of autism. There are several theories that have been widely discussed in the literature (e.g., Central Coherence Theory; Frith, 1989; executive dysfunction; Russell, 1997; Theory of Mind; Baron-Cohen et al., 1985). Given the emerging evidence related to TD children's theory of mind development and communication repair behaviors (e.g., Bosco et al., 2006; Bosco & Gabbatore, 2016; Sidera, et al., 2016), theory of mind development in children with ASD will be explored along with its potential implications for communicative repair behaviors.

Studies that have examined theory of mind development in children with ASD suggest delayed acquisition (e.g., Happé, 1995) as well as links between performance on theory of mind tasks and language and cognitive skills (for a review; see Baron-Cohen, 2000, see also Kimhi, 2014). Happé (1995) noted that although there is performance variability in children with ASD on false belief tasks, a "minority" of children with ASD are likely to pass; whereas TD children are very likely to pass first-order false belief tasks by age 4 years (see Wellman & Liu, 2004; Wimmer & Perner, 1983), children with ASD

have been shown to require a significantly higher verbal mental age to pass false belief tasks (i.e., Smarties task and Sally-Ann task; Happé, 1995). It is important to consider that, when examined longitudinally, children with ASD demonstrate growth in their theory of mind development (see Steele et al., 2003).

Although there is not a "one-to-one" mapping between success on theory of mind tasks and performance during social interactions, they appear to be interrelated (see Waugh & Peskin, 2015). Among children with ASD, theory of mind skills have been shown to positively correlate with caregiver report measures of adaptive behavior (Frith, 1994) and difficulties with theory of mind tasks has been shown to be related to difficulties with social interactions with language abilities moderating this relationship (Peterson et al., 2016).

There is a small evidence base examining the link between theory of mind and discourse development in children with ASD (e.g., Capps et al., 1998; Hadwin, Baron-Cohen, Howlin and Hill, 1997; Hale & Tager-Flusberg, 2005). The results of research in this area is mixed, with some studies suggesting a link between skills associated with theory of mind and conversational skills (Hale & Tager-Flusberg, 2005) while other studies have failed to demonstrate this link (e.g., Capps et al.,1998; Hadwin et al., 1997).

Hale and Tager-Flusberg (2005) examined the relationship between performance on theory of mind tasks and discourse skills in a heterogeneous (in terms of IQ and language skills) group of children with ASD aged 4 -13 years. Participants in this study completed a battery of criterion-referenced assessments designed to measure theory of mind (i.e., unexpected contents false belief, location change false belief, lies and jokes).

Additionally, they completed standardized measures of expressive (Expressive Vocabulary Test; Williams, 1997*)* and receptive language (Peabody Picture Vocabulary Test-3rd edition; Dunn & Dunn, 1997). Cognitive status was measured using the Differential Abilities Scale (Elliot, 1990). Finally, the participants were recorded engaging in an unstructured 30 min session with a familiar adult. A standard set of toys was available during the unstructured session as well. The primary dependent measure used to index children's conversation abilities was proportion of contingent utterances (i.e., utterances following their social partner's communicative bid that maintained the topic of discourse) during the unstructured session. Results suggest that theory of mind performance contributes unique variance, above and beyond language and IQ status, to children's ability to maintain a conversation with a familiar adult during unstructured play.

Other studies have failed to demonstrate a link between theory of mind performance and conversation skills. Hadwin, et al. (1997) examined the relationship between performance on theory of mind (i.e., emotion and mental state) tasks and conversational skills in children with ASD. Participants were 30 children with ASD who were between ages 4 years and 13 years (mean CA = 9 years; 2 months) and demonstrated expressive language skills (measured by the Expressive One Word Picture Vocabulary Test; Gardner, 1979) and verbal mental age (assessed using the Test for Reception of Grammar; Bishop, 1989) between 2 and 4 years below their chronological age. Participants were assigned to one of three intervention groups. Each group received intervention targeted toward three different areas: understanding emotions, understanding

beliefs, and developing play. The study used a pre/post-test design with eight, consecutive daily, 30 min intervention sessions in between the pre- and post-test measures.

Results revealed that post intervention children with ASD learned to pass tasks designed to assess others' states of emotions and beliefs. The groups that received intervention related to understanding emotions and understanding beliefs demonstrated statistically significant gains in performance on the theory of mind battery pre- to post-intervention. The group that received intervention designed to increase their play skills demonstrated increases in their performance on the theory of mind battery, however, the difference was not statistically significant.

The participants did not increase their conversation skills during a semi-structured social communication task in which they narrated a story with a caregiver. Specifically, none of the intervention groups demonstrated significant differences in their conversational skills or their use of emotion words. Hadwin et al. suggested several possible explanations for lack of increase in real time social interactions. It may have been that the participants with ASD failed to generalize their newly acquired understanding of beliefs and emotions to more socially complex interactions (compared to single questions related to emotion words and others' beliefs). The results fail to support a strong link between performance on structured false belief tasks (and intervention designed to increase children's abilities to pass these types of tasks) and increases in real time interactions with others.

Capps et al. (1998) suggested the absence of a unique link between theory of mind and conversation skills in children with ASD. They demonstrated that after controlling for language skills, the relationship between theory of mind and conversation skills was not significant. Participants in this study were 15 children with ASD (mean CA = 11 years; 10 months) and 15 children with developmental disorders (mean CA = 9 years; 5 months). The groups were matched according to their expressive and receptive language abilities indexed by scores on the Clinical Evaluation of Language Fundamentals-Revised (Semel, Wiig, & Secord, 1987) and their cognitive skills. Both groups demonstrated IQ scores approximately 1 SD below the mean and an average "language age" at a 6-year-old level. Participants completed a battery of theory of mind assessments, including unexpected-contents task and location-change task, as well as a 6 min conversational sample with a clinician. Dependent variables included the proportion (of the total number of questions and comments the participant had received) that were coded as "no response", provision of new information/topic maintenance, or repetition of clinician's utterance. Results revealed that for children with ASD, theory of mind performance was significantly and positively correlated with children's language status as well as with their use of topic maintenance behaviors (i.e., providing contingent and relevant new information to a conversation). However, after controlling for language skills, the relationship between theory of mind and providing relevant, new information to a conversation was no longer statistically significant. Among children with developmental disabilities, the relationship between theory of mind performance and language status was not statistically significant. Furthermore, for children with

developmental disabilities, the relationship between theory of mind performance and topic maintenance behaviors was not statistically significant.

Peterson et al. (2016) found similar results when examining the relationship between theory of mind development in children with ASD ages 5 - 12 years and social competence (as reported by teachers). For TD children, after controlling for language status and age, Peterson et al. found a significant positive relationship between theory of mind development and teacher-reported social competence. For children with ASD, after controlling for age and language status, children's performance on theory of mind tasks did not contribute significantly to their scores on a teacher-reported social competency measure. It is important to consider that Peterson et al. used the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997), a measure of receptive language ability, and specifically, semantic knowledge. A more comprehensive expressive and receptive language measure would have perhaps provided a more robust picture of language status for both children with ASD and TD children.

With respect to communication repair among children with neurodevelopmental disabilities, few studies examining repair requests have included a measure of theory of mind development and these studies present a mixed picture with respect to the link between repair requests and theory of mind. Abbeduto et al. (2008) did not find an effect of theory of mind performance (utilizing first- and second-order false belief tasks) on repair requests produced by persons with FXS, persons with DS, and TD children. However, the results of John et al. (2009) demonstrated that pass or fail performance on a first-order false belief task was a significant predictor of the likelihood of signaling the

presence of a problematic verbal instruction among children with WS. While the results of John et al. suggest a link between theory of mind performance and signaling of problematic instructions within a structured task, it remains unclear how children with a different social behavioral profile and unique challenges in understanding social interactions, like children with ASD, would perform.

To date, no studies have examined the link between repair requests and theory of mind among children with ASD. Children with ASD may demonstrate atypical performance patterns on tasks that require social initiation, particularly, when they do not understand their communicative partner and are presented with an opportunity to request communicative repair. Instead of initiating a repair request, they may allow the communication breakdown to persist or may demonstrate an idiosyncratic verbal or non-verbal behavior as a means to repair. If they implement a less conventional communicative form as a means to repair, their social partner may not recognize their communication as a repair. Increased understanding of repair requests among children with ASD, and the link between repair requests and theory of mind development, may increase our ability to design interventions targeted to this potential social communication weakness.

Summary

This literature review has examined repair requests among TD children, children with ASD, and children with neurodevelopmental disabilities whose cognitive and behavioral profiles and risk for communication breakdowns may inform our understanding of repair requests among children with ASD. Evidence suggests that TD

children begin to produce requests for communicative repair between ages 2 and 3 years (Aviezer, 2003; Pea, 1982; Revelle et al., 1985) and development continues throughout the early school years (Beal & Belgrad, 1990; Bonitatibus, 1988; Flavell et al., 1981; Morisseau et al., 2013; Patterson, et al., 1981), although there is some evidence to suggest a lack of a developmental effect in children's productions of repair requests (Walters & Chapman, 2000). Studies have demonstrated there are a number of influential variables in children's productions of repair requests including the type of insufficient opportunity presented (Beal & Belgrade, 1990; Markman, 1979; Walters & Chapman, 2000) and the social context (i.e., relationship between social partners; McDevitt, 1990). There remain many unexplored variables that may influence our understanding of children's repair requests. There is limited empirical evidence related to the relationship between the function of communicative bid implemented (that creates the opportunity for repair) and the likelihood of repair requests. Moreover, the link between theory of mind development and repair requests among TD children remains unclear.

This review showed that few studies have examined repair requests among children with ASD, despite increased risk for communication breakdowns (Keen, 2003). Increased understanding of repair requests may increase our ability to design ecologically-valid interventions targeted to this potential social communication weakness. Martin et al. (2017) demonstrated that school-age children with FXS-ASD demonstrated significantly reduced rates of repair requesting compared to TD peers, children with ASD-O, and children with FXS-O. However, Martin et al. did not include a measure of theory of mind development, which may be an important variable to consider

given that, among children with ASD, difficulty with theory of mind tasks has been shown to relate to difficulty with social interactions with language abilities moderating this relationship (Peterson et al., 2016). There is a need to better understand repair requests among children with ASD as well as the link between theory of mind development and the production of repair requests.

Chapter 3

The Current Project

This project examined repair requests among 4-year-old TD children and 4-year-old children with ASD as a function of type of insufficient communicative opportunity, either obligatory or non-obligatory, and examined the relationship between repair requests and performance on a theory of mind task (ToM task). There were two primary aims of the project and they were addressed through separate studies, Study One and Study Two.

Study One

The purpose of Study One was to examine how 4-year-old TD children produce repair requests following insufficient obligatory and non-obligatory communicative opportunities within the context of a shared book reading activity and to examine the relationship between 4-year-old TD children's performance on a ToM task and their productions of repair requests. The research questions were:

RQ1: Do 4-year-old TD children differentially request repair following obligatory compared to non-obligatory insufficient opportunities during a shared book reading activity?

Prediction: It was predicted that 4-year-old TD children would produce a greater number of repair requests following insufficient obligatory opportunities compared to insufficient non-obligatory opportunities. There is some evidence that children may produce requests for repair in non-obligatory communicative contexts (Webber et al., 1984); however, empirical evidence is limited. While obligatory opportunities

intrinsically carry a stronger social expectation to respond in a particular way (i.e., requests for information carry the expectation that the responder will provide information), non-obligatory opportunities allow more degrees of freedom to whether and how the child responds. Given the greater degree of freedom in response, repair requests may occur less frequently following non-obligatory compared to their occurrence following obligatory opportunities. Another potential source of variation in repair requests following obligatory and non-obligatory opportunities may be children's ability to discriminate between these types of opportunities. Lack of discrimination between types of opportunities may yield similar repair rates across the two types.

RQ2: What is the form of repair strategies that TD participants produce following insufficient obligatory and non-obligatory opportunities?

Prediction: It was predicted that children would demonstrate use of the four different types of repair requests (i.e., general requests for clarification or repetition, requests for specific information, statements specifying the insufficiency, and general statements indicating lack of comprehension). A common hierarchy of repair behaviors has not been established and often repair behaviors are collapsed into one broad category for analysis (e.g., non-comprehension signals, Abbeduto et al., 2008). Given the lack of evidence related to repair requests following insufficient non-obligatory opportunities, it was difficult to predict differences in response form between obligatory and non-obligatory opportunities.

RQ3: Are there differences between number of repair requests that TD participants produce following insufficient opportunities that contain an ambiguous referent compared to insufficient opportunities that contain a missing referent?

Prediction: It was predicted there would not be differences in the number of spoken repairs children produce following insufficient opportunities that contain a missing referent compared to insufficient opportunities that contain an ambiguous referent. The two types of insufficient opportunities (ambiguous reference and missing referent) used in this study have been collapsed into a broader category—inadequate content—in other studies (i.e., Walters & Chapman, 2000). Given this, differences in number of repair requests following opportunities with missing compared to ambiguous referents were not anticipated.

RQ4. Are there differences in the number of total repairs that children who pass a ToM task produce compared to those who fail a ToM task?

Prediction: It was predicted that children who pass a ToM task would be more likely to produce repairs compared to children who do not pass the ToM task. Recent studies rooted in Cognitive Pragmatics suggest a positive relationship between TD children's development of theory of mind and their abilities to recognize and repair communication failures (see Bosco et al., 2006; Bosco & Gabbatore, 2016).

RQ5. How do demographic (i.e., household income, maternal educational level) and participant level variables (i.e., age, IQ, communication abilities) relate to children's productions of repair requests?

Prediction: The majority of available evidence suggests the absence of a significant link between receptive language abilities and repair requests (e.g., Abbeduto et al., 1991; Abbeduto et al., 1998; Walters & Chapman, 2000) and IQ and repair requests (Abbeduto et al., 1998) among TD children. Although at least one study found a statistically significant relationship between receptive language abilities and repair requests (Abbeduto et al., 2008), it was predicted that expressive and receptive communication abilities and IQ would not be significantly related to repair requests. Given the narrow age range of children included in the study, age-related differences were not predicted. Studies that have demonstrated differences in the production of repair requests between younger and older children have relied on age-groups that differ by at least two years (e.g., Markman, 1979; Morisseau et al., 2013). Given the narrow age range of children, chronological age was not anticipated to be a significant variable in the production of repair requests.

To date, there is little evidence related to the relationship between household income, maternal education level, and repair requests. It is important to note that household income (and socioeconomic status) and maternal education are likely to co-vary but are not necessarily proxies for one another (see Braverman, Cubbin, Chideya, Marchi, Metzler, & Posner, 2005 for a discussion).

Although an increasing number of studies focused on children's language have reported information related to socio-economic status (SES), they vary widely in the metrics used to capture SES and approximately 25% of studies do not report this information (Inglebret, Bailey, Clothiaux, Skinder-Meredith, Monson, & Cleveland,

2017). For example, Thurman et al. (2017) included maternal education as descriptive information but did not examine this variable's relationship to repair requests. Thurman et al., did not include descriptive information about SES. It may be noted that there are empirically established positive relationships between SES and language development (e.g., vocabulary knowledge, see seminal work by Hart & Risley, 1995; see also Ingebret et al., 2017), and that, more broadly, SES has been linked to multiple areas of children's development (for a review, see Bradley & Corwyn, 2002). It may be logical to anticipate a positive relationship between SES and/or maternal education and repair requests, yet given the limited number of studies examining repair requests and limited descriptive information characterizing participants in terms of SES and maternal education, it is difficult to hypothesize about how these variables may influence the likelihood of children demonstrating use of this skill.

Study Two

The purpose of Study Two was to pilot a shared book reading task designed to provide opportunities for children to initiate communicative repairs following insufficient obligatory and non-obligatory opportunities on a small group of 4-year-old children with ASD, to descriptively examine their repair requests following these two types of opportunities, and to descriptively examine the relationship between performance on a ToM task and productions of repair requests. The research questions are:

RQ1: Is the shared book reading task a feasible method to examine repair requests among children with ASD whose expressive and receptive communication abilities fall within an average range? What percentage of participants are able to complete the task?

Prediction: It was predicted that the shared book reading task would be a feasible method for examining repair requests among children with ASD whose expressive and receptive language skills are within an average range. While the shared book reading task is a novel method to measure repair requests among children with ASD, a number of the task's features support feasibility. These include: a short amount of time required to implement, a clear turn-taking structure (i.e., researcher reads book, child listens to book and is presented with researcher's questions/comments related to the book), and the storybook served as a familiar format to the preschool-age population.

RQ2: Do participants with ASD differentially request repair following obligatory compared to non-obligatory opportunities?

Prediction: It was predicted that children with ASD would have difficulty initiating communicative repair requests. It was also predicted that there would be no differences in repair requests produced following insufficient obligatory compared to non-obligatory opportunities, given the inherent challenges with perspective-taking and social initiation among children with ASD (see Baron-Cohen et al., 1985; Jameel et al., 2014; Mundy & Stella, 2000; Waterman, et al., 1981; Weiss & Harris, 2001).

RQ3: Do participants with ASD who pass the ToM task initiate a greater number of repairs than participants with ASD who fail the ToM task?

Prediction: It was predicted that children with ASD who pass the ToM task would be more likely to produce repair requests compared to children with ASD who do not pass the ToM task. While some studies have failed to demonstrate a unique link between theory of mind performance and repair requests (e.g., among children with FXS and DS;

Abbeduto et al., 2008), there is other evidence suggesting a link between theory of mind performance and repair requests (e.g., among children with ID; Abbeduto et al., 1997; Abbeduto et al., 1998; and among children with Williams syndrome; John et al., 2009). Children with ASD may demonstrate atypical performance patterns on tasks that require social initiation, for example, when they do not understand their communicative partner and are presented with an opportunity to request communicative repair. In order for repair requests to be successful (i.e., to mitigate or eliminate the misunderstanding within the interaction), a speaker may have to craft their repair based on their understanding of their social partner's knowledge. That is, the repairer may have to understand the conversation and account for their social partner's perspective (which may differ from their own). Thus, children's abilities to understand another person's perspective (i.e., theory of mind development) may be a positive predictor of repair requests. Available evidence suggests a positive relationship between performance on theory of mind tasks and pragmatic discourse development in children with ASD (e.g., maintenance of topics during conversation; Hale & Tager-Flusberg, 2005, narrative discourse; Losh & Capps, 2003). It is unclear how children who may demonstrate difficulties with theory of mind (i.e., children with ASD) produce communicative repair requests or how performance on theory of mind tasks influences the likelihood of *producing* repairs during social interactions.

RQ4: Are there clear patterns among participants with ASD who were categorized as *repairers/non-repairers* with respect to age, IQ or expressive and receptive communication skills?

Prediction: It was predicted that there would be a positive relationship between expressive and receptive communication abilities, and IQ, and repair requests among children with ASD. There is mixed evidence related to the relationship between expressive and receptive language, and IQ, and repair requests among children with neurodevelopmental disabilities. Some evidence suggests a link between expressive language and repair requesting among children with ID (Abbeduto et al., 1998), while other studies have failed to demonstrate this link (Abbeduto et al., 1997; Abbeduto et al., 2008). Results from Abbeduto et al. (1997) and Abbeduto et al. (2008) suggest that receptive language abilities are an influential variable in the production of repair requests among children with ID, including children DS and FXS who also have ID. However, other studies have failed to demonstrate the link between receptive language abilities and repair requests among children with ID (i.e., Abbeduto et al., 1991; Abbeduto et al., 1998; Thurman et al., 2017). Moreover, evidence suggests the absence of a significant link between cognitive status and repair requesting among children with ID (Abbeduto et al., 1991; Abbeduto et al., 1998; Abbeduto et al., 2008). Martin et al. (2017) noted that for children with ASD-O or FXS-O, higher receptive language and non-verbal cognitive skills may relate to repair request abilities similar to TD children. Given that Martin et al. is one of the only studies to include children with ASD, it was relied upon for driving the hypothesis of a positive relationship between expressive and receptive communication skills, and IQ, and repair requests among children with ASD.

Chapter 4

Study One

Method

Participants

Inclusion criteria. Participants included 25 TD children between the ages of 4 years; 0 months and 4 years; 11 months. Inclusion criteria were: (a) absence of history of language disorder or developmental delay as reported by parents, (b) vision and hearing status within normal limits or corrected to within normal limits, (c) monolingual English language backgrounds, (d) expressive and receptive communication and cognitive skills within a typical-range (i.e., no greater than 1 SD below mean), and (e) reciprocal social behavior not related to the clinical presentation of ASD. These criteria were established through the measures implemented in the study (detailed in a subsequent section).

Recruitment. Participants were recruited through the University of Minnesota Child Development Center (n = 12) and three community-based preschools/daycares (n = 16). These partner organizations distributed an IRB-approved consent form and parent letter to families with children likely to meet inclusion criteria. The parent letter broadly described the study and what participation would entail. The consent form provided detailed information about participation. Parents had the option to consent to particpate in the study, request to be contacted by the researcher, or decline participation. Both the parent letter and consent form encouraged families to ask questions, voice concerns, and contact the researcher for more information. The partner organizations collected returned

consent forms. Then, the researcher collected the forms from the organization and contacted families to discuss next steps and answer any questions.

Twenty-eight signed consent forms were returned with 25 completing the study. Two children did not complete the study. One child was outside of the age range for inclusion criteria and one child returned the consent form after data collection was complete. One participant was excluded from analyses because he scored greater than 1SD below the mean on the standardized, norm-referenced measure of IQ. One participant's parent reported she had started receiving private SLP services related to speech. She was included in the analyses given she was intelligible to an unfamiliar listener and scored within normal limits on the language measures.

Participant characteristics. Table 1 provides the TD participant demographic characteristics. Table 2 details the participants' characteristics related to IQ, expressive and receptive communication, and adaptive behavior.

Table 1

TD Participant Demographic Characteristics (*n* = 25)

Female:Male Ratio	13:12
Maternal Education	
High School	4%
College	32%
Graduate School	64%
Annual Household Income	
$0 - $25,000	-
$25,000 - $50,000	4%
$50,001 - $100,000	16%

$100,001 - $150,000	24%
$150,001 +	56%

Table 2

Participant Characteristics (n = 25)

Characteristic		
Age (months)		
	M	52.8
	SD	3.48
	Min-Max	48-59
Theory of Mind Performance		
	Pass: Fail	17:8
IQ Standard Score[a]		
	M	112.44
	SD	7.87
	Min-Max	100-132
Expressive Communication Standard Score[b]		
	M	115.8
	SD	13.72
	Min-Max	90-150
Receptive Communication Standard Score[b]		
	M	116.56
	SD	12.88
	Min-Max	88-140
Vineland Adaptive Behavior Composite[c]		
	M	109.56
	SD	10.78
	Min-Max	89-129

Note. These standardized, norm-referenced measures have $M = 100$ and $SD = 15$;
[a]*Kaufman Brief Intelligence Test – 2nd Edition;* [b]*Preschool Language Scale – 5th Edition;* [c]*Vineland Adaptive Scale-2nd Edition*

Procedural Overview

A University of Minnesota Institutional Review Board reviewed and approved all study procedures. Additionally, partnering organizations reviewed the study procedures prior to providing recruitment materials to potential participants. After receiving signed

consent forms, the researcher contacted parents to talk through the study procedures, provide time for families to ask questions, and if the family decided to move forward, schedule research sessions.

Participants completed the research protocol across two sessions lasting a total of 2 to 3 hours. During the first session, the participants completed standardized, norm-referenced and criterion-referenced assessments (detailed in a subsequent section). During the second session, the researcher administered a video recorded shared book reading task followed by any remaining assessment measures.

Setting

All research sessions took place at the participants' homes (n = 9) or preschools (n = 16) which represented familiar environments chosen by parents.

Materials

Shared book reading task materials included: the children's book, *The Bear Ate Your Sandwich* (Sarcone-Roach, 2015), a set of toy objects that related to the content of the book (i.e., four small plastic toy dogs approximately 3 in. tall, 1 in. wide, and three small fish approximately 2 in. long, and 1 in. wide), color pictures that related to the content of the book (i.e., four color lined drawings of boats and four color line drawings of trees, each on a separate 1.5 in. by 1.5 in. square laminated card), two 22 in. round rugs, and a Panasonic SDR-S50P/PC video recorder mounted on a tripod.

The book was selected because it was appropriate in thematic content and language for a preschool-age audience, sufficient length to reasonably accommodate the experimental opportunities that were embedded throughout, and had been recently

published. The final criterion was implemented to increase the likelihood that the participants were unfamiliar with the book. During the shared book reading task, the researcher and the child each sat on the round rugs that had been placed approximately 4 feet from the video recorder. This setup was standard across participants.

Measures

Parent-report measures. Participants' parents completed a short demographic and child history form. The researcher developed these forms (provided in Appendix A) modeled after demographic forms used in previous studies related to children's communication (e.g., Miller & Finestack, 2014). Demographic information obtained included: race, ethnicity, maternal education, household income, and child developmental history. In addition to the demographic and child history forms, parents completed two standardized parent-report measures, the Social Responsiveness Scale - 2nd Edition (SRS-2; Constantino & Gruber, 2012) and the Vineland Adaptive Behavior Scales - 2nd edition Parent Report Form (Vineland-2; Sparrow, Cicchetti, & Balla, 2005).

The SRS-2 is a rater-report measure of social behaviors in children and adults across three different age groups: preschool, school-age, and adult. The measure invites a caregiver or other familiar person (e.g., parent, teacher) to use 4-point Likert scale to rate reciprocal social behaviors. Examples of constructs that are covered include: repetitive behaviors, inflexibility, emotional connectedness, and appropriate play with others. Constantino (2012) reported strong internal consistency data ranging from .94 to .98 as well as strong ranges for coefficients for sensitivity (.84 to .93) and specificity (.91 to .94). Scores from the SRS-2 were used descriptively to characterize participants in this

study and to document that reciprocal social behavior (as reported by parents) was within a typical range. Scores on the SRS-2 that fall at or below 59 are generally not related to clinical presentations of autism spectrum disorder. Participants demonstrated scores on *SRS-2* within normal limits ($M = 45.72$, $SD = 5.35$).

The Vineland-2 is a parent report measure of child development across four developmental domains: communication, daily living skills, socialization, and motor skills. Internal consistency data, including moderate to strong test re-test reliability, ranged from .77 to .93. The Vineland-2 can be administered using one of two methods, a Survey Interview Form or Parent Report Form. An examiner administers the Survey Interview Form as a structured interview. Parents or caregivers directly fill out the Parent Report Form after the examiner provides instructions and background information. The Parent Report Form method was used in this study to provide maximal flexibility to parents as to when they could complete the form. Sparrow et al. (2005) report high correlations (range .75 to .92 for 3- to 5-year-olds) between the Parent Report Form and the Survey Interview Form. Scores on the Vineland-2 were used descriptively to characterize participants in this study.

Direct measures. All participants completed two standardized norm-referenced assessments: the Preschool Language Scales-5th Edition (PLS-5; Zimmerman, Steiner, & Pond, 2011) and the Kaufman Brief Intelligence Test – 2nd Edition (KBIT-2; Kaufman & Kaufman, 2004), and two criterion-referenced assessments: a first-order false belief task (modeled after Hogrefe et al., 1986; Tager-Flusberg & Sullivan, 2000) designed to measure theory of mind development (ToM task), and a metalinguistic probe. The

participants also completed a hearing screening to establish that their hearing was within normal limits. The participants' hearing was screened in a quiet room with pure tones at 1000Hz, 2000Hz, and 4000Hz at 20dB in each ear. All participants (with one exception) passed the hearing screening at this presentation level in both ears. One participant required 30dB presentation level at 1000Hz in his left ear. His mother reported he had tubes placed during his second year of life and believed he had fluctuating hearing status prior to that. She reported he recently passed his well-child hearing screening and that she had no concerns about his hearing status or his ability to participate fully in research sessions.

The PLS-5 is a measure of expressive and receptive communication skills for children ages 0 years; 2 months to 7 years; 11 months. Internal consistency data range from .93 to .97 for the Auditory Comprehension, Expressive Communication, and Total Language Composite scores for children 4 years; 0 months to 4 years; 11 months (Zimmerman et al., 2011). To be included in the study, participants had to score no lower than 1*SD* of the average standard score (100) on both Expressive Communication and Auditory Comprehension subscales. Scores were used descriptively to characterize the participants and the aggregiate group characteristics.

The KBIT-2 is a measure of verbal and nonverbal intelligence for individuals between the ages of 4 years; 0 months and 90 years; 11 months. Internal consistency data have been reported in the "acceptable" (p. 51) range with coefficients ranging from .78 to .94 across Verbal, Nonverbal and IQ Composite scores (Kaufman & Kaufman, 2004). To

be included in the study, participants had to score no lower than 1*SD* of the average standard score (100). Scores were used to characterize the participants.

The researcher audio recorded the administration of these assessments but determined basal and ceilings (using raw score performance) in real time. Subsequent to administration, standard scores were derived.

In addition to the standardized, norm-referenced measures, participants completed a criterion-referenced measure designed to assess theory of mind performance (ToM task). During the ToM task, the researcher presented a familiar container that contained unexpected contents (i.e., a crayon box containing paper horses). The researcher asked the participants, "What do you think is inside?" (*control question*). After providing the expected answer (i.e., crayons), the researcher showed the participant that there were paper horses inside the box. Then, the researcher closed the box and asked three additional questions: (a) "What is really in the box?" (*reality control question*), (b) "If I show the crayon box to your <insert mom/dad>, will s/he know what is in here?" (*ignorance question*), and (c) "What will s/he think is in the box?" (*false-belief question*). The *control* and *reality control* questions were not counted toward the score for the task. The *ignorance* and *false-belief* questions were scored as either 0 or 1. A pass score was assigned if participants answered the *false-belief* question correctly by indicating "crayons." The ToM lasted approximately 3 min. The materials used in the task included an empty 8 count Crayola® crayon box and a string of 12 red and green paper horses approximately 18 in. in length. Appendix B provides the script and data-recording sheet for the ToM task.

Participants also completed a metalinguistic probe. The metalinguistic probe was part of another research study designed to evaluate vocabulary and morphology metalinguistic skills (Finestack & Bangert, 2017). The metalinguistic probe took approximately 15 min to complete. Specific tasks in the probe included: a renaming task, a word swap task, a morpheme production task, and a grammatical judgment task. Table 3 provides examples of each of the tasks.

Table 3

Examples of Items within Each Metalinguistic Task

Task	Example:
Word Manipulation	Researcher presents picture of **carrot** and asks, *Could this be a "gok?" Yes, it could. What is this?* Researcher removes picture. ***Can you eat a gok?*** ***Do goks have wheels?***
Word Swap	Researcher asks child, *Suppose that everyone in the world agreed that from now on we will call a cat a dog and a dog a cat. All we are going to do is change the names.* Researcher shows picture of **dog.** **What would this animal's name be? _____. (cat)**
Morpheme Production	Researcher presents picture of **one bird-like animal**. *This is a wug /wʌg/.* Shows picture of **two bird-like animals**. *Now there is another one. There are two of them. There are two* _____. (wugs)
Grammaticality Judgement	*Child judges whether verbally presented sentences are grammatically correct:* ***The girl is look.*** ***Everyday my horse reads.***

Appendix C details the metalinguistic task protocol and experimental items. The materials used in the task included an iPad® with audio and visual stimuli items preloaded through the SlideShark® App.

Shared Book Reading Task

During the second session, the researcher engaged the participants in a structured, shared book reading activity. This activity provided a naturalistic context with

opportunities for social interaction (Vogler-Elias, 2009). During the shared book reading task, the researcher used a responsive style of interaction and followed the participants' attentional focus as much as possible within the boundaries of presenting the experimental opportunities. Thus, the researcher's language was systematically structured to create opportunities for the participants to initiate request for repair.

Communicative opportunities. During the shared book reading activity, the researcher provided 24 standardized communicative bids. Appendix D provides the script the researcher used to implement the opportunities. The bids were short utterances (average mean length of utterance in morphemes [MLUm] = 5.5) that related to the story, including characters, setting, and actions, within the book. Such communicative bids have been used to assess young children's emerging comprehension skills (see Paris & Paris, 2003; Skarakis-Doyle & Demspey, 2008). Table 4 presents each of the structured communicative bids organized by condition and type. The bids reflected one of two conditions, *insufficient* (IN) or *sufficient* (S). Twelve opportunities of each condition were delivered. Insufficient communicative bids provided an opportunity for the child to initiate a request for repair. Communicative bids were insufficient in one of two ways, either via a missing referent or ambiguous referent. Sufficient communicative bids provided a comparison to examine participants' overall responsiveness. The sufficient communicative bids were designed to be syntactically and morphologically similar the insufficient communicative bids.

Within each condition (IN and S), opportunities reflected one of two types, *obligatory* (O) and *non-obligatory* (NO*)*. The obligatory communicative type was a

request for information that the researcher initiated. The non-obligatory communicative type was a provision of information that the researcher provided. Thus, there were four different versions of bids: Insufficient Obligatory (IN-O; "What is the cat doing?"), Insufficient Non-obligatory (IN-NO; "I like this brown bear."), Sufficient Obligatory (S-O; "What is the butterfly doing?"), Sufficient Non-obligatory (S-NO; "Peanut butter and jelly is my favorite.").

Table 4

Structured Communicative Bids Presented During Shared Book Reading Task

	Condition	
Type	Insufficient	Sufficient
Obligatory	What is the cat doing? (MR)	What is the butterfly doing?
	Do you have the pencil? (MR)	Where is the bear climbing?
	Where is the car going? (MR)	Where is the bear going?
	What is that one doing? (AR)	What is the girl doing?
	Where is the green one? (AR)	What is the bear do/ing?
	What did the cat eat? (MR)	Who at the sandwich?
Non-Obligatory	I like this brown bear. (AR)	Peanut butter and jelly is my favorite.
	The bee is sleep/ing. (MR)	I like berries!
	The purple boat is my favorite! (MR)	The bear can hang upside down!
	This fish is very stinky. (AR)	The man has a silly bee costume!
	I like that one! (AR)	The bear is hiding!
	I love that one! (AR)	I love the black dog!

Note. MR = Missing Referent; AR = Ambiguous Referent

The presentation order was quasi-randomized across the shared book reading task. This was necessary because the opportunities were related to the story's narrative, thus could not be randomly presented across participants. Opportunities of the same condition-type (i.e., Insufficient Non-Obligatory) were never presented back to back. Additionally, opportunities from the same condition (Insufficient or Sufficient) were never presented

more than twice in a row and opportunities from the same type (Obligatory or Non-obligatory) were never presented more than twice in a row.

Shared book reading task procedures. After 1-2 min of unstructured conversation and/or play with toys that the child was familiar with (i.e., toys from their home or something they like to play with at the clinic), the researcher introduced the book and activity. Appendix D provides the scripted language used to introduce and guide the task. The researcher indicated that she and the participant were going to read a book together and that the child could help her answer some questions about the story. The researcher also introduced a set of standard materials (i.e., small toy bears and dogs that related to the story's plot). If during the activity, the participant initiated a request for repair, the researcher acknowledged the request by providing an appropriate response (e.g., additional information, repetition of the original utterance). If the child became disengaged in the task and/or wandered away, the researcher provided verbal redirection, using the rug as a cue (i.e., "Please come sit on the yellow circle and we'll finish up the book.") The shared book reading task was video recorded and the recordings were used to derive the data. The average time from the presentation of the title of the book to the examiner's closing question (i.e., "Have you ever seen a bear eat a sandwich") was 9 min and 26 s (range: 8 min 23 s - 12 min 33 s).

Coding

An undergraduate research assistant naïve to the purpose of the study or clinical diagnosis (i.e., ASD or TD) coded the recordings of the shared book reading task and completed fidelity monitoring across experimental sessions. Prior to coding the

participant video files, the research assistant completed the online *Basic Course for Social/Behavior or Humanist Research* offered through the Collaborative Institutional Training Initiative (CITI) Program. Then, the researcher trained the research assistant through direct instruction on each specific code, utilizing video examples. The researcher also utilized this training method with the research assistant in completing fidelity checks. The research assistant completed approximately 45 min of training with the researcher. Next, the research assistant independently coded one video file (i.e., one shared book reading task in its entirety) as well as a fidelity check for the same file. The researcher coded the training video file and calculated inter-rater reliability between the research assistant and the researcher for each individual code as well as the fidelity checklist. Reliability on the training file across individual codes ranged from 83.3% - 100%. The researcher and the research assistant met a second time to discuss instances of disagreement and used the coding manual as a reference. The researcher encouraged the research assistant to refer to the coding manual while coding instead of attempting to apply the codes from memory. Appendix E provides the coding manual.

The participants' verbal and nonverbal behaviors following both insufficient and sufficient communicative bids were coded using a pre-established coding scheme. Definitions were adapted from studies examining discourse management, comprehension monitoring, and communication repair (Brinton & Fujiki, 1984; John et al., 2009; Morisseau et al., 2013; Revelle et al., 1985). Participants' emission of repair requests was contingent upon and temporally linked to each insufficient opportunity. The first behavior emitted within 5s following the examiner's communicative bid was coded. The 5s

window of repair was selected based on previous and related studies that have used "online" tasks (i.e., children's comprehension monitoring skills and the Expectancy Violation Detection Task; Skarakis-Doyle & Dempsey, 2008). Table 5 provides a list of the codes that were used to measure spoken requests for repair following insufficient obligatory and non-obligatory communicative opportunities. Table 6 provides a list of codes used to capture participants' verbal and non-verbal behaviors following sufficient communicative opportunities. Appendix E provides the detailed coding manual with further operationalized definitions of each behavior and corresponding code.

Table 5

Definitions Used to Code Repair Requests across Insufficient Opportunities

Definition	Example
General request for clarification or repetition	"What?" or "Huh?"
Specific verbal request for clarification: Child provides specific information related to the nature or topic of the breakdown	"Which one?" "Where is the cat?"
Statement specifying the insufficiency or correction of error: Child verbally indicates something that was insufficient about the examiner's communicative bid	"I don't see a cat." "There's no car." "Not the bee, the bear."
General statement indicating lack of comprehension: Child verbally indicates that they do not understand the examiner's communicative bid.	"I don't know." "I don't understand."
Provision of information that matches or mirrors examiner's bid: Child expresses idea that is similar to examiner's communicative bid, may share information about their preference for something. The child may change the demonstrative pronoun or the referent	"I like that one, too!" Researcher: "I like the black dog." Child says: "I like the white dog."

Verbal provision of information, maintains or shades topic. Topics are considered to be maintained if the child acknowledges the clinician's utterance (e.g., Mmhmm), responds to a question directly or agrees with the clinician (e.g., "Okay."). Topics are considered to be shaded if some component of the previous utterance is maintained but slightly shifted the subject matter (see Brinton & Fujiki, 1984)	Researcher: "The bear is sleeping." Child: "But I can see his butt."
Provision of information, introduces new topic (e.g., child shifts to unrelated topic/subject). The "New Topic" code should be used when the child introduces a completely new topic without any part of the clinician's previous utterance/topic in what the child is now talking about.	Researcher: "The bear is sleeping." Child: "I like animal crackers."

Table 6

Definitions Used to Code Behaviors Following Sufficient Opportunities

Definition	Example
Provision of information, maintains or shades topic. Topics are considered to be maintained if the child acknowledges the clinician's utterance (e.g., Mmhmm), responds to a question directly or agrees with the clinician (e.g., "Okay."). Topics are considered to be shaded if some component of the previous utterance is maintained but slightly shifted the subject matter (see Brinton & Fujiki, 1984)	Researcher: "I like berries!" Child: "Mmhmm." Researcher: "What's the butterfly doing?" Child: "Flying." Researcher: "The bear is sleeping." Child: "But I can see his butt."
Verbal, Provision of information, new topic (e.g., child shifts to unrelated topic/subject)	Researcher: "Peanut butter and jelly is my favorite." Child: "I'm the oldest kid in my family."
Verbal, Request for information	Researcher: "What's the girl doing?" Child: "Where is the girl?"
Gaze check: Child shifts gaze from book toward examiner or from examiner toward book but does not hold gaze (up to 2 seconds)	Child's gaze moves back and forth between book and examiner or examiner and book

Sustained gaze on examiner: Child shifts gaze from book toward examiner and sustains gaze for more than 2 seconds	Child's gaze is on book, then shifts toward examine and continues looking at examiner
Sustained gaze on book or other task materials (i.e., pictures, toys): Child may be checking correspondence between communicative bid and the environment and/or attempting to make an inference	Child's gaze is on book and continues looking at book without changing gaze or providing a verbal response
Off-task behavior that begins immediately following examiner's bid	Child gets up from rug or makes non-speech noises or lays head on floor

Reliability and Fidelity

A second undergraduate research assistant naïve to the purpose of the study or clinical diagnosis of the participants coded 32% of the experimental sessions for reliability on the dependent variables and reliability on the fidelity coding. This research assistant was trained using the same methods as the first research assistant (detailed in previous section). Reliability was calculated for 14 individual codes. Reliability was computed by dividing the number of instances of agreement by the total number of opportunities and multiplying by 100. Reliability across individual codes ranged from 90.6% - 100%. This reliability was established after both research assistants had completed one training file (as outlined in previous section).

Procedural fidelity was completed for 100% of experimental sessions by the first research assistant. Procedural fidelity included a measure of item-by-item fidelity and general procedural. Item-by-item fidelity was derived by examining how each individual opportunity was presented. For each experimental opportunity, the first research assistant

coded whether (a) the opportunity was delivered in the correct order, (b) the child was attending to the examiner and/or book when the opportunity was implemented, and (c) the experimental opportunity was intelligible. Item-by-item fidelity was calculated by taking the number of accurately implemented experimental opportunities, for each for each fidelity item (i.e., correct order, attending to experimenter, intelligible) divided by the total number (24) and multiplying by 100. Item-by-item fidelity was 99.8% for items presented in correct order, 100% for participant attending to task, and 100% for intelligible opportunities.

General procedural fidelity was derived from a task analysis of eight broad components of shared book reading task: (a) researcher talks or plays with child during set-up, (b) researcher provides verbal instructions related to task, (c) researcher reads title of book, (d) researcher indicates book's author, (e) researcher asks the child a question to build interest in the story, (f) researcher provides verbal praise for child's attention to the task, (g) researcher follows child's attentional focus during off-script conversational turns (up to 3 turns), and (h) researcher closes book by asking a question relating book to child's life. The general procedural components were based on a dialogic book reading intervention task analysis reported by Rahn (2013). General procedural fidelity was calculated by dividing the number of accurately implemented task components by the total number (8) for each participant and multiplying by 100. General procedural fidelity across participants was 100%.

Design

A within-subjects experimental design was implemented to compare participants' productions of repair requests following obligatory and non-obligatory insufficient communicative opportunities. Between-subjects analyses were completed to examine the relationship between participant level variables (i.e., theory of mind performance, expressive and receptive communication abilities, IQ, and age) and the production of repair requests.

Independent variable. The function of the insufficient opportunity, obligatory (information request) or non-obligatory (information provision), served as the primary independent variable. Other independent variables included the type of insufficient information (missing referent versus ambiguous referent) and participant level variables (i.e., IQ, expressive and receptive communication skills).

Dependent variable. The primary dependent variable was the total number of spoken repair requests produced following the insufficient communicative opportunities. Performance on the ToM task was also examined as a dependent variable.

Data Analyses

Descriptive analyses were used to determine how participants responded to the sufficient communicative opportunities implemented throughout the book task. The sufficient opportunities served as control items to demonstrate engagement with the task and overall responsiveness to the examiner's communicative bids.

Categorization of Repairers/Non-Repairers. Participants were categorized as *repairers* or *non-repairers* based on the total number of repairs they produced following insufficient obligatory and non-obligatory opportunities. Utilizing a categorical variable

(*repairer/non-repairer)* facilitated differentiation between participants who tended to produce repairs and those that did not and allowed for between-participant comparisons based on this feature. Participants who produced more than six total repairs were categorized as *repairers.* Participants who produced six or fewer total repairs were categorized as *non-repairers.* The criterion of more than six repairs was utilized because it represented the production of at least one repair following *both* types of communicative opportunities (obligatory and non-obligatory) as well as the production of repair requests for more than 50% of the 12 total insufficient opportunities.

Wilcoxon signed ranks tests were utilized to compare the number of repair requests participants produced following insufficient obligatory and non-obligatory opportunities (RQ1) and to compare number of repair requests participants produced following insufficient opportunities containing an ambiguous referent and those containing a missing referent (RQ3). The Wilcoxon signed ranks test is a non-parametric tool that allows for comparison of matched pairs/related samples by determining which member of any pair is greater (i.e., provides direction of the difference) (Siegel & Castellan, 1988). Effect size estimates were calculated according to Rosenthal (1994) and interpreted according to Cohen's (1988) criteria for r-family estimates: 0.10 (small), 0.30 (medium), and 0.50 (large). Descriptive analysis was used to examine the form of repair strategies participants produced following insufficient obligatory and non-obligatory opportunities (RQ2).

Spearman's rank-order correlation was used to examine the relationship between demographic and participant level variables and production of repair requests (RQ5).

Spearman's rank-order correlation examines the direction and strength of relationship between variables of which may be ordinal in scale.

Chi-square tests were implemented to examine differences in repair requests produced by participants who passed the ToM task compared to those who failed the ToM task (RQ4) and to examine differences repair requests produced based on participant level variables (RQ5).

Wilcoxon Mann-Whitney *U*-tests were used to determine if there were differences in average IQ, average total language score, or average chronological age between participants categorized as *repairers* versus *non-repairers.* Although Shapiro-Wilk tests confirmed that the distribution of scores for IQ and total language were approximately normal, the distribution of chronological ages of participants was positively skewed and violated the assumption of normality for independent samples *t*-test. Thus, the Mann-Whitney test provided a more conservative non-parametric approach to test whether two independent groups had been sampled from the same population (Siegel & Castellan, 1988).

Results

Participation in Shared Book Reading Task

Participants responded to the sufficient communicative opportunities presented throughout the shared book reading task. They verbally responded to 91.33% of total sufficient obligatory opportunities by providing information that maintained or shaded the topic (further defined in Table 6). Topics were considered to be maintained if the child acknowledged the clinician's utterance (e.g., Mmhmm), responded to a question

directly or agreed with the clinician (e.g., "Okay."). Topics were considered to be shaded if some component of the previous utterance was maintained but slightly shifted the subject matter (see Brinton and Fujiki, 1984). Other observed behaviors following sufficient obligatory opportunities included: sustained attention on the examiner, book, or task materials (4% of responses), verbal requests for information (3.3% of responses), and gaze checking between examiner and book (1.3% of responses). No off-task behavior occurred following sufficient obligatory opportunities.

Participants verbally responded to 51.33% of total sufficient non-obligatory opportunities by providing information that maintained or shaded the topic. Other observed behaviors following suffcient non-obligatory opportunities included: sustained attention on the examiner, book, or task materials (33.3% of responses), verbal request for information (8.67% of responses), gaze checking between examiner and book (6%). Off task behavior was coded for 0.67% of reponses following sufficient non-obligatory opportunities.

RQ1. Do 4-year-old TD children differentially request repair following obligatory compared to non-obligatory insufficient opportunities during a shared book reading activity?

A Wilcoxon signed ranks test was utilized to compare the number of repair requests participants produced following insufficient obligatory and non-obligatory opportunities. Participants produced a significantly greater number of repair requests following obligatory opportunities compared to non-obligatory opportunities, $z = 3.55$, $p < 0.001$, $r = 0.50$. Table 7 provides the descriptive data for total number of repairs

following obligatory and non-obligatory opportunities. Participants initiated repair requests for an average of 54.0% (range: 0 - 100%) of insufficient obligatory opportunities and 31.3% (range: 0 – 83.3%) of insufficient non-obligatory opportunities.

Table 7

Descriptive Statistics for Number of Repairs Following Different Insufficient Opportunities

	M	*SD*	Range
Obligatory	3.24	1.23	0-6
Non-Obligatory	1.88	1.33	0-5
Missing Referent	2.84	1.21	0-5
Ambiguous Referent	2.28	1.57	0-5

Note. 6 total opportunities for each type

RQ2. What is the form of repair strategies that participants produced following insufficient obligatory and non-obligatory opportunities?

Descriptive analyses revealed differences in participants' productions of specific requests (e.g., "Which one?") and general statements indicating lack of comprehension (e.g., "I don't know") following non-obligatory compared to obligatory opportunities. Specific requests for clarification constituted 74.4% of total repairs produced following non-obligatory compared to 43.2% following obligatory opportunities. General statements indicating lack of comprehension constituted 22.2% of total repair requests following obligatory opportunities compared to 2.1% of total repair requests following non-obligatory opportunities. There were smaller differences in productions of statements specifying the insufficiency (e.g., "I don't see a cat.") and general requests for clarification (e.g., "What?). Table 8 details the distribution of repair requests types

produced by participants following insufficient obligatory and non-obligatory opportunities.

Table 8

Raw Numbers of Different Forms of Repair Requests Following Obligatory and Non-Obligatory Opportunities

Form of Repair	Obligatory	Non-Obligatory
General Request for Clarification	3/81 (3.7%)	3/47 (6.4%)
Specific Request for Clarification	35/81 (43.2%)	35/47 (74.5%)
Statement Specifying Insufficiency	25/81 (30.9%)	8/47 (17.0%)
Statement Indicating General Lack of Comprehension	18/81 (22.2%)	1/47 (2.1%)

RQ3. Are there significant differences between number of repair requests produced by TD participants following insufficient opportunities that contain an ambiguous referent compared to insufficient opportunities that contain a missing referent?

A Wilcoxon signed ranks test indicated there was not a statistically significant difference observed in the number of repair requests 4-year-old TD children produced following insufficient opportunities that contained an ambiguous referent compared to insufficient opportunities that contained a missing referent, $z = 1.39$, $p = 0.17$, $r = 0.20$. Table 5 details the total number of repairs following opportunities that contained a missing referent and opportunities that contained an ambiguous referent. Participants produced repairs following an average of 38% (range: 0 - 83.3%) of insufficient opportunities that contained an ambiguous referent and 47.3% (range: 0 - 83.3%) of insufficient opportunities that contained a missing referent.

RQ4. Are there differences in the number of total repairs produced by TD who pass a ToM task compared to those who fail a ToM task?

Chi-square tests were implemented to examine differences in repair requests produced by participants who passed the ToM task compared to those who failed the ToM task. Seventeen participants passed the ToM task. Six of these participants were categorized as *repairers* and 11 were categorized as *non-repairers.* Eight participants failed the ToM task. One of these participants was categorized as a *repairer* and seven were categorized as *non-repairers*. Participants who passed a ToM task were no more likely to be categorized as repairers compared to participants who failed the ToM task $\chi^2(1) = 0.49$, $p = 0.45$. Table 9 shows the categorization of participants according to theory of mind performance and *repairer/non-repairer* status.

Table 9

Categorization of Participants According to Performance on ToM Task and Productions of Total Repairs

	Repairer Group	
ToM Performance	Repairer	Non-Repairer
Pass	6	11
Fail	1	7

RQ5. How do demographic and participant level variables relate to children's productions of repair requests?

Spearman's rank-order correlation was used to examine the relationship between demographic and participant level variables and production of repair requests. Table 10 details the bivariate correlations between total repairs and participants' age, maternal education level, self-reported family income, performance on theory of mind task, total language score, and IQ. Overall, there were weak bivariate relationships between repair

requests and age, performance ToM task, and total language score. Family income and IQ did not appear to have an association with total repair requests.

Table 10
Correlation Matrix for Production of Total Repairs Produced by Participants

Variable	1	2	3	4	5	6
Total Repairs	0.36	0.19	0.09	0.23	0.24	0.09
1. Age	---	-0.12	-0.02	0.53	0.17	-0.17
2. Maternal Education		---	0.28	-0.28	0.03	-0.11
3. Income			---	-0.35	0.13	0.05
4. Theory of Mind Task				---	0.17	0.23
5. Total Language Score[a]					---	0.61
6. IQ[b]						---

Note. [a]Total Language Standard Score from *Preschool Language Scale-5th Edition*
[b]Verbal and Nonverbal IQ Composite Standard Score from *Kaufman Brief Intelligence Test – 2nd Edition*

Chi-square tests revealed no significant differences between *repairers* and *non-repairers* based on age, sex, and IQ. Older participants were no more likely to be categorized as repairers compared to younger participants, $\chi^2(1) = 0.04$, $p = 0.85$. Girls were no more likely to be categorized as repairers compared to boys, $\chi^2(1) < 0.001$, $p = 1$. Participants who scored below the group median IQ were no more likely to be categorized as repairers compared to participants who scored above the group median IQ $\chi^2(1)= 0.14$, $p = 0.71$.

Wilcoxon Mann-Whitney *U*-tests were used to determine if there were differences in average IQ, average total language score, or average chronological age between participants categorized as *repairers* versus *non-repairers.* There were no statistically significant differences in mean IQ between participants categorized as *repairers* (M = 111, SD = 7.28) versus *non-repairers* (M= 113, SD = 8.22)*;* $U = 70$, $p = 0.69$. There were no statistically significant differences in mean PLS total language score between

participants categorized as *repairers* (M = 115.71, SD = 10.47) versus *non-repairers* (M = 117.5, SD = 14.59); $U = 65$, $p = 0.93$. There were no statistically significant differences in mean chronological age between participants categorized as *repairers* (M = 53.4, SD = 2.8) versus *non-repairers*, (M = 52.6, SD = 3.8); $U = 48$, $p = 0.38$.

Discussion

The purpose of Study One was to examine how 4-year-old TD children produce repair requests following insufficient obligatory and non-obligatory communicative opportunities within the context of a shared book reading activity and to examine the relationship between 4-year-old TD children's performance on a theory of mind task and their productions of repair requests. The results suggest the function of the insufficient utterance (which creates the opportunity for repair) is an influential variable in our understanding of repair requests. One potential explanation is that the obligatory communicative opportunities may have carried a stronger social expectation to respond in a particular way (i.e., requests for information carry the expectation that the responder will provide information); thus, these types of opportunities may have been more likely to be repaired compared to non-obligatory opportunities. Non-obligatory opportunities allowed more degrees of freedom to whether and how the child responded.

Children's experiences receiving feedback about communicative repair may also influence the likelihood of repair following different opportunities. During real-time social interactions, children may be more likely to receive feedback from social partners when they fail to initiate a communicative repair following an obligatory communicative opportunity (e.g., after an adult requests action or information). If the child does not

respond or does not repair, the adult may be more likely to provide instructive feedback. For example, if an adult requests action, "Please bring me my shoes," and a child does not respond (perhaps it is unclear which shoes the adult would like), the adult may state, "If you didn't know which shoes to bring, you could ask, 'Which shoes would you like?'" Children may be less likely to receive feedback after not initiating a communicative repair following a non-obligatory opportunity (e.g., after an adult provides information; Webber et al., 1984). If the child does not respond, the social partner may infer the child's comprehension (even if there remains a mismatch in understanding) because the social partner's utterance does not carry a social expectation about a particular response. Failure to respond to a comment (as a result of a communication breakdown, for example) has less of a detrimental effect compared to failure to respond to a request for action (Fey et al., 1988). McDevitt (1990) noted that mothers who draw their children's attention to different communicative activities and communicators' responsibilities within interactions create opportunities for their children to better monitor their own comprehension and indicate when something seems to be confusing. Thus, participants in this study may have been more likely to repair following insufficient obligatory opportunities because they have had more experience receiving feedback about responding (and repairing) following requests for information/action during natural social interactions. Thus, the results of this study fill a gap in the literature by providing evidence that the function of the adult's utterance is an influential variable in children's productions of repair requests; future investigations need to attend to this variable.

This study addressed the need to implement a more naturalistic task for examining repair requests than has been previously implemented to investigate repair requests (see Martin et al., 2017). The shared book reading task afforded the opportunity to examine repair requests with a higher degree of social and external validity. Previous studies related to the communicative repair requests in TD children have utilized obligatory communicative opportunities, typically implemented in referential communication tasks, direction-following tasks, or cooperative building tasks (e.g., Flavell et al., 1981; Morisseau et al., 2013; Revelle et al., 1985; Walters & Chapman, 2000). These tasks provide an opportunity to examine repair skills within an experimental environment with high internal validity and clearly defined speaker and listener roles. That is, the researcher is providing instructions and the child is listening to the instructions. Although this study utilized a more naturalistic task, it was still a scripted, structured task. To further increase ecological and external validity of evidence related to repair requests, there remains a need to examine them within more dialogic, less structured tasks, for example, play-based or conversation-based tasks. Insufficient communicative opportunities would have to be carefully engineered and implemented to fit the more natural interaction.

The second research question focused on the form of participants' repair requests. Following non-obligatory opportunities, participants tended to make specific requests for clarification (e.g., "Which one?"). The non-obligatory opportunities provided information, albeit ambiguous or insufficient, about the examiner's preference (e.g., "I like that one!"). Thus, a specific request for clarification would allow the participant to

most efficiently learn about an examiner's preference, compared to a general request for clarification (e.g., "What?") which may yield a repetition but not provide additional information about the examiner's preference. These results fill a gap in the literature by providing evidence related to the form of children's repairs following non-obligatory opportunities. As previously noted, few studies have examined repair requests following non-obligatory communicative opportunities (cf. Webber et al., 1984). Although the Webber et al. (1984) study reported children produced repair requests following non-obligatory opportunities, the form of repair requests was not described. Thus, results from this study begin to clarify how children may request repair following non-obligatory communicative opportunities.

Following obligatory opportunities, participants tended to produce general statements indicating lack of comprehension, these constituted 22.2% of total repair requests. The obligatory opportunities were requests for information (e.g., "What's that one doing?"), thus, a general statement indicating lack of comprehension (e.g., "I don't know") provided the participant with a means to answer the question. These results provide interventionists with additional evidence for developing specific criterion to use when designing intervention that targets communication repair requests by providing evidence related to the form of repair requests that may follow insufficient opportunities.

The third research question examined differences in repair requests depending on the way in which the opportunity was insufficient (i.e., ambiguous referent versus missing referent). There were no statistically significant differences in production of repair requests following these two types of opportunities. While, these results differ

from a number of previous studies that have demonstrated the type of insufficient information is an influential variable in production of repair requests (i.e., Beal & Belgrade, 1990; Markman, 1979; Walters & Chapman, 2000), they were in line with the predicted outcome. The two types of insufficient opportunities utilized in the current study have been collapsed into a broader category---inadequate content—in previous studies (i.e., Walters & Chapman, 2000). The primary focus of this study was to examine the influence of the function (i.e., obligatory versus non-obligatory) of the communicative opportunity. The two different types of insufficient opportunities (i.e., missing referent and ambiguous referent) allowed for variation in the task while mitigating risk of threats to internal validity by confounding the ability to examine the relationship between obligatory versus non-obligatory opportunities (because differential responding between types was not predicted).

The fourth research question examined the relationship between performance on the ToM task and categorization as a *repairer/non-repairer.* Seventeen participants passed the ToM task, eight did not pass the task. I predicted that children who passed the ToM task would be more likely to produce repairs compared to children who did not pass the ToM task. This prediction was based on studies suggesting a positive relationship between TD children's development of theory of mind and their abilities to recognize and repair communication failures (see Bosco et al., 2006; Bosco & Gabbatore, 2016). There were no statistically significant differences in children who passed versus failed the ToM task and the likelihood of being categorized as a *repairer* versus *non-repairer*. Participants who passed a ToM task were no more likely to be categorized as a *repairer*

compared to children who failed the ToM task. Although there is some evidence that suggests a link between children's development of theory of mind and their abilities to recognize and repair communication failures (Bosco et al., 2006; Bosco & Gabbatore, 2016), evidence from this study does not support a relationship between more performance on a first-order false belief task and communication repair abilities. One potential explanation for these findings could be the ceiling effect of the task (approximately 70% of the participants passed). A theory of mind task that yielded greater differentiation among participants may have been a more sensitive measure to examine the relationship between perspective-taking abilities and repair requests.

It remains unclear how theory of mind development as indexed on static measures (often employed in research studies) relate to broader social competencies like the production of communication repair requests following communication breakdowns. It may be that performance on theory of mind tasks within structured question-answer format present a structured set of behavioral expectations compared with the more numerous behavioral options within a dialogic activity as was used in this study. A more advanced performance on the theory of mind task (i.e., a pass) may not directly translate to more advanced communicative repair behavior (i.e., greater number of repair requests). One potential future direction would be to include a theory of mind task with a higher degree of external validity, for example, the *Theory of Mind Inventory* ([ToMIl; Hutchins, Prelock, & Bonazinga, 2010). The ToMI is a parent-report measure of theory of mind development that has emerging empirical evidence of reliability and strong

construct validity for both TD children and children who experience differences in theory of mind development, like children with ASD (Greenslade & Coggins, 2016).

The fifth research question focused on the relationship between participant level variables and production of repair requests. The results suggest that the participant level variables included in this study may be not be highly influential variables in the production of communication repair requests among 4-year-old TD children. Differences in "young" 4-year-olds and "old" 4-year-olds were not observed. Studies that have found differences in chronological age and repair requests have generally compared performance across greater age differences (e.g., Flavell et al., 1981; Morisseau et al., 2013; Revelle et al., 1985). The 12-month age range within this study represents a relatively short period of development in which we do not observe statistically significant differences in the production of repair requests between "young" and "old" 4-year-olds.

Notably, few studies have specifically examined the relationship between receptive and expressive communication abilities, IQ participant level variables and repair requests. Although at least one study has found a link between receptive language abilities and repairs among TD children (Abbeduto et al., 2008), data from the present study mirror the majority of available evidence which has suggested the absence of a significant link between receptive language abilities and repair requests (e.g., Abbeduto et al., 1991; Abbeduto et al., 1998; Walters & Chapman, 2000) and IQ and repair requests (Abbeduto et al., 1998).

There may be other participant level variables at play, including attention, a child's interest in a particular topic, and a child's experience with receiving instructional

opportunities related to repairing communication breakdowns. Children may be more likely to request repair following insufficient utterances related to a highly motivating topic compared to utterances based on more neutral topics. Dollaghan (1987) has previously noted a child's motivation to uncover an ambiguity or contradiction may influence the likelihood of repair. A future study could potentially examine the relationship between motivation and repair by creating insufficient communicative opportunities utilizing both highly motivating or preferred topics (specific to a particular child) and more neutral topics. Researchers could interview parents to identify conversational topics or objects that their child prefers. The researchers could also sample different topics/objects to identify which objects/topics the child selects. Insufficient communicative opportunities could then be implemented within these motivating topics and children's repair request could be measured (and compared to when insufficient opportunities are embedded in neutral topics).

The overall responsivity of a social partner during an interaction may also influence repair requests. High levels of responsivity may increase the likelihood that a child would initiate a repair. Moreover, the adequacy of the social partner's repair (following the child's request for repair) may influence the likelihood of future repair requests. If a child receives inadequate information following their repair request, they may be less likely to produce future repair requests.

In addition to social partner responsivity, communicative repair requests may also be a function of the familiarity between social partners and their communicative competence. Social partner familiarity remains a relatively unexplored variable within the

repair request literature. If a child's social partner is a familiar person (i.e., sibling or caregiver), the child may feel more comfortable requesting repair compared to a less familiar social partner. Conversely, if a child's social partner is unfamiliar, the child may be more reticent to request repair and may leave the communication breakdown unrepaired. A future direction in research may be to examine the likelihood of repair requests when insufficient opportunities are implemented by a familiar person (e.g., a primary caregiver) compared to an unfamiliar person (e.g., a researcher). Evidence related to the influence of familiarity between social partners on repair requests may potentially inform how interventionists design intervention that targets communication repair strategies. If children are more likely to request repair when insufficient opportunities are implemented by a familiar adult, interventionists may partner with caregivers to initially create opportunities for repair requests, then progress to unfamiliar social partners.

Critically, a more nuanced understanding of some of the aforementioned variables that may affect repair requests could ultimately inform intervention. This is an important pursuit given the limited number of intervention studies related to teaching repair requests (see Dollaghan & Katson, 1986; Ezell & Goldstein, 1991),

Limitations

There are several limitations to Study One. First, the study relied on a relatively modest sample size of participants. The small sample size limits the statistical analyses that are appropriate to implement when examining the data. A larger sample size would allow for more complex modeling of the relationship between repair requests and

participant level variables such as theory of mind development and language skills. Second, the participants in this sample represented a homogenous group with respect to self-reported household income and maternal education. The small sample size and homogeneity of participants limits the external validity and generalizability of the findings.

A third limitation is that the study did not sample a broad range of "typical" expressive and receptive communication skills demonstrated by 4-year-old TD children. The participants' average expressive and receptive communication skills fell one standard deviation above the mean. It would be inappropriate to extend the results of this study to a broader population of 4-year-old TD children as the sample in this study demonstrated above average communication abilities rather than a broad range of average communication abilities.

A fourth limitation relates to the ToM task. The ToM task utilized in this study provides one method to measure the development of perspective-taking abilities. A different measure (or set of measures) of theory of mind development or social communication may yield different results with respect to the link between perspective-taking abilities and children's productions of repair requests.

Future Directions

There remains a need to better understand communication repair requests among TD children. A first step in future research would be to replicate the findings of this study with a larger and more diverse sample with respect to household income and maternal education, as well as a broader range language abilities. A larger sample would allow for

more complex statistical modeling to understand the relationship between participant level variables (i.e., expressive and receptive communication or language abilities, IQ, theory of mind development) and the production of repair requests. Studies should also explore the influence of variables discussed in the previous section, including child's interest in a particular topic, attention, motivation, familiarity between social partners, and responsivity of social partner. Beyond the influence of these factors, future investigations should examine how repair requests emerge within children's development (i.e., conduct longitudinal analyses of repair requests) and within more naturalistic, less structured interactions. Relatedly, future studies may examine the link between communication repair skills elicited during structured, experimental tasks and communication repair behaviors produced in unstructured real-time interactions. There remains work to be done to most fully understand preschool-age children's productions of repair requests. Additional evidence will ultimately serve interventionists as they design and implement interventions targeting communication repair requests for individuals who demonstrate difficulties with communicative repair.

Chapter 5

Study Two

Method

Participants

Inclusion criteria. Inclusion criteria for the participants in Study Two were the same as for the TD children in Study One, with the additional criterion that they had been diagnosed with ASD by a licensed psychologist according to *Diagnostic and Statistical Manual of Mental Disorders - 5th Edition* (DSM-5; American Psychiatric Association, 2013) criteria.

Recruitment. Participants were recruited through two local school districts and the FIND Network. The school districts distributed an IRB-approved consent form and parent letter to families with children likely to meet inclusion criteria. The parent letter broadly described the study and what participation would entail. The consent form provided detailed information about participation. Parents had the option to consent to particpate in the study, request to be contacted by the researcher, or decline participation. The FIND Network is a voluntary registry that connects families of children with neurodevelopmental disabilities with research and educational opportunities. Prior to obtaining contact information for families, the FIND Network reviewed the study's IRB-approved protocol. Subsequently, the network provided the contact information for families of children who were likely to meet inclusion criteria.

Six consent forms were signed for chlidren with ASD. One child was identified as meeting criteria for ASD by a school-based evaluation team. Given the exploratory nature of Study Two, this participant was included in the analyses although he had not met the initial inclusion criteria of having been diagnosed by a licensed clinical psychologist. Thus, there were six participants in Study Two.

Participant characteristics. Table 11 provides the demographic information for participants.

Table 11

ASD Participant Demographic Characteristics (*n* = 6)

Characteristic	
Female: Male Ratio	1:5
Maternal Education	
High School	16.7%
College	83.3%
Graduate School	-
Annual Household Income	
$0 - $25,000	33.3%
$25,000 - $50,000	16.7%
$50,001 - $100,000	33.3%
$100,001 - $150,000	-
$150,001 +	16.7%

According to parents' report, which parents indicated on the participant demographic form, the average age of diagnosis for participants was 40 months (range: 27 months – 48 months). Parents reported that participants did not have a history of Attention Deficit Hyperactive Disorder (ADHD) and were not currently taking any

medications. One participant's mother reported he had experienced seizures early in infancy and had received medication for them but he was not currently taking prescription medication for seizure activity nor experiencing seizures. With respect to intervention services, 66.7% of participants receieved (school-based or private) SLP services, 83.3% received occupational therapy (OT) services, and 16.7% received physical therapy (PT) services. The range of hours of services per week ranged from 0 - 4 hours (SLP services), 0 - 4 hours (OT services), and 0 - 2 hours (PT services).

Participants demonstrated scores on the SRS-2 ranging from 49-90 (*M* = 64.5, *SD* = 16.63), with three participants scoring at or below 59, and three participants scoring above 59 (scores were: 49, 49, 59, 61, 79, 90). Scores on the SRS-2 that fall at or below 59 are generally not related to clinical presentations of autism spectrum disorder; scores from 60-65 are considered within the mild range, indicating deficits in reciprocal social behavior; scores 66-75 are considered in the moderate range of impairment; and scores 76 or higher are considered to be in the severe range.

Table 12 details the participants' characteristics across communication, cognitive and adaptive behavior domains.

Table 12

ASD Participant Characteristics (n = 6)

Characteristic		
Age (months)		
	M	52
	SD	3.85
	Min-Max	48-58
Theory of Mind Performance		
	Pass: Fail	2:4

IQ[a]	
M	102.17
SD	12.12
Min-Max	93-121
Expressive Communication[b]	
M	93.5
SD	10.8
Min-Max	80-111
Receptive Communication[b]	
M	102.17
SD	7.47
Min-Max	93-113
Adaptive Behavior Composite[c]	
M	94.17
SD	16.41
Min-Max	76-114

Note. These standardized measures have M = 100 and SD = 15;
[a]*Kaufman Brief Intelligence Test – 2nd Edition;*
[b]*Preschool Language Scale – 5th Edition;*
[c]*Vineland Adaptive Scale-2nd Edition*

Setting

As in Study One, the researcher conducted the sessions in a location that was familiar to the participants and convenient for parents. Locations included: participants' homes (n = 3) and preschools (n = 3).

Materials

The materials utilized in Study Two were the same as those used in Study One.

Measures

The parent-report measures and direct measures were the same as those used in Study One.

Procedures

The same procedures that were implemented with TD participants in Study One were implemented with participants in Study Two.

Coding

The participants' verbal and nonverbal behaviors following both insufficient and sufficient communicative bids were coded using a pre-established coding scheme that was the coding scheme applied in Study One. The same undergraduate student research assistants who coded participant videos in Study One completed the coding for Study Two. The research assistants were blinded to the participants' clinical diagnoses.

Reliability and Fidelity

Reliability was computed using the same method used in Study One. A second undergraduate research assistant naïve to the purpose of the study or diagnosis of the participants coded 33.3% of the experimental sessions for reliability on the dependent variables and reliability on the fidelity coding. Reliability across 14 individual codes ranged from 83.3% - 100%. Reliability on fidelity each of the fidelity coding was 100%.

Procedural fidelity was completed for 100% of experimental sessions. Procedural fidelity included a measure of item-by-item fidelity and general procedural fidelity. Item-by-item fidelity and general procedural fidelity were analyzed using the same method as described in Study One. Item-by-item fidelity was 100% for each individual item (i.e., correct order, attending to experimenter, intelligible). General procedural fidelity ranged from 96.3%-100%.

Data Analyses

Data were descriptively analyzed given the modest sample size and exploratory nature of the study. As in Study One, participants were categorized as *repairers* or *non-repairers* based on the total number of repairs they produced following insufficient obligatory and non-obligatory opportunities. Utilizing a categorical variable (*repairer/non-repairer)* facilitated differentiation between participants who tended to produce repairs and those that did not and allowed for between-participant comparisons based on this feature. Participants who produced more than six total repairs were categorized as *repairers.* Participants who produced six or fewer total repairs were categorized as *non-repairers.* The criterion of more than six repairs was utilized because it represented the production of at least one repair following *both* types of communicative opportunities (obligatory and non-obligatory) as well as the production of repair requests for more than 50% of the 12 total insufficient opportunities.

Design

A descriptive study was implemented to examine the feasibility of the shared book reading task for preschool-age children with ASD. Within-subjects descriptive analyses were conducted to examine how participants responded following insufficient obligatory and non-obligatory opportunities as well as to descriptively examine the relationship between participant-level variables and the production of repair requests.

Independent variable. The function of the insufficient opportunity, obligatory (information request) or non-obligatory (information provision), served as the primary independent variable.

Dependent variable. The primary dependent variable was the total number of spoken repair requests produced following the insufficient communicative opportunities. Performance on the ToM task was also examined as a dependent variable.

Results

RQ1. Is the shared book reading task a feasible method to examine repair requests among children with ASD whose expressive and receptive communication abilities fall within an average range? What percentage of participants are able to complete the task?

Participants were observed to engage in the shared book reading task by verbally responding to the examiner's sufficient communicative bids and directing their gaze toward the book or other task-related materials. The average time from the presentation of the title of the book to the examiner's closing question (i.e., "Have you ever seen a bear eat a sandwich") was 11 min and 32 s (range: 9 min 45 s - 13 min 2 s). Participants verbally responded to 91.67% of total sufficient obligatory opportunities by providing information that maintained or shaded the topic. Other observed behaviors following sufficient obligatory opportunities included: sustained attention on the examiner, book, or task materials (2.77% of responses) and verbal requests for information (5.5% of responses). No off-task behavior occurred following sufficient obligatory opportunities.

Participants verbally responded to 50% of total sufficient non-obligatory opportunities by providing information that maintained or shaded the topic. Other observed behaviors following sufficient non-obligatory opportunities included: sustained attention on the examiner, book, or task materials (44.44% of responses) and verbal

request for information (5.5% of responses). No off-task behavior occured following following sufficient non-obligatory opportunities.

RQ2. **Do participants with ASD differentially request repair following obligatory compared to non-obligatory opportunities?**

Participants produced repairs following both obligatory and non-obligatory opportunities. Table 13 shows the total number of repairs produced by each participant following both obligatory and non-obligatory opportunities. Three participants (Participants B, C, and F) produced a greater number of repairs following obligatory compared to non-obligatory insufficient opportunities. Two participants (Participant A and Participant E) produced an equivalent number of repairs following obligatory compared to non-obligatory insufficient opportunities. These participants each produced two repairs (i.e., one following an obligatory opportunity and one following a non-obligatory opportunity). Participant D did not produce repairs following obligatory or non-obligatory communicative opportunities.

Table 13

Raw Number of Repair Requests Produced by Participants with ASD Following Obligatory and Non-Obligatory Opportunities

Participant	Obligatory	Non-Obligatory
Participant A	1	1
Participant B	5	3
Participant C	5	3
Participant D	0	0
Participant E	1	1
Participant F	2	0

With respect to the form of the participants' repair requests, participants produced four types of repair requests: general requests for clarification, specific requests for clarification, general statements indicating lack of comprehension, and statements specifying the insufficiency in the examiner's utterance. Table 14 details the distribution of repair requests types produced by participants following insufficient obligatory and non-obligatory opportunities.

Table 14

Raw Numbers of Different Forms of Repair Requests Produced by Participants with ASD Following Obligatory and Non-Obligatory Opportunities

Form of Repair	Obligatory	Non-Obligatory
General Request for Clarification	1/14 (7.1%)	1/8 (12.5%)
Specific Request for Clarification	7/14 (50.0%)	7/8 (87.5%)
Statement Specifying Insufficiency	2/14 (14.3%)	-
Statement Indicating General Lack of Comprehension	4/14 (28.6%)	-

Participants produced statements indicating general lack of comprehension or statements specifying the insufficiency only following obligatory opportunities. These forms were not observed following non-obligatory opportunities. Following non-obligatory opportunities, participants tended to make specific clarification requests. Specific clarification requests constituted 87.5% of total repairs produced following non-obligatory compared to 50% following obligatory opportunities. There were smaller differences following obligatory and non-obligatory opportunities across the three remaining forms of repair.

RQ3. Do participants who pass ToM task initiate a greater number of repairs than those who fail the ToM task?

There appeared to be a contrast between participants who passed the theory of mind task compared to those who failed the ToM task with respect to whether or not they were categorized as *repairers*. The two participants who passed the ToM task each produced 8 total repairs and were categorized as *repairers*. Four participants failed the ToM task. These participants produced between 0-2 total repairs and were categorized as *non-repairers.* Table 15 categorizes participants according to performance on the theory of mind task and the status as *repairer/non-repairer.*

Table 15

Categorization of ASD Participants According to Performance on Theory of Mind Task and Productions of Total Repairs

	Repairer Group	
ToM Performance	Repairer	Non-Repairer
Pass	2	0
Fail	0	4

RQ4. Are there clear patterns among participants with ASD who were categorized as repairers/non-repairers with respect to age, IQ or expressive and receptive communication skills? Figure 1 displays participants' standard scores on communication and IQ measures as a function of chronological age. Participants are faceted by performance on ToM task and *repairer/non-repairer* status. There were no marked trends with respect to age, IQ, and expressive and receptive communication skills and whether or not participants were categorized as *repairers* or *non-repairers*. Both "younger" 4-year-old participants and "older" 4-year-old participants were categorized as *repairers.* The two participants who demonstrated the highest standard scores on

expressive and receptive communication and IQ measures were categorized differently, one as a *repairer* and one as a *non-repairer*. Heterogeneity in performance among children with ASD is often noted in the literature, given the very limited sample size, trends may be difficult to discern and observed trends should be conservatively interpreted.

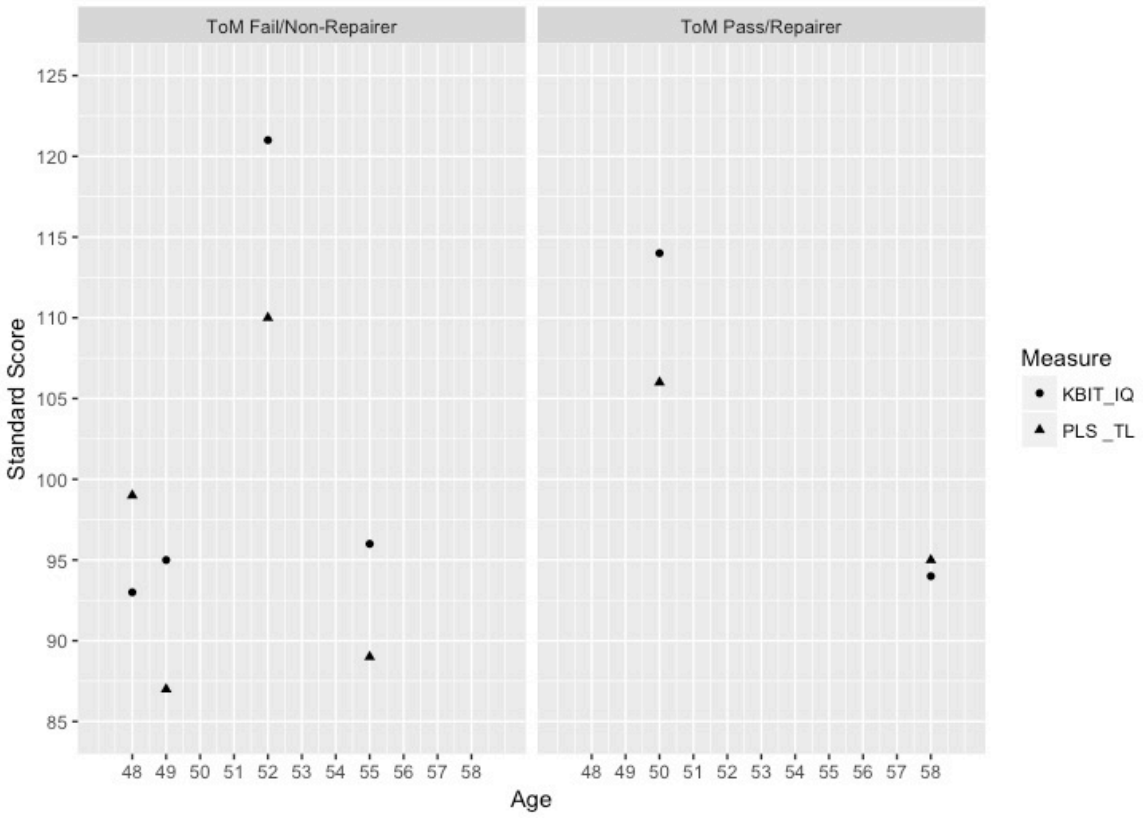

Figure 1. Standard scores from PLS-5 and KBIT as a function of chronological age among participants with ASD. Participants are faceted by performance on theory of mind task and repairer/non-repairer status.

Discussion

The purpose of Study Two was to pilot a shared book reading task designed to provide opportunities for children to produce communicative repairs following insufficient obligatory and non-obligatory opportunities with a small group of 4-year-old children with ASD and to descriptively examine the relationship between performance on a theory of mind task and productions of repair requests.

Broadly, the results from Study Two suggest that the shared book reading task is a feasible method to study communicative repair requests among preschool-age children with ASD whose expressive and receptive language and cognitive skills fall within an average range. The average time to implement the task was slightly longer for the participants with ASD compared to the TD participants in Study One. Six out of six (100%) participants were able to complete the task.

Participants in Study Two demonstrated verbal responsiveness to sufficient obligatory and non-obligatory opportunities task that was similar to the that of TD participants. The participants verbally responded to 91.67% of sufficient obligatory opportunities by providing information that maintained or shaded the topic; while TD participants verbally responded to 91.33% of total sufficient obligatory opportunities. No off-task behavior was coded following sufficient obligatory opportunities from either participants with ASD or TD. Participants with ASD verbally responded to 50% of total sufficient non-obligatory opportunities by providing information that maintained or shaded the topic. Similarly, the TD participants verbally responded to 51.33% of total sufficient non-obligatory opportunities. No off-task behavior was observed following

sufficient non-obligatory opportunities for participants with ASD. For TD participants off task behavior was coded for 0.67% of reponses following sufficient non-obligatory opportunities. Notably, participants with ASD responded for a similar percentage of opportunities following sufficient obligatory and non-obligatory opportunities as TD participants. A future area of investigation may be to examine how children with ASD may have differentially utilized topic maintence and topic shading following obligatory and non-obligatory opportunities. Topic maintenance and topic shading serve the same function (to maintain conversational discourse), however, topic shading may be considered a more sophisticated conversational strategy (see Brinton & Fujiki, 1984). All of the participants with ASD demonstrated use of topic shading following at least one sufficient non-obligatory opportunity. Of the two participants who engaged in topic shading most frequently, one was classified as a *repairer* and one was classified as a *non-repairer.* One might expect a potential link between more sophisticated conversational strategies (i.e., engaging in topic shading) and producing repair requests but this area remains unexplored. There is sparse empirical evidence related to chlidren with ASD and their use of topic shading during social interactions.

Evidence from this preliminary study suggests that the shared book reading task is a feasible tool for measuring communicative repair requests among preschool-age children with ASD whose expressive and receptive language and cognitive abilities are within an average range.

The second research question focused on whether participants differentially request repair following insufficient obligatory compared to non-obligatory opportunities.

For three participants, there was a clear difference in repair requests following obligatory compared to non-obligatory opportunities. These participants produced 2-3 more repairs following obligatory compared to non-obligatory insufficient opportunities. More data are needed to discern whether differential responding following obligatory compared to non-obligatory opportunities is present among children with ASD. With respect to the form of requests, participants demonstrated the four types of repairs; however, each type of repair was not observed following both obligatory and non-obligatory opportunities. Participants only produced statements indicating general lack of comprehension or statements specifying the insufficiency following obligatory opportunities.

Following non-obligatory opportunities, participants tended to make specific requests for clarification. Specific requests for clarification constituted 87.5% of total repairs produced following non-obligatory compared to 50% following obligatory opportunities. The non-obligatory opportunities provided information, albeit ambiguous or insufficient, about the examiner's preference (e.g., "I like that one!"). Thus, a specific request for clarification would allow the participant to most efficiently learn about an examiner's preference, compared to a general request for clarification (e.g., "What?") which may yield a repetition but not provide additional information about the examiner's preference. There were less remarkable differences following obligatory and non-obligatory opportunities across the three remaining forms of repair. These results contribute to the relatively small evidence base related to repair requests produced by children with ASD and suggest that children with ASD produce a variety of forms of repair requests. Moreover, while some children with ASD may discriminatively produce

repair requests following obligatory and non-obligatory opportunities (similar to the TD participants in Study One), this pattern was observed for only 50% of the participants with ASD.

The third research question addressed the relationship between performance on the ToM task and production of repair requests. There was an observed contrast between participants who passed the ToM task compared to those who failed the theory of mind task with respect to whether or not they were categorized as *repairers*. These data provide very preliminary evidence that theory of mind development may be related to production of repair requests during a structured book-reading task among children with ASD (an area that has not been explored) and are concordant with studies suggesting positive relationship between theory of mind performance and repair requests among children with neurodevelopmental disabilities (e.g., among children with ID; Abbeduto et al., 1997; Abbeduto et al., 1998; and among children with Williams syndrome; John et al., 2009). Although at least one study has not found an effect of theory of mind performance and repair requests among children with neurodevelopmental disabilities (Abbeduto et al., 2008).

Data from this study provide preliminary data related to children with ASD and the positive relationship between theory of mind and repair requests, yet it is critical to distinguish between having the ability to take the perspective of another person (and perhaps passing a first-order false belief task) and using that knowledge within real time social interactions (Nilsen & Fecica, 2011). Nilsen and Fecica (2011) noted the importance of both understanding another person's perspective and using that knowledge

during participation in social interactions. Children with ASD who are able to pass first-order false belief tasks may still struggle to use their perspective-taking abilities during interactions with others to resolve (complex) communication breakdowns. Nilsen and Fecica also highlighted the inter-relatedness of social participation and the further development of perspective-taking abilities. They note that for children with ASD, challenges with perspective-taking abilities may reduce the opportunity to engage in robust social participation and ultimately reduce opportunities to increase perspective-taking abilities through interactions with others. There remains work to be in done to fully understand the link between theory of mind development and communication repair skills among children with ASD.

The fourth research question focused on the relationship between age, IQ, and expressive and receptive communication skills and participants' categorization as *repairer/non-repairer.* There were no marked trends with respect to age, IQ, and expressive and receptive communication skills based on status of being a *repairer* or *non-repairer* suggesting that the production of repair requests is not greatly influenced by these variables. Results from Martin et al. (2017) suggested that children with neurodevelopmental disabilities who performed most similarly to TD children in their productions of repair requests had higher receptive language and nonverbal cognitive skills compared to children who demonstrated significantly weaker performances (i.e., reduced rates of repair requests). The participants in this preliminary study demonstrated expressive and receptive language abilities and IQ scores within an average range (although some participants were lower average and some were higher average).

Accounting for the results of Martin et al. (2017), we may have expected similar performance in production of repair requests among participants given their average language and IQ status, yet the data were heterogeneous with some participants producing many repairs and others producing few to none. Heterogeneity in performance among children with ASD is often noted in the literature and given the very limited sample size, more evidence is needed to better understand repair requests among children with ASD. This includes better understanding expressive and receptive language abilities influence the likelihood of the production of communication repair requests. More nuanced cognitive variables, such as sustained attention and motivation to repair the interaction, may also be influential but have not yet been well-examined.

Limitations

There are several limitations to Study Two. First, this study relied on a small sample of children with ASD. While descriptive analyses yield valuable information, a larger, more heterogeneous sample is needed to increase external validity. Second, the study relied on parent reported diagnosis of ASD and did not confirm diagnosis using a robust diagnostic measure such as the ADOS. While SRS-2 scores provided some index of reciprocal social behavior that was within a clinically significant range for ASD, the SRS-2 is not a diagnostic tool. Finally, the participants in this study represented a relatively heterogeneous group with respect to age, IQ, and expressive and receptive communication abilities. Although their performance on standardized measures of communication and cognitive abilities fell within an average range, there were participants who performed at the low end of average and participants who performed at

the high end. This range in performance combined with the small sample size limits the ability to discern patterns related to repair requests and participant level variables.

Future Directions

There remains much work to be done to fully understand repair requests among children with ASD. This study provides evidence that the shared book reading task represents a feasible and naturalistic measure to implement with the population of children with ASD included in this study and yields information about a child's productions of repair requests following obligatory and non-obligatory opportunities. A reasonable next step would be to implement the shared book reading task with a larger sample of children with ASD whose receptive and expressive language abilities fall within an average range and further examine differential responding following obligatory compared to non-obligatory communicative opportunities. The shared book reading task should also be examined for its feasibility with children with ASD whose expressive and receptive language skills fall below average and to better understand the relationship between expressive and receptive language abilities and the likelihood of repair requests.

Future studies should examine how theory of mind development, (and language and cognitive abilities) influence the likelihood of communication repair, particularly among children with ASD who demonstrate expressive and receptive language challenges. Studies in this area may also examine the link between children's use of repair requests and broader positive social competency outcomes. For example, if children with communication challenges learn to request clarification discriminatively, do peer and parent ratings of social competence increase as well? Do children who learn to

conditionally request repair experience increased learning opportunities or participation in their educational settings? We might hypothesize that children who are more successful at initiating repairs are able to more fully participate in activities with a variety of social partners. Broadly, increased understanding of repair requests among children with ASD and the link between repair requests and theory of mind development may increase our ability to design interventions targeted to this area of social communication.

Chapter 6

Overall Conclusion

There were two primary aims of the project, addressed through two separate studies, Study One and Study Two. The purpose of Study One was to examine how 4-year-old TD children produce repair requests following insufficient obligatory and non-obligatory communicative opportunities within the context of a shared book reading activity and to examine the relationship between 4-year-old TD children's performance on a ToM task and their productions of repair requests. The results from Study One suggest TD participants produced a greater number of repairs following obligatory compared to non-obligatory communicative opportunities. Thus, the function of the adult's utterance (that creates the communication breakdown and directly precedes that child's potential repair) is an influential variable when examining repair requests. There were no statistically significant differences in the production of repair requests between TD participants who passed the ToM task and those who failed.

The purpose of Study Two was to pilot the shared book reading task on a small group of 4-year-old children with ASD, to determine task feasibility. Additional objectives were to descriptively examine repair request production following obligatory and non-obligatory opportunities, and to descriptively examine the relationship between performance on a ToM task and repair requests. The results from Study Two suggest that the shared book reading task is a feasible method to examine repair requests among children with ASD whose receptive and expressive communication skills fall within an average range. Modest preliminary evidence supports the use of the same methodology

for future between-group design studies comparing TD children and children with ASD. Study Two also generated preliminary evidence related to children with ASD, the production of repair requests by children with ASD following obligatory compared to non-obligatory communicative opportunities, and the relationship between the production of repair requests and performance on the ToM task. Although there was not a clear pattern with respect to differential production of repairs following obligatory compared to non-obligatory opportunities, there was a marked trend in performance on the ToM task and whether or not a participant was categorized as a *repairer* or *non-repairer.* There were no clear patterns with respect to expressive and receptive communication and cognitive abilities and repair requests among participants with ASD. Further research is needed to better understand if and how and participant-level variables are influential in the production of repair requests.

Communication repair requests serve as one measure of children's emerging social competence. Repair requests provide evidence that the child (a) is attending to the speaker's communicative bids, (b) is monitoring her own comprehension, (c) has strategies for repairing communicative breakdowns, and (d) has skills to successfully repair (Dollaghan, 1987). This project filled a number of gaps in the literature, specifically related to influence of the adult's communicative utterance preceding the potential repair request and the feasibility of the shared book reading task among preschool-age children with ASD. A more complete understanding of repair requests among TD children and children with ASD will allow us to better design intervention strategies targeting this social communication skill. Ultimately, for those who experience

challenges during communication breakdowns, increased production of repair requests may increase participation and social learning opportunities.

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Appendix A

PARENT QUESTIONNAIRE

Current Zip Code Where Your Child Resides: _____

I. Your relationship to the child participating in the project: Mother Father Other: _____

II. Please answer the following questions about your child's household.

A. How many parents/guardians currently live in your child's home? _____

B. What is the total number of children who currently live in your home? _____

C. What is approximate yearly income of your child's household

☐ $0 - $25,000 ☐ $25,001-$50,000

☐ $50,001 - $100,000 ☐ $100,001 - $150,000 ☐ $150,000+

D. What is your education history?

Level	Number of Years?	Completed?	Degree
Kindergarten-8th grade		YES NO	NA
High School		YES NO GED	NA
Technical School/College		YES NO	
Graduate School		YES NO	

III. Please answer the following questions about the child who is participating in the project:

A. Child's Gender: MALE FEMALE

B. Child's Age: _____years _____months

C. Child's Ethnicity? HISPANIC/LATINO NOT HISPANIC/LATINO

D. Child's Race? (You may check more than one category if you consider your child as having a dual- or multi-racial background)

___ African-American ___ Hispanic/Latino/a

___ Asian/Pacific Islander ___ White, European-American (non-Hispanic)

___ American Indian or Alaskan Native ___ Other: _____

E. Are there languages in addition to English, spoken in your home (circle one)?

YES NO If yes, please provide the name of the language:_____

F. Does your child speak any language other than English? YES NO

If yes, please provide the name of the language: _____

If yes, please describe your child's use of the language:

G. Does your child currently receive any of the following services? If yes, please indicate (using the boxes below) approximately how many hours per week for both school and private settings:

1. Speech-Language Therapy? NO YES
2. Occupational Therapy? NO YES
3. Physical Therapy? NO YES
4. Special services for reading or writing? NO YES

Type of Service	**Number of Hours Per Week in School Setting**	**Number of Hours Per Week in Private Setting**
1. Speech-Language Therapy		
2. Occupational Therapy		
3. Physical Therapy		
4. Special services for Reading or Writing		

H. To the best of your knowledge, does your child have typical hearing? YES NO

I. Does your child have a history of any of the following conditions?

Condition	History?	Currently Taking Medication?
1. Seizures	YES NO	YES NO
2. Behavior Disorder	YES NO	YES NO
3. ADHD	YES NO	YES NO
4. Autism Spectrum Disorder	YES NO	YES NO
5. Stroke/TBI/Cerebral Palsy	YES NO	YES NO
6. Other (e.g., other neurodevelopmental disabilities)	YES NO	YES NO

J. If your child has been diagnosed with Autism Spectrum Disorder, please describe approximately at what age and how your child was diagnosed:

1.Approximate month/year when your child was diagnosed:_____

2. Child's age when diagnosed:_____

3. Assessments used to diagnose:

a. Autism Diagnostic Observation Schedule (ADOS)

b. Other:_____

4. What professional discipline diagnosed your child?

a. Physician/Pediatrician

b. Licensed Psychologist

c. Neuropsychologist

d. Other, please specify:_____

5. Type of Setting Where Your Child Was Diagnosed:

a. Hospital/Clinic

b. Preschool/School Setting

c. Social Service Organization (i.e., Fraser, Minnesota Autism Center, St. David's)

d. Other: _____

Appendix B
Theory of Mind (ToM)/Perspective-Taking Task Protocol

We are going to talk about something that I brought with me. It will take just a couple minutes. (Take out crayon box).

1. Control Question	Child's response	
What do you think is inside?		

Provide 5-10 s of wait time if necessary. Then, open the box and pull out the paper horses. *Look there are paper horses!* The child may touch/hold the paper horses, then put them back inside the crayon box.

2. Reality Control Question	Child's response	
What is really inside the box?		

Close the crayon box.

3. Ignorance Question	Child's response	
If I show the crayon box to your <insert mom/dad>, will s/he know what is in here? (Show the box again)		No=1 Yes = 0
		Enter Score:

4. False-Belief Question	Child's response	
What will s/he think is inside the box?		Crayons = 1 Horses = 0
		Enter Score:

Appendix C

METALINGUISTIC AWARENESS PROBE

ID: _____	Date: _____	Examiner:

Task 1: Word Manipulation

My friend and I are making up a new language and we need help coming up with new names for things. Show picture of **chair**. *We decided to call this a "tiv." See, here's a "tiv" in our new language. Now look at some more.*

1. Picture of **carrot**. *Could this be a "gok?" Yes, it could. What is this?* Remove picture.		
a. *Can you eat a gok?*	**Y**	N
b. Do goks havewheels?	Y	**N**
b. *Are goks orange?*	**Y**	N
c. *Can you read a gok?*	Y	**N**
2. Picture of **cow**. *Could this be a "mib?" Yes, it could. What is this?* Remove picture.		
a. *Can you throw a mib?*	Y	**N**
b. *Do mibs eat?*	**Y**	N
c. *Do mibs moo?*	**Y**	N
d. *Can you read a mib?*	Y	**N**
3. Picture of **ball**. *Could this be a "sem?" Yes, it could. What is this?* Remove picture.		
a. *Can you eat a sem?*	Y	**N**
b. Can you throw a sem?	**Y**	N
b. *Are sems round?*	**Y**	N
c. *Do sems talk?*	Y	**N**
4. Picture of **nose**. *Could this be a "biff?" Yes, it could. What is this?* Remove picture.		
a. *Can you eat a biff?*	Y	**N**
b. *Do biffs have wheels?*	Y	**N**
c. Can you smell with a biff?	**Y**	N
c. *Do you have a biff?*	**Y**	N

Total Correct: _____

Task 2: Word Swap VERSION: A B

1. No picture. *Suppose that everyone in the world agreed that from now on we will call the sun the moon and the moon will be called the sun. All we are going to do is change the names. Could we do that if we wanted to?*	
a. If we did this, when you go to bed at night, what would you call the thing that you see up in the sky? _____. (sun)	
b. What will the sky look like when you go to bed if this is so? _____. (dark)	
c. Show picture of **sun**. What would this be? _____. (moon)	
d. What will the sky look like when you see this? _____. (blue)	
2. No picture. *Suppose that everyone in the world agreed that from now on we will call a cat a dog and a dog a cat. All we are going to do is change the names.* Show picture of **dog.**	
a. What would this animal's name be? _____. (cat)	
b. What sound would it make? _____. (bark)	
c. Show picture of **cat.** What would this animal's name be? _____. (dog)	
d. What sound would it make? _____. (meow)	

Sun/MoonTotal Correct: _____

Cat/DogTotal Correct: _____

Task 3: Wug Task

I am going to show you some pictures and say some sentences. Sometimes a word will be missing. I want you to tell me the missing word. Let's try one. I am a (boy/girl) and you are a _____. Let's try another one. When it's cold outside, I wear a _____. Now let's do some more.

1. Picture of **one bird-like animal**. *This is a wug /wʌg/.* Picture of **two bird-like animals**. *Now there is another one. There are two of them. There are two* _____. (wugs)	Pl
2. Picture of **one animal**. *This is a niz /nɪz/.* Picture of **two animals**. *Now there is another one. There are two of them. There are two* _____. (nizzes)	Pl
3. Picture of **one animal wearing a hat**. *This is a niz who owns a hat. Whose hat is it? It is the* _____ *hat.* (niz's)	Sing Pos
4. Picture of **two animals wearing hats**. *Now there are two nizzes. They both own hats. Whose hats are they? They are the* _____ *hats.* (nizzes')	Plur Pos
5. Picture of **one animal wearing a hat**. *This is a wug who owns a hat. Whose hat is it? It is the* _____ *hat.* (wug's)	Sing Pos
6. Picture of **two animals wearing hats**. *Now there are two wugs. They both own hats. Whose hats are they? They are the* _____ *hats.* (wugs')	Plur Pos
7. Picture of **dog covered with irregular green spots**. *This is a dog with quirks /kwɚks/ on him. He is all covered with quirks. What kind of dog is he? He is a* _____ *dog.* (quirky)	Der Adj
8. Three pictures **dogs with spots**. Point to 1st pic: *This dog has quirks on him.* Point to 2nd pic: *This dog has more quirks on him.* Point to 3rd pic: *And this dog has even more quirks on him.* Point to 1st pic: *This dog is quirky.* Point to 2nd pic: *This dog is* _____. (quirkier)	Com Adj
9. Point to 3rd pic: *And this dog is the* _____. (quirkiest)	Sup Adj
10. Picture of **man balancing a ball on his nose**. *This is a man who knows how to zib /zɪb/. What is he doing? He is* _____. (zibbing)	Prog
11. *What would you call a man whose job is to zib? A* _____. (zibber)	Der Comp
12. Picture of **man doing calisthenics**. *This is a man who knows how to mot /mat/. What is he doing? He is* _____. (motting)	Prog
13. *What would you call a man whose job is to mot? A* _____. (motter)	Der Comp
14. Picture of **man swinging an object**. *This is a man who knows how to rick /rɪk/. He is ricking. He did the same thing yesterday. What did he do yesterday? Yesterday he* _____. (ricked)	Past

15. Picture of **man dangling an object on a string**. *This is a man who knows how to bod /bad/. He is bodding. He did the same thing yesterday. What did he do yesterday? Yesterday he* _____. (bodded)	Past
16. Picture of **man shaking an object**. *This is a man who knows how to naz /næz/. He is nazzing. He does it every day. Every day he* _____. (nazzes)	3S
17. Picture of **man holding an object**. *This is a man who knows how to loodge /luwdž/. He is loodging. He does it every day. Every day he* _____. (loodges)	3S

Task 4: Grammatical Judgment

Picture of **green creature.** *This is Wobo. Wobo is a creature from outerspace. Sometimes she says things the wrong way. Sometimes she says things that are silly. That is alright because it is fun to be a little silly. But she does not want to say things the wrong way. You need to tell her when she says a sentence the wrong way.*

Picture with **faces**. Point to the **frowny face**. *If Wobo says something the wrong way point to the frowny face.* Point to the **smiley face**. *If Wobo says it the right way even if it sounds a little silly, point to the smiley face. Let's try some!* Give direct feedback for practice items and instruct as necessary: For example, for Gm can say, "That one sounded funny, but we could say that if we wanted to."

Practice 1: *I have two pencil.*		Y **N**		
Practice 2: *Apples grow on noses.*			**Y** N	
Practice 3: *They is running.*		Y **N**		
Practice 4: *I like dogs.*	**Y** N			
Practice 5: *I drank mud.*			**Y** N	
1. *The shoe are teaching.*				Y **N**
2. *The cars are shoes.*			**Y** N	
3. *I got a bigger cookie than you.*	**Y** N			
4. *I have the tree's boot.*			**Y** N	
5. *I am dirt from taking a bath.*				Y **N**
6. *A girl who sings is a singer.*	**Y** N			
7. *Yesterday I climb a tree.*		Y **N**		
8. *Everyday my horse reads.*			**Y** N	
9. *The girl is look.*		Y **N**		
10. *The car are fast.*		Y **N**		
11. *The car is reading.*			**Y** N	

12. *The boot is look.*				Y **N**
13. *I have two books.*	**Y** N			
Total	GM	gM	Gm	gm

Appendix D
Shared Book Reading Script

Instructions: You will begin the session by building rapport with the participant. Please follow the child's lead and interest in toys. Follow their pace as they become familiar with you. Tell the child that you are going to spend a little bit of time playing together and then would like to read a book together. Tell the child, ***"We are going to read a book about a bear. We are going to talk about the book and I am going to ask you some questions. We are going to look at pictures and also at some toys. I want to learn more about what kids think about the book. If you don't understand something I say, it's okay to tell me that you don't understand."***

Throughout the task, please provide verbal praise for their child paying attention, sitting nicely and/or reading with you (e.g., "I like how you are sitting!" "Thanks for paying such great attention." "Good job reading together with me.")

As you read, the child may be interested in talking about something that leads you off the script. It is fine to take 2-3 conversational turns with the child to talk about what they want to discuss. Please redirect the child back to the book using the verbal prompts, for example:

(a) I like that you are interested in the (insert whatever they are talking about here), let's talk more about the book.
(b) Those are great ideas. Let's look at this page.

A. Introducing the book.

The title of this book is *The Bear Ate Your Sandwich.*
The author is the person who wrote the book. Her name is Julia Sarcone-Roach.

Ask a question to build interest:

What do you think the book will be about? Do you see any clues?

B. Reading the book.

Open the book to the first page. Direct the child's attention to all the sandwiches on the first two pages.

Peanut butter and Jelly is my favorite. (S-NO-1)

Allow wait time. Turn the page.

The Bear Ate Your Sandwich.

Turn the page.

By now I think you know what happened to your sandwich. But you may not know how it happened. So let me tell you. It all started with the bear.

Turn the page.

I like this brown bear. (IN-NO-1)

Allow wait time.

Look at that butterfly. What is the butterfly doing? (S-O-1)

Allow wait time.

The morning air was warm and bright when the bear stepped out of his den. He stretched and sniffed.

What's the cat doing? (IN-O-1)

The scent of ripe berries drifted toward him and led to a wonderful discovery – a truck filled with berries.

I like berries! (S-NO-2)

Allow wait time. Turn the page.

Where is the bear climbing? (S-O-2)

After the berry feast, the bear curled up in the sunlight and listened to the buzzing of the bees.

Before long, he was asleep.

The bee is sleeping. (IN-NO-2)

Allow wait time. Turn the page.

Do you have the pencil? (IN-O-2)

Allow wait time.

By the time the bear opened his eyes, the buzzing had become a rumbling.

Where is the bear going? (S-O-3)

Allow wait time.

He was being quickly swept along like a leaf in a great river. The forest disappeared in the distance and high cliffs rose up around him.

There is a neat bay with boats in it. I have these pictures of boats. Shall we put them in the water? Bring out four color drawings of boats.

The purple boat is my favorite. (IN-NO-3)

Allow wait time. Turn the page.

Once the rumbling stopped, the bear found himself in a new forest.
It was like nothing he'd ever seen before.

Turn the page.

This forest had many great climbing spots.

The bear can hang upside down! (S-NO-3)

Allow wait time.

The trees were still itchy here.

There was good bark for scratching. And mud squished nicely under his feet.

Where is the car going? (IN-O-3)

Allow wait time. Turn the page.

That man has a silly bee costume! (S-NO-4)

There were many interesting smells in this forest.

But some of the tastiest ones had already been found.

The bear looked for food in the fish market and in the dumpster.

I have some little fish. Bring out three fish manipulatives. Direct child's attention toward them.

This fish is very stinky. (IN-NO-4).

Allow wait time. Turn the page.

Leafy green smells led the bear to new fun.

What is the girl doing? (S-O-4)

Allow wait time.

What is that one doing? (IN-O-4)

Allow wait time.

And that is when he (pause) **saw** (pause) **it.**

Turn page.

There it was. Your beautiful and delicious sandwich. All alone.

The bear is hiding! (S-NO-5)

He waited to make sure no one saw him (not even the sandwich) before he made his move.

I like that one! (IN-NO-5)

Allow wait time. Turn the page.

Wow! It was such a great sandwich. The bear loved it.

What is the bear doing? (S-O-5)

Allow wait time.

But just as he was almost finished, he heard sniff (pause) **snuffle** (pause) **slobber** (pause) **snort** (pause) **behind him.**

Turn the page.

He had been seen! All the dogs saw him eat the sandwich.

I have some little dogs. Bring out the dog manipulatives. Direct the child's attention to the dogs.

I love the black dog! (S-NO-6)

Allow wait time. Direct the child's attention back to the book.

The bear was so surprised that he ran out of the park and down the street – until he spotted a very tall tree.

Turn the page.

From the top of the tree, the bear could see his forest. It was time to go home.

The waves rocked the bear and he began to doze.

I think he is going back to the forest. I have some pictures of things that go in a forest. Shall we look at them?

Bring out 4 color drawings of trees and flowers.

Where it the green one? (IN-O-5)

Allow wait time. Turn the page.

When he opened his eyes, he heard the breeze in familiar branches and the birds' and bugs' evening song.

Well the bear made it home just fine.

I like that one! (IN-NO-6)

Allow wait time. Turn the page.

So. That's what happened to your sandwich. The bear ate it.

Look. There are some ears. (point to dog's ears)

Who ate the sandwich? (S-O-6)

Allow wait time. Turn the page.

Let's find out! Oh it was a dog!

I saw it all. I tried to save your sandwich. I was able to save this little bit of lettuce here. The bear dropped it as he ran off, but I couldn't save the rest. I'm sorry to have to tell you about your sandwich this way, but now you know.

Allow wait time.

What did the cat eat? (IN-O-6)

Allow wait time. Turn the page.

Ruff. Ruff. Ruff. Ruff. Ruff.

C. Closing the book.

That was a silly story about a sandwich and a bear. Have you ever seen a bear eat a sandwich?

Praise the child for their attention and work on reading the book with you.

Appendix E

Shared Book Reading Task: Coding Guide

Codes adapted from previous studies (including John et al., 2009; Morisseau et al., 2013; Revelle et al. 1985; see also Skarakis-Doyle & Dempsey, 2008)

Column A. Context
Column B. Condition
Column C. Type of Insufficiency

Column D. Did the researcher present the opportunity in the correct order?
1=Yes
0=No

Column E. Was the opportunity intelligible (i.e., did the researcher speak clearly)?
1=Yes
0=No

Column F. Did the researcher present/deliver the opportunity when the child was attending to the task? The child's attention may be on the book and/or on the examiner.
1=Yes
0=No

Column G. Experimental Opportunities.

Column H. Transcribe child's response.

Column I. How did the child respond to the examiner's sufficient communicative bid? Response must occur within 5 s of examiner's bid. Use only one code. If verbal behavior (codes 1-3) occurs with nonverbal behavior (i.e., codes 4-6), enter code for verbal behavior.

1=Verbal, Provision of information, maintains or shades topic. Topics are considered to be maintained if the child acknowledges the clinician's utterance (e.g., Mmhmm), responds to a question directly or agrees with the clinician (e.g., "Okay."). Topics are considered to be shaded if some component of the previous utterance is maintained but slightly shifted the subject matter (e.g., Researcher: "The bear is sleeping." Child: "But I can see his butt.") (see Brinton and Fujiki, 1984)
2=Verbal, Provision of information, new topic (e.g., child shifts to unrelated topic/subject)
3=Verbal, Request for information

4=Gaze check: Child shifts gaze from book toward examiner or from examiner toward book but does not hold gaze (up to 2 seconds)
5=Sustained gaze on examiner: Child shifts gaze from book toward examiner and sustains gaze for more than 2 seconds
6=Sustained gaze on book or other task materials (i.e., pictures, toys): Child may be checking correspondence between communicative bid and the environment and/or attempting to make an inference
7= off-task behavior that begins immediately following examiner's bid (e.g., gets up, makes non-speech noises, lays head on floor)

Column J-.U How did the child respond to the examiner's insufficient communicative bid? Response must occur within 5 s of examiner's bid. Repairs are verbal and nonverbal behaviors that function to resolve communicative breakdowns and increase the likelihood that the interaction will continue. Enter 1 if you observe the behavior, enter 0 if you do not observe the behavior listed in the column.

Column J
1=General verbal request for clarification or repetition (e.g., "What?" "Huh?"):

Column K
1=Specific verbal request for clarification (e.g., "Which green one?" "Where is the cat?" "What/Which one?"): Child provides specific information related to the nature or topic of the breakdown

Column L
1= Statement specifying the insufficiency or correction of error (e.g., "I don't see a cat." "There's no car." "Not the bee, the bear."): Child verbally indicates something that was insufficient about the examiner's communicative bid

Column M
1=General statement indicating lack of comprehension (e.g., "I don't know." "I don't understand."): Child verbally indicates that they do not understand the examiner's communicative bid.

Column N
1=Provision of information that matches or mirrors examiner's bid (e.g., "I like that one, too!"): Child expresses idea that is similar to examiner's communicative bid, may share information about their preference for something. The child may change the demonstrative pronoun (i.e., this/that, these/those) or the referent (e.g., Clinician says: "I like the black dog." Child says: "I like the white dog.")

Column O
1 = Verbal, Provision of information, maintains or shades topic. Topics are considered to be maintained if the child acknowledges the clinician's utterance (e.g., Mmhmm),

responds to a question directly or agrees with the clinician (e.g., “Okay.”). Topics are considered to be shaded if some component of the previous utterance is maintained but slightly shifted the subject matter (e.g., Researcher: “The bear is sleeping.” Child: “But I can see his butt.”) (see Brinton and Fujiki, 1984)

Column P
1 = Provision of information, introduces new topic (e.g., child shifts to unrelated topic/subject). The "New Topic" code should be used when the child introduces a completely new topic without any part of the clinician's previous utterance/topic in what the child is now talking about.

Column Q
1= Gaze check: Child shifts gaze from book toward examiner or from examiner toward book but does not hold gaze (up to 2 seconds)

Column R
1=Sustained gaze on examiner: Child shifts gaze from book toward examiner and sustains gaze for more than 2 seconds

Column S
1=Sustained gaze on book or other task materials (i.e., pictures, toys): Child may be checking correspondence between communicative bid and the environment and/or attempting to make an inference

Column T
1= off-task behavior that begins immediately following examiner’s communicative bid (e.g., gets up, makes non-speech noises, lays head on floor). This code does not apply if behavior was occurring prior to when communicative opportunity was implemented.

Column U. If the child engaged in more than one response, how did the responses occur? Responses are considered the behavior(s) the immediately follow the examiner’s communicative bid and must occur within 5s.

1= Only 1 response was observed
2=Sequential (nonverbal+verbal)
3=Sequential (verbal+nonverbal)
4=Simultaneous (verbal/nonverbal)