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Examining the Impact of Deictic Relational Responding on Advanced Theory of Mind and Pretense in Children with Autism

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Examining the Impact of Deictic Relational Responding on
Advanced Theory of Mind and Pretense in Children with Autism

by

Samantha Broderick

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
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ABSTRACT

Perspective taking is a pivotal behavioral repertoire essential for social functioning and is recognized as a hallmark deficit of the Autism Spectrum Disorder. Recent advancements in the Relational Frame Theory have led to the development of a perspective-taking training protocol shown to improve performance on Theory of Mind tasks in typically developing children; however, there has been little research on the generality of these findings in children with ASD. The impact of deictic responding on social interaction is also undetermined. The current study aimed to: a), evaluate the effectiveness of multiple exemplar training of deictic relations on perspective taking abilities in children with ASD, b), assess the impact of deictic relations on naturalistic Theory of Mind tasks, and c), assess generality of the deictic repertoire on pretend play. All three participants acquired deictic repertoires through double reversed complexity. Acquisition of the relational operants was variable and required many sessions for each participant. Two of three participants showed transfer of perspective taking to the Strange Stories test, all three participants showed overall improvement in performance on various Theory of Mind tasks; and lastly, participants showed mixed results on transfer to pretend play. Implications for using multiple exemplar training in supporting social understanding, prerequisite skills for deictic relational responding, and training strategies are discussed.
CHAPTER ONE: INTRODUCTION

Autism Spectrum Disorder (ASD) is a developmental disorder marked by deficits in social skills, communicative abilities, and restricted interests (American Psychiatric Association, 2013). Such social skill deficits include social-emotional reciprocity, conversational skills with others, understanding nonverbal communication, pragmatic language, and pretend play. These social skill deficits can pose obstacles when developing language, forming relationships, seeking employment, and leading independent lives, sometimes resulting in co-morbid conditions such as anxiety disorders or depression (Friedman, Warfield, & Parish, 2013; Howlin & Moss, 2012).

One social repertoire of particular importance is perspective taking, or the ability to infer the covert behavior of others and subsequently predict behavior (Baron-Cohen, 1992; Baron-Cohen, Leslie, & Frith, 1985; Perner, Frith, & Leekam, 1989). This repertoire appears to be crucial to one’s verbal construction of the self, self-regulation, and planning (Barnes-Holmes, Hayes, & Dymond, 2000). Perspective taking also correlates with social adeptness (Dawson & Fernald, 1987; Frith, Happé, & Siddons, 1994) and is what some conceptualize as the core deficit in ASD (Baron-Cohen, 2004; Baron-Cohen at al., 1985; Perner et al., 1989). Researchers from multiple disciplines have designed interventions for remediating deficits in perspective taking, but many researchers have emphasized the need for more intense interventions, more rigor in assessing and programming for generalization across settings and people, and better maintenance in social skills interventions (Bellini et al., 2007; Rao, Beidel, & Murray, 2008; Wang & Spillane, 2009). According to Gresham, Sugai, and Horner (2001), low generalization and maintenance after social skills training is partly due to conducting training in “contrived,
restricted, and decontextualized settings.” Providing that social interactions are dynamic events that occur in multiple contexts (across people, places, and over time), behavioral programming for social skills should produce flexible behavioral repertoires that can meet the demands of these complex social environments.

Theory of Mind

Much of the research accounting for perspective taking deficits in autism falls under the cognitive developmental model of Theory of Mind. There are three domains of Theory of Mind: understanding beliefs, understanding emotions, and pretense. Each domain includes five levels that build on each other during typical child development. For a description of all domains and levels of Theory of Mind, see Appendix II.

Deficits in Understanding Mental States in ASD

Children with autism typically perform poorly on false belief tasks (Baron-Cohen, 1992; Baron-Cohen et al., 1985; Perner et al., 1989). These studies rely on assessments using various props familiar to most children (e.g., puppets and candy). While Wimmer and Perner (1983) showed that children typically understand false belief around 4 and 5 years of age, Baron-Cohen et al. (1985) found that 20 subjects with autism ages 6 to 16 years old failed the unexpected transfer story 80% of testing trials. Authors compared results to the performance of 14 age-matched children with Down syndrome and 27 typically developing peers, both groups of which passed 85-86% of trials regardless of intellectual disabilities in participants with DS.

Similar results appeared in a study by Perner et al. (1989) assessing false belief understanding using the deceptive container task. Experimenters asked participants what they believed to be the contents of a Smarties® candy box, showed that the box actually contained pencils, then asked what they believed another person would guess to be in the box. Only four of
26 subjects with autism ages 7 to 18 passed the Smarties® task compared to 11 of 12 age-matched children with specific language impairments.

Although the Theory of Mind model suggests that perspective taking deficits in ASD are due to brain abnormalities (Baron-Cohen, 2000; Baron-Cohen et al., 1985), researchers from a variety of disciplines have successfully trained children with ASD to pass Theory of Mind tests. Examples of interventions include video modeling (Charlop-Christy & Daveshvar, 2003; LeBlanc et al., 2003), thought bubbles (Wellman et al., 2002), group instruction (Ozonoff & Miller, 1995), computerized training (Feng, Lo, Tsai, & Cartledge, 2008; Swettenham, 1996), and mental state teaching (Hadwin, Baron-Cohen, & Hill, 1996; Hadwin, Baron-Cohen, Howlin, & Hill, 1997). Although performance on Theory of Mind tasks increased post-intervention, many participants were unable to generalize these skills to untrained Theory of Mind tasks (LeBlanc et al., 2003; Swettenham, 1996) or social situations (Hadwin et al., 1996, Hadwin et al., 1997; Ozonoff & Miller, 1995). The ecological validity of these interventions as well as traditional theory of mind tasks are therefore questionable.

Theory of Mind researchers have noted two important considerations while discussing research findings from studies on Theory of Mind in ASD. For one, not all children with autism fail Theory of Mind tests; a “talented minority” (Frith et al., 2004 p. 120) of individuals with ASD are able to pass second-order false belief tasks, but do not appear to apply them in everyday life (Frith et al., 1994; Happé, 1995). Subjects with autism perform significantly worse on more naturalistic, or “advanced” tests of Theory of Mind. These tests measure such applications of perspective taking as irony, social inference, faux pas, double bluff, and white lies (Baron-Cohen, O’Riordan, Stone, Jones, & Plaisted, 1999; Happé, 1994; Joliffe & Baron-Cohen, 1999). Secondly, individuals with ASD require a much higher verbal ability to pass
Theory of Mind tasks than individuals without an ASD diagnosis (Happé, 1995). Some Theory of Mind researchers hypothesize that individuals with ASD who pass Theory of Mind tasks might be utilizing compensatory skills, and that these skills are sufficient to pass these tasks but not enough to apply them in everyday life (Baron-Cohen et al., 1999; Frith et al., 1994; Happé, 1995). Several Theory of Mind interventions that report poor generalization lend support for the “hacking hypothesis” (Hadwin et al., 1996, Hadwin et al., 1997; LeBlanc et al., 2003; Ozonoff & Miller, 1995; Swettenham, 1996) and suggest a need for more effective interventions.

**Pretend Play Deficits in ASD**

Research shows that children with ASD often acquire functional play skills, but often fail to learn symbolic play skills without intervention (Baron-Cohen, 1987; Charman et al., 1997; Hadwin et al., 1996). Theory of Mind investigators attribute this deficit to problems with meta-representation due to Theory of Mind impairments. According to Theory of Mind researchers, pretend play involves “mentalizing” abilities, or “‘acting as if something is the case when it is not,’” (Leslie, 1987, p. 413). There is some evidence suggesting that having an imaginary companion and role-play positively correlates with performance on Theory of Mind tasks, suggesting the two repertoires involve similar cognitive processes (Taylor & Carlson, 1997; Youngblade & Dunn, 1995).

Many behavioral researchers have trained more complex, play-related behaviors to children with ASD using such interventions as video modeling, imitation training, and Pivotal Response Treatment (PRT). Authors of these studies often interpret results as an acquisition of advanced motor imitation that can generalize across play partners and toys (MacDonald, Clark, Garrigan, & Vangala, 2005; MacDonald, Sacramore, Mansfield, Wiltz, & Ahearn, 2009; Stahmer, 1995; Thorp, Stahmer, & Schreibman, 1995). Although results of these studies are
promising, not all interventions yield rich symbolic play. To illustrate, MacDonald et al. (2005; 2009) taught children with ASD aged 4, 5, and 7 chains of scripted vocalizations and play actions using a video modeling package. Frequency of scripted verbalizations and actions increased upon completing the intervention, but unscripted play actions actually decreased after intervention. Participants also never emitted unscripted vocalizations. The relational repertoires involved in pretend play also yet to be examined.

Taken together, the results of these studies show a shortcoming of many interventions to train a generalized and flexible perspective-taking repertoire. While cognitive interventions that only involve teaching concepts of mental states are generally ineffective (Hadwin et al., 1997; Ozonoff & Miller, 1995), a methodological behavioral approach that targets only overt responding shows limited generalization and flexibility (Charlop-Christy & Daneshvar, 2003; LeBlanc et al., 2003; Macdonald et al., 2005; Macdonald et al., 2007). One plausible explanation as to why many Theory of Mind interventions fall short of producing robust pretend play repertoires is that these interventions do not directly target the covert behaviors involved in these complex tasks. A more precise behavioral analysis of the language involved in Theory of Mind could result in more effective behavior change and better generalization for children with ASD.

Empathy in ASD

Children with autism often fail to demonstrate empathic responding towards others (Deschamps, Been, & Matthys, 2014; Howlin et al., 1999; Schrandt et al., 2009). Compared to aged-matched typically developing peers, children with autism are less likely to show prosocial behavior, understanding of emotions, and affective empathy (Deschamps et al., 2014). Interventions for remediating these deficits are limited, but some include thought bubbles
(Howlin et al., 1999) and multiple exemplar training packages of various affective discriminative stimulus compounds (e.g., event and affect) with prompting and reinforcement procedures (Schrandt et al., 2009). According to Theory of Mind, understanding thoughts in others plays an important role in empathic responding, as an individual would have to understand how one might feel in another person’s situation (Howlin, 1999, p. 7). Researchers describe perspective taking as a key component of empathic responding, and a behavior analytic account of this social skill would hold important implications for children with ASD.

**Perspective Taking**

The most comprehensive protocol to date for training perspective taking developed out of work in the area of Relational Frame Theory, or RFT. RFT offers a functional contextual view of verbal behavior as involving mutual, and combinatorially entailed relations where the primary controlling variable is non-formal, as well as subsequent transformation of stimulus function(s). Derived relational responding is the behavior of relating stimuli based on arbitrary properties and are established by the verbal community in a non-arbitrary (deliberate) way. RFT extends on Skinner’s definition of verbal behavior as behavior mediated by another individual (1957, p. 2) and defines verbal behavior as “the action of framing events relationally,” with the aforementioned characteristics of mutual/combinatorial relations and transformation of stimulus function (Hayes et al., 2000, p. 43). According to RFT, relational framing impacts the core operant process and results in development of complex cognitive skills, including perspective taking (Hayes et al., 2000).

In RFT, perspective taking frames, or deictic frames, are involved in understanding the private events of one’s self and others. Deictic frames specifically deal with relations relative to the perspective of the speaker. RFT researchers assert that one acquires perspective taking
through answering multiple exemplars containing contextual cues of I versus You, Here versus There, and Now versus Then. Throughout early life, a child learns to respond to questions such as “What are you doing now?” or “What were you doing then?” Questions phrased more conventionally such as “Where are you going?” also involve multiple deictic relations. These particular frames are termed deictic as they involve other people, other places, and other points in time but always from the speaker’s perspective I/Here/Now. Over time, an individual develops an overarching repertoire of deictic relational responding (Barnes-Holmes et al., 2001). RFT researchers suggest that deictic relations are involved in solving traditional Theory of Mind tasks (McHugh, Barnes-Holmes, & Barnes-Holmes, 2004; McHugh, Barnes-Holmes, Barnes-Holmes, & Stewart, 2006; McHugh, Barnes-Holmes, Barnes-Holmes, Stewart, & Dymond, 2007; McHugh, Barnes-Holmes, Barnes-Holmes, Whelan, & Stewart, 2007).

**Figure 1:** Diagram of deictic frames involved in deception (McHugh et al., 2007).

Perspective taking encompasses a complex and private behavioral repertoire of relating to the self to others; to observe this ability in others directly, RFT researchers have developed tasks
that require the participant to accurately respond to questions containing contextual cues believed to be most critical in the development of perspective taking. McHugh and colleagues (2004) developed a deictic protocol comprised of a list of statements with corresponding dyads of questions that requires deictic framing to arrive at a correct response. The list includes relations of varying levels of complexity (simple, reversed, and double reversed) as well as interpersonal, spatial, and temporal relations of I-You, Here-There, and Now-Then.

Several researchers have successfully trained deictic relational responding in typically developing children using the deictic protocol. The first studies to do this were performed by Rehfeldt, Dillen, Ziomek, and Kowalchuk (2007) with two participants of aged 9 and 10 and Heagle and Rehfeldt (2006) with three participants aged 4, 5, and 7. Both experiments used an automated and modified version of the deictic protocol. Heagle and Rehfeldt further assessed stimulus generalization with items familiar to the children, such as popular restaurants, video games, and pencils as well as response generalization in a conversational format about real world topics. Participants first completed a baseline measure of deictic responding without feedback. Participants then trained on each level of deictic responding and received retraining as needed. Both studies found that participants acquired deictic responding and applied these skills to real-world conversational topics with training; however, researchers did not assess participants’ application of this repertoire beyond the deictic tasks.

Weil, Hayes, and Capurro (2011) established a deictic responding repertoire in three children between ages 4 and 5 using a tabletop format of the deictic training protocol. Experimenters used training blocks similar to those by McHugh et al. (2004). Participants received tangible or edible items and praise for correct responding, or
corrective feedback. Additionally, participants demonstrated generalized perspective
taking with improved performance on levels 3, 4, and 5 perspective-taking tasks with
deictic training alone, lending further support of the role of deictic responding in Theory
of Mind. Researchers discuss the importance of perspective taking, but do not explore it
application beyond traditional Theory of Mind tasks.

Like with Theory of Mind performance, individuals diagnosed with ASD perform
poorly on deictic relational tasks when compared to typically developing age-matched
peers (McHugh et al., 2004; Rehfeldt et al., 2007). Rehfeldt et al. (2007) administered an
automated version of the deictic protocol to an experimental group of 9 individuals with
high-functioning autism/Asperger’s as well as a control group of 9 typically developing
children, all aged 6-13 years. Researchers assessed correlations between parent ratings on
the Vineland Adaptive Behaviors Scale, Interview Edition (VABS-I) and Social
Communication Questionnaire (SCQ) with participants’ performance on the deictic
protocol. Participants with ASD made more errors on reversed relations than the control
group. The experimental group’s performance on now-then relations also correlated with
low scores on the Daily Living Skills domain of the VABS-I, yet no correlations were
found between social and communication domains of the VABS-I due to a small sample
size.

Recent studies show that like typically developing children, children with ASD may
acquire deictic relational responding through multiple exemplar training; however, results that
support generalization of deictic responding to social interactions in this population remain
mixed. A study by Lovett and Rehfeldt (2014) assessed generalization and application of
perspective taking repertoires after multiple exemplar instruction of relations of You-Other,
Here- There, and Now-Then in adolescents diagnosed with Asperger’s Syndrome (now ASD) aged 17-18 years. Results support the use of MEI for increased understanding of vignettes on everyday social interactions containing deictic tasks, but post-test results of the Theory of Mind Inventory (TOMI) did not differ from pre-tests. A similar study by Jackson and colleagues (2015) assessed the effects of the same procedures used by Weil et al. (2011) on Theory of Mind performance in children with ASD aged 5-6. Researchers of this study observed moderate improvements on Theory of Mind tests in participants and no changes in performance of control participants, though results were less robust than those of previous studies by Weil et al. (2011) and Weil and O’neill (2014). Further research is needed to better understand the generalizability of these results as they pertain to perspective taking abilities in children with autism. In a study by Gilroy and colleagues (2015), participants with ASD aged 8-13 were able to both acquire and generalize perspective taking abilities in the context of a storybook format and across all three levels of deictic complexity; however, researchers did not explore whether or not participants were able to understand different beliefs as a result of the naturalistic deictic training. Although a growing body of literature is developing on the use of deictic relation training with populations with ASD, little research to date supports its utility in promoting generalized social skills.

Unlike previous intervention packages for remediating perspective taking deficits in children with ASD, the RFT deictic training protocol for perspective taking directly targets the behaviors involved in solving false belief tasks (i.e., deictic relational responding), which serve as flexible relational operant behaviors that may generalize to varying social situations. Taken together, the data from these studies demonstrate the efficacy of the current deictic training protocol in teaching typically developing children and adults with a diagnosis of schizophrenia to
pass false belief tasks. Further research is needed to determine if the current deictic protocol can meet the needs of young learners with autism and whether or not this repertoire might transfer to the natural environment. Furthermore, if the behavioral approach of RFT might remediate skills described as Theory of Mind (i.e., understanding false belief), closer examination of its impact on other domains of Theory of Mind such as pretend play could be helpful to populations who lack these conceptually related skills. The current study attempted to: a), evaluate the effectiveness of multiple exemplar training of deictic relations on perspective taking abilities in children with ASD, b), assess the impact of deictic relations on more naturalistic Theory of Mind tasks, and c), assess the role of pretend play in deictic relational responding.
CHAPTER TWO: METHOD

Participants

Three children completed this study. Participants were 6-11 years at the time of recruitment and each had a formal diagnosis of Autism Spectrum Disorder/Asperger’s Disorder on file. Baseline assessments of Theory of Mind confirmed that all participants demonstrated skills in basic listener and reading comprehension on control questions for the Strange Stories task (White, Hill, Happé, & Frith, 2009) and advanced intraverbal responding (answering “Why” questions, etc.). In addition, participants had to perform with less than 90% accuracy on reversed and double reversed deictic relational trials (during pre-instructional probes) and overall performance on Theory of Mind tasks. Participants all engaged in functional play. The PI retrieved client information from files provided by the ABA clinic through which all participants received services.

Participant 1. Participant 1 was a six-year old male with a diagnosis of Autism Spectrum Disorder. He was of higher social-economic status and lived at home with his mother, father, and one older brother. At the time of consent, parents reported that their child had acquired many verbal skills over the years, but that “something was missing’ with regard to social interaction. Participant 1 had been receiving ABA services for the past two years that included verbal behavior instruction and reduction of problem behavior. At the time of consent, Participant 1 attended therapy in clinic once a week for 2 hours. He had met all Milestones of the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP) and could answer 4 different rotating WH questions about a single topic for 10 topics, had a tact vocabulary of at
least 1000 words, had a total listener repertoire of at least 1200 words, engaged in 4 verbal exchanges on 1 topic with peers for 5 topics, demonstrated 1000 different LRFFC responses, combined noun and verb phrases to produce 10 different syntactically correct clauses or sentences containing at least 5 words, and could independently draw or write in pre-academic activity books for 5 minutes.

**Participant 2.** Participant 2 was an 11-year-old male with a diagnosis of Asperger’s Syndrome. He was of a lower social-economic status and lived at home with his mother, father, and one older sister. At the time of consent, his mother had reached out to behavioral service providers for help with frequent and severe problem behavior that included antecedent events of misinterpreting others’ gestures as offensive. Participant 2 has just begun receiving 6 hours of ABA therapy a week that included verbal behavior instruction and reduction of problem behavior. At the time of the study, he demonstrated at least 300 intraverbal responses, made tacts with complete sentences containing 3 or more words at least 20 times, exchanged in 2 verbal exchanges on 1 topic with peers for 5 topics, selected items from an array of similar stimuli based on 4 pairs of relative adjectives and demonstrates actions based on 4 pairs of related adverbs, combined noun and verb phrases to produce 10 different syntactically correct clauses or sentences containing at least 5 words, and independently engaged in sustained play activities for 10 minutes without adult prompts or reinforcement.

**Participant 3.** Participant 3 was a six-year old male with a diagnosis of Autism Spectrum Disorder. He was of higher social-economic status and lived at home with his mother, father, and two older siblings (brother and sister). At the time of consent, his mother reported that her child could identify emotional states in others, but frequently made insensitive comments to peers.
Participant 3 received 4 hours of ABA therapy a week for the past year that included verbal behavior instruction and problem behavior reduction. At the time of the study, he had mastered most skills of the VB-MAPP assessment with the fewest milestones in the social domain. He was able to answer 4 different rotating WH questions about a single topic for 10 topics, had a tact vocabulary of at least 1000 words, had a total listener repertoire of at least 1200 words, could intraverbally respond to 5 different questions or statements from peers, demonstrated 1000 LRFFC responses, combined noun and verb phrases to produce 10 different syntactically correct clauses or sentences containing at least 5 words, and could independently draw or write in pre-academic activity books for 5 minutes.

Parents of participants received both a written and spoken description of the study prior to consenting. Additionally, experimenters obtained assent from participants at the beginning of every session. The Primary Investigator (PI) informed parents of participants that they may withdraw from the study at any time without penalty. Participants did not receive any form of compensation.

**Setting**

Training and testing took place in both the participants’ homes and an ABA clinic located in Tampa Bay that provides services to children with autism. Participants underwent training in testing in a room with minimal distractions. Participants sat facing the experimenter during testing and training, and experimenters placed any items used on the table in front of the child.

**Experimental Design**

Researchers utilized a within-subject multiple probe design (Kazdin, 2010) during training of deictic relations to show the effects of training on the relational operants and complexity levels. Traditional tests of perspective taking were probed at intake, post-mastery of
reversed relations, and then again post-mastery of double reversed relations (see Appendix II).

**Dependent Variables and Dependent Measures**

**Deictic Relational Responding.** Correct vocal responses to scenarios represented the dependent variable of interest. Percentage of responses correct represented the measure of acquisition and mastery of deictic relational responding. Pre-instructional probe sessions involved the presentation of 6 trials for every untrained level of complexity (18, then 12, then 6), training sessions involved presentation of 12 trials, and post-instructional probe sessions involved presentation of 6 trials for every trained and mastered level of complexity (6, then 12, then 18).

**True and False Belief Theory of Mind Tasks.** Participants responded to 8 probe trials at baseline, mastery of reversed relations, and mastery of double reversed relations. Four trials assessed true belief, and four trials assessed false belief. These questions also assessed understanding beliefs of others and the self, therefore participants responded to all four combinations (true belief of the self, true belief of another, false belief of the self, and false belief of another). A percentage of trials correct represented performance on these tasks.

**The Strange Stories Test.** This test contained eight false belief test questions of double bluff, lie, misunderstanding, and white lie. Qualitative scores of 0-2 were based on the scoring guidelines of White et al. (1999). For example, for the false belief question, “Why did she say that?” the child received 2 points for reference a false belief, 1 point for referencing a trait, state, or intention, and 0 points for factually incorrect or irrelevant answers. The overall score of this test fell within 0-16 points. The PI converted the raw score into a percentage of accurate responses score. Refer to Appendix IV for a complete list of test items and scoring guidelines for the *Strange Stories* task.
Pretend Play. Observers measured pretend play using a frequency-within 10-second intervals data collection system. Each observation period was 10 minutes. Materials included toys appropriate for functional play, such as figurines (soldiers, pirates, and dolls), toy cars, accessories (swords, guns, wagon, boats, cannons, etc.), and structures (mountain and trenches) as well as “junk toys”, or items safe for play but not designed for play (emery board, TV controller, unused sponge, keychain, cardboard jewelry box, and flashlight). Fifty items were used in total for each session, and each participant used the same items. Dependent variables for this assessment included three forms of pretend play: object substitution, attribution of pretend properties, and use of imaginary objects (Hadwin et al., 1996). Operational definitions for these behaviors are adapted from Stahmer (1995) and are as follows:

**Object substitution.** Any instance in which the participant uses an object as if it were another object. For example, a child might hold up a toy banana and talk into it as if it were a phone receiver.

**Attribution of pretend properties.** Any instance in which the child attributes properties to an object that it would not have in real life (e.g., making a car fly or an animal talk) or that it does not appear to have (e.g., wiping food off of a doll’s clean face). Since stimuli contained figurines of fictional characters animated in television, this category did not include making non-human characters speak.

**Use of imaginary objects.** Referring to an absent object as if it were present (e.g., tilting empty hand to mouth and pretending to drink from imaginary cup). Observers did not score examples of this when the child referenced an item already present on the table. All pretend play probe sessions were video recorded, and researchers took frequency-within 10-second interval data for all three topographies of
pretend play.

**Inter-observer Reliability and Treatment Integrity**

**Deictic training.** For interobserver agreement of deictic training, two experimenters scored each trial as correct or incorrect and generated a score based on the total number of agreements divided by the total number of agreements + disagreements, multiplied by 100. IOA was taken for 33% of deictic training sessions and resulted in 98% agreement. For treatment integrity of deictic training, a trained observer scored whether the implementer engaged in the following behaviors: sat facing the child, made sure child was attending before asking questions, read each card correctly, provided appropriate consequences, and took data. A trained observer divided the number of trials implemented with full integrity by the total number of trials per observation for 33% of sessions and reported 99.3% procedural fidelity.

**Theory of Mind Tests.** For interobserver agreement of Theory of Mind tests, two experimenters scored each trial as correct or incorrect and generated a score based on the total number of agreements divided by the total number of agreements and disagreements, multiplied by 100. IOA was recorded for 30% of Theory of Mind probe sessions and resulted in 96% agreement. A trained observed scored the percentage of test questions implemented with fidelity for 30% of Theory of Mind probe sessions and reported 100% procedural fidelity of the following criteria: 1) Provided enough context for each scenario (locations of items and presence/absence of characters), 2) administered with neutral affect and no feedback, and 3) recorded data.

**Pretend play Probe Sessions.** Observers calculated frequency-within interval IOA for pretend play behaviors. Two trained observers divided the percentage of agreement (smaller frequency divided by larger frequency) for each interval. Observers then added these together,
divided this sum by the total number of intervals and multiplied by 100. For treatment integrity measures, a trained observer scored how many intervals of 30 seconds the implementer a), interacted with the child, b), administered vocal-verbal prompts if the child did not engage in pretend play, c), refrained from modeling, directly prompting, or reinforcing pretend play.

Experimenters measured treatment integrity in 30-second intervals because this was the FI for prompting of pretend play. Both IOA and treatment integrity data collection occurred for 33% of pretend play sessions. IOA for pretend play resulted in 99% agreement for attribution of pretend properties, 96% agreement for use of imaginary objects, and 98% agreement for object substitution. Treatment integrity for pretend play resulted in 99%.

**Procedures**

**Testing and Training.** Testing and training of deictic relations occurred approximately 2-3 times a week for each participant. Each participant completed the sequence of training and assessment as follows:

1. **Baseline**
   
   Pre-instructional procedures
   
   o 18 test trials (6 simple, 6 reversed, and 6 double reversed)
   
   o Traditional theory of mind tasks
   
   o Strange Stories task
   
   o Pretend play probe series
   
   o Administer parent questionnaire

2. **Simple Relations**

   o Deictic training--simple relations
   
   o Post-instructional probes—simple relations
     
     o 6 test trials (simple)

3. **Reversed Relations**

   o Pre-instructional probes—reversed and double reversed relations
     
     o 12 test trials (6 reversed, 6 double reversed)
   
   o Deictic training—reversed relations
   
   o Post-instructional probes—simple and reversed relations
     
     o 12 test trials (6 simple, 6 reversed)
   
   o Administer parent questionnaire
   
   o Traditional theory of mind tasks
   
   o Strange Stories test
4. Double Reversed Relations
   - Pre-instructional probes—double reversed relations
     - 6 test trials (double reversed)
   - Deictic training—double reversed relations
   - Post-instructional probes
     - 18 test trials (6 simple, 6 reversed, 6 double reversed)

5. Two-week follow-up:
   - Pretend play probe series
   - Administer parent questionnaire

**Traditional Theory of Mind tasks.** Participants were exposed to scenarios based on level 4 and 5, or true belief and false belief, Theory of Mind tests. Researchers assessed accuracy of performance using a percentage of trials correct measure. Procedures were adapted from Howlin, Baron-Cohen, and Hawdin (1999) and Weil et al. (2011).

**Level 4 Theory of Mind tasks.** This probe session consisted of four trials measuring the child’s understanding that people act according to their knowledge. Two of these trials measured attribution of knowledge to the self, and two of these trials measured attribution of knowledge to another. Materials for these tasks included toys such as figurines, a doll house, a cup, a box, vehicles, and small tokens such as coins.

The experimenter sat facing the child at a table or area on the floor with minimal distractions. At the start of each trial, the experimenter positioned items (e.g., a bike beside a house) before introducing the character to the scene. The implementer of these trials alternated the location of these across trials. The experimenter then told the child a true belief vignette: for example, the experimenter said, “Sometimes the boy parks his bike in the garage, sometimes he parks it on the side of the house.” The experimenter then asked the participant a series of true belief questions: “Where do you think the boy will look for his bike first? Why do you think he will look there?” The child received a + for answering that the boy thinks his
bike is in the correct location because that is where she last saw it, and that she will go to its correct location based on this belief. If the child did not make this or a functionally equivalent response, the experimenter marked the response as incorrect (−) on the designated data sheet.

**Level 5 Theory of Mind tasks.** These probe sessions consisted of four trials measuring the child’s understanding that people can hold false beliefs. Participants completed four trials of the unexpected transfer task. Two of these trials measured attribution of knowledge to the self, and two of these trials measured attribution of knowledge to another. Materials for these tasks were the same as those used in level 4 tasks.

For assessing attribution of false belief to another, the experimenter introduced two characters to the child with either dolls, figurines, or puppets. The experimenter prepared two locations, such as a cup and a box. The experimenter then narrated a scene in which the first character placed a coin or similar object in one of the locations in the presence of the second character. The first character then exited the scene. While the first character was away, the second character then moved the coin or object to the second location while outside the presence of the first character. The first character then re-entered the scene and declare that he/she would like her coin/special item. At this point, the experimenter asked the child, “Where will (first character’s name) first look for his/her (coin/object)?” and a justification question, “Why will he/she look there?”

For assessing false attribution to the self, the experimenter narrated a similar scenario, but role-played the scenario and made the first character the child. An example of this scenario is one in which the child put his bike in the garage after playing, but his dad then took the bike to the backyard to fill up the tires after school. The false belief questions for the scenario were then, “Where will you first look for your bike when you come home from school?” and “Why
will you look there?” The implementer scored the response as correct (+) if the child stated that the he or the character will first look in the original location and incorrect (−) if the child states that he or the character will look in the actual location of the item.

**Strange Stories Test.** Participants completed the *Strange Stories test* (Happé, 1994; Kaland et al., 2005; White et al., 2009) during baseline, upon mastery of deictic frames at the reversed level of complexity, and upon mastery of deictic frames at the double reversed level of complexity. The experimenter sat beside the child at a table free of distracting items. Materials for this task included a piece of paper with each variation of each of the eight *Strange Stories* tasks. The experimenter told the child, “I am going to tell you some funny stories. Listen carefully to what happens and answer my questions.” The experimenter also let the child know that reinforcement was available contingent on attending, not accuracy of responding. The experimenter read each vignette slowly to the child while moving one finger under each word, as well as asked comprehension questions throughout. After reading a task and confirming the child comprehended information directly stated within the story, the experimenter administered questions and record responses verbatim on the designated data sheet. The experimenter did not provide feedback in order to protect the integrity of the test, but did ask the child to elaborate if unclear of the child’s response. After the session, the PI scored each response according to the guidelines set by White et al. (2009). Refer to Appendix III for a complete list of the Strange Stories tasks and scoring guidelines.

**Pretend Play.** Each pretend play probe session lasted 10 minutes. Researchers of this study chose to use a 10-minute observation period because it appeared to be adequate time for the child to engage in an activity. Experimenters used a frequency-within interval data collection system because it allowed for analysis of rates of responding within a session, frequency or
responding, as well as multiple opportunities for reliability checks each observation period (Bailey & Burch, 2002). The experimenter interacted with the child and engaged with the toys, but not model or prompt any form of play that resembled pretense. The implementer administered rotating vocal-verbal, indirect prompts to facilitate pretend play (one for each form of pretend play). For example, the implementer held up an object and asked, “What else could this be?” to occasion object substitution, asked, “What else can he do?” to occasion attribution of pretend properties, or asked, “What’s missing?” to occasion use of imaginary objects. The implementer administered prompting an average of once during every 30 seconds. The implementer wore a MotivAider™ device programmed to vibrate every 30 seconds to ensure equal opportunities for pretend play behaviors across probe sessions. Data of frequency of prompting confirmed that the experimenter always prompted 19-20 times each session (average of 30 seconds). All pretend play probe sessions were video recorded, and a trained research assistant (RA) collected data for all three target behaviors within 10-second intervals of recording.

**Parent Questionnaire.** Parents or guardians of participants completed a parent questionnaire at baseline, upon the child’s mastery of reversed relations, and two weeks after the child mastered all three levels of deictic relations. This questionnaire contained four items. The first item included a seven-point Likert scale and asked, “On a scale of 1-7, how often has your child shown empathy within the past week?” This item also contained lines underneath and a follow-up question, “What did this look like?” Items 2-4 asked for a range in frequency of how often the child spoke using interpersonal, spatial, and temporal deictic relations. The PI handed this form to each parent and briefly explained each item, then instructed her to return the form after observing her child for one week. The PI also instructed parents to report any
other information they found relevant to the study and to contact the PI with any questions. All parents returned the form within one week of receiving it. Refer to Appendix IV for the entire parent questionnaire.

**Pre-instructional Testing Procedures.** Participants completed testing trials at baseline and before training of each level of complexity (simple, reversed, and double reversed). Baseline measurements of deictic relational responding included 18 trials across relational complexity levels (simple, reversed, and double reversed) as well as across relational types (I-You, Here-There, Now-Then, I-You/Here-There, and Here-There/Now-Then). Specifically, baseline measures included six trials of simple relations, six trials of reversed relations, and six trials of double reversed relations. A percentage of responses correct represented performance on this task. Mastery criteria for deictic relations was 90% for all participants; if a participant correctly responded to 90% of trials for simple relations in baseline, the experimenter conducted post-instructional testing procedures.

In addition to a baseline across all complexity levels, test trials of baseline performance on each untrained level of complexity preceded all levels of training. Pre-instructional probes only included complexity levels on which the participant had trained; for example, after mastery of simple relations, baseline probes for training reversed relations consisted of seven questions each of reversed and double reversed complexity (resulting in 18 trials total). Pre-instructional probes prior to training double reversed only included six trials of double reversed relations. In other words, the experimenter always administered six testing trials for each level not yet trained prior to training any complexity level.

Pre-instructional testing probes closely resembled training trials but included novel stimuli. The experimenter administered these without feedback. See Appendix II for exemplars.
of pre-instructional probes.

**Training Procedures.** Trials consisted of the statements and question dyads adapted from McHugh et al. (2004) and were tailored to each participant’s interests. Each participant first completed training for simple relations and upon mastery, proceeded to training on reversed relations and finally double reversed relations. Each training block consisted of 12 trials of the targeted complexity level randomized across relational types (12 simple relations with 4 I-You, 4 Here-There, and 4 Now-Then; 12 reversed relations of 4 I-You, 4 Here-There, and 4 Now-Then; and 12 double reversed relations of 6 I-You/Here-There and 6 Here-There/Now-Then). Each 12-item trial block constituted as one training session.

**Programmed Consequences.** The experimenter used differential reinforcement according to the accuracy of the child’s response. Participants only received feedback after answering the second question in each trial, and that the experimenter immediately asked the second question after the child responded to the first question. This was to avoid prompting, as Weil et al. (2011) noted that feedback on the first of two questions may serve as a discriminative stimulus for the correct answer to the second question. If the child responded correctly to both questions (e.g., “Which brick do I have?” as well as “Which brick do you have?”), the experimenter immediately reinforced the response with enthusiastic praise and a tangible item (e.g., small edible or toy) or a token conditioned with items established as reinforcers. If the participant errored on one or both questions on any given trial, the experimenter neutrally stated “I’m sorry, the correct answer is _____,” or a functionally equivalent statement, then provided the child another opportunity to respond. If the child responded correctly on this transfer trial, the experimenter delivered a smaller magnitude of reinforcement (praise only).
**Prompting Procedures and Protocol Modifications.** Whenever a participant failed to demonstrate acquisition at any level of complexity, the experimenter implemented errorless teaching procedures or corrective procedures individual to each participant. The PI chosen appropriate prompts and corrective procedures for each child after error analysis of responses and visual analysis of performance.

Both Participant 1 and Participant 2 found now-then relations particularly difficult, so experimenters replaced “now” with “today” and “then” with “yesterday” to make items clearer. Though deviating from the protocol by McHugh et al. (2004), researchers of this study found that these changes in wording facilitated correct responding and were still functionally equivalent to “now” and “then,” as a broad number of temporal contextual cues may still evoke deictic responding. Participant 1 also completed mass trials of now-then relations when he did not readily acquire these, and he returned to answering mixed trials of all relations once he met mastery criteria of now-then only. These changes are denoted with closed triangles (Figure 2).

Participant 2 used a visual aid for now-then relations, which consisted of a white laminated sheet of 8.5 x 11-inch paper divided into two columns, one headed as “Today” and one headed as “Yesterday. These are denoted with closed triangles on the first panel (Figure 5). Participant 2 also showed regression in simple relations upon mastery of reversed relations and completed mixed trials of simple and reversed complexity levels, further broken down into mass trials of each relation type (I-you, here-there, and now-then). These changes are represented by open triangles on the second panel (Figure 5). Additionally, Participant 2 was also able to manipulate extra-stimulus prompts for each trial. Extra-stimulus prompts included pictures or actual items based on stimuli in the questions, such as a DVD case, two strings of beads, photographs of chairs, etc. It should be noted that although Participant 2 was able to use
these extra-stimulus prompts during pre and post-instructional probe sessions, he independently faded prompts at the mastered reversed post-instructional probe by only looking, but not moving, the items around during the presentation of each question.

Participant 3 also used a visual aid of a white laminated sheet of 8.5 x 11-inch paper with two columns, one reading “Today” and one reading “Yesterday” as well as extra-stimulus prompts (pieces of different colored candy and pictures of chairs and activities). If Participant 3 did not independently move items after the presentation of a question at the reversed complexity level, the experimenter used the least restrictive prompt necessary to evoke the correct response (prompt delay, gestural prompt, or hand-over-hand). If Participant 3 moved the items incorrectly following the presentation of a simple relation, the experimenter blocked this response and re-read the question.

**Post-Instructional Testing Procedures.** Participants completed both post-instructional testing probes upon mastery of each level of complexity (simple, reversed, and double reversed). Mastery criteria was 90% for each level of complexity. Procedures for post-instructional probes were identical to pre-instructional probes in structure, but contained six trials for each complexity level mastered rather than each complexity level not yet trained (6 simple relations upon mastery of simple, 6 simple and 6 reversed upon mastery of reversed, and 6 simple, 6 reversed, and 6 double reversed upon mastery of double reversed relations). For example, after mastering simple relations and responding correctly to 90% of randomized trials of the reversed complexity level, mastery probes contained both simple and reversed relations. The experimenter administered these without feedback. See Table 2 of Appendix I for exemplars of post-instructional probes.
CHAPTER THREE: RESULTS

All three child participants demonstrated deficits in understanding true and false belief at baseline assessments of traditional Theory of Mind tasks. In addition to the traditional unexpected transfer task, participants also performed poorly on the Strange Stories assessment of advanced Theory of Mind. The results of these assessments also coincided with deficits in deictic relational tasks and are representative of previous research in perspective taking and Theory of Mind (McHugh et al., 2004). Participants each engaged in lower frequencies of pretend play topographies of attribution of pretend properties, use of imaginary objects, and object substitution. Finally, parents of each child reported difficulties with socialization and understanding the viewpoints of others at the time of recruitment. All the participants acquired deictic relational responding through multiple exemplar training of these relations, but like participants in previous studies in perspective taking, required several prompting strategies and antecedent manipulations (Weil, Hayes, & Capurro, 2011). Generalized perspective taking abilities as captured through Theory of Mind tasks, the Strange Stories assessment, observations of pretend play, and parent responses to surveys were mixed. Overall, transference of perspective taking to Strange Stories and traditional Theory of Mind tasks occurred for 2 of the 3 participants, while parent report measures and pretend play skills changed little from those of baseline.

Participant 1

Deictic Relational Responding. Training of deictic relations for participant 1 is depicted in Figure 2. Participant 1 performed with 83% accuracy on simple, 50% accuracy on reversed,
and 33% accuracy on double reversed levels of deictic relation tasks at baseline.

Participant 1 then completed multiple exemplar training of perspective taking tasks at the simple level across all relation types (I versus you, here versus there, and now versus then). He quickly met mastery criteria of 90% accuracy of responding within 4 training sessions, but did not demonstrate generalization during a post-instructional probe of 6 simple items across relation types containing novel stimuli. Training at the simple level continued until participant 1 responded to 12 training trials of simple with 92% accuracy, at which point he still performed with only 83% accuracy on a second post-instructional probe. He did, however, perform with 100% accuracy on a final training session of only simple trials as well as a third post-instructional probe of simple trials. Mastery of deictic tasks at the simple level did not generalize to reversed or double reversed levels.

Upon mastery of deictic responding at the simple level, participant 1 then trained on deictic training at the reversed level. As previously stated, participant 1 performed with 50% accuracy on reversed relations at baseline. He continued to perform below mastery levels throughout training at the simple level (67% at session 10 and 0% at session 18). He achieved mastery criteria of training within two sessions (sessions 19 and 20), but this trend did not continue in subsequent training sessions. Participant 1 met mastery criteria of reversed relations at the fifth training session, however, post-instructional probes showed poor responding on novel tasks in two probe sessions of 50% and 83% accuracy. Four subsequent training sessions of reversed relations resulted in only 83% accuracy on novel tasks. Participant 1 demonstrated mastery and generalization to novel stimuli on reversed deictic relations as shown by two consecutive post-instructional probes with 100% accuracy. Two post-instructional probe sessions at the
simple level after training of reversed showed regression to 83%, but this eventually returned to 100% without additional training (100% in session 35).

Deictic training at the double reversed level took fewer sessions until mastery than reversed training. Participant 1 showed steady acquisition of double reversed relations within six multiple exemplar training sessions containing 12 mixed trials of I-you, here-there, and yesterday-today (all double reversed relations). Final post-instructional probe sessions containing novel stimuli showed true acquisition of relational responding: 100% double reversed relations, 83% then 100% reversed relations, and 100% on simple relations. In total, participant 1 mastered all three levels of perspective taking within 62 sessions.

**Traditional Theory of Mind Tasks.** Performance on Theory of Mind tasks is depicted in the bottom panel of Figure 2. At baseline, participant 1 showed difficulty in understanding true and false belief; specifically, he performed with 100% accuracy in understanding true belief of the self and false belief of another, but performed with 0% accuracy in understanding true belief in others and false belief in the self. Performance of Theory of Mind tasks improved with training of reversed levels of deictic complexity (100% of true belief of the self, true belief of another, and false belief of the self), and performance on false belief in others improved to 50% accuracy. Upon mastery of relational responding at the double reversed complexity level, performance regressed to 50% accuracy on true belief of the self and true belief of another while false belief of another maintained at 100% accuracy and false belief of another improved to 50% accuracy. Participant 1 then completed a follow-up assessment of Theory of Mind tests, and performance in true belief of the self, true belief in others, and false belief in others was 100%. False belief of the self did not appear in follow up 0%). Overall, performance on traditional Theory of Mind tasks improved with acquisition of deictic relational responding.
Strange Stories. Performance on the Strange Stories test is depicted in the bottom panel in Figure 2. Participant 1 responded to the Strange Stories test as follows: 25% at baseline, 44% upon mastery of reversed relations, and 81% upon mastery of double reversed relations. Overall, accuracy of Strange Stories Theory of Mind tasks improved with deictic relation training.

Pretend Play. Participant 1’s average frequencies of pretend play are depicted in Figure 3. At baseline, Participant 1 engaged in the following average frequencies for each topography of pretend play: 10.3 counts of attribution of pretend property, 11 counts of use of imaginary objects, and 9 counts of object substitution. After mastery of deictic responding at the reversed complexity level, he engaged in an average of 5.3 counts of attribution of pretend properties, 9.7 counts of use of imaginary objects, and 4.3 counts of object substitution. After mastery of deictic responding at the double reversed complexity level, he engaged in an average of 3.7 counts of attribution of pretend properties, 3.3 counts of use of imaginary objects, and 4 counts of object substitution. Overall, pretend play performance decreased through phases of deictic training.

Parent Questionnaire. The results of participant 1’s parent questionnaire are reported in Figure 4. At baseline, parent of participant 1 reported that her son reacted appropriately/displayed appropriate affect within the past week at a level of 7 on a 1-7 Likert scale, where 1 was “Not at All” and 7 was “Always.” She reported he correctly used terms denoting the self and others 81-100 times (from a scale of 1-20, 21-40, 41-60, 61-80, and 81-100), 41-60 times denoting places and space, and 41-60 times denoting time on the same scale.
Upon mastery of reversed relations, parent reported he reacted appropriately/showed appropriate affect at a level of 7 (Always). She reported that her son denoted terms of the self and others 81-100 times, denoted places 61-80 times, and denoted time 41-60 times, within a week’s period. At a two-week follow up from participant 1’s mastery of double reversed relations, parent reported her child reacted appropriately/showed appropriate affect on a level of 6 from a scale of 1-7, denoted the self and others 81-100 times, denoted space 61-80 times, and denoted time 41-60 times within the past week. Overall, parent report of child’s empathy/affect slightly regressed from 7 to 6 with training, maintained at high levels (81-100 times/week) for denoting the self and others, improved slightly from 41-60 to 61-80 for denoting places, and maintained at moderate levels (41-60 times/week) for denoting time. Taken together, parent’s perceived effectiveness of intervention appeared for denoting places, but not denoting the self and others, time, or empathic responding.

**Participant 2**

**Deictic Relational Responding.** Training of deictic relations is depicted in Figure 5. Participant 2 performed with 0% accuracy on simple, 17% accuracy on reversed, and 40% accuracy on double reversed levels of deictic relation tasks at baseline. Participant 2 then completed multiple exemplar training of perspective taking tasks of the simple level across all relation types (I versus you, here versus there, and now versus then). He quickly met mastery criteria of 90% accuracy of responding within 6 training sessions, but did not demonstrate generalization during a post-instructional probe of 6 simple items across relation types containing novel stimuli (75%). Training at the simple level continued until participant 2 responded to 12 training trials of simple with 92% accuracy, at which point he still performed with only 83% accuracy on a second post-instructional probe. He required 12 sessions of training
at the simple level before reaching mastery criteria at session 39.

Upon mastery of deictic responding at the simplest complexity level, participant 2 trained on deictic training at the reversed complexity level. As previously stated, participant 2 performed with 17% accuracy of reversed relations at baseline levels. He continued to perform below mastery levels throughout training at the simple level (17% at session 4, 83% at session 25, 50% at session 28, and 33% at session 40). He achieved mastery criteria of training within five sessions (sessions 41-45), but this acquisition trend did not continue. Participant 2 met mastery criteria of reversed relations after 23 more training session at this level, but post instructional probes showed again low generalization on novel tasks in two probe sessions of 67% accuracy. Participant 2 responded correctly to 100% of trials of I versus you and here versus there, and required 9 training sessions of yesterday versus today before successfully reversing on appropriate tasks of all relational types. The experimenter then conducted two training sessions with all relational types and mixed trials of simple and reversed, to which participant 2 responded with 67% accuracy and then 100% accuracy. Acquisition of reversed tasks maintained throughout training at the double reversed level (100% accuracy at Sessions 102 and 106).

Deictic training at the double reversed level took fewer sessions until mastery than reversed training. Participant 2 responded to 40% of tasks correctly at baseline and maintained levels below those of mastery throughout training at simple and reversed complexity levels (17% at Session 4, 50% at Session 25, 50% at Session 28, 83% at Session 40, 67% at Session 69, 33% at Session 70, and 33% at Session 99). Participant 2 showed quick acquisition of double reversed relations within two multiple exemplar
training sessions containing 12 mixed trials of I-you, here-there, and yesterday-today (all double reversed relations). Two post-instructional probe sessions containing novel stimuli again showed lack of generalization at the double reversed level of complexity (33% and 67%). He met mastery criteria after two additional training sessions (75% at Session 104 and 92% at Session 105), and responded to 100% accuracy of all novel double reversed tasks on the final post-instructional probe. In total, participant 2 mastered all three levels of perspective taking within 106 sessions.

**Traditional Theory of Mind Tasks.** Performance on Theory of Mind tasks is depicted in the bottom panel of Figure 5. Participant 2 showed difficulty in understanding true and false belief; specifically, he performed with 50% accuracy in understanding true belief of the self, 100% accuracy in understanding true belief of others, 0% accuracy in understanding false belief of the self, and 0% in understanding false belief of others. Performance of Theory of Mind tasks improved at some levels with training of reversed levels of deictic complexity (100% of true belief of the self), regressed at 50% for true belief in others, and maintained for 0% in understanding false belief of the self and false belief of others. Upon mastery of relational responding at the double reversed level, performance on true belief of the self-maintained at 100%, improved at 100% for true belief of another, maintained at 0% accuracy in understanding false belief of the self, and maintained at 0% in understanding false belief of another. Overall, intervention resulted in some improvement, but limited effects, on performance on traditional Theory of Mind tasks for Participant 2.

**Strange Stories.** Performance on the Strange Stories test is depicted in the bottom panel in Figure 5. Participant 2 responded to the Strange Stories test as follows: 19% at baseline, 13% upon mastery of reversed relations, and 19% upon mastery of double reversed relations. Overall,
performance on Strange Stories tasks remained stable throughout training.

**Pretend Play.** Participant 2’s average frequencies of pretend play are depicted in Figure 6. At baseline, Participant 2 engaged in the following average frequencies for each topography of pretend play: 1 instance of attribution of pretend property, 6 instances of use of imaginary objects, and 2.7 instances of object substitution. After mastery of deictic responding at the reversed level, he engaged in an average of 1 instance of attribution of pretend properties, 4 instances of use of imaginary objects, and 3.5 instances of object substitution. After mastery of deictic responding at the double reversed level, he engaged in an average of .67 instances of attribution of pretend properties, 6.33 instances of use of imaginary objects, and 4 instances of object substitution.

**Parent Questionnaire.** The results of participant 2’s parent questionnaire are reported in Figure 7. At baseline, parent of participant 2 reported that her son reacted appropriately/displayed appropriate affect at a level of 5 within the past week on a 1-7 Likert scale where 1 was Not at All and 7 was Always. She reported he correctly used terms denoting the self and others 61-80 times (from a scale of 1-20, 21-40, 41-60, 61-80, and 81-100), 61-80 times denoting places and space, and 41-60 times denoting time on the same scale. Upon mastery of reversed relations, parent reported her son reacted appropriately/showed appropriate affect at a level of 5 on a scale of 1-7. She reported that her son denoted the self and others 41-60 times, denoted places 41-60 times, and denoted time 21-40 times, within a week’s period. At a two-week follow up from participant 2’s mastery of double reversed relations, parent reported her child reacted appropriately on a level of 5 from a scale of 1-7, denoted the self and others 61-80 times, denoted space 61-80 times, and denoted time 61-80 times within the past week.
Overall, parent report of child’s empathy/affect maintained at a rating of 5 throughout intervention, improved from 41-60 to 61-80 times for denoting the self and others upon mastery of reversed relations, regressed then returned to moderate-high levels at baseline of 61-80 for denoting places, and regressed then improved upon mastery of double reversed for denoting time. Taken together, parent’s perceived effectiveness of intervention appeared for denoting the self and others and time, but not denoting places or empathic responding.

**Participant 3**

**Deictic Relational Responding.** Training of deictic relations is depicted in Figure 8. Participant 3 performed with 83% accuracy on simple, 67% accuracy on reversed, and 67% accuracy on double reversed levels of deictic relation tasks at baseline. Participant 2 completed 3 consecutive mastery probe sessions of simple relations with 100% accuracy and continued to training at the reversed level of complexity across all relation types (I versus you, here versus there, and now versus then). He performed below mastery levels on pre-instructional probes of reversed tasks (33%, 17%, and 33% on Sessions 5-7). He quickly met mastery criteria of 90% accuracy of responding within 8 training sessions, and demonstrated generalization during a post-instructional probe of 6 reversed items across relation types containing novel stimuli (100% accuracy). Mastery at the simple level slightly dropped to 83% after mastery of reversed relations, but returned to mastery levels of 100% after one booster session (100% at Session 17).

Deictic training at the double reversed level took fewer sessions until mastery than reversed training. Participant 3 showed steady acquisition of double reversed relations within 4 multiple exemplar training sessions containing 12 mixed trials of I-you, here-there, and yesterday-today (all double reversed relations). Final post-instructional probe sessions containing novel stimuli showed true acquisition of relational responding: 83% then 100% double reversed
relations, 100% on reversed relations, and 100% on simple relations. In total, participant 3 mastered all three levels of perspective taking within 30 sessions.

**Traditional Theory of Mind Tasks.** Performance on Theory of Mind tasks is depicted in the bottom panel of Figure 8. Participant 3 showed difficulty in understanding true and false belief; specifically, he performed with 50% accuracy in understanding true belief of the self, 50% in understanding false belief of another, 0% accuracy in understanding false belief of the self, and 0% accuracy in understanding and false belief of another. Performance of Theory of Mind tasks improved with training of reversed levels of deictic (100% in understanding true belief of another and 100% in understanding false belief of the self), but maintained for understanding true belief of the self (50%) and understanding false belief of another (0%). Upon mastery of relational responding at the double reversed complexity level, performance improved for understanding true belief of the self (100%), maintained at 100% for understanding true belief of another and 0% for understanding false belief of others (0%), and regressed for understanding false belief of the self (0%). Overall, performance on traditional Theory of Mind tasks improved with acquisition of deictic relational responding.

**Strange Stories.** Performance on the Strange Stories test is depicted in the bottom panel in Figure 8. Participant 3 responded to the Strange Stories test as follows: 19% at baseline, 50% upon mastery of reversed relations, and 69% upon mastery of double reversed relations. Overall, accuracy of Strange Stories Theory of Mind tasks improved with deictic relation training.

**Pretend Play.** Participant 3’s average frequencies of pretend play are depicted in Figure 9. At baseline, Participant 3 engaged in the following average frequencies for each
topography of pretend play: 4.7 instances of attribution of pretend property, 2 instances of use of imaginary objects, and 3.3 instances of object substitution. After mastery of deictic responding at the reversed complexity level, he engaged in an average of 7.5 instances of attribution of pretend properties, 0.5 instances of use of imaginary objects, and 3 instances of object substitution. After mastery of deictic responding at the double reversed complexity level, he engaged in an average of 5.7 instances of attribution of pretend properties, 5.3 instances of use of imaginary objects, and 5.7 instances of object substitution. Overall, participant 3 engaged in slightly more frequent use of imaginary objects and object substitution, but stable levels of attribution of pretend properties, with deictic relation training.

**Parent Questionnaire.** The results of participant 3’s parent questionnaire are reported in Table 3. At baseline, parent of participant 2 reported that her son reacted appropriately/displayed appropriate affect at a level of 6 within the past week on a 1-7 Likert scale where 1 was “Not at All” and 7 was “Always.” She reported he correctly used terms denoting the self and others 61-80 times (from a scale of 1-20, 21-40, 41-60, 61-80, and 81-100), 61-80 times denoting places and space, and 61-80 times denoting time on the same scale. Upon mastery of reversed relations, parent reported her son reacted appropriately/showed appropriate affect at a level of 6 on a scale of 1-7. She reported that her son denoted the self and others 61-80 times, denoted places 81-100 times, and denoted time 81-100 times, within a week’s period. At a two-week follow up from participant 3’s mastery of double reversed relations, parent reported her child reacted appropriately on a level of 6 from a scale of 1-7, denoted the self and others 61-80 times, denoted space 61-80 times, and denoted time 81-100 times within the past week. Overall, parent report of child’s empathy/affect maintained at a rating of 6 throughout intervention, maintained at 61-80 for denoting the self and others throughout intervention, improved from 61-80 to 81-100 times,
and improved from 61-80 to 81-100 for denoting time upon mastery of the reversed level, and maintained at 81-100 upon mastery of double reversed relations. Taken together, parent’s perceived effectiveness of intervention appeared for denoting time, improved but did not maintain for denoting places, and maintained at baseline levels for denoting the self and others and empathic responding.
Figure 2. Deictic relation training and Theory of Mind performance for participant 1
Average Frequencies of Pretend Play: Participant 1

Figure 3: Results of pretend play for participant 1: attribution of pretend properties (AOPP), use of imaginary objects (UOIO), and object substitution (OS).

Table 1: Results of Parent Questionnaire for Participant 1, represents 1-2 week periods. Empathic responding was measured on a Likert scale of 1-7 (1 was never, 7 was always). Denoting self and others, places, and time was measured using frequency ranges of 1-20, 21-40, 41-60, 61-80, and 81-100 (over one week).

<table>
<thead>
<tr>
<th>Participant 1</th>
<th>Empathic Responding (frequency/week)</th>
<th>Denoting Self and Others (frequency/week)</th>
<th>Denoting Places (frequency/week)</th>
<th>Denoting Time (frequency/week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>7</td>
<td>81-100</td>
<td>41-60</td>
<td>41-60</td>
</tr>
<tr>
<td>Reversed</td>
<td>7</td>
<td>81-100</td>
<td>61-80</td>
<td>41-60</td>
</tr>
<tr>
<td>Double Reversed</td>
<td>6</td>
<td>81-100</td>
<td>61-80</td>
<td>41-60</td>
</tr>
</tbody>
</table>
Figure 4. Deictic relation training and Theory of Mind performance for participant
Figure 5: Results of pretend play for participant 2: attribution of pretend properties (AOPP), use of imaginary objects (UOIO), and object substitution (OS).

Table 2. Results of Parent Questionnaire for Participant 2, represents 1-2 week periods. Empathic responding was measured on a Likert scale of 1-7 (1 was never, 7 was always). Denoting self and others, places, and time was measured using frequency ranges of 1-20, 21-40, 41-60, 61-80, and 81-100 (over one week).

<table>
<thead>
<tr>
<th>Participant 2</th>
<th>Empathic Responding</th>
<th>Denoting Self and Others (frequency/week)</th>
<th>Denoting Places (frequency/week)</th>
<th>Denoting Time (frequency/week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
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<td>61-80</td>
<td>61-80</td>
<td>41-60</td>
</tr>
<tr>
<td>Reversed</td>
<td>5</td>
<td>41-60</td>
<td>41-60</td>
<td>21-40</td>
</tr>
<tr>
<td>Double Reversed</td>
<td>5</td>
<td>61-80</td>
<td>61-80</td>
<td>61-80</td>
</tr>
</tbody>
</table>
Figure 6. Deictic relation training and Theory of Mind performance for participant 3
Average Frequencies of Pretend Play:
Participant 3

Table 3: Results of Parent Questionnaire for participant 3, represents 1-2 week periods. Empathic responding was measured on a Likert scale of 1-7 (1 was never, 7 was always). Denoting self and others, places, and time was measured using frequency ranges of 1-20, 21-40, 41-60, 61-80, and 81-100 (over one week).

<table>
<thead>
<tr>
<th>Participant 3</th>
<th>Empathic Responding</th>
<th>Denoting Self and Others (frequency/week)</th>
<th>Denoting Places (frequency/week)</th>
<th>Denoting Time (frequency/week)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>61-80</td>
<td>61-80</td>
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<tr>
<td>Reversed</td>
<td>6</td>
<td>61-80</td>
<td>81-100</td>
<td>81-100</td>
</tr>
<tr>
<td>Double Reversed</td>
<td>6</td>
<td>61-80</td>
<td>61-80</td>
<td>81-100</td>
</tr>
</tbody>
</table>

Figure 7. Results of pretend play for participant 3: attribution of pretend properties (AOPP), use of imaginary objects (UOIO), and object substitution (OS).
Table 4: Sessions to Criterion and Calendar Days. Table shows the deictic training sessions to criterion and calendar days spent on each complexity level for all three participants.

<table>
<thead>
<tr>
<th></th>
<th>Simple</th>
<th></th>
<th></th>
<th>Reversed</th>
<th></th>
<th></th>
<th>Double Reversed</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sessions</td>
<td>Calendar Days</td>
<td>Sessions</td>
<td>Calendar Days</td>
<td>Sessions</td>
<td>Calendar Days</td>
<td>Sessions</td>
<td>Calendar Days</td>
</tr>
<tr>
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<td>48</td>
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<tr>
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<tr>
<td>Participant 3</td>
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<td>8</td>
<td>25</td>
<td>4</td>
<td>4</td>
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</tr>
</tbody>
</table>
CHAPTER FOUR: DISCUSSION

Several studies to date have observed the effects of multiple exemplar training of deictic responding on perspective taking abilities in children (Heagle & Rehfeldt, 2006; Jackson et al., 2014; Rehfeldt et al., 2007; Weil et al., 2011). Although previous research established perspective taking as operant behavior of deictic relational responding shapeable through multiple exemplar training strategies, few attempted to assess far generalization of perspective taking abilities as they pertain to social skills (O’Neill & Weil, 2014; Rehfeldt et al., 2007; Weil et al., 2011). The present study was the first to examine what role a perspective taking repertoire might play in everyday applications of Theory of Mind (detecting lies and misunderstandings). Furthermore, this study was the first to attempt to examine if a foundation of pretend play skills was necessary for the development of perspective taking, or the possible emergence of pretend play skills with acquisition of perspective taking. Finally, this study attempted to find effective teaching strategies for training perspective taking using the Barnes-Holmes protocol to individuals with whom language and social skills are deficient (e.g., ASD).

All three participants demonstrated deficits in understanding true and false belief, as well as everyday applications of Theory Mind, prior to intervention. Participants also showed deficits on deictic relational tasks at baseline. All three participants acquired perspective taking abilities at three complexity levels, and 2 of 3 participants showed that these skills generalized to both traditional and advanced Theory of Mind. In similar studies by Weil et al. (2011) and O’neill and Weil (2014), typical children aged 4-5 and
adults with Schizophrenia showed the highest Theory of Mind performance after mastering double reversed relations, while participants with autism in a study by Jackson and colleagues (2014) showed variable mastery of each complexity level. Interestingly, improved performance on traditional Theory of Mind tasks for 2 of the 3 participants appeared after reversed training alone, suggesting that training at the reversed level alone could be beneficial for children who present deficits in these skills. One potential explanation for weaker performance upon mastery of double reversed relations compared to reversed relations is that both participants 1 and 3 attributed knowledge of the correct location of items during false belief tasks to a belief that the story antagonist had moved the item (“He [thought] he moved it”), but were scored as incorrect because participants did not state the previous location as their belief. Similar behavior occurred during final Theory of Mind tests in Weil et al. (2011), where the participant Ariel attributed her mother’s belief to pretend properties (x-ray vision). Future studies might wish to modify scoring criteria to capture attribution of beliefs at this level of mastery. If counting these items as correct, then participants 1 and 3 would have shown the greatest Theory of Mind performance upon mastery of double reversed relations. In summary, these results support the use of multiple exemplar training in building a generalized perspective taking repertoire in children with ASD, as well as evidence of far generalization of such a deictic relational repertoire to untrained tasks, with some individuals with ASD.

The magnitude of intervention effect in the present study differed from those of Jackson and colleagues (2014). Jackson et al. concluded no meaningful change in Theory of Mind performance, while participants 1 and 3 of this study showed improved understanding of the beliefs in others with reversed training alone. One possible reason is that the present study used more stringent mastery criteria than Jackson et. al. (90% compared to 80%). Future research
might wish to more closely examine participant characteristics as well as procedural differences to better understand which variables contribute to acquisition of perspective taking in children with ASD. One trend among each of these perspective taking studies is the tendency for participants to acquire double reversed relations more quickly after mastery of reversed relations. Researchers have discussed this as a possible limitation in that participants may not have responded relationally to these tasks (Jackson et al., 2014; Rehfeldt et al., 2007).

Participants of the present study performed similarly and acquired double reversed relations in many fewer sessions than reversed. It appears that responding to reversed tasks would involve the greatest change to one’s perspective-taking repertoire, and that correct responding to double reversed tasks might only require simple discrimination of verbal antecedents rather than two reversals (I-you and here-there or here-there and now-then). For example, one might take note that answers to these tasks are the same as those at the simple level, rather than simultaneously reverse two relations. It is plausible that children with autism with limited verbal skills would be more likely than typical children to respond in this way. Researchers interested in perspective taking might wish to modify the perspective taking protocol to address this commonly reported limitation.

Both Participants 2 and 3 showed increasing use of imaginary objects and object substitution with training; the overall improvement in these frequencies, however, was minimal. Although both pretend play and understanding beliefs involve similar constructs (i.e., Theory of Mind), these topographies of behavior appear functionally independent and may develop from different learning histories. Those who wish to conduct future analysis of pretend play might consider these data while explaining pretend play, and
behavioral researchers might continue to analyze each domain of Theory of Mind as functionally independent operants, though conceptually related.

This study investigated possible transference of deictic responding to empathic responding because Theory of Mind literature describes empathy as “a crucial function” of mindreading, or Theory of Mind (Howlin, 1999, p. 7). To better understand this connection, the PI attempted to quantify these measures using a questionnaire. The subjective questionnaire used to measure empathic responding as well as everyday use of deictic terms is a potential limitation of this study. Although parents did not report meaningful improvement in these areas, the Likert scale used to measure empathy as well as the frequency ranges for deictic terms denoting people, places, and time, were written by the primary investigator and are not a standardized assessment tool. This should be noted for researchers who wish to replicate these procedures. Future investigators are strongly encouraged to use a more valid measurement for these dependent variables. Scoring video samples of conversations as well as direct observation are potential alternatives to the parent questionnaire used here.

Results of the parent questionnaire lend support for previous analyses that empathy and emotional understanding involve more complex training and the participation of other relational networks than deictic relations alone (Valdivia-Salas et al., 2009; Vilardaga, 2009). These data speak to the external validity of the current deictic protocol for learners with autism. It would seem that the deictic protocol used in the current study was effective in teaching an important element for such complex behavior as empathy, and that more comprehensive interventions and rigorous training in multiple relational frames are indeed needed to show such results (Valdivia-Salas et al., 2009). Those interested in clinical application of the perspective taking protocol might wish to train additional relations with perspective taking for more meaningful gains in
social skills. Participants required several procedural modifications to meet mastery criteria. For one, participant 1 showed lack of maintenance at the simple level after training on reversed relations (67%). Upon closer examination, it appeared that he failed to attend to contextual cues of reversed tasks. Sessions 30 and 31, then contained mixed trials of both simple and reversed relations, however, mastery did not occur with this procedural change. Closer analysis revealed that participant 1 more often errored on reversed deictic relations of now-then, therefore researchers made a second procedural modification to mass trial now-then reversed relations. After several sessions of variable responding (35-39), experimenters changed the wording of now-then items to say yesterday and today instead of now and then (e.g., “What were you doing yesterday? What would you be doing today?”). After this modification, participant 1 was able to discriminate between simple and reversed relations and demonstrated more consistent and accurate responding on now-then tasks.

Participant 2 also required procedural modifications to master perspective taking. At session 14, it appeared that participant 2 mostly errored on temporal relations (now versus then), therefore the next sessions consisted of 12 mass trials of now-then relations at the simple level. After a decelerating trend with mass trials, the experimenter implemented a visual aid that allowed the child to organize which activity took place at which time. The visual aid consisted of a laminated 8.5 by 11-inch piece of paper with two divided sections, one that read “Now” and the other that read “Then.” The visual aid also contained laminated squares representing preferred activities (“Watching Dora” and “Doing puzzles”) with Velcro backs that fit onto the board. This visual prompt had an immediate effect, and participant 2 performed at 100% accuracy on now-then tasks at
the simple level for three consecutive sessions. At the fourth session of mass trials of now-then with the visual aid, the experimenter removed the visual aid and instead used examples in the natural environment. The goal of these procedural changes was to increase acquisition by incorporating more salient stimuli for the child. In conjunction with this, the experimenter also worded questions in language more familiar to the child and changed question format from “What were you doing then? What would you be doing now?” by replacing now with today and then with yesterday, as this strategy showed to be successful with participant 1 who also frequently errored on temporal relations. Although these procedural changes led to more accurate responding, participant 2 still required 12 additional training sessions before mastery simple tasks at session 39.

Participant 2 was also provided with extra-stimulus prompts beginning at session 36, and sometimes manipulated these items to arrive at the correct answer. For example, when answering now-then tasks, he had the materials for the activities stated in the task with him at the table (puzzle pieces and a DVD case). Participant 2 also had difficulty discriminating between simple and reversed tasks as well as reversed and double reversed relations. The experimenter remediated this by implementing mass trials of simple and reversed relations, with similar stimuli and massed according to relational type (I versus you, here versus then, and today versus yesterday). Participant #2 also completed mixed trials of reversed and double reversed relations (mixed relational types). Although participant 2 demonstrated weaker stimulus control and required the actual items, he independently faded out use of these items and was able to respond without manipulating them.

Like Participant 2, Participant 3 was allowed the same visual aids during instruction (actual items and pictures of items). Participant 3 manipulated items independently, but did not
fade out the use of these stimuli as participant 1 had. These procedural modifications were necessary for acquisition of perspective taking for all participants. Jackson et al. (2014) also required more training and prompting than typical children in previous studies (Rehfeldt et al., 2007; Weil et al., 2011). Taken together, these data suggest that children with ASD perform with less accuracy and require more rigorous training and intrusive prompting than individuals without autism to acquire a perspective-taking repertoire.

Prior research in RFT supports to use of deictic relation training in rehabilitation of social cognitive skills known traditionally described as Theory of Mind. While the use of Theory of Mind assessment is widely supported in psychological communities, behavior analysis places high emphasis on teaching socially relevant, observable, and measurable behavior. In addition to replicating the use of traditional Theory of Mind tasks in previous perspective taking studies (Jackson et al., 2015; O’neill & Weil, 2014; Weil et al., 2011), this study investigated further generalization of these skills to everyday applications of Theory of Mind, i.e., the Strange Stories. For example, traditional Theory of Mind tasks both in prior research and the current study involve the use of dolls or puppets and a limited range in stimuli or scenarios, as the unexpected transfer is the commonality among all of these. The researchers of this study felt that Strange Stories, though administered in a paper and pencil format, better represented social interactions of which a perspective taking repertoire would be necessary. Vignettes such as those involving white lies to spare feelings, manipulation of others to elicit sympathy, and similar stories were a further step in examining what role a perspective taking repertoire according to RFT might play in navigating through these complex situations.
Surprisingly, 2 of 3 participants showed the greatest gains in the *Strange Stories* task even though these tasks were conceptually more complex, and represented skills emerging later in development, than the traditional unexpected transfer (“Sally Anne”) task. One could argue that although more representative of everyday life, the *Strange Stories* are not representative of everyday social skills and the authors did not directly observe behavior. While future research should look more closely at observable behavior in the natural environment, it is unlikely that a child would sooner demonstrate application of these skills in the natural environment than a set of stories containing fewer stimuli. The use of the *Strange Stories* assessment was a logical first step in observing socially relevant changes while maintaining a controlled environment, and future research might wish to explore application of these skills in the context of everyday interactions.

A limitation to this study are possible test-retest effects (Kazdin, 2003). These serve as threats to internal validity when multiple presentations of an assessment result in improved performance, or regression towards the mean. The present study attempted to minimize these effects by varying stimuli and the verbal antecedents during traditional Theory of Mind tasks, however the primary investigator only used one form of the *Strange Stories* task. It is possible that the greater gains seen in this assessment rather than the traditional tasks are the result of such test-retest effects, however it is unlikely that a participant’s performance would improve a substantial amount from test-retest alone. The use of a multiple probe design demonstrated experimental control by only showing improved performance with intervention. Had the participants been likely to vary responding at a subsequent presentation of an assessment, they would have likely shown this during pre-instructional testing procedures of deictic tasks. Nonetheless, the possibility of test-retest effects cannot be ruled out in our assessment of
intervention effects of Theory of Mind performance.

Another limitation of this study was the controlled conditions used during pretend play probe sessions. The use of the same toys each presentation, though including several items for play, may have resulted in satiation towards the end of the study. This could account for participant 1’s decelerating average of pretend play behavior. Another potential confound is that the novelty of the toys at baseline were an artifact of higher than normal engagement of pretend play, and that participants engaged less enthusiastically with these toys by the end of the study. Furthermore, the topographies of pretend play, though operationally defined, could not always be observed as they can also take form as covert behavior. There may have then been gains in pretend play undetected through the methodology of this study. Future research might better detect such behavior using a more structured, trial-based assessment. Experimenters of this study included the use of prompting and asking questions during pretend play to better access covert behavior (e.g., “What could we use this as?”), but participants may have not been motivated to report such events, if they occurred.

Interestingly, Participant 2 engaged in the lowest frequency of pretend play out of all 3 participants and also took the most sessions to meet mastery criteria of deictic relation tasks. This degree of impairment in pretend play may have served as a barrier to acquiring perspective taking. Future research might wish to more closely examine the link between pretend play skills and performance on deictic relational tasks, as mainstream research cognitive developmental research postulates that pretend play serves as a foundational skill for subsequent levels of Theory of Mind (Howlin et al, 1999). Pretend play might serve as an important prerequisite to perspective taking that one
cannot bypass with multiple exemplar training of deictic relations.

In addition to pretend play, prerequisite skills in verbal behavior is also an area in need of exploration in RFT research as it relates to this study. Participant 2, while able to respond correctly to control questions to the Strange Stories task and some “why” questions, showed skill deficits in the areas of both listening comprehension and advanced intraverbal skills, such as answering “why” questions related to cause and effect and repeating back critical elements of a story. It is possible then that these skill deficits impeded performance on any of the Theory of Mind assessments. Limited language skills could have also contributed to the several number of sessions required before mastery of the deictic protocol.

In summary, the use of deictic training was effective for improving understanding of others for some children with ASD. Of three participants, only those with a foundation of pretend play and substantial language abilities (listening comprehension and answering complex -wh questions) demonstrated improved abilities to describe the motives of others and predict another individual’s behavior based on true and false belief. In addition to these data, training took fewer sessions with participants who had more language skills and pretend play, and participants still required the use of extra-stimulus prompts, mixing/varying complexity levels, and change in temporal contextual cues (yesterday and today instead of now and then) to facilitate acquisition.

Future research is needed to offer more evidence as to which prerequisite skills are needed for deictic training. Additional research might also observe further generalization of skills by observing social behavior in the natural environment. Furthermore, more specific training in situations involving perspective taking, such as in-situ training that incorporates the use of deictic responding as well as vignettes with emotions in scenarios (Lovett et al., 2014),
might also lead to quicker acquisition and generalization of skills in the natural environment for some children. Fluency training may also result in more flexible perspective-taking repertoires. With some modification for learners with autism and refinement in the deictic protocol, the use of deictic relation training holds promising implications for remediating social deficits in children with ASD.
REFERENCES


APPENDIX A: IRB Approval Letter

11/26/2014

Samantha Broderick
USF Department of Child and Family Studies
4202 E. Fowler Ave MHC 1110
Tampa, FL 33620

RE: Expedited Approval for Initial Review
IRB#: Pro00015831
Title: Examining the Impact of Deictic Relational Responding on Advanced Theory of Mind and Pretense in Children with Autism

Study Approval Period: 11/25/2014 to 11/25/2015

Dear Ms. Broderick:

On 11/25/2014, the Institutional Review Board (IRB) reviewed and APPROVED the above application and all documents outlined below.

Approved Item(s):
Protocol Document(s):
DRR in ASD_complete protocol manuscript

Consent/Assent Document(s)*:
00015831 Parental Permission Minimal Risk_Rev 2 clean version.docx.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s).

Research Involving Children as Subjects (45 CFR §46.404)
Per CFR 45 Part 46, Subpart D, this research involving children was approved under the minimal risk category 45 CFR 46.404: Research not involving greater than minimal risk.
It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

[Signature]

John Schinka, Ph.D., Chairperson
USF Institutional Review Board
APPENDIX B: Perspective Taking Protocol

Example of deictic training trials adapted from McHugh et al. (2004) and used in the present study.

SIMPLE RELATIONS

Simple I-YOU:

I have a blue tablet and you have a white tablet.
Which tablet do I have? (Blue)
Which tablet do YOU have? (White)

You have a white tablet and I have a blue tablet.
Which tablet do YOU have? (White)
Which tablet do I have? (Blue)

Simple HERE-THERE:

I am playing in the playroom and you are playing on the playground.
Where am I playing? (Playroom)
Where are YOU playing? (Playground)

You have playing on the playground and I am playing in the playroom.
Where are YOU playing? (Playground)
Where am I playing? (Playroom)

Simple NOW-THEN:

Yesterday I watched cartoons; today I am reading comic books.
What am I doing NOW? (Reading comic books)
What was I doing THEN? (Watching cartoons)

Yesterday I read comic books; today I am watching cartoons.
What am I doing NOW? (Watching cartoons)
What was I doing THEN? (Reading comic books)

Yesterday you watched cartoons; today you are reading comic books.
What were you doing THEN? (Watching cartoons)
What are you doing NOW? (Reading comic books)

Yesterday you read comic books; today you are watching cartoons.
What were you doing THEN? (Reading comic books)
What are you doing NOW? (Watching cartoons)

REVERSED RELATIONS

Reversed I-YOU:

I have a bike and you have a scooter. If I were you and you were me,
Which toy would I have? (Scooter)
Which toy would YOU have? (Bike)

I have a bike and you have a scooter. If I were you and you were me,
Which toy would YOU have? (Bike)
Which toy would I have? (Scooter)

I have a scooter and you have a bike. If I were you and you were me,
Which toy would I have? (Bike)
Which toy would YOU have? (Scooter)

I have a scooter and you have a bike. If I were you and you were me,
Which toy would YOU have? (Scooter)
Which toy would I have? (Bike)

Reversed Here-There:

I am here at home and you are there at school. If here was there and there was here,
Where would I be? (School)
Where would YOU be? (Home)

I am here at school and you are there at home. If here was there and there was here,
Where would I be? (Home)
Where would YOU be? (School)

I am here at home and you are there at school. If here was there and there was here,
Where would YOU be? (Home)
Where would I be? (School)

I am here at school and you are there at home. If here was there and there was here,
Where would YOU be? (School)
Where would I be? (Home)

Reversed Now-Then:

Yesterday you went to Sea World; today you are at karate. If now was then and then was now,
What would you be doing NOW? (Sea World)
What would you be doing THEN? (Karate)

Yesterday you went to Sea World; today you are at karate. If now was then and then was now,
What would you be doing THEN? (Karate)
What would you be doing NOW? (Sea World)

Yesterday you went to karate; today you are at Sea World. If now was then and then was now,
What would you be doing THEN? (Sea World)
What would you be doing NOW? (Karate)

Yesterday you went to karate; today you are at Sea World. If now was then and then was now,
What would you be doing NOW? (Karate)
What would you be doing THEN? (Sea World)

Yesterday I went to Sea World; today I am at karate. If now was then and then was now,
What would I be doing NOW? (Sea World)
What would I be doing THEN? (Karate)

Yesterday I went to karate; today I am at Sea World. If now was then and then was now,
What would I be doing THEN? (Karate)
What would I be doing NOW? (Sea World)

Yesterday I went to karate; today I am at Sea World. If now was then and then was now,
What would I be doing NOW? (Karate)
What would I be doing THEN? (Sea World)

DOUBLE REVERSED RELATIONS

Double Reversed I-You/Here-There:

I am sitting on the trampoline and you are sitting in the tunnel. If I were you and you were me,
and if here was there and there was here
Where would I be sitting? (Trampoline)
Where would YOU be sitting? (Tunnel)
I am sitting in the tunnel and you are sitting on the trampoline. If I were you are you were me, and if here was there and there were here
Where would I be sitting? (Tunnel)
Where would YOU be sitting? (Trampoline)

I am sitting on the trampoline and you are sitting in the tunnel. If I were you and you were me, and if here was there and there was here
Where would YOU be sitting? (Tunnel)
Where would I be sitting? (Trampoline)

I am sitting in the tunnel and you are sitting on the trampoline. If I were you are you were me, and if here was there and there was here
Where would YOU be sitting? (Trampoline)
Where would I be sitting? (Tunnel)

_Double Reversed Here-There/Now-Then:_

Yesterday I shopped at the mall; today I am shopping at PetSmart. If here was there and there was here and if now was then and then was now
Where would I be shopping NOW? (PetSmart)
Where would I be shopping THEN? (Mall)

Yesterday I shopped at the mall; today I am shopping at PetSmart. If here was there and there was here and if now was then and then was now
Where would I be shopping THEN? (Mall)
Where would I be shopping NOW? (PetSmart)

Yesterday I shopped at PetSmart; today I am shopping at the mall. If here was there and there was here and if now was then and then was now
Where would I be shopping THEN? (PetSmart)
Where would I be shopping NOW? (Mall)

Yesterday I shopped at PetSmart; today I am shopping at the mall. If here was there and there was here and if now was then and then was now
Where would I be shopping NOW? (Mall)
Where would I be shopping THEN? (PetSmart)

Yesterday you shopped at the mall; today you are shopping at PetSmart. If here was there and there was here and if now was then and then was now
Where would you be shopping NOW? (PetSmart)
Where would you be shopping THEN? (Mall)

Yesterday you shopped at the mall; today you are shopping at PetSmart. If here was there and there was here and if now was then and then was now
Where would you be shopping THEN? (Mall)
Where would you be shopping NOW? (PetSmart)
Yesterday you shopped at PetSmart; today you are shopping at the mall. If here was there and there was here and if now was then and then was now
Where would you be shopping THEN? (PetSmart)
Where would you be shopping NOW? (Mall)

Yesterday you shopped at PetSmart; today you are shopping at the mall. If here was there and there was here and if now was then and then was now
Where would you be shopping NOW? (Mall)
Where would you be shopping THEN? (PetSmart)
APPENDIX C: Levels of Theory of Mind (Howlin et al., 1999)

Emotions

Level 1: Recognition of facial expression through photographs. The child is able to tact emotions such as happy, sad, angry, and afraid on photographs.

Level 2: Recognition of emotion from schematic drawings. The child is able to tact emotions such as happy, sad, angry, and afraid in cartoons.

Level 3: Identification of situation-based emotions. The child is able to predict how a character will feel given a situation and obvious emotional content.

Level 4: Desire-based emotions. The child understands the emotions that accompany fulfilled or unfulfilled desires. The child will attribute a character’s feelings of happiness or sadness based on their whether or not the character’s desires were met.

Level 5: Belief-based emotions. The child understands that desires are based on belief, even when beliefs are false.

Informational States

Level 1: simple visual perspective taking. Perspective taking at this level requires the understanding that different people perceive objects differently based on their position. A child at this level can accurately determine what another person can or cannot see. For example, if a teacher presents a two-sided card to the child with a picture of a teapot facing the child and a picture of a cake facing the teacher, the child should be able to respond “teapot” when asked “What do you see?” as well as “cake” when asked “What do I see?” Children typically develop this level of perspective taking as early as age 2.
Level 2: complex visual perspective taking. This level is similar to level 1 with the additional ability to understand how objects appear to other people. Consider a scenario in which the instructor places a card of an elephant on the table in front of the child and asks the child, “When I look at the picture, is the elephant right-side up, or upside down?” The instructor may alternate between asking how the picture appears from her point of view as well as the child’s point of view while repositioning the picture. If the child is able to respond correctly to both level 1 and level 2 tests, then the child possesses first order perspective-taking abilities in a Theory of Mind analysis. Children typically develop this level of perspective taking between ages 3-4.

Level 3: seeing leads to knowing. Perspective taking at level 3 requires the basic understanding that people only know information they have experienced or perceived, either directly or indirectly. That is, one learns new information through seeing, hearing, or feeling. Children with this level of perspective-taking can accurately report when they do not know certain information and explain why; for example, a child may not be able to identify what color button the instructor placed in a box and can state that he did not see the button and therefore does not know when asked why. Children typically acquire this level of perspective-taking at the age of 3, but children with autism show significant impairments in this rudimentary level of complex perspective-taking compared to their typically-developing peers and peers with other intellectual disabilities (e.g., Down Syndrome) (Baron-Cohen et al., 1985).

Level 4: true belief. This level involves predicting another person’s actions by taking into account what the person knows. One example of level 4 perspective-taking involves predicting where an individual will look for an object based on the last place she saw or placed
the object. For instance, an instructor might show a child two scenes, one in which a car is placed beside a boat and another in which an identical car is placed beside a plane. The instructor can then tell the child a story: “This morning, you saw the car next to the boat but not next to the plane.” Then instructor can then ask the child, “Where do you think the car is?” as well as “Why do you think it is by the boat?” and “Where will you go to get the car? Why will you go to the boat?” The child should respond based on the principle of true belief, or the knowledge of the location of the car based on what the child has seen.

**Level 5: false belief.** Perspective-taking at this level requires that the individual predict what another person will do based on false beliefs as well as understand that one may have previously held false beliefs. Understanding false beliefs constitutes as the most advanced level of perspective taking and is considered to be the litmus test for detecting perspective-taking deficits in individuals with autism.

**Pretense**

**Level 1: Sensorimotor play.** This is the earliest level of play. Children manipulate toys at this level. Examples of sensorimotor play include lining up, banging, waving, or sucking on objects. Some sensorimotor play behaviors look like ritualistic or stereotyped behaviors.

**Level 2: Emerging functional play.** When the child shows one of two examples of conventional play within a 10-minute observation period. Examples of this include putting a doll dress on a doll, or putting a shape in a shape sorter.

**Level 3: Established functional play.** Three of more instances of functional play within a 10-minute period.

**Level 4(a): Emerging pretend play.** The child performs one or two of the three forms
of pretend play without prompting from an adult. The three forms of pretend play include:

**Object substitution.** Using one object if it were another. For example, using a twirling baton as a scepter.

**Attribution of pretend properties.** Behaving as if an object has properties it does not actually have. For example, making a car fly.

**Use of imaginary objects/scenarios.** Behaving with respect to absent objects as if they were physically present. For example, eating “food” from an empty bowl.

**Level 4(b): The pretend-real distinction.** When asked, the child is able to discriminate whether an adult is really performing an action, or just pretending.

**Level 5: Established pretend play.** If the child engages in three or more instances of pretend play without prompting from an adult within a 10-minute period.
APPENDIX D: The Strange Stories Task

1 Simon is a big liar. Simon’s brother Jim knows this; he knows that Simon never tells the truth! Now yesterday, Simon stole Jim’s Ping-Pong paddle, and Jim knows Simon has hidden it somewhere, though he can’t find it. He’s very mad! So, he finds Simon and he says, ‘‘where is my Ping-Pong paddle? You must have hidden it either in the cupboard or under your bed, because I’ve looked everywhere else. Where is it, in the cupboard or under your bed?’’ Simon tells him the paddle is under his bed.

Q: Why will Jim look in the cupboard for the paddle?
Scoring:
2 points—reference to Jim knowing Simon lies
1 point—reference to facts (that’s where it really is, Simon’s a big liar) or Simon hiding it without reference to implications of lying
0 points—reference to general nonspecific information (because he looked everywhere else)

2 During the war, the Red army captures a member of the Blue army. They want him to tell them where his army’s tanks are; they know they are either by the sea or in the mountains. They know that the prisoner will not want to tell them, he will want to save his army, and so he will certainly lie to them. The prisoner is very brave and very clever, he will not let them find his tanks. The tanks are really in the mountains. Now when the other side asks him where his tanks are, he says, ‘‘they are in the mountains.’’

Q: Why did the prisoner say that?
Scoring:
2 points—reference to fact that other army will not believe and hence look in other place, reference to prisoner’s realization that that’s what they’ll do, or reference to double bluff
1 point—reference to outcome (to save his army’s tanks) or to mislead them
0 points—reference to motivation that misses the point of double bluff (he was scared)

3 Brian is always hungry. Today at school in the cafeteria, they are serving his favorite meal—cheese pizza. He is greedy and would like to eat all the pizza there is, even though his mom told him she was going to order pizza for dinner tonight! But everyone is allowed one slice of pizza and no more. When it is Brian’s turn in the lunch line, he asks, ‘‘Oh, please can I have two slices of pizza, because my family is poor and we won’t have dinner tonight!’’

Q: Why does Brian say this?
Scoring:
2 points—reference to fact that he’s trying to elicit sympathy, being deceptive
1 point—reference to his state (greedy), outcome (to get more pizza) or factual
0 points—reference to a motivation that misses the point of sympathy elicitation/deception, or factually incorrect
4. Jill wanted to buy a kitten, so she went to see Mrs. Smith, who had lots of kittens she didn’t want. Now Mrs. Smith loved the kittens, and she wouldn’t do anything to harm them, though she couldn’t keep them all herself. When Jill visited she wasn’t sure she wanted one of Mrs. Smith’s kittens, since they were all males and she had wanted a female. But Mrs. Smith said, “If no one buys the kittens I’ll just have to have them put down!”

Q: Why did Mrs. Smith say that?
2 points—reference to persuasion, manipulating feelings, trying to induce guilt/pity
1 point—reference to outcome (to sell them or get rid of them in a way which implies not having them put down) or simple motivation (to make Jill sad)
0 points—reference to general knowledge or dilemma without realization that the statement was not true (she’s a horrible woman)

5. One day Aunt Jane came to visit Peter. Now Peter loves his aunt very much, but today she is wearing a new hat; a new hat which Peter thinks is very ugly indeed. Peter thinks his aunt looks silly in it, and much nicer in her old hat. But when Aunt Jane asks Peter, “How do you like my new hat?” Peter says, “Oh, it’s very nice.”

Q: Why does he say that?
2 points—reference to white lie or wanting to spare her feelings; some implication that this is for aunt’s benefit rather than just for his, desire to avoid rudeness or insult
1 point—reference to trait (he’s a nice boy) or relationship (he likes his aunt); purely motivational (so she won’t shout at him) with no reference to aunt’s thoughts or feelings; incomplete explanation (he’s lying, he’s pretending).
0 points—reference to irrelevant or incorrect facts/feelings (he likes the hat, he wants to trick her)

6. Helen waited all year for Christmas, because she knew at Christmas she could ask her parents for a rabbit. Helen wanted a rabbit more than anything in the world. At last Christmas Day arrived, and Helen ran to unwrap the big box her parents had given her. She felt sure it would contain a little rabbit in a cage. But when she opened it, with all the family standing round, she found her present was just a boring old set of books, which Helen did not want at all! Still, when Helen’s parents asked her how she liked her Christmas present, she said, “It’s great, thank you. It’s just what I wanted.”

Q: Why did she say this?
2 points—reference to white lie or wanting to spare their feelings; some implication that this is for parent’s benefit rather than just for her, desire to avoid rudeness or insult
1 point—reference to trait (she’s a nice girl) or relationship (she likes her parents); purely motivational (so they won’t shout at her) with no reference to parent’s thoughts or feelings; incomplete explanation (she’s lying, she’s pretending).
0 points—reference to irrelevant or incorrect facts/feelings (she likes the present, she wants to trick them)
7. Late one night, old Mrs. Peabody is walking home. She doesn’t like walking home alone in the dark because she is always afraid that someone will attack her and rob her. She really is a very nervous person! Suddenly, out of the shadows comes a man. He wants to ask Mrs. Peabody what time it is, so he walks toward her. When Mrs. Peabody sees the man coming toward her, she starts to tremble and says, ‘‘Take my purse, just don’t hurt me please!’’

Q: Why did she say that?
2 points—reference to her belief that he was going to mug her or her ignorance of his real intention
1 point—reference to her trait (she’s nervous) or state (she’s scared) or intention (so he wouldn’t hurt her) without suggestion that fear was unnecessary
0 points—factually incorrect/irrelevant answers; reference to the man actually intending to attack her

8. A burglar who has just robbed a shop is making his getaway. As he is running home, a policeman on his beat sees him drop his glove. He doesn’t know the man is a burglar, he just wants to tell him he dropped his glove. But when the policeman shouts out to the burglar, ‘‘Hey, you! Stop!’’ the burglar turns round, sees the policeman and gives himself up. He puts his hands up and admits that he did the break-in at the local shop.

Q: Why did the burglar do that?
2 points—reference to belief that policeman knew that he’d burgled the shop
1 point—reference to something factually correct in story
0 points—factually incorrect/irrelevant answers
APPENDIX E: Parent Questionnaire

Please keep this form for one week, complete, and give back to the primary investigator (Samantha Broderick) on ____.

1. On a scale of 1 to 7, how often has your child shown empathy within the past week? This includes orienting eyes when another person shows distress, making statements of concern (“What’s wrong?”) or describing emotions in others (“He was sad.”).

   1    2    3    4    5    6    7
   Not at all       Always

   What did this look like?

2. About how many times did your child correctly use terms denoting the self or others within the past week? These include pronouns such as I, you, he, she, or proper names, or similar words.

   1-20   21-40   41-60   61-80   81-100

3. About how many times did your child correctly use terms denoting places and space within the past week? These include words such as here or there, names of locations, or similar words.

   1-20   21-40   41-60   61-80   81-100

4. About how often did your child correctly use terms denoting time? These include words such as now, then, yesterday, today, days of the week, months, years, or similar words.

   1-20   21-40   41-60   61-80   81-100
APPENDIX F: Deictic Training Data Sheet

Date: 
Phase(s): 

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Pre Training
Post
APPENDIX G: Theory of Mind Data Sheet

**Baseline**

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<th>True Belief--Self</th>
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<td>True Belief--Other</td>
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<td>False Belief--Self</td>
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<td>False Belief--Other</td>
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**Reversed**

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<th>True Belief--Self</th>
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**Double Reversed**

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### APPENDIX H: Pretend Play Data Sheet

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<tr>
<th>Attribution of pretend properties (AOPP)</th>
<th>Use of imaginary objects (UOIO)</th>
<th>Object Substitution (OS)</th>
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<tr>
<td>Any instance in which the child attributes properties to an object that it would not have in real life or that it does not appear to have. Does not include functional play of characters speaking (e.g., TV character talking).</td>
<td>Referring to an absent item as if it were present. Excluded when child names items on the table.</td>
<td>Any instance in which the child uses an object as if it were another object</td>
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<td>Examples: Making a toy car fly, making a character injured, superhuman strength/abilities</td>
<td>Example: dirt, grass, water, paint, food, items not visible</td>
<td>Example: child uses box as house, or a visible item as another item</td>
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**Instructions:** Score frequency of OS, AOPP, and UOIO.

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<tr>
<th>Minute</th>
<th>AOPP</th>
<th>UOIO</th>
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APPENDIX I: IOA and Treatment Integrity Checklist for Deictic Training

Please indicate whether the experimenter engaged in the following behaviors during training:

Phase: ____________ Date: ___ Experimenter: ______ Observer: ___

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Total trials implemented with full integrity/total trials: ______ %

Deictic Training IOA DataSheet

Participant’s initials ____________ Date: _______

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<th>Trial</th>
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IOA: ________ X 100 = ______%
APPENDIX J: Theory of Mind Probes IOA/Treatment Integrity Data Sheet

Instructions: For each of the 3 videos, follow along with the stories. There are two main types, true belief and false belief.

True belief trials are stories where one character (child or another) places an object somewhere, then returns to retrieve it. Correct answers are ones where the child accurately reports where he/another would look for the object (last place seen).

False belief ones have the same setup, but another individual moves the item while the character is away (and does not see). Correct answers to these require the child to answer that he/she would look in the original location (not the actual one).

There are 8 trials except for one video, where an extra trial was administered. Score + or – for whether the child responded correctly for each trial.

Please score treatment integrity for each trial: 1) Provided enough context for each scenario (locations of items and presence/absence of characters), 2) administered with neutral affect and no feedback, and 3) recorded data.

**Video 1**

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**Video 2**

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**Video 3**

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APPENDIX K: Pretend Play Treatment Integrity Data Sheet

Please indicate whether the experimenter engaged in the following behaviors during training:

<table>
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<tr>
<th>Minute</th>
<th>1. Interacted with the child</th>
<th>2. Administered vocal-verbal prompts if the child did not engage in pretend play</th>
<th>3. Refrained from modeling, directly prompting, or reinforcing pretend play</th>
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<tbody>
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