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Parent-Toddler Conversations About Desires and Beliefs: Characterizing Mental State Talk Between Parents and Their Children with Typical Development, Autism, and Developmental Delays

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PARENT-TODDLER CONVERSATIONS ABOUT DESIRES AND BELIEFS: CHARACTERIZING MENTAL STATE TALK BETWEEN PARENTS AND THEIR CHILDREN WITH TYPICAL DEVELOPMENT, AUTISM, AND DEVELOPMENTAL DELAYS

by

ANITA A. HASNI

Under the Direction of Lauren B. Adamson, PhD

ABSTRACT

This study aimed to characterize parent-child conversations about the mind among typically-developing (TD) toddlers, toddlers with autism spectrum disorder (ASD), and toddlers with non-ASD developmental delays (DD). I systematically assessed how often and in what ways parents and their toddlers engaged in mental state talk (i.e., production of mental state utterances) in a semi-naturalistic setting. The sample included 141 22-month old toddlers (50 TD, 44 ASD, 47 DD) and their parents recruited upon completion of screening for ASD during a well-baby checkup. Overall, I found that parents of TD toddlers and parents of toddlers with

ASD or DD did not differ in the *quantity* or *quality* of their mental state talk. In contrast, some group differences emerged among toddlers. Most notably, TD toddlers were more likely to produce mental state utterances than toddlers with ASD or DD. The few toddlers with ASD or DD who did produce a mental state utterance looked similar to TD toddlers in terms of producing desire terms most often, referencing their own mind more than their social partner's mind, using mental state terms when talking about the psychological world, and rarely initiating conversations about the mind. The present study contributes to the limited body of existing work on children's early mental state talk by characterizing the quantity and quality of conversations between two-year-old toddlers and their parents during interaction and before the child receives a formal diagnosis. Its findings provide support for the idea that parents of typically and atypically developing toddlers provide a similar linguistic environment to their child. Thus, the differences we see in toddlers' early use of mental state terms is likely more a reflection of the challenges children with ASD and other developmental delays face when trying to reason about others' thoughts and feelings during social interaction, and less a matter of the quantity and quality of language available in their environment.

INDEX WORDS: Parent-child conversations, Mental states, Theory of mind, ASD, Desires, Beliefs

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AR	At-risk for Autism Spectrum Disorder
ASD	Autism Spectrum Disorder
CPP-A	Communication Play Protocol – Auditory
DD	Non-ASD Developmental Delays
MCDI	MacArthur-Bates Communicative Development Inventories
M-CHAT R/F	Modified Checklist for Autism in Toddlers, Revised, with Follow-Up
MLU	Mean length of utterance
PDD-NOS	Pervasive Developmental Disorder Not Otherwise Specified
SALT	Systematic Analysis of Language Transcripts
SLI	Specific Language Impairment
TD	Typically Developing
ToM	Theory of Mind

1 INTRODUCTION

Theory of mind (ToM) skills enable us to react to thoughts, ideas, and emotions within ourselves and in others (Baron-Cohen, O'Riordan, Stone, Jones, & Plaisted, 1999) and to predict behavior based on inner experiences (Wimmer & Perner, 1983). Because ToM-abilities represent a capacity to reason about underlying mental states, researchers often look to an individual's outward actions and speech to explain what that person might be thinking or feeling. Several researchers have argued that ToM is not a single cognitive achievement, but rather is a set of increasingly difficult insights about the mind that emerge in the first few years of a child's life (see Bloom & German, 2000; Fabricius & Khalil, 2003; Hughes & Devine, 2015; Wellman, Cross, & Watson, 2001). In addition, there is considerable consensus that a child's ability to reason about their own and others' minds requires substantial input from their environment.

Parents often provide their children with the first window into others' complex social and communicative worlds. Researchers have long emphasized the importance of parent-child interactions for the development of children's skills related to joint attention (Mundy, Sigman, Ungerer, & Sherman, 1986), social-emotional understanding (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Maurer & Salapatek, 1976; Rollo & Sulla, 2016), ToM (Hughes & Ensor, 2007), and language abilities (Adamson, Bakeman, Suma, & Robins, 2017; Astington, 2001; Blackwell, Harding, Babayigit, & Roulstone, 2015; Hoff, 2006). Through interaction, children learn to communicate using symbols (Werner & Kaplan, 1963) and attend to objects and other people (Bakeman & Adamson, 1984). Furthermore, several studies have shown that parental linguistic input influences children's later language abilities (Hoff & Naigles, 2002; Hurtado, Marchman, & Fernald, 2008; Rowe, 2012; Ruffman, Slade, & Crowe, 2002). Both variability in the *quantity* and *quality* of parental linguistic input have been shown to predict

children's language abilities (Bang & Nadig, 2015; Snow, 1977), and mounting evidence suggests that variability in the *quality* of parents' communication predicts children's language abilities over and above variability in the quantity of parents' words (Bang & Nadig, 2015; de Rosnay & Hughes, 2006; Hirsh-Pasek et al., 2015; Snow, 1977).

Similarly, children's ability to talk about mental states has been shown to predict their performance on tasks assessing ToM abilities. Mental states are internal constructs that are largely private and unperceived, such as desires, emotions, beliefs, intentions, and other inner experiences (Wellman et al., 2001). These states can be difficult for young children to decipher because the object-of-reference of a mental state during interactions is not present in the physical environment (Lohmann & Tomasello, 2003). Young children transition from primarily talking about objects and people in their immediate present (i.e., in the here and now) to talking about internal states such as beliefs and desires (Adamson & Bakeman, 2006; Werner & Kaplan, 1963). They also move from describing their own actions, feelings and beliefs (i.e., egocentric speech) to talking about others' perspectives and mental states in conversation (Piaget, 1926). However, while we know that early parent-child interactions contain conversations about objects and people in the shared environment, it remains relatively unclear when parent-child conversations about the mind begin to occur during development.

I begin by surveying the literature on children's early ToM abilities, highlighting the controversy surrounding evidence of reasoning skills among infants and preschoolers. Then I describe the relatively limited extant research on ToM abilities among children who are diagnosed with autism spectrum disorder (ASD; see American Psychiatric Association, 2013, for a definition) or other developmental delays. Finally, I return to the notion that parents play an important role in their child's socio-cognitive and linguistic development and summarize the

research to date on the quantity and quality of parents' mental state talk in conversations with their children.

1.1 The emergence of ToM abilities

Although there are many contentions surrounding the age at which children first acquire ToM abilities, most researchers of ToM agree that reasoning about desires and beliefs are among the earliest skills to emerge. Much of the early research on ToM abilities focused on children's understanding of false beliefs (see Wellman et al., 2001, for a review), a complex ability that requires a child to be able to disregard their current belief and respond with what someone else might believe based on an inferred mental state that differs from reality (Bloom & German, 2000). However, several researchers like Gopnik and Wellman (1992) suggest that understanding false beliefs is achieved at a much later stage in the developmental of ToM skills, and in actuality, children progress through a series of understandings beginning with a *desire-only* psychology, followed by a *belief-desire* psychology based on action, and finally a *belief-desire* psychology based on internal mental states.

Contemporary researchers investigating ToM abilities continue to grapple with contradictory findings that suggest that preschoolers (three-, four-, and five-year-old children) perform inconsistently on ToM tasks (see Ruffman, 2014, for a review) while infants as young as 7-months-old are showing success on tasks that have been designed to assess the same underlying mental state constructs. The disagreement is not entirely surprising considering how supporters of infant-understanding use implicit tasks to assess ToM one set of methodologies (e.g., violation-of-expectation, anticipatory looking paradigms, spontaneous-response tasks) while supporters of preschool-understanding use methodologies that require the child to provide explicit responses to brief vignettes (i.e., elicited-response task).

Proponents of infant ToM abilities argue that preschoolers fail to pass explicit false belief tasks prior to age four years because of linguistic and task demands (Baillargeon, Scott, & He, 2010; Carruthers, 2013), and not because of underdeveloped cognitive capacities. For example, Fizke, Butterfill, van de Loo, Reindl, and Rakoczy (2017) argue that infants' ToM capacities are subject to "signature limits" (i.e., simple behavior-reading or low-level mindreading that is characteristic of infant abilities compared to full-blown, meta-representational ToM) and that future research should directly compare children's performance on implicit and explicit tasks. However, proponents of preschool ToM abilities contend that infants perform well on implicit tasks because they understand intentional action, which later evolves into desire-belief systems of understanding in childhood (Wellman, 2017).

1.1.1 *Desires and beliefs*

The capacity to attribute desires (e.g., preferences, wishes) and beliefs (e.g., thoughts, convictions) to oneself and others is a key achievement in ToM understanding (Searle, 1983). Children appear to understand desires earlier than other mental state constructs because desires are more salient (Bretherton & Beeghly, 1982). For example, children are typically able to express their desire for wanting a particular toy prior to their beliefs (i.e., thoughts) about where that toy might be hidden. Acquiring an understanding of others' (true) beliefs often develops after a desire-understanding because it requires the child to realize that others' actions may not be guided by reality, but rather by their beliefs about reality (Bugnyar, 2017). Furthermore, understanding false beliefs, as opposed to the true beliefs as just described, is now recognized as a more advanced ToM skill.

Recently, a growing body of research suggests that infants can succeed on implicit ToM tasks assessing desires and beliefs (see Baillargeon et al., 2014, for a review; see also Scott,

2014; Wang & Leslie, 2016). To study belief-understanding in pre-linguistic infants, researchers have designed a violation-of-expectation task, during which an infant is said to understand belief states if the infant looks longer at events where the protagonists in the task behaves in a manner that was not aligned to his or her beliefs (Onishi & Baillargeon, 2005; Surian, Caldi, & Sperber, 2007; Yott & Poulin-Dubois, 2016). Many studies with pre-linguistic infants utilize looking-time paradigms to explore ToM-development. For example, using a forced-choice task, Repacholi and Gopnik (1997) found support for infant-ToM abilities when they concluded that 18-month-old children, but not 14-month-old children, can recognize that others might desire a snack that they do not want, and can act according to the others' preference. Whereas Repacholi and Gopnik (1997) suggested that 14-month-old children were unable to reason about mental states, Phillips, Wellman, and Spelke's (2002) study testing 14-month-old infants' supported a different conclusion. After witnessing a person look at one of two objects with excitement, the infant saw the person reach for the "liked" object or the "not-liked" object. A majority (80%) of infants looked longer when the person reached for the "not-liked" object, suggesting that infants recognize that understanding a person's gaze and emotional expression towards an object can be a source of a person's preference and intentional behavior.

Similarly, in an anticipatory looking paradigm, researchers monitor an infant's gaze to determine what the infant understands about beliefs by observing where the infant looks in anticipation of the protagonist acting on his or her beliefs (Clements & Perner, 1994; Rubio-Fernández, 2013; Schneider, Bayliss, Becker, & Dux, 2012). Kovács, Téglás, and Endress (2010) found that 7-month-olds can actively track what others have and have not seen based on visual experiences. Furthermore, evidence from spontaneous belief studies also suggest that infants are attuned to others' beliefs and can help someone else in accordance with their beliefs

(Buttlemann, Over, Carpenter, & Tomasello, 2014; Southgate, Chevallier, & Csibra, 2016).

1.1.2 *Other mental states*

The ability to reason about desires and beliefs is argued to be among the earliest skills children acquire; however, there are several other mental state constructs that are also considered to contribute to one's ToM capacities. One model, proposed by Wellman and Liu (2004) suggests that ToM abilities develop in sequence. In an effort to describe typically-developing (TD) preschoolers' understanding of mental states, Wellman and Liu (2004) concluded that achievement on some ToM tasks consistently preceded achievement on other tasks such that once a child failed a given task he or she was likely to also fail all subsequent (more advanced) tasks. This finding led to the formulation of the ToM scale (Wellman & Liu, 2004) using Guttman's principles of scalogram analysis. Thus, proponents of the ToM scale posit that ToM skills emerge in sequence from earliest to latest reasoning abilities in the following way: Diverse Desires, Diverse Beliefs, Knowledge Access, False Belief, and Real-Apparent Emotions (Wellman & Liu, 2004).

The ToM scale provided a new framework from which to think about the development of children's ToM capacities. It has since been applied and adapted to diverse groups to determine if the sequence of abilities changes across cultures or populations with varying developmental trajectories. Researchers have found that the ToM scale sequence is maintained for TD children living in Germany (Kristen, Thoermer, Hofer, Aschersleben, & Sodian, 2006), Turkey (Etel & Yagmurlu, 2014), and Australia (Peterson, Wellman, & Liu, 2005), and deaf native and late signers (Peterson et al., 2005). However, Chinese- (Wellman, Fang, Liu, Zhu, & Liu, 2006) and Iranian-children (Shahaeian, Peterson, Slaughter, & Wellman, 2011) demonstrate reversals in the sequence at the Diverse Beliefs and Knowledge Access steps, and children with ASD (Peterson

et al., 2005) demonstrate reversals at the False Belief and Real-Apparent Emotions steps. Peterson et al. (2005) speculate that children with ASD may be able to reason about emotions prior to false beliefs for two reasons: 1) they may have developed strategies to deal with emotions to be partially successful in everyday interactions without necessarily understanding the mental state aspect of the emotion, or 2) children with autism have a propensity to "conceptualize thoughts as pictures," and thinking about emotions pictorially may be easier than thinking about false beliefs. Deaf native and late signers, children with ASD (Peterson et al., 2005) as well as children with specific language impairment (SLI; Farrant, Fletcher, & Maybery, 2006) also often demonstrate delays in their ability to pass ToM tasks.

1.1.3 *Toddler's ToM abilities*

Even with multiple replication studies and extensions designed to explain ToM skills, the discrepancy in findings between infants' success and preschoolers' lack of success in passing ToM tasks leaves open questions of how ToM abilities develop in the intervening toddler years. It is well-established that toddlerhood is a period of immense social, cognitive, and linguistic growth, and toddlers' lexicons undergo a period of rapid development during the third year of life (Bretherton & Beeghly, 1982; Shatz, Wellman, & Silber, 1983). However, investigating how much of toddlers' lexicons include references to the mind has received relatively little attention in the empirical literature.

In one study, Taumoepeau and Ruffman (2008) found that the average number of references to mental states such as *think* and *know* surges between 24 and 33 months. Moll, Carpenter, and Tomasello (2014) also found evidence that 24-month-old children can track others' knowledge of auditory experiences. Although research investigating children's social-understanding skills is increasingly probing development across time (Dunn & Brown, 1993;

Laible, 2004; Ruffman et al., 2002), populations (Baron-Cohen et al., 1999; McDuffie & Yoder, 2010; Peterson, 2004), and modalities (Williamson, Brooks, & Meltzoff, 2013), much more work is needed to understand children's socio-cognitive development during the second and third year of life (i.e., toddlerhood) before we have a comprehensive view of how ToM capacities develop.

1.1.4 *ToM abilities in toddlers with atypical development*

Children with ASD encounter challenges in knowing the mental worlds of others and have sometimes been described as "mindblind" (Baron-Cohen, Leslie, & Frith, 1985); however, like that of TD toddlers, research on ToM abilities among toddlers with atypical developmental patterns is lacking. It is well known that many children with ASD or non-ASD developmental delays (DD) experience atypical language development (Charman, Drew, Baird, & Baird, 2003), generally acquire their first words later than TD children (Kjelgaard & Tager-Flusberg, 2001), show delays in social communication (see Arunachalam & Luyster, 2015, for a review), and not surprisingly, have difficulty mastering ToM skills (Baron-Cohen, 2000, for a review; Broekhof, Ketelaar, Stockmann, Zijp, Bos, & Rieffe, 2015; Leslie & Frith, 1988; Zhang, Shao, & Zhang, 2016).

For example, Baron-Cohen et al. (1994) compared 8 to 16 year-old children with ASD to children with non-ASD mental disorders (matched on chronological and mental age) on their ability to recognize mental state terms from a list, and they found that children with ASD performed significantly worse than children with non-ASD mental disorders. Their finding extends the idea that children with ASD are delayed in their understanding, yet, it still remains unclear when the differences between typically developing and atypically developing children begin to emerge

Additionally, children with ASD often demonstrate a limited awareness of self and others

(Huang et al., 2017). For example, Hoogenhout and Malcolm-Smith (2014) investigated ToM skills in 4 to 16 year-old children who they classified into five groups as: 1) low-functioning autism, 2) high-functioning autism, 3) Asperger's syndrome, 4) pervasive developmental disorder not otherwise specified (PDD-NOS), and 5) TD children (age-matched). They found that children with high-functioning autism, Asperger's syndrome, and PDD-NOS were delayed, but progressed at normal rates and sequences in their ToM development. In contrast, children with low-functioning autism showed deviations from the normal rates and sequences in acquiring ToM skills. Aside from the few studies described above, relatively little is known about ToM development in toddlers with ASD or DD and compared to their TD peers.

1.2 Mental state talk

1.2.1 *Parent's mental state talk*

Parents who talk about mental states support their children's ability to reflect on the mind, make implicit information explicit, and consider others' perspectives (Taumoepeau & Ruffman, 2016); abilities that have all been associated with supporting ToM development. For example, the frequency of and variations in mental state talk during early mother-child interactions has been shown to correlate with children's later ToM abilities (Brown, Donelan-McCall, & Dunn, 1996; Dunn, Bretherton, & Munn, 1987; Ensor, Devine, Marks, & Hughes, 2014), and several researchers have found a correlation between parent-child conversations about the mind and children's performance on ToM tasks (Carpendale & Lewis, 2004; de Rosnay & Hughes, 2006; Nielsen & Dissanayake, 2000). Some evidence suggests that children who hear the pronouns *I* and *you* more frequently acquire these pronouns earlier (Oshima-Takane, Goodz, & Derevensky, 1996). De Rosnay, Pons, Harris, and Morrell (2004) found that mothers who used more mental states to describe their 3- to 6-year-old children, outside of a conversational

context, also promoted their child's ToM abilities.

To my knowledge, few studies have investigated how mental state talk emerges during interactions between toddlers with ASD and their parents. Children who are developing typically appear to benefit most when mother-talk appropriately matches their extant understanding (Taumopeau & Ruffman, 2008); however, the same patterns may not emerge for toddlers with atypical developmental trajectories. For example, Hutchins, Deraway, Prelock, and O'Neill (2017) examined parent-child conversations during a story-telling task and found that parents of 4 to 11 year-old children with ASD talked about desires and cognitions proportionally less than parents of TD children. They suggested that parents of children with ASD might be adjusting their conversations based on their child's abilities. Hutchins et al. (2017) also found that parents of TD children and children with ASD produced a similar number of utterances, but utterances produced by parents of children with ASD were significantly longer than those produced by TD parents. A case study by Kay-Raining Bird, Cleave, Curia, and Dunleavy (2008) suggested that parents of a three-year-old girl with ASD adjusted the frequency and type of mental state input they provided her. As is well-known, children with ASD often demonstrate delays in acquiring ToM abilities compared to their TD peers (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Happe, 1994; Leslie & Frith, 1988); however, what remains unclear is why the delay occurs even though children with ASD or DD may well be exposed to linguistic environments like those of TD children (Bang & Nadig, 2015; Wolchick, 1983).

1.2.2 *Children's mental state talk*

Children learn about mental state terms in the same way that they learn about other, non-mental state terms (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Peterson & Slaughter, 2003; Rollo & Sulla, 2016; Taumoepeau & Ruffman, 2008). San Juan, Khu, and Graham (2015)

found evidence of perspective-taking skills, which are often considered precursors to developing ToM abilities, when investigating 12-month old children's communication. Moreover, Bretherton and Beeghly (1982) found that 28-month old children can understand their own and others' mental states, and parent reports of children's internal-state language at 28 months were highly correlated with direct laboratory and home observations of the child's language.

Similarly, Harris, Yang, and Cui (2017) recorded the spontaneous speech of two English-speaking children between 27 and 36 months to examine their use of the mental state term *know*. Upon identifying all utterances referring to knowledge states, they coded for: 1) whether the utterance was produced autonomously by the child or simply parroted, 2) how often the utterance connected to the ongoing conversation, 3) the pragmatic function of the utterance, 4) whose knowledge was being discussed, and 5) how often the child affirmed, denied, or asked questions about their own knowledge compared to that of their social partner. They found that the children did produce spontaneous know-utterances that were related to the ongoing conversation, but they did not often start new topics using the mental state term. Both children used the term *know* most often to affirm their own and others' knowledge, but they primarily talked about themselves.

There is also evidence to suggest a relationship between parents' talk about mental states and their children's talk about mental states. In a picture-describing task, Taumopeau and Ruffman (2006) found that maternal talk about the child's desires to 15-month-old children predicted children's mental state talk and understanding of emotions nine months later. A follow-up study revealed that mothers' references to others' thoughts and knowledge was a stable predictor of children's mental state talk at 33 months of age (Taumoepeau & Ruffman, 2008).

Although research on ToM performance of children with ASD has increased, relatively few

studies have described how children with atypical development comprehend and produce mental state terms in everyday conversations. Compared to TD children, children with ASD show delays in the emergence of language skills (Charman et al., 2003), understanding lexical terms related to complex social-cognitive skills, mental states, and emotion words (Arunachalam & Luyster, 2015; Baron-Cohen et al., 1985; Hobson & Lee, 1989; Yi, 2013). An analysis of the spontaneous speech produced by children with ASD revealed that mental state terms, in most cases, were specifically lacking (Tager-Flusberg & Cohen, 1993). In a study exploring children's use of internal state language in a storybook task, Siller, Swanson, Seale, and Techworth (2014) found that 7-year-old children with ASD were less likely to reference a character's thoughts and emotions compared to TD controls.

Moreover, Pino et al. (2017) designed a ToM screening for 5 to 13-year-old Italian children with ASD to try to address this gap and utilized the comic strip test (CST), which has been associated with good receptive language ability, and the eyes-test, which has been used to assess non-verbal or minimally verbal children on intention-, belief- and emotion-understanding. They found that children with ASD had lower scores on both the CST and eyes-test compared to their TD peers. Broekhof et al. (2015) compared ToM understanding (specifically intentions, desires, and false beliefs) in TD children and children with ASD between the ages of 2 and 6 years and found that while children with ASD and TD children understood intentions equally well, children with ASD showed difficulties in understanding others' desires and false beliefs. One explanation for the delays in ToM understanding is that children with ASD may lack the social motivation to share intentions (Broekhof et al., 2015).

Although the number of mental state terms in TD children's vocabulary has been correlated with their performance on ToM tasks, parents of children with ASD often report that

their children's vocabulary contains few mental state terms. Furthermore, 18-month-old infants' scores on the Modified Checklist for Autism in Toddlers (M-CHAT) screening tool for ASD (a parent report) have been shown to significantly relate to infants' concurrent performance on an adaptation of Repacholi and Gopnik's (1997) desire-reasoning task (Wright & Poulin-Dubois, 2012) and expressive vocabulary skills. Thus, another plausible explanation is that differences may stem from the way parents of children with limited social-communicative abilities talk about the mind (Hutchins et al., 2017).

Overall, there is increasing interest in gathering evidence that children come to understand some mental states prior to false beliefs, yet there remains a need to further explore when earlier ToM constructs, such as desires and (true) beliefs, first emerge in parent-child conversations, and specifically how the quantity and quality of mental state talk contributes to children's conversations about the mind for typically and atypically developing toddlers. Given that children with ASD or DD face difficulties reasoning about others' thoughts and feelings, broadly, and that even many TD toddlers continue to be unsuccessful on false belief tasks until four- or five-years of age, it seems reasonable to attempt to describe typical- and atypical-ToM development in terms of the mental-state constructs that emerge earlier along the ToM scale (i.e., desires and beliefs; Wellman & Liu, 2004). Studying how toddlers with ASD use mental state terms in conversation with their parents might help us uncover why preschoolers with ASD are often delayed in passing linguistically-complex ToM tasks and may add to our understanding of children's social-cognitive development overall.

1.2.3 *Assessing quality of mental state talk*

While some studies have documented the presence of mental state utterances during parent-child conversations, most of these studies have focused on the *quantity* of mental states

and relatively few have attempted to describe the *quality* (i.e., richness) of mental state utterances. In a longitudinal study conducted by Ruffman et al. (2002), mothers who participated in more mental-state discourse with their children around age three years had children who scored higher on ToM tasks related to desire-, belief-, and emotion-understanding one year later. However, as de Rosnay and Hughes (2006) concluded in their review of the impact that conversational environments have on children's development of socio-cognitive understanding, "a simple tally of mother's references to emotions is quite poorly associated with their child's emotion understanding (p. 17)." Ensor and Hughes (2008) echoed that engaging children in mental state talk, as opposed to simply exposing them to it, promotes children's social understanding.

Quality of mental state talk is harder to define than quantity so it is not surprising that research on the quality of parent-child conversations takes many forms. For example, Adrian, Clemente, Villanueva, and Rieffe (2005) and Rollo and Sulla (2016) alluded to the importance of studying the quality of parent-child conversations when their findings suggested that using a variety of mental state terms is important in expanding children's mental state understanding. Laible's (2004) research on mental state talk and children's socio-cognitive understanding also concluded that quality of maternal discourse, defined in her study as clarity and elaborativeness, was a good predictor of children's later emotion-understanding. Parents who use appropriate mind-related comments in conversation provide their children with a linguistic scaffold to acquire an understanding of internal states and how to express them in conversations (Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991; Meins, Fernyhough, Arnott, Leekam, & de Rosnay, 2013). For example, mothers who make genuine or appropriate references to mental states (e.g., false belief, emotions) also tend to promote their child's understanding of mind (de

Rosnay & Hughes, 2006; Ensor & Hughes, 2008).

Still other studies have explored associations between the mother's and/or the child's use of mental state terms and the child's performance on ToM tasks. A study investigating the relationship between mothers' psychological lexicon and their 3- to 6-year-old children's cognitive and socio-emotive development during picture-book reading found that mothers' references to cognitive terms were more strongly associated with children's performance on false belief tasks when compared to mother's references to other mental states, such as desires or emotions (Rollo & Buttiglieri, 2009). Denham, Zoller, and Couchoud (1994) investigated mental state talk related to emotions and found that the total number of maternal emotion *explanations*, a quality indicator, was a better predictor of preschool children's emotion understanding compared to the total number of maternal *references* to emotion. Situating mental state talk in the context of shared positive talk (e.g., humor, verbal play, comforting, and assistance) has also been shown to promote children's emotion understanding (Dunn & Brown, 1993).

Not only is it important to describe the use of mental state terms in conversation, but it is also important to examine how those mental state terms are being used to differentiate between one's own mind and the minds of others. In an early account, Bretherton and Beeghly (1982) asked mothers to identify the use of internal-state words in their 28-month-old children's speech, and then went on to ask whether their child used the word to refer to *self* and/or *others*. They found that children referred to *self* more often than to *other*, but that 66% of children's internal-state words applied to *both self and other*, thus concluding that the lag between children's talk about their own states and those of others' is relatively small (Bretherton & Beeghly, 1982).

Increasingly, researchers are recognizing the need to study the quantity *and* quality of

mental state talk, but the emphasis on studies investigating quality of mental state talk, thus far, has been on how emotion- and causal-discourse relates to children's emotion-understanding, and ToM-understanding continues to be indexed by performance on false belief tasks (Denham et al., 1994; Dunn & Brown, 1993). Because of the traditional focus on the false belief paradigm, and emotion understanding to a lesser extent, little is understood about how mental state talk relates to children's understanding of earlier mental states, such as desires and (true) beliefs, and what happens for younger children or children who have difficulties engaging in the social component of an interaction.

1.3 The present study

The present study was designed to systematically characterize and compare the production of mental state terms by toddlers who were approximately 22-months old in three diagnostic groups (TD, ASD, DD) and to also characterize the mental state terms produced by their parents. The questions of how much (quantity) and what type (quality) of mental state talk is produced during parent-child interaction are largely unexplored, thus, I was interested in looking at *parent-* and *child-mental state utterances*, with a particular focus on the production of desire- and belief-terms.

This study drew from a larger project investigating the development of joint engagement (NIH/NICHD R01 HD035612; Adamson PI). Parent-child dyads engaged in three 5-minute interactions designed to facilitate shared commenting, requesting, and interacting. All utterances produced during the interaction were transcribed and utterances containing mental state terms were labeled mental state utterances and further characterized along four dimensions of quality.

The following aims were pursued to investigate how parents' and children's production of mental state terms emerges at a time when toddlers' capacities to reason about their own and

others' minds are typically burgeoning. The study aimed to address these questions and focus on some unexplored aspects of mental state talk among toddlers with typical- and atypical developmental trajectories.

1.3.1 ***Aim 1.***

Characterize mental state talk about desires and beliefs between TD toddlers and their parents. *Parent-* and *child-utterances* produced during interaction were transcribed for 50 parents and their TD toddlers in which the child screened negative for ASD-risk at an 18- or 24-month well-baby checkup. All *parent-* and *child-utterances* containing a mental state term were further coded as *parent-* and *child-mental state utterances*, respectively, and analyzed in terms of quantity and quality to characterize the presence of mental state talk.

In terms of quantity, I hypothesized that there will be: 1) a positive significant correlation between frequency of *parent utterances* and *child utterances*, such that parents who talk more will have toddlers who talk more, and 2) a positive significant correlation between frequency of *parent mental state utterances* and *child mental state utterances,* such that parents who talk more about mental states will have toddlers who talk more about mental states.

With regard to quality, I anticipated variability in how often different mental states terms would be produced. Specifically, I hypothesized that: 3) most *parent-* and *child- mental state utterances* will include *desire* terms, followed by *belief* terms, *combination* (more than one type of mental state term), and *other cognitive states* since much of the literature suggests that children come to understand *desires* and *beliefs* first (Bretherton & Beeghly, 1982; Gopnik & Wellman, 1992; Wellman & Liu, 2004), and 4) *parent mental state utterances* will include relatively equal number of references to *self* and *other,* with few references to *both self* and *other,* but *child mental state utterances* will include more references to *self* than to *other* or *both*

self and other because children demonstrate a predominantly egocentric view of the world prior to incorporating others' perspectives in to their thoughts and language (Dunn & Brown, 1993; Piaget, 1926)*;* 5) parents and toddlers will produce mental state utterances that function as *mental references* more frequently than as *conversational use* because TD children demonstrate an ability to talk about the mind around age 2 (Bretherton & Beeghly, 1982), so TD parents' use of mental state terms will reference the mind, not simply include phrases that further the conversation; and finally, 6) *parent mental state utterances* will be characterized more frequently as *initiations* than *responses,* whereas *child mental state utterances* will be characterized more frequently as *responses* than *initiations,* based on evidence from the literature suggesting that children are able to continue conversations about the mind but rarely introduce mental state terms in conversation (Harris et al., 2017).

1.3.2 ***Aim 2.***

Characterize mental state talk about desires and beliefs between toddlers with ASD and their parents and compare their mental state talk to that of dyads in the DD and TD groups. *Parent-* and *child-utterances* produced during interaction were transcribed for 91 parent-toddler dyads in which the child screened positive for ASD-risk at an 18- or 24- month well-baby checkup. Toddlers were clinically-evaluated for ASD after participating in our observation session and subsequently dichotomized into the ASD (n = 44) or DD (n = 47) group. All *parent-* and *child-utterances* containing a mental state term were further coded as *parent-* and *child-mental state utterances,* respectively, and analyzed in terms of quantity and quality to characterize the presence of mental state talk.

In terms of quantity, I hypothesized that there would be: 1) no significant correlation between the frequency of *parent utterances* and the frequency of *child utterances* for both ASD

and DD groups, since children with developmental delays, including ASD, demonstrate difficulties in acquiring language despite evidence suggesting that their parents providing similar linguistic environments (Blackwell et al., 2015). However, unlike the hypothesized relation between *parent mental state utterances* and *child mental state utterances* for the TD group, I anticipated 2) no significant correlation between *parent mental state utterances* and *child mental state utterances* for the ASD and DD groups since children with atypical development often show delays in ToM abilities (Huang et al., 2017).

In terms of quality, I anticipated variability in how often different mental states terms would be produced. Specifically I hypothesized that, like the TD group, the ASD and DD groups would produce 3) *desire* terms most frequently in interaction, followed by *beliefs*, *combination* (more than one type of mental state term), and *other cognitive states*, because parents of children with atypical development provide their children with a similar linguistic environment to that of parents of children with typical development (Bang & Nadig, 2015; Wolchick, 1983), and children with atypical development often produce and understand mental state constructs in similar sequences to TD children despite being delayed in their understanding (Broekhof et al., 2015; Peterson et al., 2005). I also anticipated that toddlers with DD and their parents would produce more and varied mental state terms compared to toddlers with ASD and their parents, since children with DD more commonly show delays, but not deficits in ToM abilities (Farrant et al., 2006; Peterson et al., 2005).

In addition, I hypothesized that 4) *parent mental state utterances* will include relatively equal references to *self* and *other,* with few references to *both self and other* for parents of children with ASD or DD, while *child mental state utterances* will contain more references to *self* than *other* or *both self and other* as children with ASD or DD, like TD children, demonstrate

an egocentric view of the world prior to incorporating others' perspectives into their thoughts and language (Piaget, 1926; Huang et al., 2017). Furthermore, toddlers with DD and their parents would produce more references to *self*, *other*, and *both self and other* compared to toddlers with ASD and their parents, since parents of toddlers with DD may not need to adjust their mental state talk as much as parents of toddlers with ASD (Blackwell et al., 2015; Hutchins et al., 2017).

I also hypothesized that 5) toddlers with ASD and their parents will produce more mental state utterances that function as *conversational use* than *mental references* because the ASD group may use phrases that contain mental state terms primarily to move the conversation along, but not necessarily to talk about the mind. However, I anticipate that, like the TD group, toddlers with DD and their parents will produce more mental state utterances that function as *mental references* than as *conversational use* because social skills among toddlers with DD are not characteristically as delayed as those of children with ASD.

Finally, I hypothesized that 6) *parent mental state utterances* for the ASD and DD groups will be characterized more frequently as *initiations* than *responses,* whereas *child mental state utterances* for both groups will be characterized more frequently as *responses* than *initiations* based on evidence suggesting that children are able to continue conversations about the mind but rarely introduce mental state terms as a change of topic (Ensor & Hughes, 2008; Harris et al., 2017). I also anticipated that toddlers with DD will produce more mental state utterances characterized as *responses* than toddlers with ASD based on evidence that the spontaneous speech of children with autism often lacks mental state terms (Tager-Flusberg, 1993).

2 METHODS

2.1 Participants

Participants included 141 parent-toddler dyads across three groups (TD, ASD, DD). The dataset included 50 TD toddlers (16 female), 44 toddlers with ASD (9 female), and 47 toddlers with DD (23 female) and their parents. As part of an on-going community-based early ASD screening and detection project (NIH/NICHD R01 HD039961; Robins PI), parents who completed the Modified Checklist for Autism in Toddlers, Revised, with Follow-Up (M-CHAT-R/F; Robins, Fein, & Barton, 2009) questionnaire during a well-baby checkup were invited to bring their toddler to The Developmental Lab at Georgia State University to participate in a larger longitudinal study investigating the development of joint engagement, communication, and social understanding (NIH/NICHD R01 HD035612; Adamson PI).

A majority of the parents observed were mothers (84%), with the exception of fathers (15%) and one female caregiver. Across groups, parents were similar in age (M = 32.5, Range = 16-59 years) and education with a majority of parents completing high school (TD: 98%, ASD: 96%, DD: 87%). Parents were predominantly Caucasian (TD: 48%, ASD: 39%, DD: 32%) and African American (TD: 42%, ASD: 46%, DD: 66%), with some parents identifying as Asian (TD: 4%, DD: 2%), Hispanic (TD: 6%, ASD: 9%), or Multiracial (ASD: 6.8%). Children were also comparable in age (M = 22.3, Range = 16-30 months), with a majority of the toddlers observed being boys (66%). The sample of children was also primarily composed of Caucasian (TD: 38%, ASD: 36%, DD: 30%) and African American (TD: 40%, ASD: 41%, DD: 64%) toddlers, with some representation from Asian- (TD: 2%, DD: 2.1%), Hispanic- (TD: 10%, ASD: 14%), and Multiracial-ethnicities (TD: 10%, ASD: 9%, DD: 4.3%). All toddlers were learning English as their native language (see Table 1).

Parents of toddlers who screened positive on the M-CHAT-R/F were invited to complete three laboratory sessions with their toddler in addition to a set of questionnaires to document their child's cognitive- and linguistic-abilities (e.g., MCDI Words + Sentences, Theory of Mind Inventory). Toddlers who screened positive on the M-CHAT-R/F completed one laboratory play session with their parents prior to the parents knowing whether their child had a formal diagnosis of ASD (Time 1; T1), followed by a clinical evaluation shortly after T1, and a second laboratory play session at 36 months old (Time 2; T2). The clinical evaluation included a report containing diagnostic information, which was used to determine whether toddlers were subsequently placed in the ASD or DD groups.

The TD group included toddlers who screened negative on the M-CHAT-R/F and their parents. They were recruited from the same sites as toddlers with ASD or DD. TD toddlers and their parents were invited to participate in three laboratory play sessions. The initial play session corresponded with T1 for toddlers with ASD or DD (around 22 months), the second play (T2) session took place around 36 months, and the final play session occurred approximately two years from the initial one (around 48 months). TD toddlers did not receive a clinical evaluation.

As part of the larger study investigating the development of children's joint engagement, I had access to information on 134 out of the 141 toddlers' expressive language skills as reported by parents around the time of observation using the MacArthur-Bates Communicative Development Inventories (MCDI) Words and Sentences language measure (Fenson, Marchman, Thal, Dale, & Reznick, 2007). The MCDI asks parents to indicate all of the words their child understands and says by marking the words they have heard their child use (i.e., *total MCDI words*).

The present study includes data from the observations made at T1 for all participants, and

does not include any data from T2, the clinical evaluation, or T3 other than information related to the toddler's diagnosis. At the time of observation (T1) parents of toddlers with ASD and parents of toddlers with DD were unaware of their child's diagnosis, thus any changes in their behavior were not a result of receiving a diagnosis for their child.

Table 1 *Demographic Information by Group*

	TD	ASD	DD
Parents			
Gender (%)			
Females	92.0	79.5	80.9
Males	8.0	20.5	19.1
Age			
Mean age in years (SD)	32.4 (7.0)	34.3 (7.2)	30.9 (6.9)
Age range in years	16–44	20–59	18–46
Ethnicity (%)			
Caucasian	48.0	38.6	31.9
African American	42.0	45.5	66.0
Asian	4.0	0.0	2.1
Hispanic	6.0	9.1	0.0
Multiracial	0.0	6.8	0.0
Education (%)			
< High school	2.0	4.5	12.8
High school	12.0	13.6	23.4
Some college	26.0	45.5	17.0
Bachelor's degree	20.0	22.7	25.5
Some graduate	0.0	2.3	0.0
Graduate degree	40.0	11.4	21.3
Children			
Gender (%)			
Girls	32.0	20.5	48.9
Boys	68.0	79.5	51.1
Age			
Mean age in months (SD)	23.7 (2.9)	22.1 (3.1)	22.2 (3.4)
Age range in months	16–27	17–30	15–30
Ethnicity (%)			
Caucasian	38.0	36.4	28.8
African American	40.0	40.9	63.8
Asian	2.0	0.0	2.1
Hispanic	10.0	13.6	0.1
Multiracial	10.0	9.1	4.3

Note. TD = typically developing (n = 50), ASD = autism spectrum disorder (n = 44), DD = non-ASD developmental delays (n = 47). Parents are grouped by their child's diagnosis. SD = standard deviation.

2.2 Observations

2.2.1 *Procedure*

All observations took place within The Developmental Laboratory at Georgia State University. Visits to the laboratory lasted approximately two hours and consisted of a 45-minute parent-toddler observational period followed by a series of cognitive- and linguistic-assessments, parent questionnaires, and social-understanding tasks when applicable. Parents were informed that the study aimed to understand early communication development and how their toddler plays, reacts to sounds, and interacts over time (Adamson NIH/NICHD R01 HD035612; Adamson PI). Prior to the start of each session, parents were asked to provide consent to participate in the study and, optionally, to allow their video records to be viewed by other researchers, teachers, and students for professional and educational purposes.

2.2.2 *Observational conditions*

Parent-toddler dyads were observed using the communication play protocol-auditory (CPP-A; Adamson & Bakeman, 2016). The CPP-A is designed similarly to the communication play protocol (CPP; Adamson & Bakeman, 2004; 2016), in which the child is the "star" and the parent is the "supporting actor." The play-like structure of the CPP-A contains seven 3- to 5-minute scenes that facilitate parent-child interaction and allows for systematic observation of parent-child discourse in a semi-naturalistic setting. Three scenes, which were used to collect data for the present study, focus on engaging the dyad in a communicative context (interacting, requesting, and commenting), while the remaining four scenes draw attention to sounds (speech, music, animals, and vehicles) in a shared environment. Parents did not receive an explicit script; however, a member of the research team ("director") provided parents with a cue card containing a general plot and suitable props at the start of each scene (see Appendix A).

Observations consisted of the three interaction scenes of the CPP-A, each scene being approximately 5 minutes in length (see Table 2). During the *Turns* scene (interacting) objects such as a ball and stacking toy were introduced and parents were asked to engage in turn-taking games with their toddler. The *I Want* scene (requesting) encouraged the toddler to request parental assistance in reaching three appealing toys (toy clock, stuffed doll/animal, and a favorite toy from home) placed on a high shelf. The *Container* scene presented the dyad with a box containing several attractive objects and prompted parents to engage their child with each object one at a time. For the present study, all parent- and child-utterances produced during the three interaction scenes at T1 were transcribed; the four scenes containing sounds were not transcribed.

Table 2 *Mean Length of CPP-A Interaction Scenes*

	TD		ASD		DD	
	M	*SD*	*M*	*SD*	*M*	*SD*
Container	5:38	0:54	5:29	0:24	5:39	0:48
Turns	5:40	0:36	5:34	0:39	5:35	0:36
I want	5:47	0:44	5:33	0:25	5:41	0:32

Note. TD = typically developing (n = 50), ASD = autism spectrum disorder (n = 44), DD = non-ASD developmental delays (n = 47). *M* = mean, *SD* = standard deviation. Times are presented as [minutes: seconds].

2.2.3 ***Video recording***

Parent-toddler interactions during the CPP-A were captured and recorded from three views. Two operator-controlled video cameras were positioned behind one-way mirrors on opposite sides of the playroom. A third video camera, a GoPro™ Hero3+, was attached to a head strap and worn by the parent (like a headband) throughout the session to capture a close view of the toddler's face when he/she was positioned in front of the parent.

2.3 Transcription

Windows Media Player software was used to view video recordings of the observations captured at T1. Speech produced during each communicative context (interacting, requesting, and commenting) was transcribed at the utterance-level from the moment the director left the room to the moment the director re-entered the room with instructions for the next scene. An utterance was defined as a sentence or a phrase representing a single complete thought, and each utterance was transcribed on a separate line and ended with a punctuation mark such as a period or question mark.

Two transcripts were generated for each observation using the video recordings and following the conventions specified by the Systematic Analysis of Language Transcripts program (SALT; Miller & Iglesias, 2010). A summary of common SALT conventions is provided in Appendix B. Additionally, SALT's *Analyze* feature allowed for analysis of all transcripts for mean length of utterance (MLU) and frequency summaries for a specified list of words, which, for the purposes of this study, included a list of mental state terms (see Appendix C).

I generated the first set of transcripts, while another trained member of the research team independently generated a second set of transcripts. I then compared both sets of transcripts alongside the video recording and reconciled any major discrepancies with the other transcriber before generating a final transcript.

2.4 Coding schemes

The present study involved two coding schemes: 1) *Mental state* and 2) *Classification*. Both schemes maintained the unit of coding as any intelligible utterance that was produced by the speaker (parent or child) during a communicative context.

The *Mental state* coding scheme served to identify all *parent-* and *child- utterances* containing one or more mental state terms (see Table 3), and the *Classification* coding scheme was applied to characterize all *parent-* and *child-mental state utterances*. The *Classification* coding scheme included the following four categories used to characterize mental state utterances: 1) type of mental state (*desire, belief, combination, other cognitive state*), 2) person referent (*self, other, both self and other*), 3) role (*mental reference, conversational use*), and 4) relatedness (*initiation, response*).

Table 3 *Coding Schemes for Parent and Child Utterances*

Scheme	Variable	[Code] and definition
Mental State		
	Mental state utterance	Identifies utterances that contain a mental state term [MSU] An utterance that refers to the thoughts, memories, or knowledge of the speaker, listener, or a third person
Classification		
	Mental state term	Identifies the mental state construct(s) in the utterance • Desire [Des]: Utterances that describe a specific object, event, or state of affairs that is sought (Wellman & Woolley, 1990) • Belief [Bel]: Utterances that describe a true belief about an object, event, or state of affairs • Combination [COMB]: Utterances that reference two or more mental state constructs (e.g., desires and beliefs) • Other cognitive state [OCS]: Utterances that reference cognitive states other than desires and/or beliefs
	Person referent	Identifies the person that the speaker is attributing the mental state to in the utterance • Self [Slf]: Utterances that attribute the mental state to the speaker • Other [Oth]: Utterances that attribute the mental state to the social partner or someone outside of the dyad • Both self and other [BSO]: Utterances that attribute the mental state to both the self and other
	Role	Describes how the mental state term is being used in discourse: • Mental reference [MRef]: Utterances in which the speaker references their own or another's thoughts, beliefs, memories, imagining, thinking. • Conversational use [CUse]: Utterances that function to maintain discourse rather than exemplify comprehension of either the state or its meaning
	Relatedness	Describes whether the speaker's mental state utterance is semantically related to their social partner's previous turn • Initiation [In]: Speaker's mental state utterance is semantically unrelated to the social partner's previous turn • Response [Rsp]: Speaker's mental state utterance is semantically related to the social partner's previous turn

2.5 Coding procedure

The coder's task was to identify all *parent-* and *child-utterances* with a mental state term, and classify further according to the type of mental state term that was produced, the person being referenced, the role of the mental state term, and whether the mental state utterance was related to the social partner's previous turn. The coder began by opening a copy of the finalized SALT transcript file for a given dyad. Next, the coder performed run 1 by reviewing each of the three interaction scenes independently to identify and mark all utterances containing a mental state term (see section 2.4.1). Then the coder performed run 2 to characterize the utterances according to the *Classification* coding scheme (see section 2.4). All codes were placed before the end-of-utterance punctuation mark in square brackets (e.g., [ ].) and some utterances were marked to reflect use of more than one mental state term (e.g., both desires and beliefs) or reference to more than one mind (e.g., *both self and other*). False starts or abandoned utterances that contained mental state terms were not coded (see Appendix D).

2.6 Reliability

After transcribing all video-recorded observations, I, as the primary researcher, coded each transcript with the knowledge of the study's hypotheses but not the toddler's diagnosis. To establish inter-coder reliability, I trained one undergraduate student, who was blind to the study's hypotheses and the toddler's diagnosis, to independently code 20% of the corpus (30 randomly-selected transcripts with representation from each group).

Inter-coder agreement was computed using the KappaAcc program (Bakeman, 2018), which provides various kappa statistics and estimates observer percentage accuracy (see Table 4). Kappa (Cohen, 1960) summarizes the agreement between two observers who have judged the same sequence of events to determine if there is adequate observer agreement. The estimated

observer accuracy is a value reported to estimate how accurate two observers would need to be to produce the observed value of kappa, given the number of codes and distributions of the marginals. Percent agreement represents the level of agreement between two observers but does not account for chance agreement.

The kappa statistic, estimated observer accuracy, and percent agreement values were computed separately for parents and toddlers based on the set of mental state utterances identified by both coders. Kappa values ranged from .48–1.00 for parent variables and from .53–1.00 for child variables. Estimated observer accuracy was greater than 93% for all parent variables and greater than 86% for all child variables. Percent agreement was above 90% for all parent variables and above 78% for all child variables (see Table 4).

Table 4 *Inter-coder Agreement and Kappa Values*

	Parents			Children		
	k	Accuracy (%)	P_O	k	Accuracy (%)	P_O
MSU	1.00	99	100	1.00	99	100
Type	0.97	99	99	1.00	99	100
Person	0.88	98	98	0.59	89	84
Role	0.48	98	98	1.00	99	100
Relatedness	0.65	93	90	0.53	86	78

Note. Reliability sample (N = 30); MSU = mental state utterance, k = Cohen's omnibus kappa, Accuracy = estimated observer accuracy, P_O = percent agreement

2.7 Data analysis

To test for group differences among the TD, ASD, DD groups, I characterized and analyzed parent-child conversations about the mind at the utterance-level. I began by determining the MLU for *parent-* and *child-utterances* and *parent-* and *child-mental state*

utterances, descriptive statistics related to means, standard deviations, and ranges (when applicable) for each variable (see Tables 5 and 6). Next, I computed Pearson *r* correlations to explore any relations between the number of *parent-* and *child-utterances* and the number of *parent- and child-mental state utterances*. Finally, if essentially all participants had non-zero scores for a given variable, I analyzed cases for which frequencies were non-zero, using one-way between-subjects ANOVAs with group as the independent variable when the assumptions of ANOVA were met (approximately normal distributions, homogeneity of variances, and independence of observations). Significant group differences were analyzed using Tukey's post-hoc analyses.

For other variables, particularly child variables where the frequency of zero observations was higher than in parent variables, I cross-classified cases by group and occurrence (frequency = 0 vs. frequency > 0) and analyzed the data using Fisher's exact tests. In the at-risk group, one toddler with ASD and eight toddlers with DD produced any mental state utterances. Given that only one toddler with ASD produced mental state utterances, I chose to report differences between TD toddlers and toddlers with DD for select analyses.

3 RESULTS

3.1 Characterizing mental state talk between parents and their TD children

3.1.1 *Parents of TD toddlers*

The TD sample consisted of 50 parents of TD toddlers who, on average, produced 317 total utterances across the three interaction scenes of the CPP-A, and whose mean length of utterance was 3.52 words. All parents of TD toddlers produced mental state terms in conversation with an average of 36.3 mental state utterances throughout the observation; mental

state utterances accounted for 11% of parents' overall linguistic input (see Table 5).

I further investigated *parent mental state utterances* along four dimensions: 1) diversity of mental state terms, 2) who mental state utterances were referring to, 3) whether mental state utterances were referring to the mind or were simply being used to further conversation, and 4) whether mental state utterances were semantically related to the social partner's previous turn (response) or functioned as the start of a new idea (initiation). I found that 86% of parents of TD toddlers produced more than one type of mental state term, with most parents producing *desire* terms, followed by *other cognitive states*, then *beliefs*, and finally some *combination* of mental state terms (see Figure 1).

Parents of TD toddlers were approximately eight times more likely to produce at least one reference to others' minds compared to their own mind. Most mental state utterances were classified as *mental reference*, with less than a quarter of parents producing mental state utterances for *conversational use*. Additionally, I found that all parents of TD toddlers initiated mental state talk; however, only 78% of parents produced a mental state utterance as a *response* to their toddler's utterances (mental state utterances or non-mental state utterances; see Figure 1).

Table 5 *Parent Utterances*

	TD				ASD				DD			
	M	*SD*	Range	*n*	*M*	*SD*	Range	*n*	*M*	*SD*	Range	*n*
Utterances												
All utterances	317	86.4	167–547	50	295	105	147–579	44	283	77.2	114–438	47
MLU of All utterances	3.52	0.61	2.46–5.93	50	3.21	0.58	2.15–4.66	44	3.12	0.69	1.97–4.86	47
Mental state utterances	36.3	19.2	5–89	50	33.8	20.8	6–88	44	30.6	20.9	3–80	47
Mental state term												
Desires	30.2	15.4	3–84	50	31.2	18.5	1–86	44	26.9	19.0	2–72	47
Beliefs	4.47	4.44	1–20	34	2.59	1.88	1–7	22	3.14	2.89	1–17	21
Combination	1.69	0.92	1–3	13	1.25	0.63	1–2	12	1.88	0.86	1–3	8
Other cognitive state	4.32	4.19	1–23	41	2.91	2.66	1–14	32	3.39	2.88	1–15	28
Person referent												
Self	4.69	3.93	1–17	42	3.31	2.80	1–11	32	3.71	2.84	1–11	28
Other	33.0	17.2	4–88	50	32.1	18.9	6–83	44	27.6	19.4	3–75	46
Both self and other	1.58	0.95	1–4	12	1.42	0.75	1–3	12	2.00	0.85	1–3	7
Role												
Mental reference	36.6	19.1	7–89	49	34.7	20.7	6–88	44	30.4	21.0	3–80	47
Conversational use	1.64	1.02	1–5	11	1.82	0.61	1–2	11	1.22	0.53	1–2	9
Relatedness												
Initiation	29.6	16.1	7–89	50	33.9	19.8	6–88	44	28.6	20.9	2–80	47
Response	9.79	7.29	1–27	39	3.75	4.56	1–23	12	3.96	3.48	1–13	25

Note. Total sample: TD = typically developing (n = 50), ASD = autism spectrum disorder (n = 44), DD = non-ASD developmental delays (n = 47); MLU = mean length of utterance. *M* = mean and *SD* = standard deviations for all parents who produced at least one instance of the respective code.

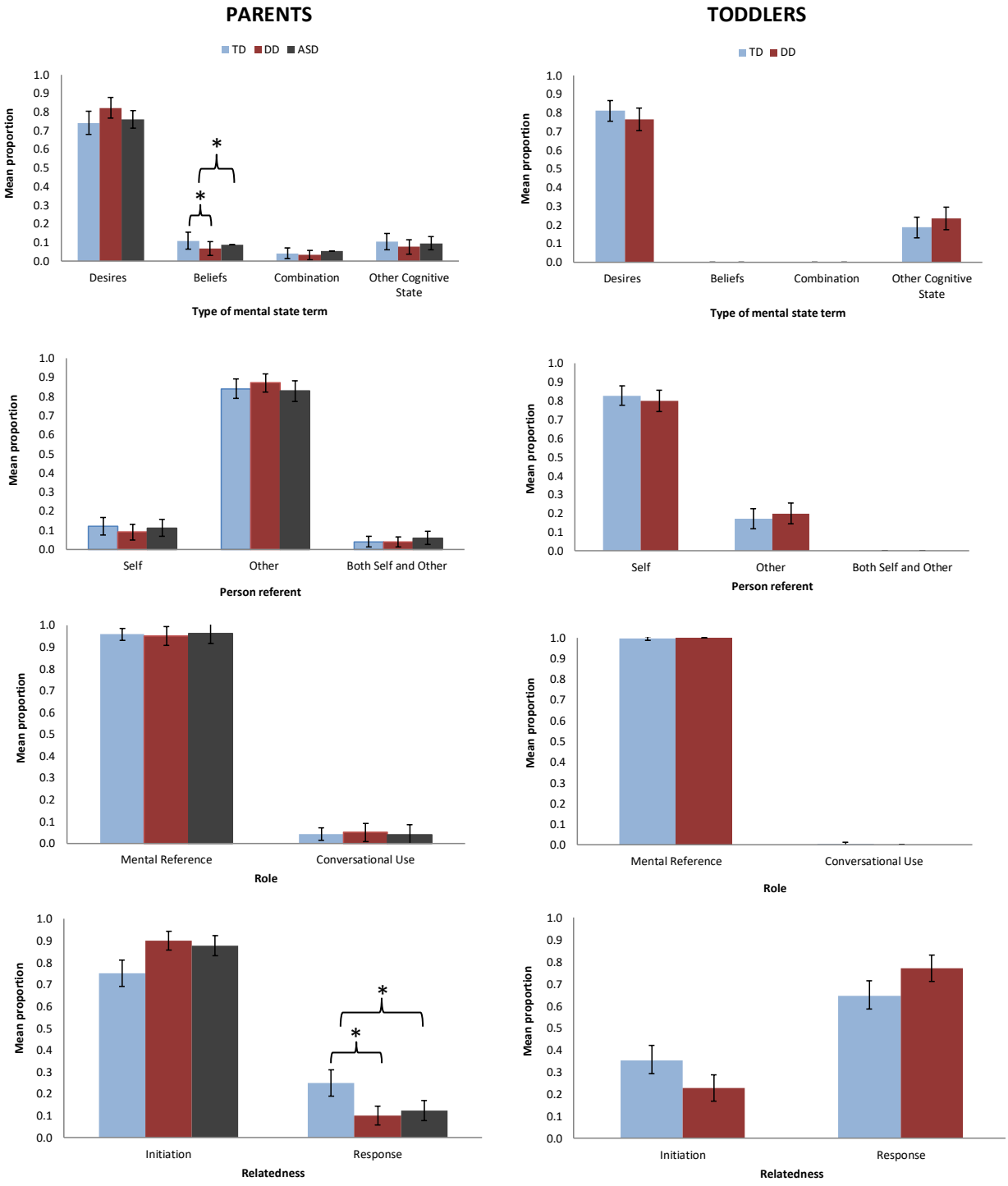

Figure 1. Mean proportion of quality variables for parents and toddlers who produced one or more mental state utterances.

TD = typically developing (parents: *n* = 50; toddlers: *n* = 24), ASD = autism spectrum disorder (parents: *n* = 44), DD = non-ASD developmental delays (parents: *n* = 47; toddlers: *n* = 8).

3.1.2 *TD toddlers*

The sample of 50 TD toddlers produced an average of 89.8 utterances with a mean length of utterance of 1.49 words (see Table 6). Twenty-six toddlers did not produce any mental state utterances; however, among those toddlers who did talk about the mind, mental state utterances were 4% of their total utterances (see Figure 2). TD toddlers who produced at least one mental state utterance ranged from 18 to 27 months old with a mean age of 23 months. Of the 24 TD toddlers who produced one or more mental state utterances, a majority of toddlers (63%) were reported to have MCDI Total Words scores above the group mean of 227.4 (*SD* = 173.5) words, and 75% of them were above the group mean in terms of producing at least one utterance during observation.

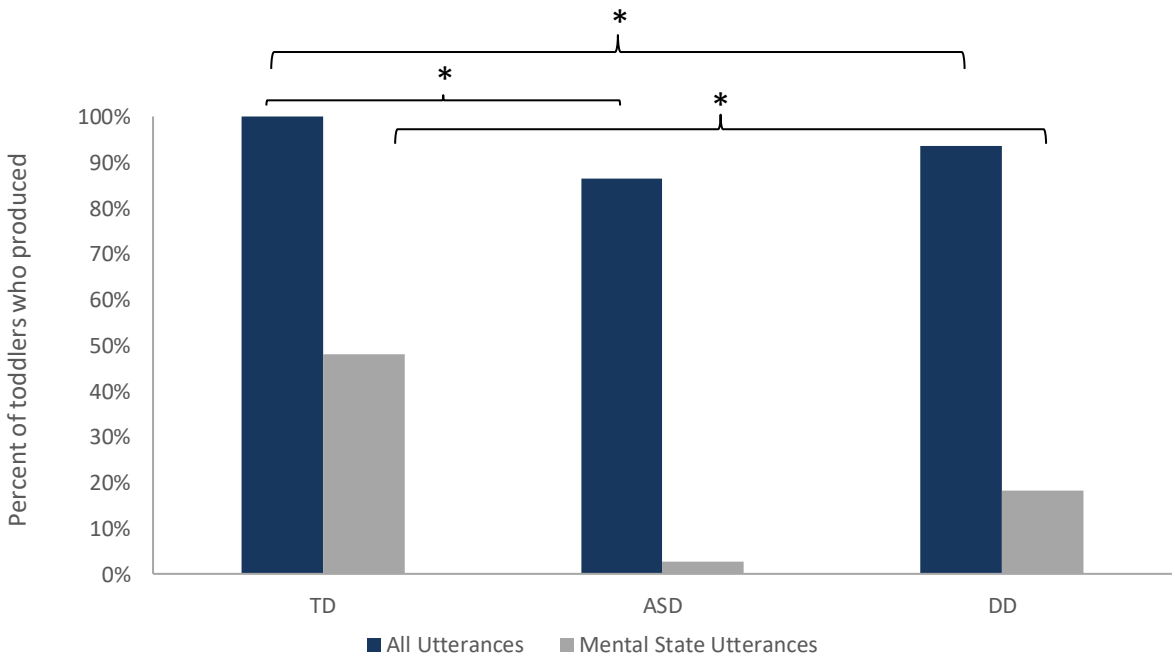

Figure 2. Percent of toddlers who produced at least one utterance or mental state utterance during observation.

Percent of toddlers who produced mental state utterances is based on percent of toddlers who produced at least one utterance. TD = typically developing (*n* = 50), ASD = autism spectrum disorder (*n* = 44), DD = non-ASD developmental delays (*n* = 47).

I further investigated TD *children's mental state utterances* for only those children who produced at least one mental state utterance (n = 24) along four dimensions: 1) diversity of mental state terms, 2) who mental state utterances were referring to, 3) whether mental state utterances were referring to the mind or were simply being used to further conversation, and 4) whether mental state utterances were semantically related to the social partner's previous turn (response) or functioned as the start of a new idea (initiation). I found that 92% of toddlers who produced a mental state utterance produced *desire* terms and 17% produced *other cognitive state* terms. However, I did not observe any instances of TD toddlers producing *belief* terms or some *combination* of mental state terms (see Figure 1).

All TD toddlers who produced a mental state utterance referenced their own mind and 17% referenced someone else's mind at least once. All but one of the 24 TD toddlers produced one or more mental state utterances that were classified as *mental reference*, and one toddler produced a mental state utterance functioning as *conversational use*. Moreover, 83% of toddlers produced at least one mental state utterance that was semantically-related (i.e., *response*) to their parent's previous utterance (mental state utterance or non-mental state utterance), while 58% of TD toddlers initiated a mental state utterance at least once (see Figure 1).

Table 6 *Child Utterances*

	TD				ASD				DD			
	M	*SD*	Range	*n*	*M*	*SD*	Range	*n*	*M*	*SD*	Range	*n*
Utterances												
All utterances	89.8	56.0	5–228	50	20.2	29.0	1–130	38	37.1	36.6	1–168	44
MLU of All utterances	1.49	0.37	1–2.8	50	1.30	0.63	1–2.5	38	1.30	0.44	1–2.5	44
Mental state utterances	5.04	4.62	1–24	24	6.00	–	–	1	3.38	2.91	1–8	8
Mental state term												
Desires	5.41	4.63	1–24	22	6.00	–	–	1	3.25	2.90	1–8	8
Beliefs	–	–	–	0	–	–	–	0	–	–	–	0
Combination	–	–	–	0	–	–	–	0	–	–	–	0
Other cognitive state	1.25	0.36	1–2	4	–	–	–	0	1.00	–	–	1
Person referent												
Self	4.83	4.53	1–24	24	5.00	–	–	1	4.00	2.83	1–8	6
Other	1.00	0.38	–	4	1.00	–	–	1	1.00	0.41	–	3
Both self and other	–	–	–	0	–	–	–	0	–	–	–	0
Role												
Mental reference	5.22	4.62	1–24	23	6.00	–	–	1	3.38	2.57	1–8	8
Conversational use	1.00	–	–	1	–	–	–	0	–	–	–	0
Relatedness												
Initiation	2.36	1.36	1–5	14	4.00	–	–	1	1.25	0.60	1–2	4
Response	4.30	3.64	1–19	20	2.00	–	–	1	4.20	2.74	2–8	5

Note. Total sample: TD = typically developing (n = 50), ASD = autism spectrum disorder (n = 44), DD = non-ASD developmental delays (n = 47); MLU = mean length of utterance. *M* = mean and *SD* = standard deviations for all toddlers who produced at least one instance of the respective code.

3.2 Characterizing mental state talk between parents and their children with ASD or DD

3.2.1 *Parents of toddlers with ASD or DD*

The ASD sample consisted of 44 parents and the DD sample of 47 parents. On average, parents of toddlers with ASD produced 295 utterances and had a mean length of utterance of 3.21 words while parents of toddlers with DD produced 283 utterances and had a mean length of utterance of 3.12 words across the three interaction scenes of the CPP-A. All parents of toddlers with ASD or DD produced mental state utterances at least once during the observation. Like that of TD parents, mental state utterances were approximately 11% of the total utterances produced by parents of toddlers with ASD or DD (see Table 5).

To test for any significant effects of group on each parent variable, I conducted a series of one-way analyses of variance (ANOVA). First, I wanted to determine if there was a significant effect of group on the number of *parent utterances* or *parent MLU*. Like other studies investigating the linguistic environment available to a child (Bang & Nadig, 2015; Ensor & Hughes, 2008; Wolchick, 1983) have revealed, and as expected, there was no significant difference in the number of *parent utterances* across groups (F (2, 138) = 1.79, p = .17, η^2 = .03). I did, however, find a significant effect of group on *parent MLU* (F (2, 138) = 5.27, p = .01, η^2 = .07). Posthoc tests revealed that *parent MLU* for parents of TD toddlers (M = 3.52, SD = 0.61) was significantly greater than *parent MLU* for parents of toddlers with ASD (M = 3.21, SD = 0.58; p = .05) and parents of toddlers with DD (M = 3.12, SD = 0.69; p < .01), but there was no significant difference between parents in the ASD and DD groups.

Next, I analyzed data resulting from the *Mental State* coding scheme (see Table 3) to test for group differences on the number of *parent mental state utterances*. In line with previous findings described in the literature (Hutchins et al., 2017), and as predicted, I did not find a

significant effect of group on number of *parent mental state utterances* (F (2, 138) = 0.95, p = .39, η^2 = .01).

As with parents of TD toddlers, I characterized *parent mental state utterances* for parents of all toddlers with ASD or DD along the same four dimensions: 1) diversity of mental state terms, 2) who mental state utterances were referring to, 3) whether mental state utterances were referring to the mind or were simply being used to further conversation, and 4) whether mental state utterances were semantically related to the social partner's previous turn (response) or functioned as the start of a new idea (initiation). I found that 82% of parents of toddlers with ASD and 75% of parents of toddlers with DD produced more than one type of mental state term, with most parents producing *desire* terms, followed by *other cognitive states*, then *beliefs*, and finally some *combination* of mental state terms (see Figure 1).

Contrary to some of my hypotheses, the results suggested significant overall effects of group on parents' production of *belief* terms (F (2, 138) = 4.35, p = .02, η^2 = .06) and *other cognitive state* terms (F (2, 138) = 3.18, p = .05, η^2 = .04), but not on *desires* (F (2, 138) = 0.77, p = .47, η^2 = .01), or a *combination* (F (2, 138) = 0.34, p = .71, η^2 = .01) of mental state terms. Among those parents who produced at least one *belief* term, parents of TD toddlers (M = 4.47, SD = 4.44) produced significantly more mental state utterances referencing *beliefs* than parents of toddlers with ASD (M = 2.59, SD = 1.88; p < .05) and parents of toddlers with DD (M = 3.14, SD = 2.89; p < .05); however, parents of toddlers with ASD or DD did not significantly differ in their production of *belief* terms (p = .99). There were no significant pairwise comparisons for parents' references to *other cognitive* states (TD: M = 4.32, SD = 4.19; ASD: M = 2.91, SD = 2.66; DD: M = 3.39, SD = 2.88); the difference between parents of TD toddlers and parents of toddlers with DD approached significance (p = .07).

Parents of toddlers with ASD or DD produced one or more references to others' minds more often than to their own minds (see Table 5). As anticipated, I did not find any group effects on person referent across parents. Initially, the results suggested an overall significant effect of parent references to *self* (F (2, 138) = 4.13, p = .02 , η^2= .06); however, pairwise comparisons revealed that the differences were not statistically significant, and there were no significant differences between parents of toddlers with ASD and parents of TD toddlers or between parents of toddlers with ASD and parents of toddlers with DD in the number of references to *self*. Parents of TD toddlers did, however, tend to produce more mental state utterances referencing the *self* than parents of toddlers with DD (p = .06). There were no significant group differences for parent references to *other* (F (2, 138) = 1.44, p = .24 , η^2= .02) or *both self and other* (F (2, 138) = 0.18, p = .83 , η^2= .01).

Like parents of TD toddlers, parents of toddlers with ASD and parents of toddlers with DD rarely produced mental state utterances functioning as *conversational use* (< 1% of the time). Although I hypothesized that TD parents would produce more mental state utterances that function as *mental references* than parents of toddlers with ASD or DD and that there would not be any significant differences in production between parents of toddlers with ASD or DD, I found that all parents referenced mental states similarly regardless of their child's diagnosis (F (2, 138) = 0.97, p = .38 , η^2= .01). I also anticipated that parents of toddlers with ASD or DD would use mental state terms in *conversational use* more often than TD parents, but this was not the case (F (2, 138) = 0.42, p = .66 , η^2= .01).

Finally, I found that all parents of toddlers with ASD or DD initiated some mental state talk during conversation, and 27% of parents of toddlers with ASD and 53% of parents of toddlers with DD produced mental state utterances at least once when responding to their child.

As hypothesized, I did not find a significant effect of group on mental state utterances being classified as *parent initiations* (F (2, 138) = 1.00, $p < .37$, $\eta^2 = .01$), but did find a significant effect of group on mental state utterances being classified as *parent responses* (F (2, 138) = 22.7, $p < .001$, $\eta^2 = .25$). Posthoc analyses indicated that parents of TD toddlers (M = 7.64, SD = 7.30) responded with significantly more mental state utterances than parents of toddlers with ASD (M = 1.02, SD = 3.58, $p < .001$) and parents of toddlers with DD (M = 2.11, SD = 3.40; $p < .001$); however, parents of toddlers with ASD or DD did not significantly differ in the amount of their mental state utterances functioning as *responses*.

3.2.2 *Toddlers with ASD or DD*

The ASD sample consisted of 44 toddlers and the DD sample consisted of 47 children. However, not all toddlers with ASD or DD produced an utterance during the three interaction scenes of the CPP-A (see Figure 2). Toddlers with ASD who produced at least one utterance (86%) during the observation produced an average of 20.2 utterances with a mean length of utterance of 1.30 words. Toddlers with DD who produced at least one utterance (94%) during the observation produced an average of 37.1 utterances with a mean length of utterance of 1.30 words (see Table 6).

To test for significant group differences among all toddlers on *child utterances* and *child MLU*, I conducted a one-way ANOVA and found a significant effect of group on *child utterances* (F (2, 138) = 37.41, $p < .001$, $\eta^2 = .35$), with TD toddlers (M = 89.8, SD = 56.0) producing significantly more utterances than toddlers with ASD (M = 20.2, SD = 29.0; $p < .001$) or DD (M = 37.2, SD = 36.6; $p < .001$). On average, toddlers with ASD produced fewer utterances than toddlers with DD; however, posthoc analyses suggested that the difference was not significant. I also found a significant effect of group on *child MLU* (F (2, 138) = 11.8, $p <$

.001, η^2 = .15). Posthoc tests suggest that TD toddlers (*M* = 1.49, *SD* = 0.37) produced significantly greater *child MLUs* compared to toddlers with ASD (*M* = 1.30, *SD* = 0.63; *p* < .001) and toddlers with DD (*M* = 1.30, *SD* = 0.44; *p* = .02), but there was no significant difference in *child MLU* between toddlers with ASD and toddlers with DD.

Although I initially planned to analyze all data using a series of one-way between-subjects ANOVAs, the sample consisted of several toddlers who did not produce any mental state utterances during the 15-minute observation, which limited the number and types of analyses that could be conducted. Only one toddler with ASD and eight toddlers with DD produced one or more mental state utterances. Among toddlers who produced at least one mental state utterance, 30% of all utterances for the child with ASD were mental state utterances, and, on average, 9% of all utterances produced by toddlers with DD were mental state utterances (see Table 6).

Given that only one toddler in the ASD group produced mental state utterances, I chose to exclude this child from further analyses and below focus on reporting my findings on toddlers with DD (*n* = 8) who produced at least one mental state utterance. Toddlers with DD were older than TD toddlers and ranged from 21 to 30 months, with a mean age of 25 months. Like TD toddlers, among the eight toddlers with DD (*M* = 90.1, *SD* = 41.6) who produced at least one mental state utterance, all produced more total utterances compared to the group mean (*M* = 37.1, *SD* = 36.6), and all but one toddler with DD was reported to have a MCDI Total Words score above average (*M* = 61.3, *SD* = 5.20).

Thus, for toddlers who produced at least one mental state utterance, I analyzed group differences using Fisher's exact tests with TD and DD as the groups. I selected Fisher's exact tests as the test of choice because the data contained two independent groups and sample sizes

were small for many toddler variables.

As predicted, I did find a significant difference in the number of mental state utterances produced by TD toddlers (M = 5.04, SD = 4.62) compared to toddlers with DD (M = 3.38, SD = 2.91) who produced at least one mental state utterance, $p < .01$. TD toddlers also produced a greater range [1−24] of mental state utterances compared to their peers with DD [1-8 mental state utterances].

I examined mental state utterances of toddlers with DD along the same four dimensions as previously described: 1) diversity of mental state terms, 2) who mental state utterances were referring to, 3) whether mental state utterances were referring to the mind or were simply being used to further conversation, and 4) whether mental state utterances were semantically related to the social partner's previous turn (response) or functioned as the start of a new idea (initiation).

First, toddlers in the DD group who produced at least one mental state utterance (n = 8) did not vary in the type of mental state terms they produced, and, like their parents, most toddlers who produced a mental state utterance produced a *desire* term. I did not observe any instances of toddlers with DD producing *belief* terms or *combinations* of mental state terms, and only one toddler with DD produced any *other cognitive state* term. Next, I analyzed toddlers' mental state utterances to identify group differences among the quality variables. I expected that TD toddlers would produce more mental state utterances containing *desires*, *beliefs*, *other cognitive states*, and *combinations* of mental state constructs compared to toddlers with DD. Fisher's exact tests indicated that TD toddlers did not significantly differ, p = 1.00, in their production of *desire* terms when compared to toddlers with DD. No toddlers produced *beliefs* or a *combination* of mental state terms during the interaction scenes of the CPP-A. Moreover, TD toddlers did not significantly differ from toddlers with DD in their use of *other cognitive states*, p = 1.00 (see

Figure 1).

More toddlers with DD referenced their own mind (*self*) compared to someone else's mind (*other*). For person referents, I had predicted that toddlers would not show any significant differences in how often they referenced the *self* across groups, and I expected TD toddlers to reference *others* and *both self and others* more often than toddlers with DD. TD toddlers and toddlers with DD did not differ in their references to *self*, as expected, $p = .06$. Additionally, TD toddlers and toddlers with DD did not differ significantly in their references to *other*, $p = .33$, and no toddlers produced *both self and other* references (see Figure 1).

In regard to the function of toddlers' mental state utterances, I expected that TD toddlers would produce significantly more mental state utterances that functioned as *mental references* and *conversational use* than toddlers with DD. There was no significant difference between TD toddlers and toddlers with DD in the quantity of mental state utterances that functioned as *mental references*, $p = 1.00$, among toddlers that produced one or more mental state utterances. No toddlers with DD produced any mental state utterances that functioned as *conversational use*, and I found that TD toddlers and toddlers with DD did not significantly differ in their use of mental state utterances functioning as *conversational use*, $p = 1.00$ (see Figure 1).

Half or more of the toddlers with DD who produced at least one mental state utterance had one or more mental state utterances that classified as *initiations* ($n = 4$) or *responses* ($n = 5$) when conversing with their parents (see Table 6). I predicted that TD toddlers' mental state utterances would be characterized with more *initiations* and *responses* compared to toddlers with DD. I found that TD toddlers did not significantly differ from toddlers with DD in the quantity of *initiations* of mental state utterances, $p = .70$. Similarly, TD toddlers did not differ from toddlers with DD in the number of *responses* containing a mental state term, $p = .33$ (see Figure 1).

As mentioned previously, 95% of parents reported information about their toddler's expressive vocabulary using the MCDI at the time of observation. To test for effects of group on toddlers' expressive vocabulary, I conducted a one-way ANOVA and found a significant effect of group on *total MCDI words* (F (2, 133) = 33.84, $p < .001$, $\eta^2 = .34$). TD toddlers (M = 227.41, SD = 173.53) were reported as having significantly greater numbers of *total MCDI words* than toddlers with ASD (M = 34.22, SD = 239.34; $p < .001$) or DD (M = 61.25, SD = 5.20; $p < .001$); however, toddlers with ASD did not significantly differ from toddlers with DD on the number of *total MCDI words* reported by their parents.

3.3 Correlations

There is evidence to suggest that ToM development is closely linked with language development (e.g., Astington & Baird, 2005; Meins et al., 2005; Pons, Lawson, Harris, & de Rosnay, 2003). Bohannon and Bonvillian (2005) concluded that children acquire language through ongoing interactions with communication partners. Thus, I tested the associations between the number of *parent utterances* and the number of *child utterances* and between the number of *parent mental state utterances* and the number of *child mental state utterances* using Pearson r correlations for all parents and their toddlers. Contrary to my predictions, I did not find significant correlations between the number of *parent utterances* and the number of *child utterances* for the full sample (r = .14, N = 141, p = .09) or the TD group (r = .19, n = 50, p = .20). As predicted, I also did not find a significant correlation between *parent-* and *child utterances* in the ASD group (r = .07, n = 44, p = .67) or the DD group (r = −.09, n = 47, p = .56).

The number of *parent mental state utterances* and the number of *child mental state utterances* among all dyads was not significantly correlated in the total sample (r = .13, N = 141,

$p = .12$) or in the TD group ($r = .13$, $n = 50$, $p = .12$), contrary to what I had hypothesized. As predicted, I also did not find significant correlations between *parent mental state utterances* and *child mental state utterances* for the ASD group ($r = -.12$, $n = 44$, $p = .48$) or the DD group ($r = -.03$, $n = 47$, $p = .82$). Additionally, I tested for an association between *parent mental state utterances* and *child mental state utterances* among the eight children with DD who produced at least one mental state utterance, but the results were not significant ($r = .24$, $n = 8$, $p = .56$).

I was also interested in determining if there was an association between toddlers' production (or lack thereof) of mental state utterances and their overall expressive vocabulary based on the total number of words reported by parents on the MCDI. To determine if there was an association between *child mental state utterances* and *total MCDI words* I conducted a Pearson *r* correlation which revealed an overall significant positive correlation, $r = .45$, $N = 134$, $p < .01$. The significant correlation suggests that toddlers who were reported to have a greater number of *total MCDI words* produced a greater number of mental state utterances, while toddlers who were reported to have fewer *total MCDI words* produced fewer mental state utterances.

Table 7 *Fisher's Exact Tests Comparing TD and DD Toddlers Across Variables*

	TD			DD			
	M	SD	%	*M*	SD	%	*p*
Utterances							
Mental state utterances	5.04	5.62	100	3.38	2.77	100	.01
Mental state term							
Desires	4.96	5.69	92	3.25	2.82	100	1.00
Beliefs	–	–	–	–	–	–	–
Combination	–	–	–	–	–	–	–
Other cognitive state	0.21	0.51	17	0.13	0.35	13	1.00
Person referent							
Self	4.83	5.58	100	3.00	2.88	75	.06
Other	0.17	0.38	17	0.38	0.52	38	.33
Both	–	–	–	–	–		
Role							
Mental reference	5.00	5.67	96	3.38	2.77	100	1.00
Conversational use	0.04	0.20	4	–	–	–	1.00
Relatedness							
Initiation	1.38	1.66	58	0.63	0.74	50	.70
Response	3.58	4.37	83	2.63	2.83	63	.33

Note. TD = typically developing (n = 24), DD = non-ASD developmental delays (n = 8); *M* = mean, *SD* = standard deviation; *%* = percent of toddlers with non-zero frequencies, and *p* = p-value for all toddlers who produced at least one instance of the respective code.

4 DISCUSSION

The aims of this study were to characterize parent-child conversations about the mind during a transformative period in language development among 1) TD toddlers and their parents and 2) toddlers with ASD or DD and their parents. I addressed these aims by systematically transcribing all parent- and child-utterances produced during the three interaction scenes of the CPP-A and then characterizing all parent- and child-utterances that were identified as mental state utterances (i.e., those that contained a mental state term) in terms of quantity and quality. In summary, I found that parents of TD toddlers and parents of toddlers with ASD or DD provide similar linguistic environments for their toddlers. Although parents talked to their toddlers about the mind similarly, significantly more TD toddlers produced mental state utterances compared to their peers with ASD or DD. In characterizing toddlers' mental state talk I found that all toddlers who produced mental state utterances, regardless of diagnosis, produced *desire* terms most often, referenced their own mind more than that of their social partner's mind, used mental state terms to talk about the psychological world, and rarely initiated conversations about the mind.

4.1 Linguistic environment and parents' mental state talk

Overall, parents, regardless of their child's diagnosis, did not differ in the *quantity* or *quality* of the mental state talk they provided for their toddler's linguistic environment. This supports previous findings that suggest that parents of 4 to 7 year-old children with ASD provide linguistic input quantitatively and qualitatively comparable to parents of TD children during interaction (Bang & Nadig, 2015), but does not support Hutchins et al.'s (2017) conclusions that parents of 5 to 10 year-olds with ASD produce proportionally less causal-, desire-, and cognitive-talk during a story-telling compared to parents of TD children. Perhaps the context of the task

(interaction vs. story-telling) could be an explanatory factor for the contradictory findings; however, another possibility is that parents of toddlers with ASD in our sample were parents of younger children than the ones in Bang and Nadig's (2015) and Hutchins et al.'s (2017) studies, and therefore may not have been adjusting their language to that of their toddlers' since most toddlers were producing less than two-word combinations at this period of language development and few were using mental state terms. Furthermore, parents of toddlers with ASD or DD in this sample were not aware of their child's diagnosis at the time of observation. Thus, it is possible that parents only begin to adjust their language and dyadic interactions after learning of their child's diagnosis.

In looking at the types of mental state terms produced, I found that all parents produced d*esire* terms, which are thought to represent the earliest mental state constructs (ToM Scale; Wellman & Liu, 2004), most often. While reasoning about *beliefs* is thought to be the next earliest ability to emerge among children, I found that parents talked more about *other cognitive states* (e.g., know, remember, guess) than *beliefs*. Since I was primarily interested in early mental state talk (*desires* and *beliefs*), for the purposes of this study I had grouped all other types of mental state terms into the category *other cognitive states*. This larger category could have artificially inflated my counts due to the sheer number of different mental state terms that would classify as *other cognitive states.*

As expected, I found that parents, regardless of their toddler's diagnosis, were talking about others' minds, either that of their toddler or someone else, more often than they were talking about their own mind. It is possible that talk about the child's mind is more beneficial to children's developing ToM abilities compared to talk about others' minds since it is suggested that the focus of children's language and thoughts are initially egocentric (Bretherton & Beeghly,

1982; Piaget, 1926). Moreover, parents may have spoken about their toddler's mind more often than their own mind since parents often tune into their child's interests during play (Tamis-LeMonda, Custode, Kuchirko, Escobar, & Lo, 2018). In this study I classified utterances referring to the social partner's or anyone else's mind under the single code *other* to identify utterances that were not referring to the *self*; however, in future coding schemes further dividing the *other* code into *social partner* (parent or toddler) or *other* (representing someone outside of the dyad) may be more informative.

I also observed relatively few instances of parents using a mental state term to maintain discourse (i.e., *conversational use*) rather than represent an internal state. Given that parents were engaging with such young social partners with elementary language skills it seems appropriate that parents primarily used mental state terms when referring to the mind. Perhaps I would find more occurrences of mental state utterances that function as *conversation use* among older parent-child dyads who use mental state terms to clarify their speech or direct the interaction.

Finally, parents in the three groups did not differ in how often their mental state utterances were classified as *initiations*. Thus, parents of toddlers with ASD or DD appear to introduce the psychological world into conversation just as often as parents of TD toddlers. However, I found that parents of TD toddlers produced significantly more mental state utterances in response to their toddlers' utterances (mental state and non-mental state) compared to parents of toddlers with atypical development. Our finding begs the question of why parents of toddlers with ASD or DD seem to introduce mental states into conversation as often as parents of TD toddlers but are less likely to take advantage of the opportunity to respond with semantically-related mental state utterances or continue talking about the mind with their children.

4.2 Toddlers' mental state talk

In contrast to parents, several more differences emerged in the *quantity* and *quality* of mental state utterances among toddlers. Since there were toddlers in each group who did not produce any mental state utterances, the discussion below focuses solely on toddlers who produced one or more mental state utterances during the 15 minutes of interaction. Among the toddlers who produced mental state utterances, TD toddlers generally talked about the mind more than toddlers with DD, suggesting that TD toddlers engaged in conversations about the psychological world more often.

After characterizing the *quality* of toddlers' mental state utterances, I found that TD toddlers produced three times as many *desire* terms compared to their peers in the DD group. TD toddlers and toddlers with DD produced a minuscule number of mental state utterances referencing *other cognitive states*, and I did not observe any instances of toddlers from either group producing *beliefs* or a *combination* of mental state terms. Our findings support the idea that children are first able to reason about *desires* (Gopnik & Wellman, 1992; Wellman & Liu, 2004), but it was surprising to see that no toddlers produced *belief* terms. Perhaps the fact that our sample was comprised of toddlers, compared to preschoolers often studied in other paradigms, accounts for the limited production of mental state terms beyond *desires*; it would be interesting to see if toddlers begin to regularly use *belief* terms in conversation at a later age.

In line with previous findings on children's mental state talk, I found that toddlers talked about themselves more than any other persons. This did not come as a surprise since researchers over many decades have suggested that children begin with an egocentric view of the world, which is reflected in their language, and later acquire the ability to incorporate others' into their conversations and thoughts (Bretherton & Beeghly, 1982; Huang et al., 2017; Piaget, 1926).

Additionally, TD toddlers and toddlers with DD generally responded to their parents with mental state utterances more often than they initiated conversations about the mind. This finding supports Harris et al.'s (2017) study which concluded that children do not often initiate mental state talk in spontaneous conversation. Given that *initiations* (utterances that were not semantically-related to the social partner's previous turn) and *responses* (utterances that were semantically-related to the social partner's previous turn) represent a moment in time when the conversation shifts from discussing things present in the manifest physical world to talking about things in the hidden psychological world, I think it seems reasonable that toddlers would be more likely to continue a conversation about the hidden mental world than initiate one because mental states represent abstract thoughts that are not observable or readily cued by the environment.

Finally, significant differences in overall expressive vocabulary skills between TD toddlers and toddlers with ASD or DD, as reported by their parents on the MCDI, are noteworthy because they may explain some of the variation in toddlers' production of mental state utterances during observation. Significant effects of group on *total MCDI* words support previous research suggesting that children with ASD and other developmental delays often show delays in their communication skills about the physical and psychological worlds compared to TD peers (Arunachalam & Luyster, 2015; Baron-Cohen et al., 1985; Charman et al., 2003; Hobson & Lee, 1989; Yi, 2013). The relationship between parent-report of their toddlers' expressive language and utterances and mental state utterances transcribed during interaction also adds support for observational techniques being a good methodological choice for documenting children's language.

Overall, parents' mental state utterances were not significantly correlated with their toddlers' mental state utterances; however, this may be explained, in part, by the observation that

toddlers produced so few mental state utterances during interaction. Moreover, mental state talk was severely lacking in the spontaneous speech of toddlers with ASD or DD, as Tager-Flusberg and Cohen (1993) also found.

4.3 Exploratory analyses

I conducted additional analyses to explore the potential effects of gender on toddler's *all utterances*, *child MLU*, and *mental state utterances* produced during observation. I was curious to know if girls (n = 48) in our sample differed from boys (n = 93) in terms of their production of all utterances, MLU, and the production of mental state utterances during observation because some studies on TD children's language development suggest girls have larger vocabularies and acquire language earlier than boys (Eriksson et al., 2012; Huttenlocher et al., 1991), while other studies suggest that gender differences are minimal (see Hyde & Linn, 1988 for a review) or arise because parents speak more frequently (Johnson, Caskey, Rand, Tucker, & Bohr, 2014) or differently (Mascaro, Rentscher, Hackett, Mehl, & Rilling, 2017) to girls than to boys.

Despite having nearly twice as many boys as girls in our sample, independent samples t-tests suggested no significant overall effects of gender on *child utterances*, $t(139) = -1.68$, $p = .10$, or *child mental state utterances*, $t(139) = .20$, $p = .85$. However, there was a significant overall effect of gender on *child MLU*, $t(139) = -2.63$, $p < .01$, with girls (M = 1.40, SD = 0.46) producing significantly longer utterances than boys (M = 1.16, SD = 0.54). A two-way multiple analysis of variance (two-way MANOVA) testing for significant interaction effects between group and gender on the combined dependent variables yielded results that were not statistically significant.

Given the mixed findings on language development among TD children, I analyzed the effects of gender on TD toddlers specifically. I found that TD girls (M = 117.31, SD = 27.05)

produced significantly more *child utterances* than TD boys (M = 76.79, SD = 61.54), $t(48)$ = −.51, p = .02, and TD girls (M = 1.64, SD = 0.36) had significantly longer *child MLU* compared to TD boys (M = 1.42, SD = 0.37). However, TD girls did not significantly differ from TD boys in their production of *child mental state utterances* (see Table 6). Thus, it appears that girls and boys did not differ in their production of mental state utterances overall nor in the TD group; however, in terms of all utterances and MLU, girls produced significantly more utterances than TD boys overall and among TD toddlers around age two years.

4.4 Limitations

While many aspects of the study were carefully planned, I raise two ideas that could constitute as limitations: 1) the DD group comprised of toddlers with a variety of diagnoses, and 2) very few toddlers with ASD or DD produced one or more mental state utterances. First, toddlers with DD were identified as toddlers who initially screened positive for ASD on the M-CHAT R/F screening tool, but were subsequently not diagnosed with ASD following a clinical evaluation. Toddlers who did not receive a formal diagnosis of ASD were categorized into a single group despite representing various diagnoses including, but not limited to: language delays, global developmental delays, and broader autism phenotype. Performing the same analyses on multiple subgroups was not possible, thus it is important to note that toddlers in the DD group show developmental delays that are quite varied in nature, but share a common characteristic in that they were not diagnosed with ASD.

Second, I acknowledge that most toddlers with ASD or DD produced zero to few mental state utterances during interaction, which limited the types of analyses we could conduct to characterize the *quality* of toddlers' mental state utterances. To help address this challenge, I focused solely on the eight toddlers with DD who produced at least one mental state utterance, so

as to be able to characterize their mental state utterances and compare them to toddlers from the TD group. Thus, despite having to remove toddlers with ASD from the final group analyses, I maintain that the data, though less than anticipated, still provide valuable insights into the *quantity* and *quality* of language exchanges between toddlers with atypical developmental trajectories and their parents.

4.5 Contributions

This study contributes to the field of developmental psychology in several ways. First, I used observational techniques to study toddlers' mental state talk in a semi-naturalistic setting rather than utilizing experimental tasks that are often linguistically-complex for the population of interest. Second, I examined toddlers at age two years, an age when language abilities are usually burgeoning and comprehension and production of mental state terms typically begins as well as a period that can help bridge the contradictory findings in the infant and preschool literature on ToM abilities. Third, the sample I chose to study consisted of parents of toddlers with developmental delays who were recruited to participate in the study prior to their knowledge of a formal diagnosis for their child, and a group of TD toddlers who were recruited from the same sites. Finally, this study is among a limited number of studies that attempts to characterize both the *quantity* and *quality* of the mental state talk that occurs between parents and their toddlers during interaction.

Traditionally, researchers interested in young children's ToM abilities have developed experimental paradigms, such as eye-tracking and implicit-response tasks for infants and brief, yet linguistically-complex, tasks to study preschoolers' understanding of the mind. Others have designed methodologies to study parents' use of mental state terms in the context of reading a story or have studied children's spontaneous speech with a single- or few cases. However,

relatively few studies investigated parents' and children's spontaneous use of mental state terms during interaction. This study was designed to understand children's comprehension and production of mental state terms in conversation with their parents, with few experimental constraints. Although the 15-minute observations took place in a laboratory setting, parents were instructed to engage with their child as they normally would at home. Additionally, the experimenter was not part of the observation, which is often the case with experimental paradigms. Thus, the child was able to engage in conversations about the mind with someone they regularly interact with and not a stranger.

For this study, I chose to observe toddlers around age two for several reasons which include toddlerhood being a period: 1) when children typically show large gains in language ability and begin to produce mental state terms, 2) that is often overlooked in the ToM literature, and 3) when a screening tool like the M-CHAT R/F we used in this study can be administered to help detect early signs of ASD. Recruitment of the sample was carefully done for the larger project investigating the development of joint engagement (NIH/NICHD R01 HD035612; Adamson PI), with a concerted effort to find children of comparable age. Having access to a sample of children of comparable age and with or without diagnoses of ASD allowed me to systematically assess how early experiences impact variations in outcome for this study.

To our knowledge, this is the first study that attempted to characterize parent-toddler conversations about the mind in a sample of children who have been identified as "at risk" for developing ASD before or around their second birthday, but whose parents were not yet aware of their child's formal diagnosis. This unique sample of parents of toddlers who screened positive on the M-CHAT-R/F (i.e., parents of children identified as "at-risk" for ASD) and were unaware of their child's diagnosis at the time of initial observation also included toddlers with ASD or

DD who were observed at an age much younger than reported in many prior studies. This also allows us to examine parent linguistic input prior to any biases or interventions related to the child's diagnosis. TD parents and toddlers were those who screened negative for being at-risk for ASD on the M-CHAT R/F and were recruited from the same sites as dyads in the ASD and DD groups.

Finally, in this study I provide a comprehensive characterization of the *quantity* and *quality* of mental state talk during 15 minutes of interaction for parents of TD toddlers and parents of toddlers who were not yet formally diagnosed with a developmental delay at age two. Determining the best way to describe not only how much but in what ways parents and toddlers talk about the mind proved to be a challenging task; however, the resulting data provide a rich picture of the types of mental states used, whose mind was being talked about, the role of the mental state utterance in conversation, and which social partner was initiating conversations about the mind. The study also resulted in the development of two coding schemes that included codes adapted from previous studies found in the literature (Brown et al,, 1996; Ensor & Hughes, 2008; Nielsen & Dissanayake, 2000; Shatz et al., 1983).

4.6 Future directions

Our efforts to characterize conversations about the mind among toddlers with atypical development and their parents were largely exploratory, and thus add to the limited body of research describing the linguistic environment available to children with ASD or DD. This study only begins to address the great needs of 1) characterizing the *quantity* and *quality* of parent-toddler conversations about the mind at a period typically described as one of tremendous language development for the child, and 2) comparing the linguistic environments available to children with atypical developmental trajectories to those of children with typical developmental

trajectories to learn how parents support their children's understanding of their own and others' psychological worlds.

I provide a systematic look at toddlers' engagement with early mental state constructs, particularly desires and beliefs, and add to the limited extant literature on the linguistic environment available to children with ASD. In a subsequent study, I would be interested in performing the same characterizations and analyses, but at the second timepoint in our observation, when the child is three years old. I would be particularly interested in documenting if 1) toddlers production of mental state utterances increases and begins to differentiate over the course of one year, and 2) parents of toddlers with ASD or DD begin to adjust their conversations after learning of their child's diagnosis.

Future studies should consider a longitudinal approach to investigating parent-child conversations so as to be able to characterize how the production of and types of mental state terms in conversation evolve over time. Additionally, research on toddlers' mental state talk can focus on children's comprehension and production of more advanced ToM constructs such as the ones I classified as *other cognitive states*. Furthermore, the context (i.e., topic) of conversation may impact parents' and toddlers' production of mental state terms. Thus, researchers interested in toddlers' mental state talk may find it interesting to test for context effects in a sample of children who produce more mental state utterances than the present sample. Recruiting a sample of children with ASD or DD who are able to produce full sentences, compared to one or two-word combinations, could increase the likelihood of identifying mental state utterances (e.g., "I want juice") in conversation and allow for further coding of those mental state utterances along the four dimensions of type, person referent, role, and relatedness. Finally, research linking toddlers' early mental state language skills to later performance on ToM tasks can help identify

delays or deficits in mental-state reasoning abilities from a younger age.

In conclusion, observational studies, such as this one, offer a rich context from which to describe children's understanding of their own and others' psychological worlds through their expressive language, and can help bridge the gap between infant and preschool studies that primarily rely on standard experimental tasks of ToM abilities.

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APPENDICES

Appendix A

Transcribing the interaction scenes of the CPP-A

Transcribing the interaction scenes of the Communication Play Protocol – Auditory (CPP-A)

Technical Report XX

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Transcribing the interaction scenes of the Communication Play Protocol – Auditory (CPP-A)

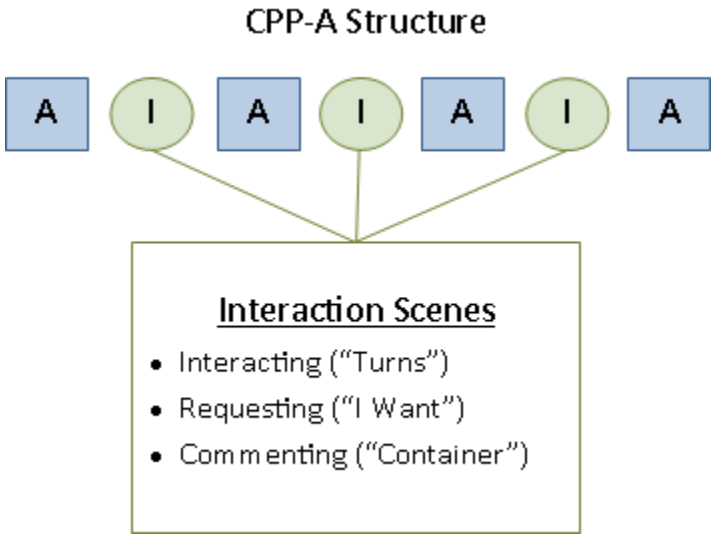
1 Purpose

This Technical Report describes the application of the Systematic Analysis of Language Transcription (SALT) to characterize observations during the interaction scenes of the Communication Play Protocol – Auditory (CPP-A; see Technical Report 20). Included in this Technical Report are instructions on how to begin transcribing an observation, definitions, SALT transcription conventions, and additional notes for transcribers.

2 Background

The Communication Play Protocol – Auditory (CPP-A) is a semi-structured observational context that is designed to display how a young child communicates with an adult about a range of topics. It systematically samples three communicative functions–requesting, social interacting, and commenting– and responses to four types of sounds–speech, music, animal, and mechanical. It is intended for use with typically developing toddlers from approximately 12 to 36 months of age and with atypically developing young children between 12 and 48 months of age. The child and his/her parent are video recorded during the Communication Play-A so that observations may be subsequently coded.

The three five-minute interaction scenes—selected from the original CPP—feature contexts that afford interacting, requesting, and commenting. An interaction scene lasts 5 minutes and is timed from the moment the door closes at the beginning of the scene until the director knocks on the door before reentering the playroom.



3 Procedure

3.1 Creating and saving a SALT file

You should generate a new file for each participant. To create a new file, double-click on the SALT 2010 Research icon to launch the program. A dialogue box called *Getting Started* should pop up. Select the *New* option to create a new transcript

Once you have selected *New*, a dialogue box labelled *New Transcript-Header Information* should appear. Input the following information as it relates to the participant:

Target speaker: Child

Other speakers: Parent

Language: English

Sampling context: Conversation

Participant ID: Enter participant ID + visit number (e.g., 001v1)

Gender: M or F

Transcriber's name: Enter your initials

Select *okay*. Ensure that all of the information in the header of the new SALT file is accurate. Save the file with the participant ID and visit number (e.g., 001v1).

3.2 Viewing the CPP-A recorded observations

All videos are stored on the DevLab (L:) drive. To access the recorded observations of the CPP-A follow this pathway: L:\CPPA Studies\Study 2. Locate and open the folder for the participant you plan to transcribe. Select the file that is labelled with the participant's ID number, visit 1, and either camera A or C (e.g., 001v1A). You should choose the camera that provides the best view of the interaction.

3.3 Transcribing the CPP-A interaction scenes

To begin the transcription process, you will need to open the participant's recorded observation and the corresponding SALT file. Arrange the recorded observation and the SALT file side-by-side on your screen. Scroll through the video file to locate the first of the three interaction scenes (Turns, I want, Container). Keep in mind that the order of the scenes is random. Once you have located the first interaction scene, edit your SALT file header to include a comment on a separate line for scene (e.g., + Scene: Container). Edit the initial start time to mark when the first scene begins (e.g., - 15:27). Once you have identified the start of the scene and updated the SALT file,

you are ready to begin transcribing.

When you reach the end of the first scene, insert a new line to mark the end time of the scene (e.g., - 20:27). Press enter and add a new comment line to mark the next interaction scene (e.g., + Scene: I want) and insert a line to mark the start time of the next scene (e.g., 27:07). Follow the same steps to transcribe the third and final interaction scene.

4 Definitions

An **utterance** is usually a sentence or phrase, reflecting a single thought; the primary goal is to document "thought completion." Determining what constitutes an utterance is easy when a turn consists of a single sentence. As a general rule, turns consisting of several sentences may be broken down into single sentences, each transcribed as a separate utterance. The two factors that will help determine the completion of a thought are: 1) falling/rising intonation, and 2) the presence of a pause. Note that utterance segmentation decisions are not strictly grammatically based but rather "attempt to be sensitive to what the speaker intends even though his grammatical knowledge may be limited or deficient". In cases in which "and" is used to separate three independent clauses, two independent clauses are conjoined to form one utterance, and the remaining clause is arbitrarily segmented to form a new utterance.

A **word** is defined as a combination of sounds that is consistently used by the child and interpreted by the listener. The "word is in the ear of the listener." Sometimes the child's partner will react in a way that reveals the word, as when the mother says "giraffe" after the child says "'raffe." However, be cautious. If you do not hear the Child's vocalization as a word, do not transcribe it as a word. You can transcribe it instead as a phonetically consistent form (PCF) or as inaudible (XX).

Mazes are filled pauses, false starts, repetitions, reformulations, and interjections. They are marked by enclosing that part of the utterance in parentheses. When the maze words are removed from the utterance, the remaining words can stand alone.

Example: C And (then um) then (h*) he left.

Communication Play Protocol cards for the interaction scenes

Below are samples of the cue cards for the interaction scenes that might be given to a subject named "Finn."

Scene 2: "I WANT"

PLOT: Finn notices toys located on a shelf too high to reach. You help Finn get what he wants, but only after you pretend to misunderstand him.

PROPS: Three toys on the bookshelf: two that we provide and one of Finn's favorites. One of the toys we provide has a made-up name. It is called a ***trober***.

SUGGESTIONS: Readily agree to help, but initially act puzzled about which toy Finn wants. Then make a mistake, offering him another toy. Finally, go ahead and give the toy.

V1

Scene 4: TAKE TURNS

PLOT: Finn and you engage in a back-and-forth game of turn-taking.

PROPS: One of the toys we provide has a made-up name. It is called a ***gobbish.***

SUGGESTIONS: To encourage communication, tease Finn a bit by pausing before you take some of your turns.

V1

Scene 6: HIDDEN OBJECTS

PLOT: Finn and you empty the contents of the container object by object. There are five hidden objects. As each object is taken out, you share it for a while before getting another one.

PROPS: One of the toys we provide has a made-up name. It is called a ***zupud***.

SUGGESTIONS: Try to name each object and play with it for a while before taking out a new object.

V1

Note. The scene *Hidden Objects* refers to the *Container* scene.

Spellings for the novel words for novel objects used during the CPP-A

All novel objects terms should be transcribed using a percent sign (%) followed by the name of the object (e.g., P Do you like the %nupa?)

bremick
clubob
felly
framble
girfus
gobbish
hampent
hodfern
lunap
nupa
peri
sevik
trober
wogger
zupud

Appendix B

Summary of SALT transcription conventions-modified

1. Transcript Format. Each entry begins with one of the following symbols. If an entry is longer than one line, continue it on the next line.

- **$** Identifies the speakers in the transcript; generally, the first line of the transcript.
  Example: $ Child, Parent
- **C** Child utterance. The actual character used depends on the $ speaker line.
- **P** Parent utterance. The actual character used depends on the $ speaker line.
- **+** Typically used for identifying information such as name, age, and context.
  Example: + Scene: Turns
- **-** Time marker.
  Example: - 02:07
- **:** Pause between utterances of different speakers.
  Example of five-second pause: :
- **;** Pause between utterances of same speaker.
  Example of three-second pause: ;
- **=** Comment line. This information is not analyzed in any way, but is used for transcriber comments.
  Example: = C kicked the ball.

2. End of Utterance Punctuation. Every utterance must end with one of these six punctuation symbols.

- **.** Statement, comment. Do not use a period for abbreviations.
- **!** Surprise, exclamation.
- **?** Question
- **~** Intonation prompt.
  Example: P And then you have to~
- **^** Interrupted utterance. The speaker is interrupted and does not complete his/her thought/utterance.
- **>** Abandoned utterance. The speaker does not complete his/her thought/utterance, but has not been interrupted.

3. { } Comments within an utterance. Use brackets to indicate comments made within an utterance or to document nonverbal utterances of communicative intent.

Comments made within an utterance example: C Lookit {C points to box}.

Nonverbal utterances example: C {nods}.

4. Unintelligible Segments. Use X to mark unintelligible sections of an utterance.
Use X for an unintelligible word.
Example: C Give me the X.

Use XX for an unintelligible segment of unspecified length.
Example: C He XX today.

Use XXX for an unintelligible utterance.
Example: C XXX.

5. Bound Morphemes. Words which contain a slash "/" indicate that the word is contracted, conjugated, inflected, or pluralized in a regular manner. The root word is entered in its conventional spelling followed by a slash "/" and then the bound morpheme.

Rule	**Example**
/S Plural	Kitten/s, Baby/s
Words that end in "s" but represent one entity are *not* slashed	Pants
/Z Possessive inflection	Dad/z, Mary/z
Do *not* mark possessive pronouns	His, Hers, Ours, Yours
/S/Z Plural and possessive	Baby/s/z
/ED Past tense	Love/ed, Die/ed
Predicate adjectives are *not* slashed	Was tired, Is bored
/3S 3rd person singular verb form	Go/3s, Tell/3s
Irregular forms are *not* slashed	Does
/ING verb inflection	Go/ing, Run/ing
The gerund use of the verb form is not slashed	Went swimming
/N'T, /'T Negative contractions	Can/'t, Does/n't
Irregular forms are *not* slashed	Don't, Won't
Do *not* slash Ain't.	Ain't
/'S, /'RE, /'M, /'LL, /'D, /'VE Contractible verb forms is, are, am, are, will, would, and have	He/'s, We/'re, I/'m, I/'ll, I/'d, We/'ve

6. Bound pronominal clitics (Spanish).

7. Mazes. Filled pauses, false starts, repetitions, reformulations, and interjections.
( ) Surrounds the words/part-words that fall into these categories.
Example: C And (then um) then (h*) he left.

8. Omissions. Partial words, omitted words, omitted bound morphemes, and omitted pronominal clitics are denoted by an asterisk (*).
* Following one or more letters this indicates that a word was started but left unfinished.
Example: C I (w* w*) want it.

* Preceding a word indicates that an obligatory word was omitted.
Example: C Give it *to me.

/* Following a slash the * is then followed by the bound morpheme which was omitted, indicating the omission of an obligatory bound morpheme.
Examples: C The car go/*3s fast. P I went run/*ing yesterday

9. Overlapping Speech. When both speakers are speaking at the same time, the words or silences that occur at the same time are surrounded by angle brackets < >.
Example: P Do you want <the ball>?
C <Mommy> ball.

10. Linked words. The underscore "_" is used to link multiple words so they are treated as a single word. Examples include titles of movies and books, compound words, proper names, and words or phrases repeated multiple times.

Example: "Little Red Riding Hood" would be transcribed as "Little_Red_Riding_Hood"
"Grandma Jones" would be transcribed as "Grandma_Jones." Common phrases like bye_bye and peek_a_boo should also be treated as a single word.

Pet names or other idiosyncratic phrases should be spelled in a consistent way throughout the transcript.

11. Root identification. The vertical bar "|" is used to identify the root word.
The root words of irregular verb forms such as "went" or "flew" are not identified.

Linked words repeated for emphasis.
Example: C The boy ran very very_very|very fast.

Non-words used in error.
Example: C He goed|go[EO:went] by hisself|himself[EW:himself].

Shortened words.
Example: C He was sad cuz|because they left.

12. Sound Effects and Idiosyncratic Forms %. The percent sign is used to identify sound effects which are essential to the meaning or structure of the utterance.
Example 1: C The dog went %woof_woof %woof_woof.

The percent sign is also used to identify idiosyncratic forms: not adult-like production of very young children which are consistent in reference to an object, person, or situation.
Example 1: C See %vroom {car}. Non-essential sound effects are entered as comments. Strings of the same sound are linked together.

13. Spelling Conventions.

Filled pause words: ah, eh, er, hm, uh, um, and any word with the code

Yes words: ok, aha, mhm, uhhuh, yeah, yep, yes

No words: ahah, mhmh, uhuh, nah, no, nope

I don't know (*intoned*): IDK

Concatenative: betcha, gonna, gotta, hafta, liketa, oughta, sposta, trynta, useta, wanna, whatcha

Numbers (*examples*): 21 or twentyone, 17

Additional notes for transcribers

- When P or C gasps with surprise, transcribe that as "oh"
- If the parent refers to the child using a nickname, transcribe the child's full name instead so that SALT does not count the nickname and full name as two separate words
- Uhoh is considered a single word.
- Transcribe Ooo as Oh
- Common spellings: Mama, ok

Appendix C

List of Mental State Terms

Desires	Beliefs	Other Cognitive States
Dream	Believe	Assure
Fancy	Mean	Bet
Hope	Pretend	Concentrate
Intend	Trick	Distract
Like	Think	Expect
Love	Thought	Figure
Keen		Forget
Prefer		Guess
Want		Idea
Wish		Ignore
		Imagine
		Interest
		Know
		Learn
		Recognize
		Remember
		Suppose
		Trust
		Understand
		Wonder

Note. Adopted from Shatz, Wellman, & Silber (1983) and Brown, Donelan-McCall, & Dunn (1996). Variations of these terms will also be coded as references to mental states (e.g., wanna for want)

Appendix D

Coding mental states in the interaction scenes of the CPP-A

Coding mental states in the interaction scenes of the Communication Play Protocol – Auditory (CPP-A)

Technical Report XX

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Support for the development of this protocol was provided by the National Institutes of Health, NICHD (R01-HD35612).

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Coding mental states in the interaction scenes of the Communication Play Protocol – Auditory (CPP-A)

1 Purpose

This Technical Report describes the coding schemes applied to characterize parent and child mental state talk during the interaction scenes of the Communication Play Protocol – Auditory (CPP-A). The unit of coding is an utterance as specified in the transcript of parent-child communication (see Technical Report XX, Transcribing the interaction scenes of the CPP-A).

The coder's task is to identify parent- and child-utterances containing a mental state term, determine the mental state construct that was expressed, and the role of the mental state term. The coder will also decide whether the mental state utterance is an initiation or a response. The coding scheme below characterizes each mental state utterance using five mutually exclusive and exhaustive codes. The codes and definitions and are as follows

2 Codes

The following codes are used to mark parent- and child- mental state utterances during the three interaction scenes of the CPP-A.

Mental state utterance

pMSU Parent Mental State Utterance **cMSU** Child Mental State Utterance

Mental state term

pDes Parent Desire
pBel Parent Belief
pCOMB Parent uses more than one type of mental state
pOCS Parent Other Cognitive State

cDes Child Desire
cBel Child Belief
cCOMB Child uses more than one type of mental state
cOCS Child Other Cognitive State

Person referent

pSlf Parent Self
pOth Parent Other
pBSO Parent Self and Other

cSlf Child Self
cOth Child Other
cBSO Child Self and Other

Role

pMRef Parent Mental Reference
pCUse Parent Conversational Use

cMRef Child Mental Reference
cCUse Child Conversational Use

Initiation or Response

pIn	Parent Initiation	**cIn**	Child Initiation
pRsp	Parent Response	**cRsp**	Child Response

3 Definitions

Parent- and child- mental state utterances are coded on five characteristics. A code must be selected for each characteristic.

3.1 Mental state utterance. An utterance is classified as a mental state utterance only if the utterance is judged, with regard to context, to refer to the thoughts, memories, or knowledge of the speaker, listener, or a third person (Shatz, Wellman, & Silber, 1983).

pMSU. The parent produces an utterance containing at least one mental state term.
e.g., I *wish* I could reach the toy on the shelf

cMSU. The child produces an utterance containing at least one mental state term.
e.g., I *want* a turn mommy

3.2 Mental state term. All utterances classified as mental state utterances will be further coded based on the mental state construct(s) present in the utterance.

pDes. The parent produces an utterance that describes a specific object, event, or state of affairs that is sought (Wellman & Woolley, 1990).
e.g., I *wish* I could reach the toy on the shelf
Do not code: Is it <u>like</u> this?

cDes. The child produces an utterance that describes a specific object, event, or state of affairs that is sought (Wellman & Woolley, 1990).
e.g., I *want* a turn mommy

pBel. The parent produces an utterance that describes a true belief about an object, event, or state of affairs.
e.g., I *thought* this was a mouse, but it's really a cat
Do not code: You can <u>pretend</u> to cut the turtle

cBel. The child produces an utterance that describes a true belief about an object, event, or state of affairs.
e.g., I *hope* there's another toy in the bag

pCOMB. The parent produces an utterance that contains two or more types of mental state terms.
e.g., I *think* the turtle *forgot* where he was going (belief and other cognitive state)

cCOMB. The child produces an utterance that contains two or more types of mental state terms.

e.g., I *think* I *like* the blue ring more than the red one (belief and desire)

pOCS. The parent produces an utterance that references a cognitive state other than desires and/or beliefs.

e.g., I *forgot* how this toy works

Do not code: Do you know what

cOCS. The child produces an utterance that references a cognitive state other than desires and/or beliefs.

e.g., I *remember* the giraffe from the zoo

3.3 Person referent. All mental state utterances will be coded to identify the person that the speaker is attributing the mental state to. Only look at the part of the utterance related to the mental state term.

pSlf. The parent attributes the mental state to themself (i.e., the speaker).

e.g., *I* want the ball

cSlf. The child attributes the mental state to themself (i.e., the speaker).

e.g., *I* like the puppy

pOth. The parent attributes the mental state to the child or someone outside of the dyad.

e.g., Do *you* want the bubbles

cOth. The child attributes the mental state to the parent or someone outside of the dyad.

e.g., *Daddy* likes the red car

pBSO. The parent attributes the mental state to both themself AND the child or someone outside of the dyad.

e.g., I don't *know* what you *want*.

cBSO. The child attributes the mental state to both themself AND the parent or someone outside of the dyad.

e.g., *I* like the guitar because *mommy* likes the guitar

3.4. Role. All mental state utterances will be coded to describe how the mental state term is being used in discourse.

MRef. The parent references their own or another's thoughts, beliefs, memories, imagining, thinking.

e.g., Let's *pretend* to build a tower

cMRef. The child references their own or another's thoughts, beliefs, memories, imagining, thinking.

e.g., I *hope* she brings more toys for us

pCUse. The parent produces a mental state to maintain discourse rather than exemplify comprehension of either the state or its meaning.

e.g., I can't *believe* it

cCUse. The child produces a mental state to maintain discourse rather than exemplify comprehension of either the state or its meaning.
e.g., I *love* you

3.5 Initiation or Response. All mental state utterances will be coded to describe whether the mental state term functions as an initiation or response.

pIn. The parent's mental state utterance is semantically unrelated to the child's previous turn.
e.g., C Dog says woof; P Do you want the blue car

cIn. The child's mental state utterance is semantically unrelated to the parent's previous turn.
e.g., P Where are you hiding; C I want the bubbles

pRsp. The parent's mental state utterance is semantically related to the child's previous turn.
e.g., C The giraffe; P Do you want the giraffe

cRsp. The child's mental state utterance is semantically related to the parent's previous turn.
e.g., P The toys are in the bag; C I *want* a toy

4 Procedure

Open a copy of the transcription file you will be working with. Review each of the three interaction scenes independently and identify all instances of utterances containing a mental state term. Once you have identified all mental state utterances (see section 3.1), review each of those utterances and select the relevant codes to apply from sections 3.2 through 3.5.

5 Additional Notes

- Leave a space between the final word in an utterance and the first code to ensure that SALT outputs utterance-level codes rather than word-level ones
- When you identify an utterance as containing a mental state term, you must then code all five aspects of the utterance. Be sure to use the parent and child codes appropriately.
- All code(s) should be placed before the end-of-utterance punctuation mark in square brackets [ ] and cannot contain blank spaces and cannot be split between lines.
- There is no limit to the number of utterance codes that may be inserted.
- Utterances that contain a mental state term within parentheses (i.e., false starts) should not be coded as part of the utterance.
- When you code, you may notice that the transcript contains an error. Even though two or three people have already reviewed the transcript, it is likely that you may hear something they did not (e.g., the C said "it goes" rather than XX) or spot a typo that should be corrected. If this happens, make a note of the participant ID, scene, and line number and inform one of the original transcribers (e.g., 001v1, Container, line 123, your

recommended change).

- *Like* can be used to refer to desires, conversationally ("Like yeah") and to refer to similarity ("It's like mine") making it a potentially confusing term to acquire (Ruffman et al., 2017)
- Some instances will have an implied "you." For example: P Remember? which could be coded as: P Remember [pMSU][pOCS][pMRef][pOth][pIn]?
- Use [pSlf] when you see instances of third person (e.g., P But mommy wants a turn).
- Response codes [pRsp and cRsp] should only be used for verbal utterances, not for responses to gestures or comments in the transcript