Training Emotion Recognition Skills In Children On The Autism Spectrum Using Derived Relational Responding

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TRAINING EMOTION RECOGNITION SKILLS IN CHILDREN ON THE AUTISM SPECTRUM USING DERIVED RELATIONAL RESPONDING

A Dissertation
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in the Department of Psychology
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by
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ABSTRACT

Prior research on traditional emotion recognition training with individuals on the autism spectrum has shown improvement in skills. However, only a handful of studies have demonstrated generalization of skills to novel stimuli and contexts. The application of derived relational responding to interventions has been shown to be an efficient and effective way of producing generalized behaviors in both typically developing and developmentally delayed populations (Healy, Barnes-Holmes, & Smeets, 2000; Rehfeldt & Barnes-Holmes, 2009).

The present study was designed to obtain preliminary data on the effectiveness of emotion recognition training that includes derived relational responding. Three Caucasian children (aged 12-15 years old) with autism spectrum diagnoses were recruited through direct solicitation at an Autism outpatient treatment center in the southeastern United States. A concurrent multiple probe design across participants was used to assess performance on an emotion matching-to-sample training task. A within participant analysis was also conducted to examine relative accuracy across more or less complex derived relational responses.

The results indicated that the emotion recognition training procedure was sufficient for improving emotion recognition performance on a matching-to-sample task for all three participants. In addition, two of the three participants demonstrated clear generalization of emotion recognition skills to novel stimuli. Assessment of generalization to the natural environment, however, yielded mixed findings. Implications for developing future social skill interventions for individuals on the autism spectrum are discussed.
ACKNOWLEDGEMENTS

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Social skills research and why it matters

Social functioning refers to an individual’s overall interpersonal performance, and it is an important aspect of everyday life (Yager & Ehmann, 2006). Social skills can be considered any and all of the behaviors that facilitate positive social interactions (Yager & Ehmann, 2006). The concept of social skills can be broken down into a number of different behavioral repertoires. It includes basic, observable behaviors such as eye contact or tone of voice as well as more complex observable behaviors such as initiating a conversation (Yager & Ehmann, 2006). Social skills also refer to complex social cognitive behaviors, such as perspective taking, emotion recognition, and the understanding of social situations (van Nieuwenhuijzen & Vriens, 2012).

Social skills vary from person to person according to a number of individual and environmental factors (Norton, Washington, Peters, & Hayes, 2009). Social skill competence affects most human behavior from the way one learns in school, to how effective one is at a chosen occupation, to one’s overall ability to recruit social support when necessary (Barth, 1988; Konold, Jamison, Stanton-Chapman, & Rimm-Kaufman, 2010; Welker & Ginn, 1974). For instance, research suggests that social skills are functionally related to depressive symptoms and
other internalizing behaviors (Reynolds, Sander, & Irvin, 2010; Ross, Shochet, & Bellair, 2010). In addition, difficulties in social skills have been documented for those diagnosed with schizophrenia (Villatte, Monestes, McHugh, Freixa i Baque, & Loas, 2010) and individuals with mild to moderate learning disabilities (Owen, Browning, & Jones, 2001). Social skill difficulty has also been documented for children diagnosed with attention deficit hyperactivity disorder (ADHD; Kats-Gold, Besser, & Priel, 2007), with conduct problems (Woodworth & Waschbusch, 2007), and with expressive specific language impairment (Merkenschlager, Amorosa, Kiefl, & Martinius, 2012).

Most notably though, social skill deficits have been established as a core therapeutic target for individuals on the autism spectrum, due in part to social competence being part of the diagnostic criteria specified in the Diagnostic and Statistical Manual of Mental Disorders 5th ed. (American Psychiatric Association, 2013; Brent, Rios, Happe, & Charman, 2004; Spek, Scholte, & Van Berckelaer-Onnes, 2010). There are a variety of studies on different types of social skill interventions for individuals on the autism spectrum. The vast majority of these interventions emerge from two different theoretical perspectives: cognitive-developmental and behavioral (Bellini, Peters, Benner, & Hopf, 2007; Ospina et al., 2008; Wang & Spillane, 2009).

Cognitive-Developmental Approach to Social Skills

There are several different interventions rooted in the cognitive-developmental perspective. Cognitive behavioral training has been used to provide individuals with a set of rules to process relevant stimuli and guide their behavior in specific social interactions (Bock, 2007; Mazurik-Charles, & Stefanou, 2010; Wang & Spillane, 2009). Other research has explored the utility of intensive interaction, a developmental technique using reciprocal imitation and repetitive social games to improve social skills (Ospina et al., 2008; Walton & Ingersoll, 2013).
A substantial amount of research within the cognitive-developmental perspective has attempted to address social skill deficits through interventions that target social-cognitive repertoires. The majority of this literature has focused on a concept known as Theory of Mind, more generally known as perspective-taking skills. Initially, Theory of Mind was defined as an individual’s ability to accurately attribute beliefs, intentions and desires to another person (Baron-Cohen, 1995; Schlinger, 2009). More recently, mainstream research has expanded this notion of perspective taking to include emotion and spatial location as well as cognition (Battanova & Loukas, 2012; Bodden et al., 2013; Harwood & Farrar, 2006; Mohr, Rowe, Kurokawa, Dendy, & Theodoridou, 2013; Schlinger, 2009; Shelton, Clements-Stephens, Lam, Pak, & Murray, 2012; Tager-Flusberg, 2007).

**Cognitive-developmental theories & research.** Empirical investigation into the development of perspective taking abilities has been dominated by several different cognitive-developmental theories. Some proponents of this theoretical viewpoint adhere to an “empathizing—systematizing” model of perspective taking (Baron-Cohen, 2003). This viewpoint holds that deficits in social skills, such as those found in individuals on the autism spectrum, result from an over-inclination to systematize or orient towards details (Baron-Cohen, 2009). This model further maintains that this propensity to systematize comes at the cost of one’s ability to empathize or understand others’ emotions and respond appropriately (Lacava, Rankin, Mahlios, Cook, & Simpson, 2010). Other researchers attribute perspective-taking difficulties to deficits in executive functioning, meta-representation, complex reasoning, simulating mental states (Boucher, 2012), or to impaired language development (Milligan, Astington, & Dack, 2007; Hale & Tager-Flusberg, 2005).
These theories have produced 30 years of research focused on the perspective-taking abilities of individuals on the autism spectrum as well as a wide variety of other populations (Paynter & Peterson, 2013; Samson & Apperly, 2010). However, empirical support for perspective taking interventions based on these theories has yielded mixed results. Some research suggests that training in perspective taking results in some improvement over time compared with a control group (Fisher & Happe, 2005). Other research suggests that training perspective taking skills results in passing theory of mind tasks, but does not generalize to everyday social interactions (Begeer et al., 2011; Hadwin, Baron-Cohen, Howlin, & Hill, 1997; Ozonoff & Miller, 1995). Still other research suggests that training children on the autism spectrum in perspective taking can improve performance on some theory of mind tasks but not others, and that this difference can generalize to subsequent parent reports of improved socialization (Gevers, Clifford, Mager, & Boer, 2006; Stitcher, O’Conner, Herzog, Lierheimer, & McGhee, 2012).

**Limitations of cognitive-developmental research on perspective taking.** There are a number of possible reasons for the variable results of the cognitive-developmental interventions targeting perspective taking. First, there are a wide range of available methods for assessing perspective taking skills from this viewpoint. Some studies utilized “direct measures” that required participants to respond with a correct answer or appropriate behavior while other studies included “indirect measures” that assess a participant’s unprompted sensitivity to differences in conditions (Surtees, Butterfill, & Apperly, 2012). Direct measures explicitly ask a participant to respond or perform a given behavior. Indirect measures assess spontaneous behavior in which an individual is not directly asked to respond or perform a specific behavior. There are also significant differences even within the “direct measure” tasks of perspective taking. The task
presentation (i.e. multiple-choice vs. free response) as well as the specific type of stimuli used (i.e. written stories, puppets, and pictures/videos of facial expressions) vary across and sometimes within many of these studies (Bell & Kirby, 2002; Brent et al., 2004; Carey & Cassels, 2013; Golan & Baron-Cohen, 2008; Kaland, Callesen, Moller-Nielsen, Mortensen, & Smith, 2008; Spek et al., 2010). While some variation in format is to be expected based on age, the wide range of different assessment methods for theory of mind is cause for concern since performance can vary depending on the format.

Some perspective-taking tasks are presented in a language heavy format. Research has shown that language influences theory of mind performance even after accounting for age (Boucher, 2012; Buitelaar, van der Wees, Swaab-Barnaveld, & van der Gaag, 1999; Happe, 1995; Milligan et al., 2007). That is, greater language ability has been shown to correlate with increased theory of mind performance. Frith and Happe (1994) maintain that this is especially true for individuals on the autism spectrum since language is the medium by which one learns to identify mental states and emotions. In addition, Carey and Cassels (2013) found that the factor structure of a common theory of mind task (e.g. Reading the Mind in the Eyes task; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) changed from one to two separate components when the response format was switched from forced-choice to open-ended. This suggests that performance on a theory of mind task can vary widely depending on the response format and the extent to which this format relies on language. While more recent studies have attempted to address this issue by controlling for vocabulary in their statistical analyses (Hale & Tager-Flusberg, 2005; Kaland et al., 2008; Tager-Flusberg, 2003), the fact is that the cognitive-developmental perspective does not fully account for the role of language in theory of mind.
development, nor its differential effect on the variety of tasks that are used to assess a
supposedly unitary construct.

Furthermore, it is possible that the many different tasks used to assess perspective taking
from a cognitive-developmental point of view are tapping into different behavioral repertoires.
Reed and Peterson (1990) suggested that individuals on the autism spectrum can pass visual
perspective taking tasks, but continue to demonstrate difficulty with cognitive perspective taking
tasks. While there is some evidence to suggest a relationship between cognitive and affective
components of perspective taking (Buitelaar & van der Wees, 1997; Heerey, Keltner, & Capps,
2003), other research maintains that they are largely distinct (Bodden et al., 2013). Kaland and
colleagues (2008) found that two standard theory-of-mind tasks (i.e., Strange Stories test—
Happe, 1994; and Stories from Everyday Life—Kaland et al., 2008) were significantly correlated
with language, whereas another standard theory of mind task did not (i.e., Reading the Mind in
the Eyes task—Adult; Baron-Cohen, et al., 2001; Reading the Mind in the Eyes task—Child;

Harwood and Farrar (2006) found that while theory of mind and affective perspective
taking scores were positively correlated, not all of the sub-scores within these domains
demonstrated this significant relationship. The social false-belief component of the theory of
mind task did not significantly relate to either of the affective perspective taking components
(Harwood & Farrar, 2006). If performance on a perspective-taking task varies based on the types
of questions being asked, it stands to reason that these items assess different behavioral
repertoires. However, the methodology used by cognitive-developmental researchers has yet to
fully address this concern. The assumptions implicit in cognitive-developmental theories on
perspective taking deficits do not account for the differential performances of individuals on
these tasks. If perspective-taking deficits result from a dysfunction in the “social brain,” as many cognitive-developmental researchers argue (Adolphs, 2009), how are some individuals able to pass certain tasks while failing others? Moreover, how do these conceptualizations contribute to the development of effective social skill interventions, particularly when the empirical findings are contradictory and don’t always generalize to everyday skills? Given the limitations to current understanding in the cognitive-developmental perspective, other approaches to improving social cognitive repertoires should be explored.

**Behavioral Approach to Social Skills**

The majority of established social skill interventions for individuals on the autism spectrum are rooted in a behavioral perspective (The National Autism Center, 2009). However, most of these interventions have focused on directly observable behavior (Schlinger, 2009). Video modeling and social stories are frequently used to model/teach individuals on the autism spectrum appropriate social behaviors (Charlop, Dennis, Carpenter, & Greenberg, 2010; Kern et al., 1995; Kokina & Kern, 2010; Ospina et al., 2008; Reynhout & Carter, 2009; Wang & Spillane, 2009). Peer mediated strategies are also commonly used, in which typically developing individuals are taught social behaviors that increase the frequency of social opportunities for those diagnosed on the autism spectrum (Goldstein, Kaczmarek, Pennington, & Schafer, 1992; Harper, Symon, & Frea, 2008; Leaf et al., 2009; Wang & Spillane, 2009). Still other social skill interventions use discrete trial training or pivotal response training to directly teach social behaviors (Banda & Hart, 2010; Bozkus Genc & Vuran, 2013; Jones, Carr, & Feeley, 2006; Koegel, Kuriakose, Singh, & Koegel, 2012).

Behavioral researchers have only just begun to develop interventions designed to improve social cognition (Almon-Morris & Diakite, 2007; Gould, Tarbox, O’Hora, Noone, &
Bergstrom, 2011; Lovett, 2012; McHugh, Stewart, & Hooper, 2012; Okuda & Inoue, 2000; Shaw, 2001; Shimamune & Hosohata, 2008; Weil, Hayes, & Capurro, 2011). However, the roots of a behavioral conceptualization of complex verbal behavior can be found earlier in the literature. Namely, Skinner’s consideration of private events, or behavior that cannot be publicly observed, is directly relevant to this area.

Skinner (1945) maintained that there are four ways in which the social verbal community trains individuals to use language to label private events. For the current review, two of these methods are relevant, namely public accompaniment and collateral responses (See Skinner, 1945, pp. 270-277, for more information). Public accompaniment occurs when the social verbal community reinforces verbal behavior such as, “That hurts” when accompanied by a blow to the head. Collateral responses refer to reinforcing appropriate verbal behavior, such as when a child is crying while rubbing her head. Skinner (1945) emphasized that empirical investigation into private events should be based on an analysis of the direct contingencies that govern this behavior, not the private event itself.

Recent advances within behavioral literature have built upon this foundation, including Sidman’s (1971) work with a phenomenon called stimulus equivalence. This phenomenon stemmed from the use of a matching-to-sample procedure to make conditional discriminations between arbitrary stimuli (Sidman, 2009). In this procedure, participants were asked to match stimuli that were not topographically similar on the basis of an experimenter-determined relation. Stimulus equivalence was noted when novel relations between these stimuli emerged without being directly trained (Sidman, 2009). For example, if stimulus A was trained to equal stimulus B, and stimulus B was trained to equal stimulus C, individuals were able to derive four different relations without being directly taught. They derived symmetrical relations such that B equaled
A and C equaled B, as well as transitive relations such that A equaled C and vice versa. These three stimuli are then said to form a stimulus class of equivalence, and can in turn be trained to relate to other stimulus classes (Sidman, 2009). This method of teaching is an efficient way to produce large increases in learning via “indirectly established new relations” (Sidman, 2009, p. 14). It was suggested that these equivalence relations resemble the word-referent relations underlying human language (Sidman & Tailby, 1982). Furthermore, the application of conditional control over equivalence classes has been suggested as the process by which humans are able to generate novel language (Wulfert & Hayes, 1988). Thus, research into stimulus equivalence had important implications for the experimental investigation of language, symbolic behavior, and other semantic relations (Horne & Lowe, 1996).

Additional behavioral research has expanded on the notion of stimulus equivalence in the form of Relational Frame Theory (RFT), a functional contextual analysis of language and cognition (Hayes, Barnes-Holmes & Roche, 2001; c.f. Horne & Lowe, 1996). RFT maintains that stimulus equivalence is only one type of derived relational responding that humans display. Steele and Hayes (1991) stated that this phenomenon results from “relational responding arbitrarily applied to the matching-to-sample situation” (p. 519). In other words, individuals learn to arbitrarily relate stimuli that do not share topographical features and are able to derive such relations as long as they are in frames of coordination with other stimulus classes.

RFT holds that there are three properties of derived relational responding (Hayes et al., 2001). The first property is mutual entailment, which describes the bidirectional nature of relational responding. In other words, if the relationship between stimulus A and stimulus B is specified, then the relationship between stimulus B and stimulus A is entailed. The second property of relational responding, combinatorial entailment, refers to a derived stimulus relation
in which two or more previously specified relations combine. If the relationship between stimulus A and stimulus B as well as the relationship between stimulus B and stimulus C have been defined, the mutual relationship between stimulus A and stimulus C is derived.

The last property of relational responding is known as the transformation of stimulus functions. The psychological functions ascribed to a given stimulus in a relational class can modify the functions of the other stimuli in the class based on the nature of the derived relation. A study conducted by Dougher, Hamilton, Fink, and Harrington (2007) exemplifies this process. Dougher et al. (2007) trained participants that stimulus A is slower than stimulus B while stimulus C is faster than stimulus B. After both mutual and combinatorial entailment were established, participants were trained to relate a shock with the appearance of stimulus B. Through the process of derived relational responding, stimulus A took on the functions of a lower magnitude of shock while stimulus C took on the functions of a greater magnitude of shock. The psychological functions of stimulus A and C were transformed as a result of their derived relations with stimulus B.

In addition to these three properties, derived relational responding can be brought under contextual control through the process of higher-order conditional discrimination (Steele & Hayes, 1991). In other words, derived relational responding is contextually bound. This conceptualization has direct implications for how we understand human behavior. In particular, RFT holds that a history of reinforcement for this generalized pattern of relational responding is the foundation of language and cognition (Steele & Hayes, 1991).

Within RFT, there is a specific type of relational responding that accounts for perspective taking skills. This is called deictic framing, and it is based on the relationship between an individual and other events in his/her environment (Hayes et al., 2001). RFT researchers posit
three critical deictic frames within this repertoire: I—You, Here—There, and Now—Then (McHugh, Barnes-Holmes, & Barnes-Holmes, 2009). These patterns of relational responding are learned via a history of reinforcing appropriate verbal responses to questions such as “What are you doing there?,” and “How do you feel now?” This history occurs across a variety of social contexts and physical environments in a given individual’s life while these three relational frames remain constant (Hayes et al., 2001). Perspective taking is refined by “learning to talk about one’s perspective in relation to the perspective of others” (McHugh et al., 2012, p. 61).

In typical daily conversation, relational responding with deictic frames includes words that are coordinated with a given individual’s environment including different places and times. The words in the deictic frames (I—you, Here—There and Now—Then) are placeholders for the relational cues that control perspective taking in everyday life (McHugh et al., 2012). However, common social discourse oftentimes includes emotive language. It is possible that difficulties in perspective taking during social interactions may also result from a weak or absent repertoire in labeling emotional functions. McHugh and colleagues (2009) suggest that some individuals on the autism spectrum may have difficulty coordinating core relational skills and emotions.

**Emotion Recognition**

Hobson (1993) maintained that one of the precursors to perspective taking is the development of affective sharing that occurs in dyadic relationships, such as that found between parent and child. One of the first steps to taking another’s perspective is to perceive and express emotions. O’Brien and colleagues (2011) found additional support for this assertion in a longitudinal study conducted with a sample of typically developing preschoolers aged three to four years. Using hierarchical multiple regression analyses, O’Brien and colleagues (2011) examined the effect of a child’s emotional understanding on perspective taking scores one year
later. The results of this study suggest that a child’s ability to effectively label emotions based on facial expressions and situations as well as to describe causes of these emotions significantly predicts subsequent perspective taking performance.

Emotions are comprised of many different behavioral components, including movements, communication, sensation, and physiology (Keltner & Kring, 1998; Kemper, 1987). Emotions are rooted in ongoing social interactions and have functions at the individual, dyadic, group, and cultural levels, all of which help humans navigate an ever-changing social environment (Keltner & Haidt, 1999). To communicate emotions effectively requires engaging in relational responding with emotional terms in a manner congruent with one’s wider social-verbal community (Hayes et al., 2001). Communication of an emotion affords the social-verbal community an awareness of an individual’s behavioral predispositions in a given moment, and facilitates positive social interactions in that others can respond in ways that are reinforcing to the individual and vice versa (Hayes et al., 2001). Over three decades of research have established the relationship between emotional competence and social competence across childhood and adolescence (see Trentacosta & Fine, 2010 for a review).

Hobson (1993) suggests that emotion recognition begins within the first year of life. A variety of studies indicate that newborns display a preference towards social-emotional stimuli such as faces and voices, with a particular preference for their mother’s face and voice over anyone else (Grossmann, 2010). Researchers using a habituation procedure have found that infants reliably discriminate among basic emotions such as happy, surprised, and angry between the ages of three to five months (Grossmann, 2010).

Moreover, the development of emotion recognition skills interacts with the development of a child’s perceptual system. As a child’s sight and hearing discrimination sharpens, she is
more likely to orient towards social stimuli (Adolphs, 2006; Grossmann, 2010; Schietecatte, Roeyers, & Warreyn, 2012). Schietecatte and colleagues (2012) found that social orienting to facial expressions, particularly the eyes, predicts subsequent initiation and response to joint attention skills in 12-month old children. Joint attention, the coordination of gaze between an individual, another person, and an object or event, is widely considered to be a precursor to perspective-taking skills (Baron-Cohen, 1991; Charman et al., 2000; Krstovska-Guerrero & Jones, 2013). Striano and Bertin (2005) found that as typically developing children grow, they increasingly coordinate joint attention with positive affect, learning to coordinate eye contact with emotional expression as early as five to nine months old. Furthermore, infants typically use facial expressions to guide their behavior as early as 12 months (Grossmann, 2010; c.f. social referencing, Walden & Ogan, 1988).

The ability to orient towards and label emotional stimuli such as facial expressions, vocal prosody, nonverbal gestures, and body posture is a crucial component of social skills. It provides individuals with feedback about the effect of their behavior on another’s emotions as well as helps them identify appropriate behaviors that are likely to result in rewarding interactions. If while talking to someone an individual recognizes that she is angry, that individual is more likely to apologize; if an individual recognizes that the other person is bored, she is more likely to change the subject so as to maintain the conversation.

The ability to take another’s perspective in social interactions is contingent upon whether one attends to emotion stimuli, can communicate about them effectively, and use this to guide one’s behavior. Emotion recognition could be considered a precursor to effective perspective taking, and a useful skill to intervene on with individuals on the autism spectrum. Evidence
suggests individuals can learn to pass traditional perspective taking tasks, but still perform poorly on tasks requiring the perception of social emotional stimuli (Tager-Flusberg, 2007).

**Deficits in Emotion Recognition Skills and Autism Spectrum Disorders**

Substantial research has documented difficulties in emotion recognition for individuals on the autism spectrum (Begeer, Koot, Rieffe, Terwogt, & Stegge, 2008; Golan, Baron-Cohen, & Hill, 2006; Gross, 2004; Hill, Berthoz, & Frith, 2004; Hobson, Ousten, & Lee, 1988; Kuusikko et al., 2009; Lindner & Rosen, 2006; Uljarevic & Hamilton, 2013). Fox, Wagner, Shrock, Tager-Flusberg, and Nelson (2013) found that infants at high risk for an autism spectrum disorder perceived facial expressions in different brain regions than those with low risk, suggesting that these difficulties in emotion recognition occur at a very young age. Other research suggests that individuals on the autism spectrum attend to unconventional stimuli. Weeks and Hobson (1987) found that children diagnosed with autism were more likely to sort a group of pictures based on the type of hat whereas their typically developing counterparts were more likely to sort based on facial expressions. Begeer, Rieffe, Terwogt, and Stockmann (2006) also found that individuals on the autism spectrum were less attentive to facial expressions than a control group. Individuals on the autism spectrum are also reported to engage in stimulus overselectivity, responding to only a restricted portion of compound cues (Schriebman, Koegel, & Craig, 1977).

In addition to salient emotional stimuli in the environment, emotion recognition also draws on language used in social interactions to label and communicate emotions. If one holds verbal behavior as the foundation of an individual’s emotion recognition repertoire, it stands to reason that language deficits, particularly those labeling emotional behavior, will coincide with difficulties in perspective taking and social skills in general. However, individuals on the autism spectrum are known to be a heterogeneous population. Different individuals may have difficulty
with different aspects of emotion recognition repertoires. Research has shown that basic emotion recognition difficulties are not universal to all individuals on the autism spectrum, and vary based on the task difficulty and complexity of the emotion being discussed (Jones et al., 2011; Nuske, Vivanti, & Dissanayake, 2013).

Based on this analysis, there are a number of different areas where individuals on the autism spectrum might demonstrate difficulty. Individuals might have difficulty labeling emotion stimuli in themselves (physiological sensations, physical movements) and/or in others (facial expressions, body posture, gestures). They also might have difficulty labeling emotions across a wide variety of contexts (i.e. difficulty with emotional verbal behavior being brought under contextual control). Still others may have difficulty using language to discuss emotions while they are experiencing the physiological sensations. Lastly, individuals may have difficulty generalizing emotional verbal behavior to novel contexts.

**Traditional Emotion Recognition Interventions**

Traditional approaches to improve emotion recognition skills have addressed all of these areas in some way with varying levels of success (Golan & Baron-Cohen, 2008). The majority of researchers have used static pictures or videos to teach individuals how to effectively perceive and label emotions in others (Golan et al., 2010; Ryan & Charragain, 2010; Williams, Gray, & Tonge, 2012; Young & Posselt, 2012). Ryan and Charragain (2010) used highlighted components of facial expression photographs in conjunction with role-playing, free-drawing, and matching games to train recognition of six basic emotions in twenty children between the ages of six and fourteen years old. The results of this study suggested significant improvement in emotion recognition performance, as well as demonstrated maintenance of these skills at a three-
month follow-up assessment. However, they did not assess for generalization of these skills to novel stimuli.

Williams, Gray, and Tonge (2012) used a video called the *Transporters* that was specifically designed to teach children on the autism spectrum emotion recognition skills. With a sample of fifty-five children diagnosed with autistic disorder and aged four to seven years old, the results suggested improved performance in the recognition of anger and matching different expressions of emotion. However, the results also suggested that this intervention demonstrated poor maintenance of skills at three-month follow-up. Young and Posselt (2012) conducted a separate study with the *Transporters* video in a sample of thirteen children on the autism spectrum aged four to eight years old. In contrast, the results of this study indicated significant improvement on a task of emotion recognition. However, this study also did not assess for generalization of this effect to novel stimuli, nor did it assess for maintenance of these skills. Golan and colleagues (2010) conducted a similar study using the *Transporters* video and obtained the same results as Young and Posselt (2012).

Short stories of emotional situations have also been used to train individuals to label emotion stimuli (Hadwin et al., 1997). For instance, Hadwin and colleagues (1997) described a brief scenario and then used a question and answer format to train emotion recognition skills in a sample of children aged four to nine years. The results indicated improvement in the emotion recognition task performance. However, these findings did not generalize to improvement in assessed social communication skills, nor did this study assess maintenance of the emotion recognition skills.

Other researchers have explored the utility of using computerized programs (Bolte et al., 2006; Golan & Baron-Cohen, 2006). Bolte and colleagues (2006) trained a sample of five adults
diagnosed with high functioning autism to label photographs of seven basic facial expressions presented via computer program. The results indicated improved emotion recognition performance on the task. However, this study did not assess for generalization to novel stimuli. Meanwhile, Golan and Baron-Cohen (2006) used an interactive computer program to train two groups of adults with high functioning autism to label complex emotions displayed by facial expressions and voices. After ten to fifteen weeks, the results indicated that these individuals improved in their emotion recognition performance on the task. However, when presented with a novel emotion recognition task, the improved performance did not generalize.

Still other researchers have used cognitive behavioral training to improve individuals’ ability to label emotion stimuli (Baghdadli et al., 2013; Bauminger, 2002; Beaumont & Sofronoff, 2008; Solomon, Goodlin-Jones, & Anders, 2004; Stitcher et al., 2012). Bauminger (2002) conducted a seven-month cognitive behavioral intervention with a sample of children with high functioning autism aged eight to seventeen years. This intervention was conducted by each child’s teacher in conjunction with a same aged peer and the child’s parents. Instruction included general social skills information, emotion recognition of four basic and six complex emotions, as well as social-interpersonal problem solving. The training consisted of defining a given emotion and then providing an example of a time the participant had experienced it. The results of this study demonstrated improved recognition performance over time. However, this study did not assess generalization of this skill into other settings. Solomon and colleagues (2004) conducted a twenty-week cognitive behavioral training with parent psychoeducation for a sample of boys aged eight to twelve years. The results indicated significant improvements in facial expression recognition compared to a wait-list control group. However, it did not assess for generalization of this skill into other settings.
Baghdadli and colleagues (2013) piloted a six-month social skills group using video modeling, social scenarios, problem-solving exercises and role-play techniques. As part of this group, they targeted the recognition of happy, sad, angry and fearful emotions in a sample of six individuals with high functioning autism. In overall emotion recognition performance, there was no significant difference between the social skills group compared to a control treatment group (i.e., leisure activities group).

Beaumont and Sofronoff (2008) conducted a seven-week cognitive behavioral program for a group of twenty-six children diagnosed on the autism spectrum aged seven to eleven years old. The program included a computer game, small group sessions, parent training sessions and teacher handouts. The results of this study failed to demonstrate improvement in effectively labeling emotion stimuli. Meanwhile, Stitcher and colleagues (2012) used a ten-week cognitive behavioral group intervention to address general social skills, theory of mind, facial expression recognition and executive functioning in twenty children aged six to ten years. The results of this study also indicated that there was no significant improvement between pre- and post-assessment of emotion recognition skills.

There have been a few behavioral studies that have used direct instruction or pivotal response training to improve an individual’s ability to label emotion stimuli either in the self or in others (Lopata et al., 2010; McHugh, Bobarnac, & Reed, 2011; Shaw, 2001). McHugh, Bobarnac, and Reed (2011) used a video-based direct instruction approach to train three five-year-old children diagnosed with an autism spectrum disorder to effectively label the emotions happy, sad, angry and afraid. The results indicated both improved emotion recognition of these emotions as well as generalization to novel video stories of puppets. Meanwhile, Shaw (2001) utilized photographs of facial expressions, drawings of body postures, as well as photographs of
social scenes to train emotion recognition skills in a sample of six children aged four to eight years. Shaw (2001) found improved emotion recognition in at least one of the three emotions being trained for all six participants in the study. However, the results indicated only partial generalization over time to natural settings.

Lastly, Lopata and colleagues (2010) conducted a randomized controlled trial to assess the efficacy of a behaviorally oriented social skills group for thirty-six children on the autism spectrum aged seven to twelve years. Using direct instruction, modeling, role-playing and feedback techniques, this intervention targeted emotion recognition skills as well as interest expansion, interpretation of non-literal language and other general social skills. The results of this study suggested significant improvements overall. However, there was no significant difference in emotion recognition performance from pre- to post- assessment, nor was there any evaluation of the maintenance of these skills past five days after the completion of the program.

**Limitations of Traditional Approaches to Emotion Recognition Training**

While several traditional approaches to emotion recognition training have demonstrated efficacy, the majority of these interventions have failed to demonstrate generalization of skills either to novel stimuli or to novel contexts. In fact, a number of these studies did not even assess generalization or maintenance of these skills past the initial training. The feasibility of training every possible scenario an individual might encounter in life is both burdensome and impractical (Cooper, Heron, & Heward, 2007, p. 250). In addition, the utility of an emotion recognition intervention that does not generalize across contexts is questionable. The ability to label an emotion only in an experimental setting does little to advance the cause of facilitating positive social interactions for individuals on the autism spectrum.
Another limitation of traditional approaches to improving emotion recognition pertains to the manner in which emotion stimuli are presented. A number of these interventions have focused on training only one type of emotion stimuli in isolation such as facial expressions, voice clips, or stories. These preparations do not approximate everyday social interactions in which a number of emotion stimuli are present and require attention for effective emotion recognition to occur. Simplifying the presentation of these stimuli is commendable, particularly due to the tendency of individuals on the autism spectrum to attend to a limited portion of compound cues. However, it may be unrealistic to expect these interventions to improve attention to relevant emotion stimuli in everyday social interactions. Koegel and colleagues (1989) suggested as much when they stated that the most effective way to increase a child’s responsivity to multiple cues is to “choose instructions and tasks that require the child to use multiple cues…This increase in responsivity seems to be extremely important for the child’s ability to effectively utilize the vast number of cues present in the everyday learning environment” (p. 23). If one is going to train an individual to label emotion stimuli, advances might be made by presenting stimuli in a compound cue format.

Lastly, all of these interventions focused on training accuracy in emotion recognition skills. While this is necessary, it may not be sufficient. These interventions may teach individuals on the autism spectrum to label emotions effectively, but fluency may be needed to use this repertoire in real-time. Oftentimes emotions are displayed quickly during social interactions. For example, an individual might display a brief smile, a fleeting wrinkle of the eyebrows, or a quick widening of the eyes. Accuracy is important, but only in so far as it doesn’t take an individual longer to perceive an emotion than is available. Behaviorists have been using fluency training since the 1970s to improve a variety of skills (Binder, 1996). Researchers have recently begun to
explore the utility of fluency procedures with individuals on the autism spectrum, and the preliminary findings are promising (Feinup & Doepke, 2008; Weiss, Fabrizio, & Bamond, 2008). The incorporation of fluency training into emotion recognition interventions could not only help increase mastery of this repertoire, but it might also help with generalization difficulties too.

**Current Study**

The current state of research on emotion recognition training suggests a number of limitations that should be targeted for improvement. The purpose of this study is to investigate a new behavioral intervention that may address some of these limitations. The application of relational frame theory to interventions has been shown to be an efficient and effective way of producing generalized behaviors in both typically developing and developmentally delayed populations (Healy, Barnes-Holmes, & Smeets, 2000; Rehfeldt & Barnes-Holmes, 2009). The ability to train only a few relations between emotion stimuli and then have the remaining relations emerge without direct training would reduce the amount of time and resources that an intervention requires, as well as afford a greater possibility of generalization of these skills to novel stimuli. The incorporation of derived relational responding into emotion recognition training for individuals on the autism spectrum could address some of the limitations of current approaches. The present study was designed to obtain preliminary data on the effectiveness of an emotion recognition training incorporating derived relational responding into the procedure.
CHAPTER 2

METHODS

Participants and Setting

Three individuals diagnosed on the autism spectrum were recruited through direct solicitation at an Autism outpatient treatment center in the southeastern United States. All participants were established clients at the treatment center. As part of intake to the center, all participants were diagnosed with ASD based on the following evaluation methods: intelligence, achievement, social skills, behavioral, and autism-specific measures (i.e. Autism Diagnostic Interview-Revised and Autism Diagnostic Observation Schedule). Assessment and training sessions were conducted in an unoccupied assessment room with a table and two chairs. All matching-to-sample procedures were computerized, and presented on a 15-inch Toshiba laptop running Windows 7. Each assessment probe lasted approximately fifteen minutes, with three to six sessions occurring per day. Each training session varied in length due to variability in the number of trial blocks in each phase (ranged between five minutes and twenty minutes). Participants were offered the option to take a short five to ten minute break between sessions with non-performance contingent access to preferred items and activities such as iPad games, video clips, or playing catch.
Measures

**Peabody Picture Vocabulary Test – 4th Edition (PPVT-4).** The PPVT-4 is a 228-item assessment of receptive language for individuals aged 2 years 6 months and older (Dunn & Dunn, 2007). It is individually administered and takes approximately ten to fifteen minutes to complete. Research suggests that it has good internal consistency (alphas above .95), as well as good test-retest reliability (.92-.96; Dunn & Dunn, 2007). In addition, the PPVT-4 demonstrates good construct validity, correlating strongly with previously validated measures of expressive vocabulary, oral language, reading ability and general intelligence.

**Kaufmann Test of Educational Achievement – 2nd Edition (K-TEA-2) Brief Form Reading Subtest.** The K-TEA-2 brief form assesses an individual’s reading, math and spelling ability (Kaufman & Kaufman, 2005). Designed for individuals aged six to twenty-two, it is an individually administered measure that takes approximately thirty minutes to complete. The reading subtest contains 52 items that evaluate word recognition and reading comprehension. This measure has demonstrated good overall reliability (ranging from .87 -.95), and good test-retest reliability (above .90; Kaufman & Kaufman, 2005). It has also displayed good construct validity, correlating with the Wide Range Achievement test, the Peabody Individual Achievement test, the Metropolitan Achievement test, and the Stanford Achievement test.

**Social Skills Improvement System Rating Scales – Parent Form and Teacher Form (SSIS-P; SSIS-T).** The SSIS parent form and teacher form assess a child’s overall social skills and competing problem behaviors (Gresham & Elliott, 2008). Parents and teachers give frequency ratings based on the occurrence of a given behavior over the previous two months. They also rate the importance of each behavior for the child’s success. The Social Skills scale addresses communication, cooperation, assertion, responsibility, empathy, engagement and self-
control. The Problem Behaviors scale assesses externalizing, bullying, hyperactivity/inattention, internalizing, and autistic behaviors. The teacher form also has an Academic Competence scale. However, this was not used for the current study. The SSIS-P and SSIS-T are designed for children between the ages of three and eighteen, and each usually takes about fifteen to twenty minutes to complete. Research suggests that it has good internal consistency (alphas ranging from .74 - .96 for the parent form, and from .83 - .97 for the teacher form). Research suggest that the SSIS-P and SSIS-T also have good test re-test reliability (median = .86 for the parent form, and median = .83 for the teacher form; Gresham & Elliott, 2008). These forms furthermore has displayed good construct validity, correlating with other social skill and problem behavior scales as expected including the Behavior Assessment System for children – 2nd edition, the Vineland Adaptive Behavior Scales - 2nd edition, the Walker-McConnell Scale of Social Competence and School Adjustment, and the Home and Community Social Behavior Scales. The SSIS-P and SSIS-T were used as a pre-to-post measure of social skills as displayed in the child’s natural environment.

**Design**

A concurrent multiple probe design across participants (Cooper et al., 2007; for an example see Berens & Hayes, 2007) was used to assess performance on the emotion matching-to-sample training task. A within participant analysis was also conducted across the different types of relational responding (i.e. directly trained, mutually entailed and combinatorially entailed). This strategy has been the preferred method of establishing experimental control in studies assessing derived relational responding (Feinup & Critchfield, 2010; Haegele, McComas, Dixon, & Burns, 2011; Lynch & Cuvo, 1995).

**Stimuli**
Control Matching-to-Sample Stimuli. During the screening process, participants were asked to complete a control matching-to-sample task consisting of different types of space ships. The stimuli used for this task consisted of nonsense words, pictures of space ships, and brief descriptive statements. These stimuli are broken down as follows (see Figure 1). Stimulus set X was comprised of the pictures of space ships. Stimulus set Y was comprised of the nonsense words, and stimulus set Z was comprised of brief descriptive statements.

![Stimuli used in the control matching-to-sample task](image)

Emotion Recognition Training Stimuli. Stimuli used for the baseline, training and generalization components of the emotion recognition match-to-sample task consisted of pictures, contextual vignettes, written emotion labels, and written appropriate responses pertaining to four emotions: worried, bored, confused and frustrated. These emotions were chosen based on informal, semi-structured interviews with parents of children on the autism spectrum that occurred prior to the study (see Appendix A). Research has shown that high functioning individuals on the autism spectrum often pass tests of basic emotion recognition (Jones et al., 2011). Yet, high functioning children on the autism spectrum have also been shown to have more difficulty detecting mild affective cues compared to a typically developing control group (Wong,
Beidel, Sarver, & Sims, 2012). These interviews were conducted in order to ensure that the training would focus on skills that were likely to benefit the participants based on their current abilities. The emotions chosen were ones that were most frequently endorsed by the parents as being difficult for their children.

The stimuli used in the emotion matching-to-sample training task are broken down as follows (see Figure 2). Stimulus set A was comprised of four different emotion labels (e.g., worried). Stimuli sets B & C were complex stimuli. Stimulus set B included colored photographs of facial expressions for all four emotions juxtaposed with brief, emotion-specific contexts. Stimulus set C included colored photographs of either a body posture or gesture for all four emotions, and juxtaposed with brief, emotion-specific contexts. The contextual vignettes in stimuli sets B & C were all different. Lastly, stimulus set D was comprised of appropriate social responses to the four emotions typed on them. For a full listing of all the emotion stimuli used in the training and assessment procedure, see Appendix B.
Development of emotion recognition matching-to-sample stimuli. The development of the stimuli to be used in the emotion recognition training procedure occurred over the course of a three-step process: the collection of individual stimuli, the creation of compound stimuli, and the selection of the final stimuli to be used. First, a pool of colored photographs with creative commons licenses was collected from the internet based on whether they appeared to express one of the four emotions that were being targeted (e.g. bored, confused, frustrated and worried). The experimenter narrowed the pool to nine pictures of facial expressions and nine pictures of body postures or gestures, for a total of eighteen photographs for each emotion. Based on these photographs, eighteen brief contextual vignettes were developed.

Approximately 21 undergraduate and graduate research assistants as well as two faculty members volunteered to take a survey in which they were asked to choose which of the four
emotions was being expressed in each of the photographs and contextual vignettes. The order of presentation for these individual stimuli was randomized to control for possible order or sequence effects as well as a response position bias. Responses were scored as correct or incorrect based on whether they matched the emotion the stimulus was initially selected to portray. Scores were then averaged across individuals to create a total percent correct score.

A 3 x 4 between-subjects Univariate Analysis of Variance (ANOVA) was conducted to compare the effect of emotion label and the type of stimulus displayed on performance. The results indicated a significant difference based on the emotion label \[ F(3, 132) = 5.186, p = .002 \]. Post-hoc follow-up analyses using Tukey’s HSD test indicated that individuals were better at identifying bored stimuli (\( M = 86.64\% \) correct, \( SD = 15.75 \)) than confused (\( M = 68.72\% \) correct, \( SD = 27.00; p = .010 \)), frustrated (\( M = 68.89\% \) correct, \( SD = 28.52; p = .011 \)), and worried stimuli (\( M = 69.36\% \) correct, \( SD = 28.30; p = .014 \)). There was also a significant difference based on the type of stimulus displayed \[ F(2,132) = 5.878, p = .004 \]. Post-hoc follow-up analyses using Tukey’s HSD test indicated that individuals were worse at identifying photographs of facial expressions (\( M = 61.67\% \) correct, \( SD = 27.37 \)) than photographs of body postures or gestures (\( M = 75.69\% \) correct, \( SD = 25.72; p = .038 \)) and contextual vignettes (\( M = 78.12\% \) correct, \( SD = 24.61; p = .003 \)). There was a significant interaction between the label and type of stimulus \[ F(6,132) = 2.357, p = .034 \]. Figure 3 displays this relationship, indicating that individuals were the best at identifying bored contexts, and had the most difficulty identifying worried facial expressions. Additionally, the figure indicates that there was more variability in performance on the type of stimuli for frustrated and worried labels than for bored and confused labels.
Figure 3. Effect of Emotion Label and Stimuli Type on Sample Performance.

A median split was then used in order to select how stimuli would be combined to create the compound stimuli for the next step of the development process. In other words, the median score was identified across each emotion for photographs of facial expressions, for photographs of body postures or gestures, as well as for contextual vignettes. Stimuli that had an average score below the median were classified as difficult to identify, while stimuli that had an average score above the median were classified as easy to identify. Photographs were then paired with contextual vignettes based on shared emotion label and plausibility. For instance, if the vignette focused on an individual waiting in line at a restaurant, it was not paired with a picture of a girl sitting in a car. Pairings also alternated the difficulty level of each individual stimulus such that easy photographs were paired with difficult contextual vignettes and vice versa. Since the number of stimuli per type of photograph was uneven, the ratio of easy to difficulty photographs was counterbalanced across emotions. For example, there were five difficult photographs of bored facial expressions and four difficult photographs of bored body postures or gestures.
Meanwhile, there were four difficult photographs of confused facial expressions and five difficult photographs of confused body postures or gestures. Minor changes were made to the previous developed contextual vignettes as needed in order to preserve coherence of the compound stimuli. For example, “her” was changed to “his” and “aunt” was changed to “uncle” depending on the picture the vignette was paired with.

These compound stimuli were then presented to a team of research assistants for a second survey in which they were asked to choose which of the four emotions was being expressed in the stimulus. A 4 x 2 between subjects Univariate ANOVA was conducted to compare the effect of emotion label and the type of photograph (i.e., facial expression vs. body posture/gestures) displayed on performance (i.e. percent correct) for the compound stimuli. The results indicated a significant difference based on emotion label $[F(3,64) = 3.935, p = .012]$ with post-hoc follow-up analyses using Tukey’s HSD test indicating that individuals were better able to identify bored stimuli ($M = 96.22\% \text{ correct}, SD = 5.82$) than frustrated stimuli ($M = 80.61\% \text{ correct}, SD = 16.39; p = .001$) and worried stimuli ($M = 85.61\% \text{ correct}, SD = 18.61; p = .026$). Performance on confused stimuli ($M = 87.30\% \text{ correct}, SD = 11.43$) was closer to that demonstrated on frustrated and worried stimuli, but was not significantly different than bored stimuli ($p = .059$). There was not a significant difference in accuracy for type of photograph $[F(1,64) = 1.48, p = .228]$, with both facial expression ($M = 85.44\% \text{ correct}, SD = 16.78$) and body postures/gestures ($M = 89.43\% \text{ correct}, SD = 12.42$) yielding moderately high levels of accurate identification. Lastly, there was no significant interaction effect for emotion label and type of photograph $[F(3,64) = .959, p = .418]$.

Inclusion of the compound stimuli in the five final exemplar sets was first based on meeting a 75% correct threshold. Stimuli were categorized into blocks based on the value of each
score. Compound stimuli closest to the 75% criteria were selected first as they were considered to be more ambiguous without sacrificing overall consensus. This was done based on the documented relative difficulties of higher functioning individuals on the autism spectrum to detect mild affective cues (Wong, Beidel, Sarver, & Sims, 2012). Stimuli in the next highest block were then chosen and so on until a total of ten stimuli were chosen for each emotion (e.g. five facial expression and five body posture/gesture compound stimuli). For instances in which there were more stimuli in the block than needed, a random number generator was used to determine which one would be included in the final stimuli. These stimuli were then randomly assigned to one of five exemplar sets. After the exemplar sets were completed, brief descriptions of appropriate responses to perceiving each of the four emotions were developed. These descriptions were developed based on clinical knowledge from working with this population, and were consistent with the literature regarding appropriate social responses to emotion. The responses were such that they would be appropriate to both the compound stimuli with facial expression and the compound stimuli body postures or gestures. Minor changes were made to the organization of the exemplar sets in order to preserve coherence. For instance, a compound stimulus was moved to a different exemplar set so that the appropriate response would be feasible for the two different contexts of the compound stimuli in a given exemplar.

In order to determine the validity and reliability of the chosen stimuli for the final stimuli sets, additional statistical analyses were conducted on the previously collected data. Given the small sample size of the final stimuli pool (i.e. 40 stimuli), it was not possible to run a three-way interaction. Each of the factors was explored individually in three separate between subject ANOVAs. Descriptive Statistics for the emotion label, type of photograph, and assigned exemplar set are depicted in Table 1 for all three of these analyses.
Table 1.  
*Descriptive statistics for the emotion label, assigned exemplar set, and type of photograph in the final stimuli analyses*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (% correct)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bored Stimuli</td>
<td>94.70%</td>
<td>6.88</td>
</tr>
<tr>
<td>Confused Stimuli</td>
<td>90.80%</td>
<td>9.14</td>
</tr>
<tr>
<td>Frustrated Stimuli</td>
<td>87.10%</td>
<td>10.09</td>
</tr>
<tr>
<td>Worried Stimuli</td>
<td>86.50%</td>
<td>7.62</td>
</tr>
<tr>
<td>Exemplar Set 1</td>
<td>87.50%</td>
<td>9.86</td>
</tr>
<tr>
<td>Exemplar Set 2</td>
<td>88.50%</td>
<td>10.82</td>
</tr>
<tr>
<td>Exemplar Set 3</td>
<td>87.38%</td>
<td>9.13</td>
</tr>
<tr>
<td>Exemplar Set 4</td>
<td>91.00%</td>
<td>6.87</td>
</tr>
<tr>
<td>Exemplar Set 5</td>
<td>94.50%</td>
<td>7.01</td>
</tr>
<tr>
<td>Facial Expression Stimuli</td>
<td>87.60%</td>
<td>9.34</td>
</tr>
<tr>
<td>Body Posture/Gesture Stimuli</td>
<td>91.95%</td>
<td>7.97</td>
</tr>
</tbody>
</table>

A 4 x 2 between subjects ANOVA was conducted to evaluate whether the emotion label and the type of photograph influenced overall performance scores. The results indicated that there were no significant differences in accuracy based on type of emotion \( [F(3,32) = 2.122, p = .117] \), or based on type of photograph \( [F(1,32) = 2.79, p = .105] \). There was also no significant interaction effect between emotion label and type of photograph \( [F(3,32) = 1.265, p = .303] \).

Next, a 4 x 5 between subjects ANOVA was conducted to evaluate whether the emotion label or the assigned exemplar set had any effect on overall performance scores. The results of the 4 x 5 between subjects ANOVA indicated that there were no significant differences based on emotion label \( [F(3,20) = 1.481, p = .25] \), or the assigned exemplar set \( [F(4,20) = .749, p = .57] \). There was also no significant interaction effect between emotion label and assigned set \( [F(12,20) = .328, p = .974] \). Lastly, a 2 x 5 between subjects ANOVA was conducted to evaluate whether the type of photograph and the assigned exemplar set influenced overall performance scores. The results of this ANOVA indicated that there were no significant differences based on the type of photograph \( [F(1,30) = 2.303, p = .140] \), or based on the assigned exemplar set \( [F(4,30) = 886, p \)
There was also no significant interaction effect between the type of photograph and the assigned exemplar set \[F(4,30) = .315, p = .866\]. Based on these results, the specific stimuli being used for the emotion recognition training procedure appear to be valid and reliable indicators of the targeted emotions. Furthermore, the results suggest that the exemplar sets are balanced in regards to difficulty. Thus, the order of presentation of the exemplar sets is not anticipated to interfere with participant performance.

Procedure

Assessment and training materials were presented on the laptop, with the examiner and participant sitting next to one another. The procedure was broken up into four parts: screening, baseline, training, and generalization assessment. The procedure for each part is described below.

**Screening.** Upon gaining parental informed consent and participant assent, participants were screened for adequate reading and language ability using the PPVT-V and the K-TEA-2. The SSIS-P and the SSIS-T were also completed to establish a parent and teacher reported baseline of each child’s overall social skill ability in his natural environment. Next, participants were asked to complete two different matching-to-sample screening tasks. These tasks required participants to choose a stimulus from a matching array that relates to the sample stimulus. Before beginning either matching-to-sample task, participants were required to read the following instructions:

“This program will show you different pictures and descriptions. One will be at the top of the screen. This is your target. There will be 4 others at the bottom of the screen. These are your answer choices. Choose 1 of the answers that matches the target. Sometimes you will find out if your choice was correct. Other times you won’t. Any questions? Click continue when you’re ready to begin.”

First, participants were required to complete the control matching to sample task. The administration format for this task is depicted in Figure 4. There was a twenty-second limited
hold contingency on responding. That is, if a response was not emitted within twenty seconds, the computer presented the next trial, and the previous trial was scored as incorrect. Fluency, defined as the number of correct responses per minute, was measured throughout the duration of the task. This allowed for a baseline measurement of fluency for each participant’s matching to sample performance.

*Figure 4. Screenshot of the control matching-to-sample task.*

The last task in the screening process was an initial assessment of existing emotion recognition ability. The administration format for this task was the same as that of the control matching-to-sample task (see Figure 5). Assessment of the relations among the four classes of stimuli for all four emotions was conducted over the course of 48 trials with a twenty-second limited hold contingency for responding.
Baseline. Participants responded to trials assessing all possible relationships among the different classes of emotion stimuli using three different exemplar sets. Stimulus class A, the emotion label, remained the same throughout the exemplars. Each exemplar assessment included twelve different relations (See Table 2 for a listing of all relations and relation types). As such, there were 48 trials for each probe of an exemplar set. Training commenced for the first participant after a steady state of responding was evident, with the other two participants sequenced into training following multiple baseline design logic.

Training. Each exemplar set was trained using the sequential procedure displayed in Table 2. Mastery criterion for each phase was 90% or more correct responses. The number of trials per phase varied depending on the number of relations between stimuli classes that were included as well as the number of trial blocks needed to achieve mastery criteria. Each trial type was presented to the participant four times in a given trial block. In other words, trial blocks consisted of either 16 trials for one relation, 32 trials for two relations, 48 trials for three relations, or 64 trials for four relations. The order of trials in a block and the position of stimuli in the matching array were randomized to control for possible order or sequence effects as well as a response position bias. There were two types of trial phases: training and testing. Training phases

Figure 5. Screenshot of the emotion matching-to-sample task.
involved the presentation of a trial followed by feedback (i.e. “Correct!” or “Incorrect.”). If a participant did not meet mastery criteria during training, the trial block was repeated until mastery criterion was obtained for this phase. Testing phases involved the presentation of a trial without any feedback or programmed reinforcement.
Table 2.
Sequential order of trial blocks for emotion recognition training paradigm

<table>
<thead>
<tr>
<th>Phase</th>
<th>Type of Phase</th>
<th>Type of Relation</th>
<th>Relation</th>
<th># of Trials per Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Train</td>
<td>Directly Trained</td>
<td>A--&gt;B</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Test</td>
<td>Mutual Entailment</td>
<td>B--&gt;A</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Train</td>
<td>Directly Trained</td>
<td>A--&gt;C</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>Test</td>
<td>Mutual Entailment</td>
<td>C--&gt;A</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>Test</td>
<td>Mixed Mutual Entailment</td>
<td>B--&gt;A</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C--&gt;A</td>
<td></td>
</tr>
<tr>
<td>*6</td>
<td>Train</td>
<td>Mixed Directly Trained</td>
<td>A--&gt;B</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A--&gt;C</td>
<td></td>
</tr>
<tr>
<td>*7</td>
<td>Test</td>
<td>Mixed Mutual Entailment</td>
<td>B--&gt;A</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C--&gt;A</td>
<td></td>
</tr>
<tr>
<td>*8</td>
<td>Train</td>
<td>Mixed Mutual Entailment</td>
<td>B--&gt;A</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C--&gt;A</td>
<td></td>
</tr>
<tr>
<td>*9</td>
<td>Test</td>
<td>Mixed Mutual Entailment</td>
<td>B--&gt;A</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C--&gt;A</td>
<td></td>
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<tr>
<td>10</td>
<td>Test</td>
<td>Combinatorial Entailment</td>
<td>B--&gt;C</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C--&gt;B</td>
<td></td>
</tr>
<tr>
<td>*11</td>
<td>Train</td>
<td>Mixed Directly Trained</td>
<td>A--&gt;B</td>
<td>32</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>A--&gt;C</td>
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<td>*12</td>
<td>Test</td>
<td>Combinatorial Entailment</td>
<td>B--&gt;C</td>
<td>32</td>
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<tr>
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<td></td>
<td></td>
<td>C--&gt;B</td>
<td></td>
</tr>
<tr>
<td>*13</td>
<td>Train</td>
<td>Combinatorial Entailment</td>
<td>B--&gt;C</td>
<td>32</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>C--&gt;B</td>
<td></td>
</tr>
<tr>
<td>*14</td>
<td>Test</td>
<td>Combinatorial Entailment</td>
<td>B--&gt;C</td>
<td>32</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>C--&gt;B</td>
<td></td>
</tr>
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<td>15</td>
<td>Train</td>
<td>Class Expansion</td>
<td>A--&gt;D</td>
<td>16</td>
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<td>16</td>
<td>Test</td>
<td>Mutual Entailment</td>
<td>D--&gt;A</td>
<td>16</td>
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<td>17</td>
<td>Test</td>
<td>Mixed Mutual Entailment</td>
<td>B--&gt;A</td>
<td>48</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>C--&gt;A</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>D--&gt;A</td>
<td></td>
</tr>
<tr>
<td>*18</td>
<td>Train</td>
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<td>A--&gt;B</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>A--&gt;C</td>
<td></td>
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<tr>
<td>*19</td>
<td>Test</td>
<td>Mixed Mutual Entailment</td>
<td>B--&gt;A</td>
<td>48</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>C--&gt;A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D--&gt;A</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Test</td>
<td>Combinatorial Entailment</td>
<td>D--&gt;B</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B--&gt;D</td>
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<tr>
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<td></td>
<td>D--&gt;C</td>
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<td>C--&gt;D</td>
<td></td>
</tr>
<tr>
<td>*21</td>
<td>Train</td>
<td>Mixed Directly Trained</td>
<td>A--&gt;B</td>
<td>48</td>
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<td>A--&gt;D</td>
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<td></td>
<td>Data</td>
<td>D--&gt;B</td>
<td></td>
</tr>
<tr>
<td>*22</td>
<td>Test</td>
<td>Combinatorial Entailment</td>
<td>B--&gt;D</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>D--&gt;C</td>
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<td>C--&gt;D</td>
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<td></td>
<td></td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>*23</td>
<td>Train</td>
<td>Combinatorial Entailment</td>
<td>D--&gt;B</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B--&gt;D</td>
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<td>D--&gt;C</td>
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<td></td>
<td>C--&gt;D</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>*24</td>
<td>Test</td>
<td>Combinatorial Entailment</td>
<td>D--&gt;B</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>B--&gt;D</td>
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<td>D--&gt;C</td>
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<td></td>
<td>C--&gt;D</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>64</td>
<td></td>
</tr>
</tbody>
</table>

* Denotes phases that occurred only as a result of failure to meet mastery criteria.
Training and testing proceeded in a linear fashion for up to twenty-four phases. The goal of this training sequence was to facilitate the acquisition of mutual and combinatorial entailed relations between stimuli in the exemplar set. It was theoretically assumed that the acquisition of these relations would emerge from directly training three relations (i.e. A→B, A→C, & A→D; Hayes et al., 2001). If this did not occur, remedial steps would be taken and these relations would be directly trained in additional phases. Research has suggested that the most effective way of establishing relational repertoires like mutual entailment and combinatorial entailment is to explicitly train these responses on an exemplar and then test for these derived relations on a novel exemplar (Gomez, Lopez, Martin, Barnes-Holmes, & Barnes-Holmes, 2007).

During the training sequence for the first participant, emotion recognition performance on exemplars one, two and three were probed for all participants once the mastery criteria was reached for all phases of an exemplar set. After the first participant met mastery criteria on all three exemplar sets (i.e. 90%), the second participant began emotion recognition training with exemplar set one while the remaining participant stayed in baseline. For the training sequences of the second and third participant, probes of emotion recognition performance on all three exemplars occurred as soon as training on all three exemplars was completed. That is, once the second participant met mastery criteria on all three exemplars, emotion recognition performance was probed on exemplars one, two and three for all participants. The third participant then began the training. All three exemplars were probed again once the third participant met mastery criteria on all three exemplars.

The demonstration of mastery on each exemplar determined whether a participant continued on in the study for a second or third round of training. If a participant demonstrated
mastery on all three probes, the emotion recognition training was said to have generalized across exemplars and no additional training was needed. If the participant did not meet mastery criteria for exemplar sets two and three, he then began the same training procedure with exemplar set two. The training portion of the study was considered finished after the third participant reached mastery criteria on all three exemplars.

**Generalization Assessment.** At the conclusion of emotion recognition training, all participants were asked to complete two generalization matching-to-sample tasks. The first generalization task included the stimuli used in the initial assessment of existing emotion recognition ability (i.e. screening). The second generalization task included a novel set of exemplars for all four emotions. The procedure for these tasks was the same as that used in the baseline assessment (i.e. a 48 trial probe of all relations between stimuli in the exemplar set with no programmed reinforcement). In addition, parents and teachers of participants were asked to complete the SSIS-P and SSIS-T again to establish whether the emotion recognition training produced observable changes in social skills displayed in each child’s natural environment.
CHAPTER 3

RESULTS

Both within subject and between subject analytic strategies were used to determine the utility of the emotion recognition training program and to provide a comprehensive summary of participant performance. For the reader’s convenience, the results have been broken down based on the level and content of the analysis. First, participant demographics and performance on screening measures are considered. Next, the results of the concurrent multiple probe design are analyzed to determine the efficacy of the emotion recognition training paradigm across participants. Then a within-subject analysis across contexts is discussed to evaluate each participant’s performance across the different exemplar sets and relation trial types, both during assessment probes and training blocks. Following this, an analysis of individual fluency rates is reviewed for each participant, comparing his control task performance to that on emotion recognition trials. Lastly, the current study analyzed pre-to-post data is for each participant on SSIS-P & SSIS-T scores to determine if the training generalized to the natural environment.

Participant Demographics and Screening Performance

Participant’s reading comprehension skills were assessed using the Peabody Picture Vocabulary Test-4th Edition (PPVT-4) and the Kaufmann Test of Educational Achievement-2nd
Edition (K-TEA-2) reading subtest. Inclusion criterion was a standard score of 70 or greater on both measures. Standard scores have a mean of 100 and a standard deviation of 15. The criterion of 70 or greater was chosen because it is two standard deviations below the average, and scores below it indicate skills within the extremely low range of functioning. Table 3 displays each participant’s demographic information as well as performance on these measures. Fred’s performance on these screening measures places him in the average range of functioning for both receptive vocabulary and reading comprehension. Hank’s performance on these screening measures also places him in the average range of functioning for both receptive vocabulary and reading comprehension. Chuck’s performance places him in high average range of functioning for reading comprehension, and the superior range of functioning for receptive vocabulary.

Table 3. 

<table>
<thead>
<tr>
<th>Participant</th>
<th>Demographic</th>
<th>Receptive Vocabulary (PPVT-4)</th>
<th>Reading (K-TEA-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fred</td>
<td>12 year old Caucasian male</td>
<td>93</td>
<td>96</td>
</tr>
<tr>
<td>Hank</td>
<td>15 year old Caucasian male</td>
<td>94</td>
<td>93</td>
</tr>
<tr>
<td>Chuck</td>
<td>13 year old Caucasian male</td>
<td>130</td>
<td>116</td>
</tr>
</tbody>
</table>

Participants were also screened to determine the presence of difficulties with emotion recognition skills as well as to evaluate their ability to display derived relational responding with non-emotional stimuli (i.e. a control matching-to-sample task). This was to ensure that participants had the core relational responding skill needed to engage in the training procedure, and that they would benefit from the emotion recognition training. Scores reflect the overall percent correct of 48 trials. Chance responding would yield a score of 25%. Table 4 shows each participant’s performance on the emotion and control matching-to-sample screening tasks. Fred
obtained the poorest score on the Emotion Matching-to-Sample task, but demonstrated perfect performance on the control task. Hank and Chuck also failed the Emotion Matching-to-Sample task, but obtained near perfect scores on the control task. This suggests that all three participants are able to demonstrate derived relational responding, but have difficulty relating specific emotion stimuli.

Table 4.

*Participant Performance on the Matching-to-Sample Screening Tasks*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Emotion Matching-to-Sample Screening Score</th>
<th>Control Matching-to-Sample Screening Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fred</td>
<td>38%</td>
<td>100%</td>
</tr>
<tr>
<td>Hank</td>
<td>50%</td>
<td>100%</td>
</tr>
<tr>
<td>Chuck</td>
<td>56%</td>
<td>94%</td>
</tr>
</tbody>
</table>

**Concurrent Multiple Probe Design**

Figure 6 depicts the percentage of correct responses for all three participants during the screening, baseline, training and generalization portions of the study.
Figure 6. Percentage of correct responses on emotion recognition probes during screening, baseline, training and generalization assessment.

**Hank.** During baseline performance on the emotion recognition probes, Hank displayed stable responding under the mastery criteria (M= 56%; range, 46% to 62%). After training on stimulus set one, Hank’s correct responding increased for set one probes to above mastery criteria (M=99.33%; range, 98% to 100%) while his performance on stimulus sets two and three...
remained below mastery criteria. After training on stimulus set two, Hank’s correct responding increased for set two probes to above mastery criteria (M=99.28%; range, 98% to 100%) while his performance on stimulus set three remained below mastery criteria. After training on the final stimulus set, Hank’s correct responding increased on stimulus set three to above mastery criteria (M=99.85%; range, 99.55% to 100%). His performance was maintained during subsequent assessment of all three stimuli sets. In addition, Hank demonstrated some generalization of these emotion recognition skills in his performance on the novel stimuli set (88%) and his increased performance on the generalization set first assessed during the screening portion of the study (from 50% to 75%).

**Chuck.** During baseline performance on the emotion recognition, Chuck also displayed stable responding under the mastery criteria (M= 61.75%; range, 56% to 69%). After training on stimulus set one, Chuck’s correct responding increased for set one probes to above mastery criteria (M=98%; range, 92% to 100%) while his performance on stimuli sets two and three remained below mastery criteria. After training on stimulus set two, Chuck’s correct responding increased for set two probes to above mastery criteria (M=94.51%; range, 90% to 99.55%). In addition, his performance on set three also increased to meet mastery criterion. His emotion recognition skills were said to have generalized, and he did not require training on a third exemplar. His performance was maintained during subsequent assessment of all three stimuli sets. In addition, Chuck demonstrated further generalization of these emotion recognition skills in his performance on the novel stimulus set (100%) and his increased performance on the generalization set first assessed during the screening portion of the study (from 56% to 92%).

**Fred.** During baseline performance on the emotion recognition probes, Fred also displayed stable responding under the mastery criteria (M= 62.67%; range, 54% to 73%). After
training on stimulus set one, Fred’s correct responding increased for set one probes to above mastery criteria (M=96.53%; range, 90% to 100%) while his performance on stimuli sets two and three remained below mastery criteria. After training on stimulus set two, Fred’s correct responding increased for set two probes to above mastery criteria (M=96.33%; range, 92% to 98%) while his performance on stimulus set three remained below mastery criteria. After training on the final stimulus set, Fred’s correct responding increased (98.66%). However, a subsequent probe indicated that he did not retain his performance on stimulus set three (75%) above mastery. A remedial training session was conducted, after which he obtained 99.55% correct responses on stimulus set three. A final subsequent probe indicated that Fred’s performance was maintained above mastery criteria for all three stimuli sets. Generalization assessment of these emotion recognition skills was then conducted but showed limited performance on the novel stimulus set (56%) and only slightly increased performance on the generalization set first assessed during the screening portion of the study (from 38% to 56%).

**Within Subject Analysis Across Contexts**

A visual inspection was conducted across exemplar sets for each participant to further explore obtained findings and to assess the degree of generalization across exemplar sets. A pre-to-post training score comparison was also conducted for each of the exemplars across all three participants to evaluate the efficacy of the training sequence in greater detail. Pre-training scores refer to the assessment probes directly before training each of the three exemplars. Post-training scores refer to the assessment probes directly after training on each of the three exemplars. In addition, a visual inspection analysis was conducted across phases and different relations for each participant during the course of training.
**Hank.** Figure 7 depicts Hank’s performance over time on the assessment probes for each exemplar set.

![Graph showing performance improvement over time](image)

**Figure 7. Hank’s percentage of correct responses on emotion recognition probes for each of the exemplar sets.**

While still below mastery criteria, Hank’s performance on exemplar sets two and three appear to have improved before he was directly trained on these stimuli. His performance on exemplar set two improved after the introduction of exemplar set one training. His performance on exemplar set three improved after the introduction of exemplar set two training. A visual pre-to-post comparison of Hank’s emotion recognition performance scores also suggests improved performance with each subsequent presentation of an exemplar set. Hank’s post-training scores remained consistently above mastery criteria for all three exemplars. Table 5 displays the pre-to-
post comparison of Hank’s performance on each relation type for directly before and after each exemplar was trained.

Table 5.
Hank’s Emotion Recognition Performance By Relation Type and Exemplar Set

<table>
<thead>
<tr>
<th>Exemplar set 1</th>
<th>Directly Trained Trials</th>
<th>Mutual Entailment Trials</th>
<th>Combinatorial Entailment Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>58%</td>
<td>42%</td>
<td>42%</td>
</tr>
<tr>
<td>Post</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Exemplar set 2</td>
<td>Pre</td>
<td>100%</td>
<td>92%</td>
</tr>
<tr>
<td>Post</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Exemplar set 3</td>
<td>Pre</td>
<td>92%</td>
<td>83%</td>
</tr>
<tr>
<td>Post</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Prior to training, Hank’s performance improved from 58% to 92% correct responding on directly trained trials, as well as from 42% to 83% correct responding on mutual entailment and combinatorial entailment trials. Hank did display more variable improvement in pre-training scores for mutually entailed trials. Also, Hank’s performance prior to training suggested particular difficulty on combinatorial entailment trials compared to those directly trained, and to a lesser extent, compared to the mutual entailment trials for the second exemplar. This differential performance across relation types is consistent with research literature maintaining that these relations increase in complexity from directly trained, to mutually entailed to combinatorially entailed relations (Hayes et al., 2001). Improved performance across exemplars can furthermore be concluded when analyzing Hank’s training data. Table 6 displays the number of training trial blocks Hank needed before reaching mastery criteria, broken down according to phase and relation type.
Table 6.

*Training data across exemplar sets for Hank*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Type of Phase</th>
<th>Type of Relation</th>
<th>% Correct or Blocks to Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exemplar Set 1</td>
</tr>
<tr>
<td>1</td>
<td>Train A-B</td>
<td>Directly Trained</td>
<td>1 block</td>
</tr>
<tr>
<td>2</td>
<td>Test B-A</td>
<td>Mutual Entailment</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>Train A-C</td>
<td>Directly Trained</td>
<td>1 block</td>
</tr>
<tr>
<td>4</td>
<td>Test C-A</td>
<td>Mutual Entailment</td>
<td>94%</td>
</tr>
<tr>
<td>5</td>
<td>Test B-A/C-A</td>
<td>Mixed Mutual Entailment</td>
<td>97%</td>
</tr>
<tr>
<td>10</td>
<td>Test B-C/C-B</td>
<td>Combinatorial Entailment</td>
<td>100%</td>
</tr>
<tr>
<td>15</td>
<td>Train A-D</td>
<td>Class Expansion</td>
<td>3 blocks</td>
</tr>
<tr>
<td>16</td>
<td>Test D-A</td>
<td>Mutual Entailment</td>
<td>94%</td>
</tr>
<tr>
<td>17</td>
<td>Test B-A/C-A/D-A</td>
<td>Mixed Mutual Entailment</td>
<td>100%</td>
</tr>
<tr>
<td>20</td>
<td>Test D-B/B-D/D-C/C-D</td>
<td>Combinatorial Entailment</td>
<td>100%</td>
</tr>
</tbody>
</table>

Hank did not require any remedial training phases once he reached mastery criteria for each given training phase regardless of which exemplar he was presented. Overall during the training phases, Hank typically required one trial block before reaching mastery criteria. However, during the class expansion phase of the first exemplar set, Hank required three trial blocks to meet mastery criteria. During the testing trials of the emotion recognition training, Hank obtained an average of 98.07% correct responses on mutually entailed relation trial types (range: 88%-100%). This average increased slightly from the first exemplar set (M=97%; range, 94%-100%) to the third and final exemplar set (M=99.6%; range, 98%-100%). Interestingly, Hank obtained an average of 100% correct responses on combinatorially entailed relation trial types during training with no variability across phases or exemplars (i.e. all equaled 100%).

**Chuck.** Figure 8 depicts Chuck’s performance over time on the assessment probes for each exemplar set.
Figure 8. Chuck’s percentage of correct responses on emotion recognition probes for each of the exemplar sets.

Chuck’s performance on exemplar set two appeared to improve after the introduction of exemplar one training. However, his performance on exemplar set three was more variable after the first training. His performance on exemplar set three eventually reached mastery criteria after the introduction of training on exemplar set two. No direct training was required on the exemplar set three stimuli. The visual pre-to-post comparison of Chuck’s emotion recognition performance scores also suggests improved performance with each subsequent presentation of an exemplar set. Chuck’s post-training scores remained consistently above mastery criteria for all three exemplars. Table 7 displays Chuck’s performance on each relation type for the assessment probes directly before and after exemplar training.
Prior to training, Chuck’s performance improved from 67% to 83% correct responding on directly trained trials, from 67% to 100% correct responding on mutual entailment trials, as well as from 71% to 96% correct responding on combinatorial entailment trials. Chuck did display more variable improvement in pre-training scores for directly trained trials. Chuck’s performance prior to training also suggests particular difficulty on combinatorial entailment trials compared to those directly trained and to the mutual entailment trials. In fact, even after training with the second exemplar, Chuck’s performance on combinatorially entailed relations was below the overall mastery criteria of 90%. However, advancement through the training paradigm depended on overall performance which includes all three types of relations. Chuck’s higher performance on directly trained and mutual entailment trials elevated his overall score such that he met mastery criteria for the second exemplar. In addition, his overall performance on the third exemplar stimuli prior to possible training was above mastery criteria. As such, Chuck did not receive training and no pre-post comparison can be made for him on the third exemplar. Table 8 displays the number of training trial blocks Chuck needed before reaching mastery criteria broken down according to phase and relation type.
Chuck did not require the assistance of any remedial training phases once he demonstrated mastery criteria with the exemplar stimuli. He required 1 training block before meeting mastery criteria during the early directly trained trials. However, he required two training blocks during class expansion before meeting mastery criteria, suggesting the increased number of relational stimuli in this phase caused some difficulty for him. During the testing trials of the emotion recognition training, Chuck obtained an overall average of 99.4% correct responses on mutually entailed relation trial types (range: 94%-100%). This average decreased negligibly from the first exemplar (M= 100%; range=0) to the second exemplar (98.8%; range, 98.8%-100%). Meanwhile, he obtained an overall average of 100% correct responses on combinatorially entailed relation trial types with no variability across phases or exemplars.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Type of Phase</th>
<th>Type of Relation</th>
<th>Exemplar Set 1</th>
<th>Exemplar Set 2</th>
<th>Exemplar Set 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Train A-B</td>
<td>Directly Trained</td>
<td>1 block</td>
<td>1 block</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Test B-A</td>
<td>Mutual Entailment</td>
<td>100%</td>
<td>100%</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Train A-C</td>
<td>Directly Trained</td>
<td>1 block</td>
<td>1 block</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Test C-A</td>
<td>Mutual Entailment</td>
<td>100%</td>
<td>94%</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Test B-A/C-A</td>
<td>Mixed Mutual Entailment</td>
<td>100%</td>
<td>100%</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>Test B-C/C-B</td>
<td>Combinatorial Entailment</td>
<td>100%</td>
<td>100%</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>Train A-D</td>
<td>Class Expansion</td>
<td>2 blocks</td>
<td>2 blocks</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>Test D-A</td>
<td>Mutual Entailment</td>
<td>100%</td>
<td>100%</td>
<td>-</td>
</tr>
<tr>
<td>17</td>
<td>Test B-A/ C-A/D-A</td>
<td>Mixed Mutual Entailment</td>
<td>100%</td>
<td>100%</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>Test D-B/B-D/ D-C/C-D</td>
<td>Combinatorial Entailment</td>
<td>100%</td>
<td>100%</td>
<td>-</td>
</tr>
</tbody>
</table>
Fred. While Hank and Chuck’s performance clearly improved across exemplars, Fred’s performance appeared to be much more variable. Figure 9 depicts Fred’s performance over time on the assessment probes for each exemplar set.

Fred’s performance on exemplar sets two and three did not appear to improve after either the introduction of exemplar set one training or after the introduction of exemplar set two. Even after exemplar set three was directly trained, his performance fell below mastery criteria. He required remedial training before demonstrating mastery of exemplar set three. However, Fred’s post-training scores showed marked improvement with less variability (i.e. consistently around the mastery criteria). Table 9 displays a comparison of Fred’s performance on each relation type for the assessment probes directly before and after each exemplar was trained.
The visual pre-to-post comparison of Fred’s emotion recognition performance scores prior to training suggests slight improvement for directly trained relations (from 50% to 83% correct responding) and mutually entailed relations (from 58% to 83% correct responding). However, performance on combinatorial entailment trials was variable. While Fred’s scores increased from pre-to-post training for each exemplar, prior to training scores appeared to decrease across exemplars (from 92% to 67%). In addition, despite meeting mastery criteria during training, Fred did not consistently demonstrate performance above mastery criteria on either directly trained or mutual and combinatorial entailment trials for the third exemplar. This necessitated a second exposure to the entire third exemplar training procedure, after which Fred demonstrated performance at 100% correct for all three types of relations.

A closer look at Fred’s training data provides additional useful information. Table 10 displays the number of training trial blocks Fred needed before reaching mastery criteria broken down according to phase and relation type.
Fred required two training blocks before meeting mastery criteria across all directly trained phases of exemplar one. For the second exemplar, he required one training block for the early directly trained phases, but two training blocks for the class expansion phase. For the first attempt at the third exemplar, he continued to require two training blocks for one of the three directly trained phases. However, after his second attempt at training with the third exemplar, he only required one training block for each of the directly trained phases. During the testing trials of the emotion recognition training, Fred obtained an overall average of 99.4% correct responses on mutually entailed relation trial types (range: 94%-100%). This average decreased negligibly from the first exemplar (M= 100%; range, 98%-100%) to the first attempt at the third exemplar.

Table 10.
*Training data across exemplar sets for Fred*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Type of Phase</th>
<th>Type of Relation</th>
<th>% Correct or Blocks to Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exemplar Set 1</td>
</tr>
<tr>
<td>1</td>
<td>Train A-B</td>
<td>Directly Trained</td>
<td>2 blocks</td>
</tr>
<tr>
<td>2</td>
<td>Test B-A</td>
<td>Mutual Entailment</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>Train A-C</td>
<td>Directly Trained</td>
<td>2 blocks</td>
</tr>
<tr>
<td>4</td>
<td>Test C-A</td>
<td>Mutual Entailment</td>
<td>100%</td>
</tr>
<tr>
<td>5</td>
<td>Test B-A/C-A</td>
<td>Mixed Mutual Entailment</td>
<td>100%</td>
</tr>
<tr>
<td>10</td>
<td>Test B-C/C-B</td>
<td>Combinatorial Entailment</td>
<td>100%</td>
</tr>
<tr>
<td>15</td>
<td>Train A-D</td>
<td>Class Expansion</td>
<td>2 blocks</td>
</tr>
<tr>
<td>16</td>
<td>Test D-A</td>
<td>Mutual Entailment</td>
<td>100%</td>
</tr>
<tr>
<td>17</td>
<td>Test B-A/C-A</td>
<td>Mixed Mutual Entailment</td>
<td>98%</td>
</tr>
<tr>
<td>20</td>
<td>Test D-B/B-D</td>
<td>Combinatorial Entailment</td>
<td>97%</td>
</tr>
</tbody>
</table>
(M=98.4%; range, 94%-100%). However, with an additional training on the third exemplar, the average increased (M=100%; range=0). Meanwhile, he obtained an overall average of 98.13% correct responses on combinatorially entailed relation trial types. This average increased from the first exemplar (M=98.5%; range, 97%-100%) to the first attempt at the third exemplar (M=100%; range=0). With the second attempt at the third exemplar, it decreased negligibly (M=98.5%; range, 97%-100%).

**Fluency Analysis.** Fluency scores were calculated for each participant’s performance on the control task as well as for each exemplar set. Each score corresponds to the number of correct responses per minute on each task. Fluency scores were calculated by summing the latency in milliseconds from stimulus presentation to response including the 1.5 second inter-trial interval, and were then expressed in terms of correct responses per minute. Table 11 depicts each participant’s fluency scores for each task.

Table 11. *Participant Fluency Scores Expressed as Correct Responses per Minute for the Control Task and Emotion Recognition Training Task*

<table>
<thead>
<tr>
<th>Task</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hank</td>
</tr>
<tr>
<td>Control Task</td>
<td>16.72</td>
</tr>
<tr>
<td>Exemplar Set 1</td>
<td>17.03</td>
</tr>
<tr>
<td>Exemplar Set 2</td>
<td>16.91</td>
</tr>
<tr>
<td>Exemplar Set 3</td>
<td>18.65</td>
</tr>
</tbody>
</table>

*Two scores per column refer to the first and second attempt.*

Hank’s average fluency score on the emotion recognition-training task was 17.53 correct responses per minute, which is slightly higher than his fluency score on the control task (16.72).
Chuck’s average fluency score on the emotion recognition training task was 6.17 correct responses per minute, which is lower than his fluency score on the control task (9.28). Lastly, Fred’s average fluency score on the emotion recognition task was 11.32 correct responses per minute, which is lower than his fluency score on the control task (14.24). However, since each participant’s scores across the emotion recognition stimuli were within five responses of their control task fluency score, no supplemental fluency intervention was conducted. This criterion was chosen based on research that has found estimated standard errors of measurement for oral reading fluency range between five and fifteen responses per minute (Christ & Silberglitt, 2007).

**Generalization to the Natural Environment.** Assessment of generalization to the natural environment was conducted by comparing parent-reported and teacher-reported scores in the SSIS prior to training with those obtained after all training was completed. A significant change in score on the SSIS was conceptualized any increase or decrease outside the bounds of the pre-test score’s confidence interval. A clinically meaningful change in scores was considered as any increase or decrease in score that also coincided with a change in the level of functioning categories.

**Hank.** Table 12 depicts the pre- and post- scores on the SSIS-P and the SSIS-T for Hank.
Table 12.
Pre- and Post- Scores on the SSIS-P and the SSIS-T for Hank

<table>
<thead>
<tr>
<th>Parent Report Form</th>
<th>Social Skills Scale</th>
<th>Standard Score</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>67</td>
<td>61-73</td>
</tr>
<tr>
<td></td>
<td></td>
<td>69</td>
<td>63-75</td>
</tr>
<tr>
<td></td>
<td>Problem Behavior Scale</td>
<td>126</td>
<td>120-132</td>
</tr>
<tr>
<td></td>
<td></td>
<td>118</td>
<td>112-124</td>
</tr>
<tr>
<td>Teacher Report Form</td>
<td>Social Skills Scale</td>
<td>83</td>
<td>78-88</td>
</tr>
<tr>
<td></td>
<td></td>
<td>95</td>
<td>90-100</td>
</tr>
<tr>
<td></td>
<td>Problem Behavior Scale</td>
<td>102</td>
<td>96-108</td>
</tr>
<tr>
<td></td>
<td></td>
<td>105</td>
<td>99-111</td>
</tr>
</tbody>
</table>

A pre-to-post score analysis of the SSIS parent and teacher rating forms yielded mixed results for Hank’s generalization of emotion recognition skills to the natural environment. Hank’s score on the parent reported social skills scale did not significantly change after receiving the emotion recognition training. His parent reported that Hank’s social skills continued to be in the well-below average range of functioning. Hank’s score on the parent reported problem behavior scale, however, significantly decreased. Although, his parent reported that Hank’s problem behaviors continue to be in the above average range compared to same-aged peers. Meanwhile, Hank’s score on the teacher reported social skills scale significantly increased from the below average range to the average range of functioning. Hank’s score on the teacher
reported problem behavior scale did not significantly change, remaining in the average range of functioning.

Chuck. Table 13 depicts the pre- and post- scores on the SSIS-P and the SSIS-T for Chuck.

Table 13.

Pre- and Post- Scores on the SSIS-P and the SSIS-T for Chuck

<table>
<thead>
<tr>
<th></th>
<th>Social Skills Scale</th>
<th>Problem Behavior Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parent Report Form</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Skills Scale</td>
<td>Standard Score 62</td>
<td>Standard Score 130</td>
</tr>
<tr>
<td></td>
<td>95% Confidence Interval 56-68</td>
<td>95% Confidence Interval 124-136</td>
</tr>
<tr>
<td><strong>Teacher Report Form</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Skills Scale</td>
<td>Standard Score 79</td>
<td>Standard Score 127</td>
</tr>
<tr>
<td></td>
<td>95% Confidence Interval 74-84</td>
<td>95% Confidence Interval 121-133</td>
</tr>
</tbody>
</table>

A pre-to-post score analysis of the SSIS parent and teacher rating forms yielded mixed results for Chuck’s generalization of emotion recognition skills to the natural environment.

Chuck’s score on the parent reported social skills scale and the parent reported problem behavior scale did not significantly change after receiving the emotion recognition training. His parent reported that Chuck’s social skills continued to be in the well-below average range of
functioning while the frequency of his problem behaviors continued to be in the above average range. Chuck’s teacher reported social skills score also did not change significantly, remaining in the below-average range. However, Chuck’s score on the teacher reported problem behavior scale significantly decreased. Chuck’s teacher reported that the frequency of his problem behavior changed from the above average range to the average range of functioning compared to same-aged peers.

**Fred.** Table 14 depicts the pre- and post- scores on the SSIS-P and the SSIS-T for Fred.

<table>
<thead>
<tr>
<th></th>
<th><strong>Social Skills Scale</strong></th>
<th><strong>Problem Behavior Scale</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parent Report Form</strong></td>
<td><strong>Standard Score</strong></td>
<td><strong>95% Confidence Interval</strong></td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>64-76</td>
</tr>
<tr>
<td></td>
<td>94</td>
<td>88-100</td>
</tr>
<tr>
<td><strong>Teacher Report Form</strong></td>
<td><strong>Standard Score</strong></td>
<td><strong>95% Confidence Interval</strong></td>
</tr>
<tr>
<td></td>
<td>107</td>
<td>102-112</td>
</tr>
<tr>
<td></td>
<td>108</td>
<td>103-113</td>
</tr>
</tbody>
</table>

Lastly, a pre-to-post score analysis of the SSIS parent and teacher rating forms yielded mixed results for Fred’s generalization of emotion recognition skills to the natural environment. Fred’s score on the parent reported social skills scale significantly improved after receiving the
emotion recognition training. His parent reported that Fred’s social skills changed from being in the below-average range to being in the average range of functioning. However, Fred’s score on the parent reported problem behavior scale did not significantly change, remaining in the above average range of functioning. Fred’s teacher reported social skills score and problem behavior score did not change significantly, both of them remaining in the average range compared to same-aged peers.
Overall findings from this investigation lend initial support to the use of derived relational responding in emotion recognition training paradigms for individuals on the autism spectrum. Visual inspection of collected data revealed relative stability of baseline performance prior to intervention for each participant. After the introduction of the training, Chuck and Fred’s performance continued to remain at stable levels ($M = 65\%$), while Hank’s performance improved above mastery criteria ($M = 100\%$). This effect was then replicated with Chuck’s introduction to the training and subsequent improvement in scores ($M = 96\%$) while Fred’s performance without training continued to remain stable ($M = 68\%$). The effect of the emotion recognition training was further replicated when Fred’s performance increased above mastery criteria after its introduction ($M = 94\%$). This indicates that the three elements needed to establish experimental control (i.e. prediction, verification and replication) have been met. As such, it is likely that a functional relationship existed between the emotion recognition training and improved emotion recognition performance demonstrated by participants.

**Efficacy of the Emotion Recognition Training**
The current study was conducted over the span of two months, including screening, baseline, training, and generalization assessment. However, training sessions for each participant occurred across the span of two to three days for at most an hour per day ($M = 35$ minutes). The second and third participant attended sessions on eight days mainly due to the extended baseline probes and post-training probes. All three participants displayed poor performance on an emotion recognition task prior to the training (range = 38% to 56% correct), suggesting that they had difficulty with coordinating specific emotion functions such as facial expressions and contexts with the socially-accepted verbal labels. None of the participants required direct training between stimuli classes for any given exemplar set. In fact, only one participant (Fred) required any remedial training, and it was to further establish the previously directly trained relations in the final exemplar set. Furthermore, improved performance was maintained above 90% correct after the training was completed for all three participants.

The findings of this study add to a growing body of research suggesting that the use of derived relational responding in interventions may be an efficient and effective way of helping address skill deficits for individuals with developmental disabilities (Dunne, Foody, Barnes-Holmes, Barnes-Holmes & Murphy, 2014; Kilroe, Murphy, Barnes-Holmes & Barnes-Holmes, 2014; McHugh & Stewart, 2012; Rehfeldt et al., 2009; Walsh, Horgan, May, Dymond, & Whelan, 2014). The amount of time this training took (i.e. two to three days for at most an hour per day) was substantially less than the majority of traditional interventions targeting emotion recognition, some of which range from ten hours through thirty hours of training (Bolte et al., 2006; Golan & Baron-Cohen, 2006; Lopata et al., 2010; Solomon et al., 2004). The use of derived relational responding in training paradigms could be a promising strategy to address some of the limitations of previous interventions by reducing the amount of time and resources
required and making the intervention more efficient. One of the limitations of this study was that follow-up assessment was not conducted over a longer period of time. Future research should explore whether improved performance on emotion recognition tasks is maintained for at least six months.

**Generalization to Novel Stimuli**

The current study incorporated multiple exemplar training with different variations of the emotional cues (i.e. different people displaying facial expressions and body postures or gestures across different contexts). Two of the three participants demonstrated clear generalization of emotion recognition skills to novel stimuli. The third participant in the current study (Fred) displayed only a slight increase in accuracy on the stimuli used for screening purposes, and performed poorly on the novel stimuli during generalization testing. This participant also did not demonstrate generalization of skills across exemplars during the training process.

A number of factors could have influenced these results. Fred was the youngest of the three participants, and had performed the worst on the emotion recognition screening task. It is possible that more extensive multiple exemplar training than what was provided would facilitate generalization. Future research should explore the range of exemplars needed for most individuals on the autism spectrum to demonstrate generalization of emotion recognition skills to novel stimuli. This research would help to inform treatment developers about the number of possible exemplars that would maximize the chance for generalization of skills. Other factors that might have played a role in Fred’s lack of generalization of skills include his decreased fluency rate over time. This may indicate a decrease in motivation over time. It is possible that the inclusion of a supplemental fluency intervention with more potent and more frequent reinforcement might have increased the likelihood of generalization of skills. Fred also seemed
to display increased difficulty with combinatorially entailed relations on assessment probes as training progressed. McHugh et al. (2009) suggested that some individuals on the autism spectrum may have difficulty coordinating core relational skills and emotions. It’s possible that a remedial intervention specifically targeting combinatorially entailed relations or core relational skills in general might have improved his performance on the emotion recognition task and increased the likelihood of generalization. Future research should explore the effect such remedial interventions on fluency and core relational skills have on performance in an emotion recognition task that incorporates derived relational responding.

The majority of prior emotion recognition research has failed to demonstrate generalization of skills to novel stimuli (Bolte et al., 2006; Golan & Baron-Cohen, 2005; Ryan & Charragain, 2010; Young & Posselt, 2012). With multiple exemplar training across three stimuli sets that incorporated different variations of emotion cues, two of the current study’s participants were able to generalize emotion recognition skills to other novel stimuli of comparable quality. It is possible that the use of multiple exemplar training in this way facilitated generalization to novel stimuli via stimulus generalization. It is also possible that simply practicing attending to context and stimuli might improve an individual’s ability to do so with emotions in general, including ones not directly trained (Pesce & Bosel, 2001).

The majority of prior research on emotion recognition training has also not documented the number of stimulus exemplars used during training (Baghdadli et al., 2013; Beaumont & Sofronoff, 2008; Hadwin et al., 1997; Lopata et al., 2010; Ryan & Charragain, 2010; Solomon et al., 2004), has used a video instead of static stimuli (Golan et al., 2010; Williams et al., 2012; Young & Posselt, 2012), or has used direct instruction with rules, modeling and behavioral rehearsal (Bauminger, 2002; Stitcher et al., 2012). A few have documented multiple exemplars
utilizing 400+ different facial expressions for a variety of emotions, but have not demonstrated clinically meaningful improvements in addition to generalization to novel stimuli (Bolte et al., 2006; Golan & Baron-Cohen, 2006; Kuusikko et al., 2009).

Future research should explore whether multiple exemplar training with varying stimuli is sufficient to produce generalization of improved performance. Research might also compare this strategy with one that incorporates derived relational responding to determine whether it has any additive effect on generalization of skills. The generalization of skills in the current study address a major limitation of prior emotion recognition training, and it is important to isolate the intervention components to determine which are actively contributing to improved performance. Future research should also explore the effect of emotion recognition interventions on those emotions that have not been directly trained. This would be useful in determining whether the procedure is teaching participants an emotion recognition strategy that would be useful when stimuli are presented in a novel context (i.e. indirect assessing generalization to the natural environment).

**Fluency**

The current study did not incorporate any supplemental fluency interventions since participants’ fluency rates did not appear to significantly deviate from that demonstrated on the control task. However, it is noteworthy that one participant (Chuck) displayed a markedly lower fluency rate than the other two participants. Chuck also ended up displaying the most generalization of skill. Behavioral observations of the experimenter during training and testing sessions indicate that Chuck was visually scanning the stimuli on the computer screen during the majority of the task. This suggests that Chuck may have been paying greater attention to the
emotion stimuli before responding. However, this relatively lower rate of responding may prevent him from effectively using his emotion recognition skills in everyday social interactions.

Future research should explore the use of a smaller limited-hold contingency during emotion recognition training to improve fluency on trials regardless of baseline performance. Research has noted the importance of fluency compared to accuracy alone (Holding, Bray & Kehle, 2011; Lee & Singer-Dudek, 2012; Weiss, Pearson, Foley & Pahl, 2010). It is likely that the incorporation of fluency training into emotion recognition interventions would increase mastery of this repertoire, and it would be interesting to observe its effect on generalization of these skills to the natural environment.

Prior to the current study, expected fluency rates in derived relational responding tasks were unknown, particularly during a task that involved attending to multiple cues. A limitation of the current study is that the fluency rate criterion was arbitrarily selected as within five correct responses of the control task baseline. Future research should explore acceptable ranges for fluency rates when completing matching-to-sample tasks involving multiple cues. Of particular interest would be developing normed fluency rates for those who are typically developing and those diagnosed with difficulties such as Autism Spectrum Disorder.

**Assessment of Skills in the Natural Environment**

The current study attempted to address the need for using emotional cues to guide behavior by including a class expansion phase that coordinated an effective action with the previously trained emotion stimuli. While the participants eventually demonstrated the ability to coordinate appropriate responses with the emotion cues during a matching-to-sample procedure, it is unclear whether these relations were able to generalize across contexts. Findings on generalization of the emotion recognition training to outside of the preparation were indirectly
assessed through parent and teacher reports, the results of which were variable and unclear. Some parents reported improvement in either social skills or problem behaviors while the participant’s teacher reported no change or the opposite, and vice versa.

The mixed results on generalization to the natural environment were in part due to the presence of two different informants for the SSIS who typically observe the participants in different environments (i.e. home vs. school/church). However, one would hope the effects of the intervention would permeate across different environments. It is possible that the intervention did not assist with fully bringing emotion recognition skills under contextual control through the process of higher-order conditional discrimination. That is, participants may have learned to apply these skills in the experimental environment, but not the natural one, or possibly to apply these skills in the home environment but not in a classroom-like setting.

The main issue with the current study’s assessment of generalization to the natural environment, however, stems from the very nature of relying on parent and teacher reports to evaluate a change in behavior. Research has shown that caregiver reports are easily biased, and may not accurately reflect an individual’s skill set (Stokes, Pogge, Wecksell & Zaccario, 2011). It is also a global questionnaire about social skills rather than specifically evaluating emotion recognition performance. Furthermore, as it is a pre-to-post comparison of scores, there is no experimental control over whether the intervention alone influenced a change in scores rather than as a matter of historical influences. These are limitations of the current study that future studies could address by using a randomized control trial or multiple baseline design with frequent measurement of social skills in the natural environment for enhanced experimental control.
A number of traditional social skill interventions have focused on directly training specific behavior to engage in during social situations in order to increase the likelihood that skills will generalize to the natural environment (Bock, 2007; Koegel, Kuriakose, Singh & Koegel, 2012; Leaf et al., 2009). However, a substantial portion of research on traditional social skill interventions has not found generalization of appropriate responses to emotional cues across contexts (Kokina & Kern, 2010; LeBlanc et al., 2003; Mazurik-Charles & Stefanou, 2010; Wang & Spillane, 2009). This is important as emotion recognition is of little use if one is unable to communicate it effectively and use it to guide one’s behavior (Keltner & Haidt, 1999; Trentacosta & Fine, 2010). The indirect assessment of effective action used in the current study is a limitation. Future research should incorporate the use of an in vivo behavioral assessment of effective action when presented with an emotional cue to determine whether these relations generalize outside of the computerized training contexts.

While the development of a behavioral assessment of emotion recognition skills was outside the scope of this investigation, future research might look into developing a standardized set of analogue social situations during which a participant’s response can be coded for proficiency. For instance, investigators may arrange social situations that mirror some of the contexts incorporated into the training in addition to other contexts that are not directly trained. Using these analogue situations, participants could be assessment both before and after training to evaluate the extent to which effective action skills have generalized to a more natural setting.

**The Importance of Multiple Cues in Training**

Over the course of stimulus set development, typically developing undergraduate and graduate research assistants in addition to two faculty members were presented with individual emotion cues similar to those used in certain emotion recognition training procedures (i.e. facial
expressions, body/postures or gestures, and contexts presented individually). An analysis of
their performance on labeling these individual stimuli suggested that typically developing
individuals are not especially skilled at agreeing on an emotion given only one cue, particularly
if it is a facial expression out of context. The current study went to great lengths to attempt to
validate the stimuli used in training by ensuring overall consensus from the social-verbal
community. While there was some variability in performance, the stimuli selected were all those
with a 75% consensus or greater suggesting that they were relatively common across the sample
of individual learning histories. As such, they were considered appropriate for training purposes.

The observed reduced performance on individual emotion stimuli could mean that the
stimuli selected were not especially representative of the specific emotion cues observed in the
everyday learning environment. This notion calls into question how an individual learns to
respond in ways congruent with experimenter expectations for emotion stimuli. Skinner (1945)
stated that we learn to label private events such as emotions through the reinforcement of our
social-verbal community. To identify appropriate stimuli, one must rely on his or her own
learning history in regards to what the surrounding social-verbal community reinforces as
coordinated emotion cues.

The finding that typically developing individuals had significant variability in labeling
individual emotion cues compared to compound stimuli is an important one. It suggests that
reliance on training with isolated emotion cues is much more susceptible to individual variation
in learning histories. This finding underscores the importance of incorporating multiple cues into
emotion recognition training procedures. The ability to recognize and effectively label a given
emotion involves the utilization of multiple sources of information. If interventions are
attempting to improve the ability of an individual on the autism spectrum to do this in everyday social interaction, training stimuli that better approximate such an environment are needed.

Future research might explore varying degrees of complexity for emotion recognition stimuli and the impact this has on training and subsequent results. For example, one might add an establishing operation or historical cue such as “Sally hasn’t eaten all day,” to the context of “She has been waiting for a table at a restaurant for an hour,” to the existing compound stimuli. While this will likely increase training duration and difficulty, it may also improve an individual’s awareness of the multiple factors that play a role in effective labeling of an emotion. Increasing the complexity of the stimuli could also improve the responsivity of individuals on the autism spectrum to multiple cues through multiple exemplar training. The use of such complex stimuli much more readily approximates the everyday environment, and will likely increase an individual’s ability to effectively recognize emotion in social situations.

General Limitations of the Current Study

The design of the current study suggests a functional relationship between improved performance and the emotion recognition training. This demonstration of experimental control is a strength of single case designs. However, future research should incorporate experimental designs that optimize external validity. In particular, it is an empirical question as to whether this procedure will be effective in a more diverse population of children. Future research should seek to replicate and extend the current findings. Also, the emotion stimuli included in the procedure only consisted of four emotion labels. The informal interview with parents prior to training indicated that participants did not understand a number of other emotions, including embarrassment, tired, and jealous. Future research might explore the use of additional emotion labels in the current study’s training procedure. Particular interest might be paid to using
different types of relational framing, including hierarchical relations. For example, research could look into training different gradations of emotion such as irritated, angry, and furious using hierarchical relations. Additional research could explore the use of this procedure to expand an effective action repertoire, as the appropriate responses chosen are not the only types of effective action available in the given situations. Still another limitation of the current study is the lack of social validity measures to evaluate the acceptability of the intervention to the intended consumer. This is particularly relevant since effective action was not directly trained or assessed. Future research should incorporate surveys asking both the participants and their parents about how effective they believed the training to be, and whether they would be willing to participate again or to refer someone to participate in the training. These surveys could be used to improve the training procedure.

**Emotion Recognition, Language, and Perspective Taking**

Prior research on perspective taking has for the most part viewed this behavior as a unitary construct (Kaland et al., 2008). However, it is much more likely that such a complex skill set incorporates a number of behavioral repertoires that when underdeveloped may lead to deficits in perspective taking, and in turn social skills (Samson & Apperly, 2010; Valdivia-Salas, Luciano, Gutierrez-Martinez & Visdomine, 2009). Emotion recognition skills, arguably a component of perspective taking (Carey & Cassels, 2013), exemplify this notion as deficits could be in attending to relevant emotion stimuli, in the effective communication of said emotions, or in the use of bringing behavior under contextual control of emotion stimuli to guide behavior. While all three participants in the current study demonstrated initial difficulties in all three skill domains, two of the participants were able to demonstrate generalization of skills to novel stimuli for attending to relevant emotion stimuli. This result provides promising support for an
effective emotion recognition intervention that may produce generalization of skills. However, it does not support the notion that emotion recognition is only one of the behavioral repertoires comprising perspective taking.

Research from the cognitive-developmental perspective has begun to explore the notion of multiple repertoires in perspective-taking by looking into emotion recognition or affective perspective taking (Bodden et al., 2013; Kaland et al., 2008). However, cognitive-developmental methods of assessment do not allow for performance to be easily parsed into specific behavioral repertoires. These methods also do not sufficiently account for the relationship between language and perspective taking performance. Research has shown that greater language ability correlates with increased perspective taking performance even after accounting for age (Boucher, 2012; Frith & Happe, 1994). The findings from the current study are consistent with this notion. Chuck had the highest scores on the receptive vocabulary and reading screening measures, and he was also the participant to show the greatest generalization of emotion recognition skills to novel stimuli.

The importance of language in the development of social-cognitive behavior like perspective taking has thus far been under-explored in the research literature. Research from the behavioral perspective has recently begun to explore the role of language and cognition in social skills (Rehfeldt & Barnes-Holmes, 2009). Such behavioral theories and methodology are particularly qualified for an analysis of the behavioral repertoires involved in complex social cognitive behavior like perspective taking. For instance, Skinner’s (1945) analysis of how the social-verbal community reinforces speaking about private events may help investigators identify relevant functions that can be coordinated with specific verbal behavior to improve perspective taking skills. Contextual descriptions that are often used in social skill vignettes could be tied to
language specific to observed public accompaniments, such as a blow to the head or a kick to the shins. Meanwhile, training stimuli used to for specific emotions could be tied to language by generating a pool of common collateral responses, such as specific facial expression, body postures, gestures or vocal prosody, and then facilitating their effective labeling.

Research stemming from Relational Frame Theory further expands on this solid behavioral foundation for addressing the role of language in social skill interventions. Derived relational responding remains a promising area of literature, particularly for developing interventions to assist those with developmental disabilities (Rehfeldt & Barnes-Homes, 2009). Derived relational responding has been purported to be the process underlying language generativity (Hayes et al., 2001; Stewart, McElwee & Ming, 2013), which yields a number of different research questions relevant to treatment development for those with language deficits.

Relational Frame Theory has also accumulated a substantial amount of research in regards to social cognitive behaviors like perspective taking. Based on this theory, deictic framing is a core component of perspective-taking skills. However, many studies using deictic framing do not necessarily incorporate the emotive language used in everyday social interactions and instead focus on tangible objects (McHugh et al., 2009). It is an open empirical question as to whether the use of emotive language in conjunction with deictic framing is sufficient to address perspective taking deficits. Based on the previously aggregated literature, the assessment and training of emotion recognition and perspective taking appears to be verbally mediated. Future research might explore whether the equivalence relations (with the various emotion functions and appropriate verbal labels for an individual’s social-verbal community) are intact prior to training in deictic framing, as well as investigate the relationship between emotion recognition and deictic framing. Future research might also expand on the use of relational
framing in conjunction with multiple exemplar training procedures to facilitate generalization of social communication skills to novel stimuli and contexts.

**Summary and Conclusion**

The findings from the current study indicate that the emotion recognition training procedure was sufficient for improving emotion recognition performance on a matching-to-sample task for three individuals on the autism spectrum. Directly training three relations between stimulus classes was sufficient to allow nine other relations to emerge for all three participants. In addition, two of the three participants demonstrated clear generalization of emotion recognition skills to novel stimuli. Assessment of generalization to the natural environment, however, yielded mixed findings. Overall the results of the current study suggest that incorporating derived relational responding into an emotion recognition matching-to-sample training is a promising method for remediating skill deficits. Future research is needed to replicate and extend these findings to more diverse populations and different content areas.
LIST OF REFERENCES


LIST OF APPENDICES
Informal Semi-Structured Parent Interview

1. What are the biggest improvements you would like to see in your child's social skills?

2. Do they have difficulty recognizing certain emotions in others? If so, what are they? Do they have difficulty identifying emotions that they are experiencing? If so, what are they? {if needed, I would ask: Have they ever had difficulty recognizing certain emotions in others or themselves? If so, what are they?}

3. Are there situations in which they do recognize these emotions? What are the situations in which they have particular difficulty recognizing emotions?

4. What about these situations do you think they have difficulty with? Do you think they don't understand the emotions? Do you think they are just not paying attention? Do you think they don't know what to do even if they recognize the emotion?

5. Do you think training emotion recognition skills would be helpful to your child?
APPENDIX B
**All Stimuli Used for Emotion Recognition Training & Assessment**

**Exemplar Set 1**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Bored</td>
<td>Confused</td>
<td>Frustrated</td>
<td>Worried</td>
</tr>
<tr>
<td>B</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
</tr>
<tr>
<td>B</td>
<td>Your friend is watching a movie that you chose.</td>
<td>A group is talking about football. You join them and talk about cars.</td>
<td>You grabbed your sister's favorite figurine without asking.</td>
<td>Your aunt told your cousin to be home at 8:00 but he is 2 hours late.</td>
</tr>
<tr>
<td>C</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
</tr>
<tr>
<td>C</td>
<td>Your friend is sitting alone in the corner at a party.</td>
<td>You are telling your aunt about today's science lesson in school.</td>
<td>Your mother asked you to clean your room, but you forgot to do it.</td>
<td>Your friend tells you that she forgot her homework in her bedroom.</td>
</tr>
<tr>
<td>D</td>
<td>Say “Hey. How are you doing?”</td>
<td>Ask “Did what I just say make sense?”</td>
<td>Say “I’m sorry. I’ll make it right.”</td>
<td>Say “It will be okay.”</td>
</tr>
</tbody>
</table>

**Exemplar Set 2**

<table>
<thead>
<tr>
<th></th>
<th>5</th>
<th>6</th>
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<tbody>
<tr>
<td>A</td>
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<td>Confused</td>
<td>Frustrated</td>
<td>Worried</td>
</tr>
<tr>
<td>B</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
</tr>
<tr>
<td>B</td>
<td>You've been playing cards with your cousin for hours.</td>
<td>Your dad is sitting at the table. You ask him, “Are you mad at me?”</td>
<td>Your dad broke a glass and spilled juice all over the floor.</td>
<td>Your cousin looks up as an ambulance drives by.</td>
</tr>
<tr>
<td>C</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
<td>[Image]</td>
</tr>
<tr>
<td>C</td>
<td>You and your cousin have been in the car for two hours.</td>
<td>You tell your classmate a joke, but he doesn't laugh.</td>
<td>Your brother studied hard, but received a bad grade on an exam.</td>
<td>A neighbor tells you that she lost her pocketbook.</td>
</tr>
<tr>
<td>D</td>
<td>Say “So, what do you want to talk about?”</td>
<td>Say “Nevermind” and change the subject.</td>
<td>Say “What can I do to help?”</td>
<td>Say “I hope everything turns out okay.”</td>
</tr>
</tbody>
</table>
### Exemplar Set 3

<table>
<thead>
<tr>
<th></th>
<th>9</th>
<th>10</th>
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<th>12</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Bored</td>
<td>Confused</td>
<td>Frustrated</td>
<td>Worried</td>
</tr>
<tr>
<td>B</td>
<td>Your uncle is waiting for a table at a local restaurant.</td>
<td>You explain to your friend how to play a game.</td>
<td>You told your brother he can’t play a game with you and your friends.</td>
<td>You told your dad that someone is bullying you at school.</td>
</tr>
<tr>
<td>C</td>
<td>Your sister is waiting for your mom to finish grocery shopping.</td>
<td>The teacher asks you a question. You try to answer it.</td>
<td>You don’t let your friend take his turn in a game.</td>
<td>Your mom finds out that you were in a fight at school.</td>
</tr>
<tr>
<td>D</td>
<td>Say “Want to play a game while we wait?”</td>
<td>Say “I’m sorry. Let me try explaining it a different way.”</td>
<td>Say “I’m sorry. You can play.”</td>
<td>Say “What do you think I should do?”</td>
</tr>
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</table>

### Exemplar Set 4: Screener/Generalization

<table>
<thead>
<tr>
<th></th>
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<td>Bored</td>
<td>Confused</td>
<td>Frustrated</td>
<td>Worried</td>
</tr>
<tr>
<td>B</td>
<td>You are sharing your favorite music and why you like it with your cousin.</td>
<td>Your sister asks if you like her dress. Half-listening, you say, “Thank you.”</td>
<td>Your cousin was told she can’t play outside today until she finishes her chores.</td>
<td>The new kid at school stands alone in the lunchroom, looking for an open seat.</td>
</tr>
<tr>
<td>C</td>
<td>Your uncle is watching you play a video game.</td>
<td>Your mother opens the refrigerator and sees your action figure on the shelf.</td>
<td>Your cousin is trying to learn to ride a bike but he keeps falling off.</td>
<td>Your friend heard that his mom will be late picking him up from school today.</td>
</tr>
<tr>
<td>D</td>
<td>Say “Let’s do something else. What do you want to do?”</td>
<td>Say “Did I do something wrong?”</td>
<td>Say “You seem upset. Can I help?”</td>
<td>Say “Want to hang out with me for a bit?”</td>
</tr>
</tbody>
</table>
### Exemplar Set 5: Novel Generalization

<table>
<thead>
<tr>
<th></th>
<th>17</th>
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<tbody>
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<td>Bored</td>
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<td>Frustrated</td>
<td>Worried</td>
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<td>B</td>
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<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>B</td>
<td>You are telling your sister about the new movie you want to see.</td>
<td>Your friend sees something in the sky, and says “Huh.”</td>
<td>The teacher tells the class to be quiet, but you keep talking to your friend.</td>
<td>Your cousin just found out she has 3 cavities and needs to see the dentist.</td>
</tr>
<tr>
<td>C</td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
</tr>
<tr>
<td>C</td>
<td>Your father is listening to a museum program about history.</td>
<td>Your friend gets handed math work in science class.</td>
<td>You interrupt your father while he is working on a computer project.</td>
<td>Your sister has a math test tomorrow and she hasn’t started studying yet.</td>
</tr>
<tr>
<td>D</td>
<td>Say “Hey, you want to go do something fun!”</td>
<td>Say “What doesn’t make sense?”</td>
<td>Say “I’m sorry” and then stop talking.</td>
<td>Say “Everything will work out.”</td>
</tr>
</tbody>
</table>
VITA

Kerry Whiteman
Kwhiteman07@gmail.com

EDUCATION

2010 to present  Doctor of Philosophy (Anticipated August 2015)
University of Mississippi, Oxford, MS
Clinical Psychology
Dissertation: Training emotion recognition skills in children on the autism spectrum using derived relational responding (proposed 10/2013)
Dissertation Chair: Kelly Wilson, Ph.D.

2009 to 2010  Post Baccalaureate Certificate in Autism Studies
Office of Collaborative Programs, College of Health Professions
Towson University, Towson, MD

2008 to 2010  Masters of Arts
Clinical Psychology
Towson University, Towson, MD
Thesis: Differentiating between poor emotional intelligence and empathic dysfunction across high functioning autism, anorexia nervosa, and alexithymia
Thesis Chair: Alix Timko, Ph.D.

2003 to 2007  Bachelor of Arts, Cum Laude
Franklin & Marshall College, Lancaster, PA
Double Major: Psychology and Theater

AWARDS/GRANTS


CLINICAL EXPERIENCE:
August 2014 to August 2015  Doctoral Psychology Intern
Nebraska Internship Consortium for Professional Psychology
Beatrice State Developmental Center, Beatrice, NE
Supervision provided by Shawn Bryant, Psy.D.
Duties included:
• Providing individual therapy to clients with intellectual disability
• Conducting functional assessments on problem behaviors and then developing behavior support plans based on those assessments
• Conducting psychodiagnostic testing and writing of integrated psychological assessment reports for individuals living at Beatrice State Developmental Center
• Training direct support professionals to implement behavior support plans effectively and conducting treatment integrity checks
• Data analysis of progress made towards behavioral goals identified in behavior support plans
• Working as part of an interdisciplinary team and consulting on different behavioral issues that arise over the course of active treatment in a residential setting for individuals diagnosed with intellectual disability

July 2012 to July 2014  Clinical Doctoral Intern
Autism Center of Tupelo, Tupelo, MS
Supervision provided by Scott Bethay, Ph.D.
Duties included:
• Provided one-on-one behavioral instruction using discrete trial training, natural environment teaching and functional communication training
• Skills assessment of social and verbal behavior using the VB-MAPP as well as subsequent program development
• Behavioral interventions and support to increase alternative appropriate behavior
• School consultations incorporating TEACCH and behavioral principles
• Conducted comprehensive diagnostic assessments on intellectual, academic, language, adaptive behavior, and
maladaptive behavior as well as measures specific to autism spectrum symptoms (i.e. ADI-R & ADOS)

- Wrote integrated reports with specific treatment recommendations
- Successfully authored grants to provide scholarship funding for behavioral interventions and diagnostic services to low-income clients as well as to provide equipment needed to expand the Autism Center facility.

**June 2011 to July 2014**

**Graduate Student Therapist**

**Psychological Services Center, University of Mississippi**

Group and individual supervision provided by Scott Gustafson, Ph.D., Kelly Wilson, Ph.D., Todd Smitherman, Ph.D., Scott Bethay, Ph.D., and John Young, Ph.D.

Duties included:

- Conducted intakes, structured interviews, individual psychotherapy and group psychotherapy for children, adolescents and adults with a broad range of presenting concerns (ex: autism, ADHD, anxiety, SMI, migraine, insomnia, body image disturbance).
- Treatment was conducted with a focus on traditional behavior therapy, contemporary behavior therapies (e.g. Acceptance and Commitment Therapy), and traditional Cognitive Behavioral treatment packages.

**June 2011 to June 2012**

**Clinical Psychology Intern**

**North Mississippi Regional Center, Oxford, MS**

Supervision provided by Scott Bethay, Ph.D.

Duties included:

- Conducted diagnostic assessments and writing integrated reports
- Consultation with clients and families including education on diagnoses, explanation of service eligibility and the location of additional beneficial resources
- Conducted group therapy and individual therapy for adults with intellectual disabilities
- Conducted functional behavioral assessments and writing behavior programs.

**Sept. 2009 to May 2010**

**Research Assistant & Clinical Intern**

**Pediatric & Developmental Neuroscience Branch**

**National Institute of Mental Health, Bethesda, MD**

Supervision provided by Audrey Thurm, Ph.D.

Duties included:
• Outcome evaluation
• Scored assessment measures and managed a large database of screening evaluations for different research projects
• Worked on the Regression Validation Interview project to explore different patterns of skill attainment and loss in children on the autism spectrum
• Observation and reliability training on a number of different assessment measures (e.g. ADI-R, ADOS, Mullen Scales, DAS)
• Conducted a literature review on restricted, repetitive behaviors in individuals on the autism spectrum
• Attended a number of didactic seminars on topics related to pediatric and developmental neuroscience.

June 2009 to May 2010 Social Facilitator
Hussman Center for Adults with Autism, Towson, MD
Supervision provided by Lisa Crabtree, Ph.D.
Duties included:
• Organized social events for local adults on the autism spectrum
• Provided modeling and in vivo feedback on appropriate social behaviors during these events
• Conducted group therapy sessions specifically for females on the autism spectrum.

Jan. 2008 to July 2008 Volunteer Assistant
Fay J. Lindner Center for Autism, North Shore-LIJ Health System, Bethpage, NY
Duties included:
• Observed interdisciplinary case meetings
• Scheduled clients
• Scored assessment measures
• Organized medical records
• Provided psychoeducation and referrals to appropriate sources of treatment
• Managed Medicaid reimbursement and private billing.

May 2006 to May 2007 Behavior Therapist
The Tommy Foundation, Lancaster, PA
Duties included:
• One-on-one interaction using behavioral principles to increase social and verbal skills in a nonverbal child diagnosed with PDD-NOS.
• Assisted in organizing and participating in community outreach and Autism Awareness events

RESEARCH EXPERIENCE:

Aug. 2010 to July 2014  Research Assistant, Mississippi Center for Contextual Psychology
Department of Psychology, University of Mississippi, Oxford, MS
Duties included:
• Conducted experiments pertaining to emotion recognition and language, perspective taking and deictic relations, different ways of analyzing Implicit Relational Assessment Procedure data, the response cost of rigidly adhering to coherence, and the effects of contextual manipulations on therapy
• Organized and mentored undergraduate research assistants
• Managed and analyzed data
• Provided assistance with and feedback on fellow lab members research projects, presentations and manuscripts

Aug. 2008 to Aug. 2010  Research Assistant, Disordered Eating and Body Image Lab
Department of Psychology, Towson University, Towson, MD
Duties included:
• Conducted experiments pertaining to theory of mind, Implicit Relational Assessment Procedures for anxiety and body image, cognitive flexibility, and eating habits of parents and children
• Managed and analyzed data
• Provided assistance with the administration of fellow lab members research projects

May 2006 to May 2007  Undergraduate Research Assistant, Child Development Lab
Franklin & Marshall College, Lancaster, PA
Duties included:
• Recruited participants aged 23-25 month olds
• Conducted experiments pertaining to the teleological function of tools, and how children learn to use and name everyday objects
• Managed data collection

Sept. 2006 to May 2007  Undergraduate Independent Study
Franklin & Marshall College, Lancaster, PA
The effects of experiential and biological development on the improvement of theory of mind in autistic children.
Conducted a study examining the effects of total contrived social interactions and chronological age on theory of mind performance in children diagnosed on the autism spectrum

Managed and analyzed data

PUBLICATIONS


MANUSCRIPTS UNDER REVIEW


PAPER PRESENTATIONS, SYMPOSIA & PANELS


Whiteman, K. C., Kellum, K. K., Wilson, K. G. & Bordieri, M. (2014, June). Using RFT to train complete emotion recognition skills. Presentation at the meeting for the Association for Contextual Behavior Science, Minneapolis, MN.


Whiteman, K. C. (chair), Friman, P. C., Moran, D. J., & Kellum, K. K. (2013, May). Speak behavior analysis and be heard (like a boss!). Panel discussion at the meeting for the Association for Behavior Analysis International, Minneapolis, MN.


Bordieri, M. J., Whiteman, K. C., Kellum, K. K., & Wilson, K. G. (July 2011). Generalization of relational stimulus control beyond the lab: A preliminary investigation. Presented at the annual meeting for the Association for Contextual Behavioral Science, Parma, Italy.


POSTER PRESENTATIONS


WORKSHOPS


TEACHING EXPERIENCE:
Jan. 2011 to May 2011 Teaching Assistant Learning
Sept. 2010 to Dec. 2010 Teaching Assistant Abnormal Psychology

EDITORIAL POSITIONS
2011 Guest Reviewer for the Behavior Analyst Today

PROFESSIONAL ACTIVITIES
2012- 2013 Student Program Representative Association for Applied Behavior Analysis International
MEMBERSHIP IN PROFESSIONAL ASSOCIATIONS

Association for Behavior Analysis International
Association for Behavioral and Cognitive Therapies
Association for Contextual Behavioral Science
American Psychological Association

REFERENCES AVAILABLE ON REQUEST