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Evaluating the Effectiveness of Discrete Trial Procedures for Teaching Receptive Discrimination to Children with Autism Spectrum Disorders

Desiree J. Sepulveda
Florida International University, despi007@fiu.edu

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FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida

EVALUATING THE EFFECTIVENESS OF DISCRETE TRIAL PROCEDURES FOR TEACHING RECEPTIVE DISCRIMINATION TO CHILDREN WITH AUTISM SPECTRUM DISORDERS

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To: Dean Michael R. Heithaus
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This dissertation, written by Desiree Jasmin Sepulveda, and entitled Evaluating the Effectiveness of Discrete Trial Procedures for Teaching Receptive Discrimination to Children with Autism Spectrum Disorders, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

Bethany C. Reeb-Sutherland

Leslie D. Frazier

Kyle Bennett

Anibal Gutierrez, Jr., Major Professor

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The dissertation of Desiree Jasmin Sepulveda is approved.

Dean Michael R. Heithaus
College of Arts and Sciences

Dean Lakshmi N. Reddi
University Graduate School

Florida International University, 2015

DEDICATION

This dissertation is dedicated to my husband, Oliver, my parents, and my brother, Manny. Thank you for your continued support throughout this process and for believing in me when I found it difficult to believe in myself. I would also like to dedicate this dissertation to my daughter, Alexandra Andrea, and my niece, Alina Patricia. Remember that with hard work and perseverance, anything is possible. I love you.

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ABSTRACT OF THE DISSERTATION

EVALUATING THE EFFECTIVENESS OF DISCRETE TRIAL PROCEDURES FOR TEACHING RECEPTIVE DISCRIMINATION TO CHILDREN WITH AUTISM SPECTRUM DISORDERS

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Desiree Jasmin Sepulveda

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Professor Anibal Gutierrez, Jr., Major Professor

Research has found that children with autism spectrum disorders (ASD) show significant deficits in receptive language skills (Wiesmer, Lord, & Esler, 2010). One of the primary goals of applied behavior analytic intervention is to improve the communication skills of children with autism by teaching receptive discriminations. Both receptive discriminations and receptive language entail matching spoken words with corresponding objects, symbols (e.g., pictures or words), actions, people, and so on (Green, 2001). In order to develop receptive language skills, children with autism often undergo discrimination training within the context of discrete trial training. This training entails teaching the learner how to respond differentially to different stimuli (Green, 2001). It is through discrimination training that individuals with autism learn and develop language (Lovaas, 2003). The present study compares three procedures for teaching receptive discriminations: (1) simple/conditional (Procedure A), (2) conditional only (Procedure B), and (3) conditional discrimination of two target cards (Procedure C). Six children, ranging in age from 2-years-old to 5-years-old, with an autism diagnosis were taught how

to receptively discriminate nine sets of stimuli. Results suggest that the extra training steps included in the simple/conditional and conditional only procedures may not be necessary to teach children with autism how to receptively discriminate. For all participants, Procedure C appeared to be the most efficient and effective procedure for teaching young children with autism receptive discriminations. Response maintenance and generalization probes conducted one-month following the end of training indicate that even though Procedure C resulted in less training sessions overall, no one procedure resulted in better maintenance and generalization than the others. In other words, more training sessions, as evident with the simple/conditional and conditional only procedures, did not facilitate participants' ability to accurately respond or generalize one-month following training. The present study contributes to the literature on what is the most efficient and effective way to teach receptive discrimination during discrete trial training to children with ASD. These findings are critical as research shows that receptive language skills are predictive of better outcomes and adaptive behaviors in the future.

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Introduction

Autism spectrum disorders (ASDs) are neurodevelopmental disorders characterized by stereotyped/repetitive behaviors, social deficits, and impairments in communication (American Psychiatric Association [APA], 2012; Lord & Bishop, 2010). Prior to the recent revision of The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013), the "autism spectrum" generally referred to three subgroups of disorders: (a) autistic disorder, (b) pervasive developmental disorder – not otherwise specified (PDD-NOS), and (c) Asperger's disorder. Recently, however, the diagnostic criteria for autism have been redefined and "simplified" (Vivanti et al., 2013). Because numerous studies have found little differences between these subgroups of disorders (Macintosh & Dissanayake, 2004), autistic disorder, PDD-NOS and Asperger's disorder have been collapsed and are now collectively considered Autism Spectrum Disorder (ASD).

Nevertheless, one of the biggest treatment goals of behavior analytic interventions is to improve the communication skills of individuals with ASD. The primary goal of the current study was to compare three procedures and examine which is the most efficient and effective way of teaching young children with ASD receptive discriminations. Receptive discrimination programs are the means by which children with ASD are taught "receptive language," or what is being said by another person (Green, 2001; Gutierrez et al., 2009). Since Asperger's disorder was considered primarily a social disorder (Rice, Warren, & Betz, 2005) and was generally not characterized by language deficits (Cashin, Gallagher, Newman, & Hughes, 2012), the focus of the present study was strictly on

children with a diagnosis of autistic disorder (more commonly known as autism) and, to a lesser extent, children with a diagnosis of PDD-NOS.

Although the principles of applied behavior analysis and how they relate to autism intervention will be explained in greater detail later, it is critical that an important point about terminology be made before proceeding. Applied behavior analysis is based on the operant theory put forth by B.F. Skinner in the early twentieth century. Skinner, unlike behaviorist John Watson, did not dismiss private events (i.e., thoughts) as unimportant or irrelevant; he viewed them not as causes for behavior but as behaviors themselves. Nevertheless, like Watson, Skinner did emphasize the direct study of observable behavior. As a result, inferences are not made regarding the thought processes of organisms during learning. Instead, learning is observed when change in overt behavior is observed. This is a fundamental point to make as cognitive psychologists and linguists make distinctions between receptive identification, receptive language, and receptive vocabulary. These distinctions are not made by the behavior analysts writing and implementing the skill acquisition programs of children with ASD. To behavior analysts, receptive discrimination, receptive identification, receptive language, and receptive vocabulary are all demonstrated when an individual can listen to a verbal instruction and behave accordingly in response to those instructions (Lovaas, 2003). For example, a toddler is told by her caregiver to “come here,” and the toddler proceeds by walking towards the caregiver. An additional, perhaps more relevant example is as follows: a toddler is told by her caregiver to “point to the teddy bear,” and the toddler proceeds by pointing towards the brown teddy bear sitting on the shelf. Here, cognitive psychologists might argue that the child has mapped the word onto the object (word-object mapping).

However, behavior analysis focuses on the investigation of observable behavior. What is known is that the child can discriminate the bear from all other toys on the shelf and therefore "understands" the caregiver's instruction.

Overview of Autism: A Review of the Literature

Autistic disorder (more commonly known as autism) is characterized by serious deficits in social and communicative skills. Another characteristic of autism is engagement in repetitive behaviors and/or restricted interests (Horovitz & Matson, 2010). Pervasive developmental disorder – not otherwise specified (PDD-NOS), on the other hand, was characterized by milder deficits in social and communication skills (Rice et al., 2005) as well as stereotyped behaviors. It is useful to note that the line drawn to differentiate a child with autism and a child with PDD-NOS was not always clear. Walker et al. (2004) attempted to better differentiate between children with autism disorder, Asperger's disorder and PDD-NOS. They found that the PDD-NOS diagnosis was usually assigned to children whose symptoms were not as severe as those with autism but whose language delays disqualified them from being diagnosed with Asperger's disorder. In general, the PDD-NOS diagnosis was given for the presence of "atypical autism," characterized by impairments in communication and social interactions, but not by the presence of stereotyped behaviors ("PDD-NOS and Asperger Syndrome," para. 1). Their findings were consistent with the idea of PDD-NOS as a "working diagnosis" for children who exhibit milder indicators of autism and for children who exhibit less repetitive behaviors (APA, 2012, "Autism Spectrum Disorders," para. 1). More recently, the DSM-5 addresses the heterogeneity observed within this population by supplementing the ASD diagnosis with descriptions of relevant clinical

details (e.g., intensity of symptom severity, verbal abilities, cognitive abilities; Vivanti et al., 2013).

Autism Symptomology. Autism was first described by child psychiatrist Kanner (1943) as a disorder of "extreme… aloneness" (p. 242). Kanner viewed autism as an acute form of child psychopathology, present from birth, characterized by rigidity, indifference towards people and social interactions, and abnormal language. Other more recent authors have agreed noting that individuals with autism exhibit several pathological behaviors including, but not limited to, engagement in self-stimulatory behaviors, engagement in stereotyped, ritualistic, or repetitive behaviors, abnormal language development, atypical speech (e.g., echolalia, psychotic speech), limited responsiveness to their external environment, social alienation, impoverished affect, poor eye contact, deficits in orienting toward social stimuli, and disinterest in socializing with peers (Lovaas, Koegel, & Schreibman, 1979; Lovaas, Schreibman, & Koegel, 1974; Sigman, Dijamco, Gratier, & Rozga, 2004; Smith, 1999).

Prevalence of ASD. Over the past three decades, autism diagnoses have increased 16-fold (Hattier & Matson, 2012). Hattier and Matson note that it remains unclear whether this increase is a direct result of the disorder becoming more prevalent or whether improved diagnostic tools and public attention are responsible. Regardless of the factors contributing to the considerable increase in diagnoses, as of 2010, 1 in 68 children are diagnosed with an autism spectrum disorder, with the disorder affecting five times more males than females; 1 out of 42 boys are diagnosed with ASD, whereas 1 out of 189 girls are diagnosed (Centers for Disease Control and Prevention [CDC], 2014).

Causes, Course, and Prognosis. The exact cause of ASD is unknown. Research suggests that it is likely a combination and interaction of various genetic, environmental, and neurological factors (CDC, 2014; Dawson et al., 2002; Herbert, 2010). Studies have consistently shown that having a close family member with ASD increases the likelihood of the child being afflicted by the disorder as well (CDC, 2014; Dawson et al., 2002). The Centers for Disease and Prevention (2014) report that chances of a child being diagnosed with an ASD disorder ranges from: (a) 36% to 95% if their identical twin has an ASD; (b) 0% to 31% if their fraternal twin has an ASD; or (c) 2% to 18% if their older sibling has an ASD. Additional risk factors reported include the child being born to older parents and a child being born prematurely or with low birth weight (CDC, 2014). These findings suggest that genetics play a role, yet no single biological cause for autism has been identified to date (Cashin et al., 2012).

Although research has focused heavily on the genetic contributors of ASD, it has become evident that external variables also play an important role (Herbert, 2010). What's more, an emphasis on environmental risk factors corroborates the idea that the relationship between an organism's internal and external environment of an organism is inseparable (Lickliter & Honeycutt, 2003). In fact, evidence suggests that environmental influences on bodily processes contributing to the neurological and biological changes highly associated with autism might begin while the infant is still developing in the womb (Herbert, 2010).

Recent neurological studies with mice pose some interesting hypotheses about the neurological differences between individuals with ASD and individuals without ASD. For instance, Kane et al. (2012) found that mice lacking serotonin in their brains

exhibited many of the behavioral manifestations characterized by autism: deficits in social interaction, impairments in communication, highly repetitive and compulsive behaviors, delays in reaching certain developmental milestones, and a reduced preference for the scent of their mother when compared to the scent of an unrelated female mouse. These findings may provide useful information regarding the neurological events of individuals with autism and how these individuals differ from typically developing populations. This area of research is undoubtedly promising, yet it is important to remember that the field is still developing (Cashin et al., 2012) and individuals with ASD vary widely in symptom severity. Regardless of the lack of knowledge regarding the specific causes of autism, research suggests that ASD is not caused by parent behavior, as first hypothesized by Kanner (1943), nor is it caused by vaccines (Madsen, 2005), but a combination of biological, neurological, and environmental factors.

Autism is a lifelong disorder (Rogers, 2004; Smith, 1999). Although cases of diagnosed children living functionally and independently as adults are on the rise (APA, 2012), Howlin, Mawhood, and Rutter (2000) found that the prognosis for individuals afflicted with autism is generally poor. Howlin and colleagues refer to longitudinal research in Europe, North America, and Asia which show that many adults with ASD do not live independently, are unemployed, suffer from anxiety disorders, lack friendships, and lack sexual relationships even when they score within normal range on assessments of intelligence. Still, other researchers prefer to focus on the improvements made by individuals with autism after receiving intervention (Helt et al., 2008), particularly early intensive behavioral intervention (McEachin, Smith, & Lovaas, 1993; Rogers & Vismara, 2008). It is very possible that the adults sampled in the review of the literature do not

show a significant increased quality of life over time because early intervention has become of grave importance recently; these adults may not have had access to such services early in development limiting their improvements over time.

Helt et al. (2008) found that a very small group of individuals diagnosed with ASD as children eventually lose their diagnosis; that is, after some time, they score within normal range on social, cognitive, and adaptive domains. These children differed from others in that they originally scored high on intelligence, receptive language, imitation and motor development. Furthermore, it is of utmost importance to point out that these "recoveries" came about after behavioral intervention (Rogers & Vismara, 2008). Despite these findings, there exists no cure for autism and children do not "outgrow" the disorder (APA, 2012).

Therefore, the literature suggests that without intervention, individuals diagnosed with autism will experience poor outcomes, whereas those individuals exposed to intervention are more likely to experience better outcomes (Rogers & Vismara, 2008). Indeed, studies have repeatedly shown that early diagnoses paired with early interventions that target the behavioral deficits (social and communicative) and behavioral excess (stereotyped behaviors) characteristic of individuals with autism, can significantly improve their quality of life and prognosis (Helt et al., 2008; McEachin, Smith, & Lovaas, 1993; Rogers & Vismara, 2008). Consequently, one of the primary goals of early intervention programs is increasing the communication skills of children with ASD (Sundberg & Partington, 1998).

Communication Deficits. Prior to the fifth edition of the DSM, communication deficits were one of the three main diagnostic criteria for autism spectrum disorder (Lord

& Bishop, 2010). Currently, however, the social and communicative deficits observed in individuals with ASD were collapsed into one category: social/communication deficits (American Psychiatric Association, 2013). By combining these deficits, the focus becomes more on how the child uses language to initiate and sustain social interactions and less on when the child develops language (Vivanti et al., 2013). Nevertheless, it is the deficits in communication that parents tend to notice first at around 18 months of age (Horovitz & Matson, 2010) and it is the delay in communication that typically encourages caretakers to request professional advice (Kasari, Paparella, Freeman, & Jahromi (2008).

Whereas typically developing infants begin indicating signs of word comprehension at approximately 9 months of age and begin producing functional words by 12 months (Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994), children with autism often experience significant delays in language development (Wiesmer, Lord, & Esler, 2010). According to Weismer and colleagues (2010), these language delays are significant in both receptive and expressive language. As with typically developing children, there appears to be significant variability in language development among toddlers with ASD. In fact, language abilities are one of the most variable characteristics of individuals with autism (Weismer et al., 2010).

According to Horovitz and Matson (2010), some research suggests the delays in specific behaviors linked to communication (e.g., use of gestures, comprehension of small phrases, babbling, engagement in joint attention, social smiling, proper facial expressions), are evident in children later diagnosed with ASD by the time they are one year old. By 18 to 24 months old the signs become more evident; these children fail to

respond to their name and manifest impairments in vocabulary comprehension and production and by the time the child is 36 months old, even more communication impairments are apparent (e.g., impairments in the use of gestures, eye gaze, and language development). It is typically around this age that formal diagnoses are given (Horovitz & Matson, 2010).

Deficits in the use of gestures to communicate are particularly noteworthy as Tomasello, Carpenter, and Liszkowski (2007) posit that infant pointing contains the fundamental aspects of language that make it unique to humans: joint attention, reference via perspectives, reference to absent entities, cooperative motives, and other forms of shared intentionality. As defined by Mundy, Sigman, Ungerer, and Sherman (1986), joint attention refers to the individual's ability to "coordinate attention between interactive social partners with respect to objects or events in order to share an awareness of the objects or events" (p. 657). Joint attention has repeatedly been shown to accurately predict the current and future language abilities of children with ASD (Dawson et al., 2004; Siller & Sigman, 2008). If joint attention is a necessary prerequisite for language development and communication, this would explain why social and communicative deficits seen in ASD are so strongly associated.

Negative Impact of Communication Deficits on Other Behaviors. The fact that all three core characteristic of autism must be present to a significant degree for an individual to be diagnosed suggests that the symptoms are strongly associated with one another. Some researchers believe that the main deficit in individuals with autism is communication (Rutter & Bartak, 1971); meanwhile, others posit that communication difficulties appear to be the result from impairments relating to social behaviors (Sigman

et al., 2004). In reality, extensive research shows that the exact relationship between the three symptoms is unknown (Hattier & Matson, 2012). Communication deficits may appear to be the root of the problem because it is the most obvious problem at an early age; whereas, social deficits may appear to be the root of the problem because social behaviors are prerequisites to learning language (Tomasello et al., 2007). Nevertheless, it is critical to keep in mind that causation cannot be implied from correlations; an additional factor may exist, simultaneously influencing these core characteristics of autism. Furthermore, if a causal relationship does exist, the direction of the influence remains up for debate. On the basis of the literature, it seems very probable that the relationships, at least between social and communicative deficits, are bidirectional.

Despite the field's lack of understanding of the direction of influence, it remains clear that the communication deficits demonstrated by individuals with autism have widespread effects. For instance, Newborg (2005) stated that impairments in communication exacerbate social deficits already present by making it difficult to communicate with others. The link between communication impairments and repetitive behaviors is much more debatable. While Dworzynski et al. (2007), found no significant correlation between communication impairment and repetitive and restricted behaviors and interests, Leekam, Prior, and Uljarevic (2011) argued that restricted and repetitive behaviors can be caused by or triggered by communication problems. There exists less debate, however, surrounding the notion that communication deficits often result in elevated problem behaviors (Matson & Neal, 2010).

Communication in ASD: Delayed or Deviant? As with all developmental language disorders, there exists questions as to whether the language impairments

exhibited indicate a mere delay or an underlying deviance in development when compared to typically developing children (Rice et al., 2005). According to Rice and colleagues making the distinction of an impairment as being a delay or a deviance taps into the question of whether the development of such systems are the same or different to those individuals without ASD. Because there is significant variability in the communicative abilities of children with autism, it is difficult to come to a conclusion. Approximately 25-50% of all children with ASD never develop functional language (Hattier & Matson, 2012; Horovitz & Matson, 2010). Those individuals who eventually develop functional speech are likely to use it predominantly for different purposes than individuals not diagnosed with ASD. The speech of verbal individuals with ASD is usually egocentric and one-sided; they are often more concerned with expressing their wants and needs than engaging in interactions for social purposes (Smith, 1999). Nevertheless, there still exists that large population with ASD diagnosis that does eventually acquire language. It may be prudent, therefore, to conclude that while some individuals with ASD exhibit a language delay, others experience a deviant language system altogether.

The literature points to various examples that point towards a deviant language system for individuals with ASD. First, some individuals remain nonverbal well into adolescence. Rice et al. (2005) define being nonverbal as using less than six words daily. Second, Lord, Risi, and Pickles (2004) found that 20% of children with autism showed a period of language loss; at around 12 months, these children were using at least three words for at least a month, followed by the absence of words for at least another month. Lastly, Luyster, Kadlec, Carter, and Tager-Flusberg (2008) found that within a sample of

164 toddlers with ASD (129 boys and 35 girls), assessment scores for expressive language were significantly higher than the scores for receptive language. The finding that these toddlers performed better on items assessing expressive language than those assessing receptive language is of particular interest because it clearly defines a difference between typical language development and language development among children with ASD. It is true that significant variability across individuals exists, both within typical populations and ASD populations; however, comprehension must develop before production as it is impossible to accurately utilize words one does not understand (Hudry et al., 2010). A thorough review of the literature by Hudry and colleagues shows that preschoolers with autism generally show greater impairments in receptive communication than in expressive communication abilities.

Theoretical Perspective

Operant Learning Theory. The behavioral deficits (i.e., communication and social) and behavioral excess (i.e., stereotyped behaviors), impede development for individuals with an ASD diagnosis. These impairments do not improve without effective intervention (Matson & Neal, 2010). Strong evidence supports behavioral interventions, particularly those delivered early and intensively, as effective treatments for children with autism (Love, Carr, Almason, & Petursdottir, 2009). These intervention programs often improve developmental functioning by targeting the specific "symptoms" of autism (Rogers & Vismara, 2008); in other words, fundamental skills are targeted for acquisition and problem behaviors are targeted for reduction. The procedures of these behavioral intervention programs follow from operant principles and learning theory (i.e., behaviorism).

Behaviorism, driven largely by John B. Watson in the beginning of the 1900s, urged for observable behavior to be the focus of the field of psychology. Watson, like Russian physiologists Ivan Pavlov, focused on the study of respondent conditioning, which involved stimulus-stimulus pairing and reflexive behaviors. All humans are born with a set of reflexes. These reflexes are believed to have been established over evolutionary time because they have contributed to the survival of the species. Specific environmental stimuli elicit specific involuntary responses. For example, sudden exposure to a bright light will result in constricted pupils in humans. No learning is required and individuals do not voluntarily constrict their pupils. The bright light is called the unconditioned stimulus (US) and the pupil constricting is called the unconditioned response (UR). Watson believed human behavior could be explained by conducting studies that paired neutral stimuli with unconditioned stimuli to elicit conditioned responses.

The experimental analysis of behavior was established by B.F. Skinner (1938). Skinner made a clear distinction between respondent behavior, or behavior elicited by a stimulus, and operant behavior, behavior emitted and influenced by its environmental consequences and focused on the latter.

Operant behaviors are established through functional relationships and these functional relationships are established through repeated instances of behavior and the reliable change in the environment it yields (Glenn, Ellis, & Greenspoon, 1992). Unlike conditioned reflexes, what is important with regards to operants is the effect the emitted response has on the organism’s environment, not the effect a stimulus has on the response it elicits. Skinner believed it was operant behavior, not respondent behavior, which could explain the complexity of human behavior.

Unit of Analysis: Three-Term Contingency. Skinner's concept of behavior was revolutionary because he studied behavior in terms of its relationship with environmental stimuli (Glenn et al., 1992). The operant unit is not an isolated response or an isolated stimulus; it is the relationship between a response class and a consequential stimulus change. The aforementioned behavior-consequence relationship implied a two-term contingency.

In addition to describing the role of consequences, Skinner also described the role of antecedent stimuli in operant conditioning. Skinner explained that an antecedent stimulus can acquire evocative functions, making certain behaviors more likely to occur in their presence and allowing the behavior to come into contact with reinforcement. Together the three-term (antecedent-behavior-consequence) contingency form the basic unit of study of operant behavior (Glenn et al., 1992). To further clarify the three-term contingency, it may be convenient to describe each element separately, starting with the third element (consequences) and working backwards. However, it is *critical* to remember that what is important is the *relationship* between the three terms in the contingency; no one element can stand alone.

Consequence. Within an operant theory framework, responses emitted by living organisms create changes in the environment (removal or presentation of stimuli) that makes a behavior more or less likely to occur in the future. For the purposes of the current study, a focus will be on the former (making behaviors more probable). The process in which a stimulus is presented (or removed), contingent on a response, resulting in the strengthening of that response, in one or more dimensions (e.g., frequency), in the future is called reinforcement (Skinner, 1953). In the case of stimulus presentation

(positive reinforcement), the stimulus being presented is a called a "reinforcer." For instance, if a mother providing attention to her child (contingent on the child babbling) results in the child continuing to babble in the presence of his mother over time, attention is functioning as a reinforcer for babbling and that behavior is being positively reinforced. On the other hand, if a stimulus being removed is aversive, and its contingent removal results in the future strengthening of behavior, negative reinforcement has taken place. For example, a child babbles loudly contingent on his mother turning on the radio; consequently, the mother responds by immediately turning the radio off. If the child continues to babble each time the radio is turned on, its behavior is being negatively reinforced (by way of escape). Regardless of whether the term used to describe the reinforcement contingency at work is "positive" or "negative," these words only indicate the presentation or removal of a stimulus. Reinforcement, by definition, *always* denotes the strengthening of a behavior.

The concept of a reinforcer is commonly misunderstood. A reinforcer is a stimulus in the external or internal environment of an organism that when presented, strengthens one or more dimensions of a behavior (e.g., frequency, rate, duration). A stimulus in the environment is not a reinforcer defined by its physical characteristics. The reinforcing value of a stimulus is not permanent and changes depend on a number of environmental factors. For example, food is likely to function as a reinforcer after an organism has gone without eating for a prolonged amount of time. However, the presentation of food may become less reinforcing immediately after an individual has consumed a large Thanksgiving meal. Likewise, the presentation of food may act as a neutral stimulus if the individual is simply not hungry. Reinforcers are defined by their effect on future

behavior and not by their physical properties; they vary across individuals and they vary across situations. It is necessary to conceptualize a reinforcer as a stimulus that strengthens a behavior, as opposed to conceptualizing a reinforcer simply as a stimulus.

Behavior. According to Johnston and Pennypacker (2009), behavior is the "portion of an organism's interaction with its environment that involves movement of some part of the organism" (p. 31). It is important to remember that the environment can be internal or external. A common misconception about behavioral theory is that it discredits thoughts and other private events. However, unlike his predecessors (i.e., Watson), Skinner acknowledged thoughts, but he viewed them as behavior, not the cause or explanation for behavior (Cooper, Heron, & Heward, 2007). Simply stated, behavior is defined as anything an individual does. Nevertheless, there is an emphasis on observable behavior.

Through his analysis of behavior-environmental relationships, Skinner noticed that no two instances of behavior are exactly the same; consequently he introduced the notion of response classes, responses that are similar in form and/or function. Consider, for example, the behavior of a student raising his or her hand to get his teacher's attention. This student may raise his right hand on one occasion, and raise his left hand on another. Additionally, he may raise his entire arm in various different angles, or rest his elbow on the desk as he positions his forearm in an upward direction. All of these responses share some similarities, yet more importantly, all of these responses function to get the teacher's attention. Continuing with the example of the child who babbles to get his mother's attention, no two babbling sounds will sound exactly alike (e.g., some babbling sounds will be louder than others).

Skinner also discussed the concept of “response induction,” the process that occurs when a response is reinforced and other similar responses are by default reinforced as well. With respect to response induction, also known as response generalization, Skinner argues that it is difficult to find examples of two responses that share nothing in common; therefore, it is not surprising that as one operant is reinforced, others may be as well insofar that they “possess identical elements” (Skinner, 1953, p. 94). Variability across instances of behavior is inevitable. Some variations of operant behavior are reinforced, while others are extinguished (not reinforced) or punished (Donahoe, 2012).

Antecedent. Antecedents are environmental events (or stimuli) that occur or are present immediately before (or during) the occurrence of a behavior (Johnston & Pennypacker, 2009). When operants are more likely to occur under certain situations and less likely to occur under others they are said to be discriminated (Skinner, 1953). Stimuli that precede or are present when a response is reinforced, acquire evocative functions. In other words, these stimuli make behaviors more likely to occur in their presence because the probability of contacting reinforcement increases; in the past, that specific behavior had been reinforced in the presence of that stimulus (or one very similar to it). The antecedent stimulus acquires what is known as stimulus control.

Consider for example the child who babbles in the presence of his mother. Suppose a different family member, his aunt, did not provide attention contingent on babbling. If the child never babbles in the presence of his aunt but always babbles in the presence of his mother, his mother has become a discriminative stimulus (S^D). In the presence of his mother, the child is more likely to receive attention by babbling. In the presence of his

aunt, the child's babbling behavior is not likely to be reinforced; the aunt becomes an S^{Δ}, a stimulus correlated with non-reinforcement.

Antecedent stimuli that make certain behaviors more probable, allow a behavior to contact reinforcement. Discriminative stimuli cue the availability of reinforcement and, according to operant learning theory discriminated operants provide the groundwork for understanding more complicated behavioral relations. The three-term contingency is how organisms learn to discriminate.

Generalization. In addition to discrimination and the three-term contingency, Skinner (1953) also discusses the importance of generalization. Skinner spoke about response generalization using the term "response induction," which describes a process by which a response is reinforced and other similar responses are by default reinforced as well. Of particular relevance to the proposed study is the notion of stimulus generalization, or "stimulus induction," which describes a process that occurs when a response evoked by a particular stimulus is reinforced, and responses to other similar stimuli are by default reinforced as well. The more physically alike the second stimulus is to the first, the higher the probability that organisms will respond similarly to it. Continuing with the previous babbling child example, the child may behave similarly to both his mother and his aunt if they are identical twins and he is unable to discriminate between the two.

The notion of stimulus generalization is particularly relevant to the topic at hand since research shows that learning, for children with ASD, is often impeded by stimulus overselectivity (Lovaas et al., 1979). Lovaas and colleagues found that individuals with ASD often attend to very restricted parts of stimuli. Consequently, these individuals may

respond only to parts of the stimulus' properties that are relevant, and sometimes to irrelevant features of the stimulus during training. As a result, stimulus overselectivity makes it more difficult for these individuals to generalize what they have learned to similar stimuli. Additionally, they may be unable to emit learned behaviors under conditions that differ from the original training condition.

Applied Behavior Analysis Intervention. Applied behavior analysis (ABA) is a clinical area of psychology derived from behaviorism, the philosophy of the science of behavior (Cooper et al., 2007). Although not the first study to use principles of operant behavior (e.g., reinforcement) to modify and improve human behavior, ABA is traced back to the publication by Ayllon and Michael (1959), in which principles of behavior (i.e., reinforcement and extinction) were used to decrease problem behaviors exhibited by patients in a psychiatric hospital. Ferster (1961) was the first documented experimenter to attempt to understand the behavior of children with autism within an operant framework.

The defining characteristics of ABA, and consequently of ABA therapy, are as follows: (a) applied, (b) behavioral, (c) analytic, (d) technological, (e) conceptually systematic, (f) effective, and (g) generalizable (Baer, Wolf, & Risley, 1968). In other words, ABA: (a) focuses on modifying behaviors to better people's lives; (b) targets behaviors that are measurable, precise, reliable, and in need of improvement; (c) aims to demonstrate functional relationships between the independent variable (i.e., procedure) and a reliable change in the dependent variable (i.e., target behavior); (d) uses behavior modification procedures that are described clearly in detail, and replicable; (e) uses behavior modification procedures relevant to behavioral principles; (f) changes behaviors

in a manner that is clinical or socially significant; and (g) aims for the changes to be durable, occur in novel environments, and extend to other behaviors.

Teaching Receptive Language within an ABA Framework. Receptive language entails matching spoken words with corresponding objects, symbols (e.g., pictures or words), actions, people, and so on (Green, 2001; Lovaas, 2003). For instance, a child is verbally instructed by her teacher to pick up a pencil from the floor. The child picking up the pencil, instead of picking up the scrap sheet of paper next to the pencil, is an indicator that the child can discriminate between what a pencil looks like from what a sheet of paper looks like and "understands" the teacher's instruction. Additionally, the child picking up the pencil, as opposed to only looking at the pencil, also indicates some level of language comprehension (and perhaps compliance).

In order to develop receptive language skills, children with autism often undergo discrimination training within the context of discrete trial training (Lovaas, 2003). Discrimination training involves teaching the learner how to respond differentially to different stimuli (Green, 2001). A discrete training session is comprised of a number of discrete trials, as predetermined by a clinician. For example, one session may consist of 10 discrete trials and several sessions may be conducted each day of treatment.

According to Green, each discrete trial consists of five elements. The first element is the discriminative stimulus (S^D). The discriminative stimulus is usually the instruction or question presented by the therapist (e.g., "Touch (item)" or "What is it?"). The second element is the prompt. A prompt can be presented as the S^D is being delivered or immediately after. It helps the learner emit the correct response to the instruction or question provided if necessary. Examples of prompts include, but are not

limited to, the therapist modeling the correct response, pointing to the correct answer, or verbally providing the correct response. The third element is the response emitted by the child, which may be correct (or independent), incorrect, or prompted. The forth element of a discrete trial is the consequence, in which a reinforcer is delivered immediately after the correct or prompted response. A reinforcer can be any stimulus that strengthens responding over time. Common stimuli used in training, as reinforcers, include edibles and/or preferred toys. Incorrect responses typically result in the trial starting over. The fifth and final element is the intertrial interval, the time in between the delivery of the consequence and the beginning of the next trial. Discrete trial training sessions usually last between two to five minutes; different training sessions can be separated by a break of at least one to two minutes (Green, 2001).

According to Lovaas (2003), it is through discrimination training that individuals with autism and other developmental delays learn language. The goal of this type of training is to teach the learner how to respond differentially to different stimuli (Green, 2001). When training receptive discrimination, the trainer presents the learner with verbal stimuli and the learner is taught to make the correct nonverbal response to those stimuli (Lovaas, 2003). The nonverbal response can take on various forms. The learner may be taught how to “point to” the correct stimulus, “touch” the correct stimulus, or hand the trainer the correct stimulus. In its simplest form, a discrimination contingency is comprised of three elements: the antecedent stimulus (S^D), the response, and the consequence (Green, 2001).

Simple discriminations come about when the learner contacts reinforcement after emitting a particular response in the presence of particular antecedent stimuli;

consequently, in the future, the behavior is more likely to occur in the presence of those stimuli, yet not in the presence of other stimuli (Green, 2001). For example, a child who says "apple" (response), after being presented with a picture card of an apple (S^D) is consistently provided with access to a preferred toy (consequence). Let us assume for the sake of the example that the preferred toy functions as a reinforcer. In the future, the child is more likely to verbally say "apple" when presented with that stimulus. Additionally, if the child is not likely to verbally say "apple" when presented with a different stimulus (e.g., a picture card of a banana), the child is said to have learned a simple discrimination. The verbal response "apple" is under the control of the antecedent stimulus (e.g., the picture card of the apple). In sum, an antecedent stimulus that makes a response more likely to occur in its presence is called a discriminative stimulus; this antecedent event is said to have stimulus control over the behavior.

It is also important that learners respond to stimuli that are not identical, yet are physically or functionally similar, as if they were the same (stimulus generalization). In other words, it is useful for the child to say "apple" when being presented with a picture card of a red apple, green apple, and so forth.

In order to match spoken words with corresponding stimuli, as is required for receptive discrimination, conditional discriminations are required. Conditional discriminations are taught by reinforcing responses to particular antecedent stimuli, if and only if, specific stimuli come before or accompany that antecedent stimuli. In contrast with simple discriminations, in conditional discriminations, the antecedent stimulus functions as a discriminative stimulus signaling reinforcement depending on the presence of another antecedent stimulus (i.e., the conditional stimulus; Sidman, 1986). Consider

the example provided above with the child naming apples. Suppose the behavior that has been previously reinforced is that of the child pointing to the picture card of the apple when it is present. If the trainer now presents the child with two picture cards, one of an apple and one of a banana, the “correct” response resulting in reinforcement, would depend on (i.e., be conditional on) the trainer’s verbal instruction. Pointing to the apple will only result in reinforcement if the trainer instructs the child to point to the apple.

Conditional stimuli are considered antecedent stimuli, as they come before the response. Conditional discrimination contingencies, therefore, involve four (instead of three) elements: conditional stimuli, discriminative stimuli, responses, and consequences.

As previously stated, “receptive vocabulary” or “receptive identification,” are all demonstrated when an individual can match spoken words to corresponding stimuli. In other words, a learner responds to stimuli if and only if that stimulus was preceded by a specific spoken word. For example, suppose that a trainer is teaching a child how to receptively identify items of clothing. The trainer presents the learner with two picture cards: one of a shoe and one of a shirt. After hearing “shoe,” pointing to, touching, or giving the trainer the card with a shoe printed on it is reinforced, whereas pointing to, touching, or giving the trainer to card with a shirt printed on it is not. Likewise, after hearing “shirt,” pointing to, touching, or giving the trainer the card with a shirt printed on it is reinforced, whereas pointing to, touching, or giving the trainer the card with the shoe printed on it is not.

According to Green (2001), in order for a learner to consistently respond correctly and contact reinforcement during conditional discrimination trials, he or she must be able to do three things: (a) make successive simple discriminations, (b) make simultaneous

simple discriminations, and (c) match. Making successive simple discriminations means that the learner can differentiate between all of the sample stimuli presented in a session (across trials). Making simultaneous discriminations means that the learner can differentiate between each comparison stimuli presented in a trial. Lastly, matching means that the learner can match the sample stimulus with only one of the comparison stimuli presented. The learner's ability to do these things is evident in sessions where the "correct answer" varies across trials. These discrimination skills are frequently taught within the context of discrete trial training, but can also be taught through incidental teaching opportunities.

Two Teaching Approaches: Discrete Trial Training and Incidental Teaching. Typically developing children and children without autism learn language largely through experiences with the environment (Ellis, 1998). They need not to be taught how to discriminate across stimuli in such a systematic fashion. Children with autism, on the other hand, have a much harder time learning from their environment and picking up useful cues from adults (Smith, 2001), which is evident by their deficits in the realm of social interactions. Since children with autism experience these difficulties, they may fail to learn important skills if not granted the opportunities to do so (Green, 2001). Green argues that these "failures" may result in increased frustrations made evident through tantrums and escape and/or avoidance behaviors. There are two common ways of teaching children with ASD discrimination skills: (a) discrete trial training, and (b) incidental teaching. According to Newsom (1998), discrete trial training simplifies the "continuous flow of ordinary adult-child interactions into highly distinctive (discrete)

events that are more easily discriminated by the child” (p. 436). Green makes the case this type of training minimizes failures and maximizes success.

Discrete trial training is only one aspect of ABA treatment. Incidental teaching (Hart & Risley, 1968), a procedure originally designed to teach language skills to at-risk preschool children in naturally occurring interactions between them and the adults around them (i.e., teachers), is more similar to how typically developing children learn language. Incidental teaching entails the child’s environment to be rich in stimuli desired by the child. The role of the teacher is to provide positive attention (i.e., praise), as well as instruction, when the child initiates an interaction or shows interest in a stimulus. When teaching receptive vocabulary, an incidental teaching opportunity may take place as follows: a child is taken to an area of the room abundant in toys, the teacher asks the child to hand him or her the “car,” the teacher helps the child, if necessary, locate the car and they continue to play with the toy car together. It is always an advantage if the teacher targets an object that is likely to function as a reinforcer in that particular moment (McGee, Krantz, Mason, & McClannahan, 1983). Although researchers agree that these procedures are effective in facilitating language learning, McGee and colleagues (1983) state that it is usually only an effective method with children who have some developed language and are capable of initiating verbal interactions; in other words, incidental teaching is more effective in teaching speech production as opposed to teaching receptive discriminations. Although ABA includes various different procedures, identified by researchers to be effective for teaching children with ASD, the most common and validated method is discrete trial training (Green, 1996; Smith, 2001).

Errorless Learning. Errorless learning is a procedure characterized by the therapist ensuring that the learner makes no errors, or makes minimal errors (Warmington, Hitch, & Gathercole, 2013). With the errorless learning method, prompts are provided to ensure the correct response is emitted by the learner (Cooper et al., 2007). Errorless learning is commonly applied in the context of discrete trial training.

Terrace (1963) was the first experimenter to evaluate errorless training by using the procedure to teach pigeons how to discriminate visual stimuli. Specifically, he trained them to respond differentially to a red key and a green key without or with minimal amounts of error. The red key signaled the availability of reinforcement. In other words, the red key was the discriminative stimulus (S+). The green key did not signal reinforcement and consequently functioned as the non-discriminative stimulus (S-). Groups of pigeons differed in when the S- was presented (early or late) and how the S- was presented (progressively or constant). The pigeons who performed best and committed the least amount of errors in subsequent trials were the "early progressive" group. These pigeons were trained to respond when the red light was illuminated and trained to not respond when the light was dark. Initially, the amount of time the key was dark was short; however, eventually the dark light *progressively* turned green. Once both lights were equated (true discrimination), these pigeons reliably discriminated between both keys by only pressing the red one. Terrace found that operant discrimination can be learned with few, if any, responses to the S- and that accuracy was greatest for the pigeons that learned the discrimination without responding to S-. Interestingly, Terrace's findings showed that the pigeons that learned "with errors," exhibited "emotional" responses in the presence of S- (errors), and occasional bursts of responses to S-. Since

then, errorless learning procedures have widely been used to teach humans, particularly individuals with ASD (Koegel & Rincover, 1976; McGee & McCoy, 1981).

An alternative to errorless teaching is the error correction procedure, in which the student is allowed to make errors in responding. The error correction method involves resetting the trial following an incorrect response to the instruction or question (Green, 2001). For example, an instruction is given to a child to "clap." If the child does not respond, or responds incorrectly (e.g., waves goodbye), the therapist would redeliver the instruction and immediately provide a prompt to increase the chances of a correct response by the child. The lowest level prompt appropriate for this example is modeling the behavior. Therefore, the therapist would say “clap,” model the behavior by clapping, and wait for the child to respond. If the child responds correctly, the consequence (reinforcer) is delivered. If the child does not respond, or responds incorrectly, the therapist would use a more intrusive prompt such as physical (hand-over-hand) assistance. Once the correct behavior is emitted, a distracter trial, or a previously mastered instruction is given, such as "touch head," and the child responds to this instruction. The therapist then redelivers the original instruction, "clap hands." If a correct response is given, the child receives immediate reinforcement. If an incorrect response is given, the therapist goes back to the prompting sequence and distracter trial until a correct, independent response occurs.

There are several benefits to using an errorless training approach. Terrace (1963) found that pigeons that learned with this method exhibited less emotional responding and made fewer errors in the future. Sullivan, Sunberg, Partington, and Acquisto (2000) list other advantages to using the error correction technique. One advantage is that by

preventing incorrect responses from occurring, the number of times a trial has to be reset or restarted is limited. Consequently, more time during a session is dedicated to instruction, as opposed to implementing error correction procedures. A second advantage is that the chances of the child learning an incorrect chain of behaviors is diminished, resulting in a reduction of future errors. Lastly, errorless learning provides the individual with more opportunities for contact with reinforcement, providing a rich learning environment and a decrease of feelings of frustrations. Decreasing feelings of frustration is of particular importance because frustration is often manifested as the occurrence of problem behavior and it is difficult to conduct effective trials if the child is engaging in such behaviors. In sum, errorless learning is frequently used in discrete trial training sessions because it promotes positive learning opportunities and helps minimize errors and problem behaviors.

A Replication and Expansion

The current study aimed to evaluate three different procedures for teaching receptive vocabulary, or "receptive identification" of word-object pairs within a discrimination training paradigm. An additional goal of the current study was also to replicate and extend on a past study conducted by Gutierrez et al. (2009). In the original study, Gutierrez and colleagues evaluated two discrete trial procedures commonly used for teaching receptive language to children with ASD. The first procedure, the simple/conditional procedure (Lovaas, 1981) involved two steps. The first step (simple discrimination) involved teaching a novel stimulus in isolation (without a distracter stimulus present). The second step involved teaching the novel stimulus with a distracter stimulus present. For example, when using this procedure to teach "egg," the stimulus is

presented alone. The child is taught to point, touch, or hand the “egg” to the trainer when the egg is the only available stimulus to choose from. Once the child has mastered identifying the “egg” (determined by a preset mastery criterion), the conditional discrimination step is introduced in which a novel distracter stimulus, not targeted, is brought in (e.g., a picture of a tree). During this step, the correct response requires the learner to choose the egg from an array of more than one stimulus.

In the second procedure (conditional discrimination only), receptive discriminations are taught only in a conditional discrimination context, which includes the presence of distracter stimuli (Leaf & McEachin, 1999). Therefore, the second procedure is identical to the first with the exception that the initial no-distracter step is removed; target stimuli are always presented with at least one other non-target distracter stimulus. For example, when teaching “egg,” at least two stimuli are present from the first training session: a picture of a egg and another novel stimulus not being targeted.

Gutierrez and colleagues (2009) taught three children with ASD receptive discriminations using the simple/conditional procedure, as well as the conditional only procedure. All of the participants were able to learn to discriminate stimuli regardless of the procedure used. However, the results show that the simple/conditional procedure required more initial training sessions before discrimination was demonstrated. The finding that the conditional only procedure required less sessions is not particularly surprising considering that the simple/conditional procedure inherently requires more steps than the conditional only procedure for the participant to reach mastery. Importantly however, the authors found that including the “no distracter” step did not considerably improve the participant’s ability to learn how to receptively discriminate

stimuli. Gutierrez et al. argued that on the basis of the findings from their study, there is no empirical evidence suggesting that the "no distracter" step is necessary for children to learn and that having such a step may significantly reduce useful instructional opportunities by forcing the learner to engage in unnecessary practice trials. Additionally, Green (2001) agrees and argues that although a learner can respond correctly during trials in which the stimulus is presented in isolation, they may not be paying attention to the specific auditory or visual stimuli being presented. Instead, they could simply be engaging the same response that was reinforced in preceding trials. Lovaas (2003) refers to this error pattern as a molecular win-stay response, responding to the same visual stimulus in the same way as preceding trials because it resulted in reinforcement and not because of its relevant stimulus properties.

These findings corroborate another aspect of Terrace's (1963) study that is much less discussed by the field. Terrace is often credited with conducting the first experiment on the benefits of errorless learning, but he also found that the timing in which the S- (distracter stimulus) was presented played a very important role in discrimination training. The pigeons who were exposed to just the S+ initially (late groups) made significantly more errors than those pigeons who were exposed to the S+ and S- at the beginning of training (early groups) and for these pigeons, training took longer. Terrace's finding is consistent with the results of Gutierrez et al. (2009) in children with ASD. In regards to the present study, the first procedure which entails presenting the S+ in isolation before bringing in a distracter card (S-) should then yield more prompted responses (less accuracy) than the second procedure which eliminates the first step completely and begins with the distracter present.

A study by Grow, Carr, Kodak, Jostad, and Kisamore (2011) looked at the best way to teach children with autism receptive discrimination. However, in addition to comparing the two steps examined by Gutierrez et al. (2009), they also examined a third procedure in which three stimuli were targeted from the first training session. For example, within a session the therapist asked the child to identify “aardvark,” “hedgehog,” or “gazelle.” The correct target card could alternate across trials. They found that eliminating the “no distracter step,” as well as the “distracter step” resulted in a more efficient procedure. Additionally, the authors suggest that skipping the first two steps prevent pattern errors (i.e., win-stay responses) from emerging as a result of faulty stimulus control. Although the study by Grow and colleagues (2011) evaluated the multiple stimuli training condition, there are a number of limitations with these results. First, the procedures were changed numerous times during the experiment; error correction procedures were added for one participant and the prompting procedures changed three times for a second participant. Second, some of the participants in the study were not able to learn the first two steps: the simple discrimination step and the distracter step, calling into question the findings of their maintenance data. Third, one out of the three participants in the sample appeared to have considerably more advanced skills than the other two; consequently, discrete trial training may not have been an appropriate intervention. Finally, the authors did not provide any assessment scores, making it impossible to characterize the sample and verify where on the spectrum these children lie. The current study aims to improve upon the study by Grow et al. (2011) by more systematically evaluating the procedures and by gathering more descriptive information about the participants. Furthermore, the current study posits that children

who score higher on receptive language on assessments, like the Mullen Scales of Early Learning (Mullen, 1995), or children who exhibit less severe autism-related behaviors, as indicated by their scores on the Autism Diagnostic Observation Schedule: Second Edition (ADOS-2; Lord et al., 2012), may require fewer steps to learn new stimuli than children who score lower, or more severe, on these assessments. In other words, one size may not fit all.

Investigating the One-Size-Fits-All Approach to Treatment

According to Schreibman, Dufek, and Cunningham (2011), recent research has consistently shown that not all individuals with autism benefit from interventions the same way and to the same extent. Indeed, the variability among individuals with ASD make it quite plausible that a one-size-fits-all approach to treatment is likely not the best approach. Nevertheless, Schreibman and colleagues point out that not much is known about how to implement individual treatment protocols for this population; much less is known about how to determine a priori which treatment method is likely to work best for which child. Designing individualized procedures for children with autism, or any clinical population, requires a thorough understanding of the child's characteristics and skills before treatment. Furthermore, a link must be made between these characteristics and baseline skills to disparities in treatment outcomes. Schreibman et al. make a strong argument for research to find these links which would allow clinicians to tailor treatments to specific children optimizing their outcomes. One of the goals of the current study was to investigate the "once-size-fits-all" approach to treatment by administering pre-tests to each participant and assessing whether their scores on subtests related to receptive language skills provided information regarding which discrete trail procedure was best

for teaching them receptive discrimination. In other words, perhaps children who scored lower on subtests directly related to receptive language benefit from one procedure, while children who scored higher on these subtests benefit from another.

Purpose of the Current Study

The current study aimed to: (a) further evaluate the effectiveness of the two previously evaluated procedures (simple/conditional and conditional only); (b) investigate whether it is it more advantageous and efficient to teach two targets at the same time and eliminate not only the first (no distracter) step but the distracter phase as well; (c) evaluate differences between procedures regarding measures of response maintenance, as well as different measures of generalization (e.g., across therapist and within stimulus class); and (d) provide some insight as to whether different children with different characteristics and learning abilities differ in which procedure is most effective and efficient in teaching receptive discrimination.

Hypotheses. On the basis of past studies examining the most efficient and effective methods for teaching receptive discriminations (Gutierrez et al., 2009; Terrace, 1963), the following hypotheses were formulated:

Hypothesis 1. The simple discrimination step will not significantly improve any of the participants' ability to learn how to receptively discriminate between stimuli, replicating the findings of Gutierrez and colleagues (2009) and Terrace (1963).

Hypothesis 2. The distracter step will be necessary to teach receptive discriminations. Eliminating the distracter step and attempting to teach two target stimuli at once will result in significantly more sessions before mastery is reached.

Hypothesis 3. Accuracy in responding at one-month follow-up will be best with stimuli taught using the conditional only procedure.

Hypothesis 4. The conditional only procedure will result in better generalization at one-month follow-up. However, whether participants' performance during the generalization probes (across therapist and within stimulus class), will vary across participants depending on their scores on the ADOS-2 and the Mullen Scales of Early Learning.

Hypothesis 5. The higher a participant scores on receptive skills, as indicated by the Mullen Scales of Early Learning, the less number of sessions he or she will need to acquire discriminations, and the more likely they are to generalize the discriminations across therapists and within stimulus class at one-month follow-up.

Significance of the Current Study

Although an overwhelming amount of effective treatments for children with autism follow the principles of applied behavior analysis, there still exists many differences and variations in the methods and procedures used by practitioners to teach children with autism certain skills. Carr, Love, Almason, and Petursdottir (2006) surveyed ABA practitioners and found that 37% of them used the simple/conditional procedure to teach receptive discrimination, while 32% of them used the conditional only procedure. A few years later they surveyed ABA practitioners and members of 120 listservs dedicated to the topic of autism or applied behavior analysis (including therapists, supervisors, and parents) and revealed that the discrepancy among practices still existed (Love et al., 2009). The current study will contribute to the literature on what is the most efficient and effective way to teach receptive discrimination during discrete

trial training to children with ASD. These findings are critical as language skills in individuals with ASD shed light on prognosis.

Venter, Lord, and Schopler (1992) evaluated 58 high-functioning children over the course of eight years, starting when they were in preschool. The researchers tested these children using psychometric and language assessments. Additionally, they conducted direct observations and parent interviews in which they inquired about the children's severity of symptoms. Venter and colleagues then used the information gathered to investigate whether these assessments and observations predicted later social-adaptive functioning. The authors found that: (a) early vocabulary predicts future language abilities, and (b) speech development by the age of 5 years in children with autism is predictive of more positive developmental outcomes.

Helt et al. (2008) corroborated these finding. Their study showed that certain skills (i.e., receptive language, imitation, motor abilities), higher scores on intelligence tests, earlier diagnosis and treatment, as well as a diagnosis of PDD-NOS, instead of autistic disorder, predicted better outcomes. These individuals were more likely as adults to be living independently, working, married and maintaining relationships with friends.

Lastly, a link between communication skills and adaptive behaviors was also established by Park, Yelland, Taffe, and Gray (2012). In a study containing 57 preschoolers, some with autism, others with developmental delays (without autism), and others typically developing, it was found that for the autism population, higher receptive communication skills predicted improved adaptive behaviors in the future (i.e., daily living skills and social skills). The study emphasized a previous point made by Paul (2005) of the importance of teaching functional communication skills to children with

autism, specifically receptive communication skills. Park and colleagues found that receptive communication skills seem to play a more dominant role in predicting future outcomes for preschool-aged children with autism than the more structural parts of language (e.g., grammar).

All in all, research supports the notion that early communication skills, particularly receptive language skills, are predictive of more positive outcomes and better adaptive behaviors for individuals with ASD.

Method

Participants

Six children (1 female, 5 males, age range: 2-5 years) with an ASD diagnosis participated in the study. Children diagnosed with Asperger's disorder were not included as this disorder is not generally characterized by language deficits (Cashin et al., 2012). Participants were recruited from the Early Intensive Behavioral Intervention program and the Summer Treatment Program for ASD at Florida International University (FIU). Their parents received a thorough explanation of the study. Next, they were presented with the informed consent (see Appendix A) and asked to sign if they agreed to allow their child to participate.

Sophia. Sophia was a 2-year-old girl diagnosed with autistic disorder. She was participating in FIU's Early Intensive Behavioral Intervention program when she was recruited to participate in the study. Consequently, she had prior experience with receptive discrimination training. Sophia made vocal sounds and word approximations but did not yet spontaneously communicate using single words or phrases.

Francis. Francis was a 5-year-old boy diagnosed with autistic disorder. He was enrolled in FIU's Summer Treatment Program for ASD when he was recruited to participate in the study. Francis also had extensive experience with receptive discrimination training. He very often used phrase speech to communicate.

Elijah. Elijah was a 2-year-old boy diagnosed with autistic disorder. He was recruited to participate in the study from FIU's Early Intensive Behavioral Intervention program. Elijah had received receptive discrimination training within a discrete trail training paradigm for over a year before he was recruited. Elijah used phrase speech occasionally but mostly communicated using single words.

Jonathan. Jonathan was a 3-year-old boy diagnosed with autistic disorder. He was recruited to participate in the study from FIU's Summer Treatment Program for ASD. At the start of the experiment, Jonathan had not received formal receptive discrimination training within a discrete trial training paradigm. To communicate, Jonathan emitted word approximations and a few single words (less than five).

Liam. Liam was a 3-year-old boy who was also diagnosed with autistic disorder. He was enrolled in FIU's Summer Treatment Program for ASD when he was recruited to participate in the study. Liam had past experience with receptive discrimination training as a result of in-home ABA services. At the start of the study, Liam was able to emit word approximations and use one to four single words to communicate.

Luis. Luis was a 3-year-old boy diagnosed with autistic disorder. He had been enrolled in FIU's Early Intensive Behavioral Intervention program for a year before leaving to enroll in another school. During his time in the program, he received receptive discrimination training. Eight months later, his parents enrolled him in FIU's Summer

Treatment Program for ASD where he was recruited to participate in the study. Prior to the start of the study, Luis made no spontaneous use of words or word approximations.

All participants were evaluated with the Autism Diagnostic Observation Schedule: Second Edition (ADOS-2; Lord et al., 2012) by a research reliable assessor prior to their participation in the current study. The ADOS-2 results confirmed the autism diagnosis for all of the participants, except Francis. During Francis' ADOS-2, an administration error was made; therefore, his scores are not provided. However, Francis did obtain a community diagnosis of autism prior to his participation in the present study.

Assessments

Autism Diagnostic Observation Schedule: Second Edition (ADOS-2; Lord et al., 2012). The assessment is a semi-structured, standardized interaction intended to evaluate the current level of communicative and social functioning in children suspected of having autism spectrum disorder. The ADOS-2 sets the occasion for behaviors directly linked to an ASD diagnosis to occur and be assessed by an extensively trained examiner. The ADOS-2 consists of five modules (Toddler Module, Module 1, Module 2, Module 3, and Module 4) lasting approximately 40 to 60 minutes each. The module administered to a given child is determined the child's age, as well as his or her level of expressive language. Both the Toddler Module and Module 1 are administered to children who are preverbal and who do not consistently use phrase speech flexibly; however, the Toddler Module is designed for children 12 to 30 months old, whereas Module 1 is administered to children 31 months old and older. Module 2 is administered to children with more flexible speech but who are not yet verbally fluent. Verbal fluency is defined as having "spontaneous, flexible use of sentences with multiple clauses that describe logical

connections within a sentence" (Lord et al., 2000, p. 207). Additionally, verbal fluency is demonstrated if the individual can speak about an object or event present in the immediate environment. The more advanced Modules 3 and 4 are intended for children and young adolescents with fluent speech and older adolescents and adults, respectively.

All of the participants in the current study were administered either the Toddler Module or Module 1. Both modules include the following activities: Free Play, Snack, Response to Name, Response to Joint Attention, Bubble Play, Anticipation of a Routine with Objects, Anticipation of a Social Routine, Functional and Symbolic Imitation, and Responsive Social Smile (Lord et al., 2012; Luyster et al., 2009; Rice, 2013). Each activity assesses the child's ability to engage in developmentally appropriate interactions. The Free Play activity is a warm-up exercise to get the child engaged with the administrator. The Snack activity evaluates the child's ability to request items in a common setting. The Response to Name activity assesses the child's ability to response to his or her own name and the Response to Joint Attention activity assesses the child's ability to use gestures (i.e., pointing), verbalizations, eye contact and face orientation in response to the administrator drawing attention to an object at a distance. The goal of the Bubble Play activity is to elicit eye contact, vocalizations, and requesting behaviors (e.g., pointing, reaching); this activity also evaluates the child's ability to initiate joint attention. The Anticipation of a Routine with Objects activity tests the child's ability to anticipate or initiate the repetition of an action. For instance, if the administrator blows up a balloon and says "Ready, set, go," before allowing the balloon to deflate, will the child request the repetition of the activity? The Anticipation of a Social Routine is similar to the previous task except that the activity is a social one (i.e., Peek-A-Boo). The

Functional and Symbolic imitation activity tests the child's ability to imitate with real-objects in meaningful and non-meaningful ways. For example, the child is given the opportunity to imitate after the model drinks from a toy cup (meaningful) or after the model bounces the cup on the table (non-meaningful). The Social Smile activity can take place anytime throughout the administration of the module. This task assesses the child's smile in response to purely social interactions.

Although the activities in both Toddler Module and Module 1 overlap significantly, there are minor differences between the two: (a) Module 1 includes the Birthday Party activity, in which a pretend birthday party is held for a doll and engagement in functional and symbolic play is evaluated, and (b) activities have been slightly modified for the Toddler module to make the assessment more developmentally appropriate (Luyster et al., 2009). For instance, the Birthday Party activity can be substituted with a Bathtime activity because younger children may not be familiar with birthday parties yet.

According to Lord et al. (2000), items on the ADOS are typically scored on a 3-point scale from 0 (*no evidence of abnormality related to autism*) to 2 (*definite evidence of abnormality related to autism*). Sometimes a score of 3 is coded to indicate that the abnormalities observed are so severe that it interferes with observation. However, when analyzed, scores of 3 are converted into scores of 2. Scores of this assessment were used to describe five of the six participants of the current study (see Table 1).

Algorithms. The ADOS-2 provides evaluators with diagnostic algorithms for each module, and in the case of the Toddler Module and Module 1, for particular age ranges and/or levels of expressive language within modules. For the Toddler Module, two

algorithms take into account the child's level of expressive language. One algorithm (All Younger/Older with Few to No Words) is for children between 12 and 20 months of age or children between 21 and 30 months of age with a score of 3 or 4 on Item A1 "Overall Level of Non-Echoed Spoken Language" of the ADOS-2. The other algorithm (Older with Some Words) is for children 21 to 30 months of age with a score of 0, 1, or 2 on Item A1. Likewise, two algorithms take into account the child's level of expressive language For Module 1. The first algorithm (Few to No Words) is used to calculate the score of children who used four or less words or word approximations during the ADOS-2 administration. The second algorithm (Some Words) is for children who used five or more words or word approximations during the ADOS-2 administration.

Table 1

Participants' ADOS-2 Scores and Classification

Participant	Module	Algorithm	SA Total	RRB Total	Overall Total	Comparison Score	Range of Concern or ADOS-2 Classification
Sophia	Toddler	Few to No Words	15	4	19	N/A	Moderate-to-Severe
Francis	-	-	-	-	-	-	-
Elijah	1	Some Words	14	2	16	7	Autism – Moderate
Jonathan	1	Few to No Words	12	6	18	6	Autism – Moderate
Liam	1	Few to No Words	16	3	19	6	Autism – Moderate
Luis	1	Few to No Words	19	6	25	10	Autism – High

Overall Totals. The algorithms for the ADOS-2 are devised from a select number of items on the assessment. These algorithms are separated into two areas: Social Affect

(SA) and Restricted and Repetitive Behavior (RRB). The Social Affect (SA) area consists of items that assess a participant's "Communication" and "Reciprocal Social Interactions;" while the Restricted and Repetitive Behavior (RRB) area consists of items that assess a participant's "Restricted and Repetitive Behaviors." Although the algorithms are separated into two different areas, these areas are not interpreted separately; the SA Total is added to the RRB Total to yield a single Overall Total score.

Range of Concern. For the Toddler Module, the Overall Total Score is used to classify the child into one of three ranges of concern: *(a) Little-to-No Concern,* (b) *Mild-to-Moderate Concern,* or (c) *Moderate-to-Severe Concern.* Each range suggests the degree to which the child exhibited behaviors consisted with ASD during the ADOS-2 administration.

To determine the range of concern for a participant, a table located on the back of the algorithm form is used. The examiner selects the column corresponding to the child's language level (i.e., algorithm type) and locates the obtained Overall Total in that column. For instance, for the algorithm "All Younger/Older with Few to No Words," an Overall Total score of 0 to 9 indicates *Little-to-No Concern,* meaning that during the ADOS-2 Toddler Module administration, the child behaved similarly to children of the same age and language level without ASD, while an Overall Total score of 10 to 13 indicates *Mild-to-Moderate Concern,* meaning that during the ADOS-2 Toddler Module administration, the child exhibited some behaviors consisted with an ASD diagnosis. Lastly, an Overall Total score of 14 or higher indicates a *Moderate-to-Severe Concern,* meaning that during the ADOS-2 Toddler Module administration, the child displayed many behaviors similar to children of the same age and language level with ASD.

Comparison Scores. For Module 1, the Overall Total can be used to obtain a Comparison Score. The Comparison Score "provides a way of indicating a participant's level of autism-spectrum related symptomology, as observed during the ADOS-2, compared with that of children with ASD who are of the same chronological age and language level" (Lord et al., 2012, p. 5). The Comparison Score ranges from 1 (*Minimal-To-No Evidence of autism spectrum-related symptoms*) to 10 (*High level of autism spectrum-related symptoms*).

A table, found on the back of the algorithm form, is used to obtain the Comparison Score from the Overall Total score. First, the administrator chooses the relevant column corresponding to the participant's level of expressive language (i.e., algorithm) and age. Second, he or she finds the participant's Overall Total in that column. Lastly, the administrator follows the row with the obtained Overall Total to the far left (or right) of the table to pinpoint the Comparison Score for that participant.

Luyster et al. (2009) found that for the ADOS-2: (a) the interrater reliability for individual items, (b) the test-retest reliability for individual items, (c) the interrater reliability within domains, and (d) the assessment's internal consistency were excellent. Additionally, the assessment's ability to be sensitive, but specific enough, to detect autism and PDD-NOS relative to non-spectrum disorders was excellent (generally above 88% accuracy; Rice, 2013).

Mullen Scales of Early Learning (Mullen, 1995). The assessment was designed to evaluate the developmental functioning of children up to 69 months old. The Mullen Scales can typically be administered within 15 minutes to an hour depending on the child's age. The older the child, the longer the assessment takes. The Mullen Scales of

Early Learning provides an overall score (Early Learning Composite; *M* = 100, *SD* =15) and scores for subtests which assess gross motor skills, fine motor skills, visual reception, receptive language and expressive language. For each of the subtests, T scores (*M* = 50, *SD* = 10), percentile ranks, and age equivalents are available. Furthermore, the T score allows the evaluator to determine which of the five descriptive categories the participant falls in with regard to the five subtests, as well as with regard to their Early Learning Composite Score. The five descriptive categories are as follows: (a) very low, (b) below average, (c) average, (d) above average, and (e) very high.

Of particular relevance to the current study are the scores for the visual reception subtest and the receptive language subtest. According to Mullen (1995), both of these scales focus on language comprehension, or decoding input information; visual processing for the Visual Reception scale and auditory and auditory-visual processing for the Receptive Language scale.

Visual Reception Scale. The visual reception subtest assesses visual discrimination and visual memory. The tasks in this scale are intrasensory; visual stimuli of various shapes and patterns are presented and visual processing skills are assessed. For example, one of the tasks ("Stares at own hand") requires the infant to be laid on his or her back and the administrator is to record whether or not the infant stares at his or her own hand. A more advanced task, for children 33 to 44 months old, is the "Sorts spoon and block by category" task, which requires the administrator to place six blocks and six spoons mixed together on a table in front of the child. A container is then placed to the right of the objects and another container is placed to the left. The administrator demonstrates the sorting task by saying "See, this goes in here" as he or she places a

block into one of the containers and saying “This goes in here” as he or she places the spoon into the other container (p. 31). They repeat the procedure with a second block and gives a third block to the child saying, “Put this where it goes.” Because the tasks in this subtest are intrasensory, objects and pictures are not labeled and no vocalizations from the participant are required, with the exceptions of two tasks: (a) Item 14 (attends to pictures), and (b) Item 17a (matches objects).

Receptive Language Scale. The Receptive Language subtest aims to assess the child’s ability to decipher verbal input. The tasks in this scale are intrasensory and intersensory as well. The intrasensory tasks involve auditory information being presented and the child’s ability to discriminate auditory information is assessed. The intersensory tasks entail the child being presented with both auditory and visual information and demands being placed on his or her auditory/visual comprehension and short- and long-term memory. According to Mullen (1995), short-term memory is assessed when the child is provided with directions for each item in the scale. For instance, in Item 20 (Follows related commands), the administrator places a red ball on the floor and instructs the child to “Stand up and get the ball.” Next, the administrator places a low shelf or desktop and instructs the child to get the box and bring it to him or her (p. 81). On the other hand, long-term memory is evaluated via intersensory tasks (auditory retention with visual associations). For instance, in Item 30 (General knowledge), the child is asked a number of questions (e.g., “How old are you?”; “How many legs does a horse have?”; p. 88). For a majority of the tasks included in the Receptive Language scale, the child is only required to respond by pointing. For example Item 23 tests comprehension of language words; the Stimulus Book is placed in front of the child and the child is asked

three questions: (a) “Where is the baby eating?,” (b) “Where is the baby sleeping?”; and (c) “Where is the baby washing?”. The child is scored based on how many pictures he or she identified correctly. According to Mullen (1995), failing this subtest is typically due to the child’s inability to “derive linguistic meaning from language” (p. 11).

The Record Form of the Mullen Scales of Early Learning is divided into five areas for each of the subtests: Gross Motor, Visual Reception, Fine Motor, Receptive Language, and Expressive Language. Under the heading for each scale, the Item and Item numbers are listed. To the left of the Item number are black flags with ages which show suggested starting points for typically developing children. For most of the items, a score of 1 indicates a correct response and a score of 0 indicates an incorrect response. Some other items include more possible points (range 0 to 5). The administrator begins the assessment with the item suggested based on the child’s age, followed by the next two items. Base level is established if the child scores at least 1 point for each of the three items. If the child does not score at least 1 point on each of the first three items, the administrator moves back to the next lower starting point, repeats Step 1, and continue to move backwards until base level is reached. Once base level is established, the child is credited with the maximum point for all items below the basal items. The administrator continues testing up the scale until the child obtains zero points for three consecutive items (ceiling level) and obtains the raw score for the subtest by adding all the points below the base item plus all the points between the base item and the ceiling item.

Scores of this assessment (see Tables 2 and 3) were used to examine whether children who are more developmentally advanced in the Visual Reception scale and the Receptive Language scale benefit from a receptive discrimination procedure that requires

less steps (i.e., conditional discrimination of two target cards), while children who score lower on these assessments may benefit from a receptive discrimination procedure that requires more steps (i.e., a distracter step).

Table 2

Participants' Mullen Visual Reception Scale Scores

		Visual Reception Scale				
Participant	C.A. (months)	Age Equivalent (months)	Raw Score	T Score	Percentile Rank	Descriptive Category
Sophia	29.9	18	21	24	1%	Very Low
Francis	64.6	33	33	20	1%	Very Low
Elijah	30.1	12	15	20	1%	Very Low
Jonathan	44.4	20	23	20	1%	Very Low
Liam	41.7	21	24	20	1%	Very Low
Luis	46.6	24	26	20	1%	Very Low

Table 3

Participants' Mullen Receptive Language Scale Scores

		Receptive Language Scale				
Participant	C.A. (months)	Age Equivalent (months)	Raw Score	T Score	Percentile Rank	Descriptive Category
Sophia	29.9	6	8	24	1%	Very Low
Francis	64.6	34	31	20	1%	Very Low
Elijah	30.1	11	13	20	1%	Very Low
Jonathan	44.4	11	13	20	1%	Very Low
Liam	41.7	23	23	20	1%	Very Low
Luis	46.6	28	27	20	1%	Very Low

Relative to their chronological age, all six participants fell under the same descriptive category (i.e., “very low”) for both the Visual Reception scale and the Receptive Language scale of the Mullen. Moreover, relative to their chronological age, all six participants’ Early Learning Composite Score placed them in the “very low” descriptive category (see Table 4).

Table 4

Participants’ Early Learning Composite

	Early Learning Composite			
Participant	Cognitive T Score Sum	Composite Standard Score	Percentile Rank	Descriptive Category
Sophia	84	50	1%	Very Low
Francis	101	56	1%	Very Low
Elijah	100	56	1%	Very Low
Jonathan	80	49	1%	Very Low
Liam	80	49	1%	Very Low
Luis	80	49	1%	Very Low

Setting

All sessions were conducted in the participants’ classroom in a section of the room intended for 1:1 therapist-led instruction or in a small session room at the Center for Children and Families (CCF) at Florida International University. The set up for the classroom and the session room were similar in that the therapist sat at a small table directly across the participant. In both settings, the therapist sat on the floor to remain at eye-level with the participant and a research assistant sat behind the participant in order to keep him or her seated throughout the entire session.

Because the sessions took place in the participant's classroom, the participant's parent(s) were not present during training or follow-up. Toys, and other possible reinforcers, were placed on the floor near the therapist but out of the participant's reach. Before the child sat at the session table, the therapist allowed the child to briefly explore the toys for a few minutes. Upon sitting down at the table, the therapist conducted a brief preference assessment to assess which items would likely function as reinforcers.

The biggest difference between the two settings is that the classroom was significantly larger and divided into eight or more learning stations, where other children were present and receiving 1:1 instruction. Additionally, there were a lot more stimuli in the classroom (e.g., numerous bookshelves with many toys) than there were in the session rooms. All baseline and training sessions took place in the classroom setting. However, follow-up sessions either took place in the classroom setting (if the Summer Treatment Program or the Early Intensive Behavioral Intervention Program were still on-going) or in a small-session room (if the Summer Treatment Program or the Early Intensive Behavioral Intervention Program had ended).

Experimental Design

The design for the current study was a within-subject, multiple treatments design (Engel & Schutt, 2008), in which each participant was taught to receptively discriminate stimuli on picture cards using three different discrimination training procedures: (a) simple/conditional (Procedure A), (b) conditional only (Procedure B), and (c) conditional discrimination of two target cards (Procedure C). A multiple treatments design is a single-subject experimental design where the type or nature of an intervention changes across phases; the differences between treatments may be quantitative (i.e., different

intensities of a single treatment are evaluated) or qualitative (i.e., different treatments altogether are evaluated; Engel & Schutt, 2008).

To rule out sequence effects, the presentation of each procedure was counterbalanced across participants. Thus, all of the children participated in each of the three procedures. For replication purposes, each participant was exposed to each procedure a total of three times (three rounds; see Table 5).

Table 5

Presentation of Procedures across Participants

	Procedure Sequence								
Participant	Round 1			Round 2			Round 3		
Sophia	A	B	C	A	B	C	A	B	C
Francis	A	C	B	A	C	B	A	C	B
Elijah	B	A	C	B	A	C	B	A	C
Jonathan	B	C	A	B	C	A	B	C	A
Liam	C	A	B	C	A	B	C	A	B
Luis	C	B	A	C	B	A	C	B	A

A – Simple/conditional procedure
B – Conditional only procedure
C – Conditional discrimination of two target cards procedure

Materials

The materials used for the study included a small table, a chair for the child to sit in, data sheets (see Appendix B), a video camera to record all of the sessions, training stimuli (i.e., picture cards; see Appendix C) printed in color on card stock paper, and reinforcers. The picture cards were approximately 7.5 cm by 12.5 cm for Sophia and approximately 11.4 cm by 14 cm for the Francis, Elijah, Jonathan, Liam, and Luis.

Possible reinforcers were identified for each participant at the start of each session through a single stimulus preference assessment and included, but were not limited to, toys (e.g., cars, puzzles), bubbles, stickers, books, praise, access to videos, and edibles (e.g., M&Ms®, Gerber Graduate Puffs Cereal Snacks) .

Preference Assessment

The literature provides various procedures for identifying items that might function as reinforcers when provided contingently on behavior (Carr, Nicolson, & Higbee, 2000; DeLeon & Iwata, 1996). In general, research suggests that during skill acquisition training, highly preferred items are more likely to serve as effective reinforcers than items which are only moderately preferred and items are that not preferred at all (DeLeon & Iwata, 1996).

A single-stimulus presentation method, also known as “successive choice” method was used to identify possible reinforcers. This trial-based method is the most basic assessment available for identifying highly preferred items that may function as reinforcers (Cooper et al., 2007). During this assessment, target stimuli are presented, one at a time, and the child’s reaction to it is noted, such as: (a) whether the child “approached” or “rejected” the item, (b) how many times (per minute) the child touched the item, and/or (c) how long the child spent engaged with the item (Logan et al., 2001; Pace et al., 1985). Approaching the item indicates a preference for the stimulus, whereas rejecting the item does not. Likewise, a higher the rate of touching the item and a longer duration engaged with the item suggests a stronger preference for that stimulus. Once the child’s reaction to the item is recorded, the next stimulus in the sequence is presented to the child.

Preference assessments provide a fast and easy way of identifying possible reinforcers (Roane et al., 1998). In this study, the reinforcer used for a given session depended on the results of the preference assessment conducted prior to the beginning of the session. Items that were "approached" were used as reinforcers throughout that session. Items that were rejected were not used during that session.

Procedures

Participants were taught receptive discrimination of picture cards using 1:1 discrete trial training (Lovaas, 1981). The procedure was adapted from Gutierrez et al. (2009). Errorless training, training in which the learner is not permitted to make errors, was used during all three training procedures. Reinforcers were delivered on a variable ratio schedule of reinforcement (VR2); meaning that on average, every other correct (or prompted) response was followed by the presentation of a reinforcer. However, praise (which may or may not function as a reinforcer for a given child during a given session) was delivered after each trial, regardless of whether the response was independent or prompted. No consequences (aside from the therapist saying "thank you") were delivered for identifying the correct card during the pre-treatment and follow-up phases to avoid any training from taking place.

Pre-treatment Assessment. A pre-treatment assessment was conducted to identify receptive labels that were unknown to each participant prior to the start of each training phase. A card was considered unknown if the participant responded incorrectly three out of five trials. During this assessment, the participant was simultaneously presented with two picture cards and asked to receptively identify (e.g., touch) one of the two picture cards during each trial. For example, when assessing to see if the child could

receptively identify a picture of a “ball,” the therapist presented two picture cards: one of a ball and one of a different stimulus (e.g., a cookie). The therapist would say “Touch the ball.” The child either responded correctly by touching the ball, responded incorrectly by touching the cookie, or did not respond at all. After each response, whether correct or incorrect, the therapist removed the cards and said “thank you.” If the child did not respond at all within 3 seconds of the instruction (or S^D) being delivered, the therapist also removed the cards and said “thank you.” The position of the cards were counterbalanced quasi randomly across trials. Once a card was deemed unknown, it was used in the subsequent training phase as a target card or as a distracter card.

Because reinforcement was not provided contingent on correct or incorrect responses to avoid training during the pretreatment assessment, there was a risk that the participant would lose behavioral momentum and stop responding. This was problematic because it would be difficult, if not impossible, for the researcher to determine whether lack of responding was a result of the participant not being able to identify the stimulus or as a result of the participant not complying. To help solve this issue, reinforcement was provided contingent on alternative, irrelevant behavior that the participant could engage in with little effort (e.g., touch your head). These behaviors varied across participants, as each participant differed in what behaviors they had in their repertoire. Informal probes of simple behaviors were conducted before training began to identify what the participant could and could not do. The therapist asked the child to engage in an irrelevant behavior after every two trials in which the child did not contact reinforcement.

Receptive Discrimination Training of Unknown Cards. For the simple/conditional and conditional only procedures, two of the four unknown cards were

randomly identified as “target” cards, or cards to be taught, and the other two were identified as “distracter” cards, and not explicitly taught. For the conditional discrimination of two target cards procedure, only two unknown cards were identified and both cards were considered “target” cards. Each participant was exposed to the three discrimination training procedures three times throughout the course of the study. Therefore, each child had the opportunity to learn how to receptively discriminate a minimum of 18 stimuli. Table 6 shows the two target stimuli taught for each training set for all six participants.

Table 6

Target stimuli taught for each training set for all six participants

	Participant					
Training Set	Sophia	Francis	Elijah	Jonathan	Liam	Luis
1	bird goat	want know	waving bouncing	basket clock	window crayon	hat cup
2	bowl clock	should which	hugging crying	fan coat	soap broom	flowers markers
3	paint soap	take what	swinging walking	stapler vacuum	jeans plate	easel laptop
4	comb spoon	very gave	swimming kissing	grapefruit salad	asparagus cauliflower	bin tape
5	pencil lunchbox	fast walk	singing blowing	abacus sharpener	teddy bear instruments	strawberries pineapple
6	leaf shoes	said long	dancing sliding	ax fence	saw net	carrots popcorn
7	skirt gloves	read came	splashing raking	hydrant lumber	birdhouse iron	mushrooms pretzel
8	desk skates	high more	fishing smelling	chinchilla alpaca	vase barn	ice cream hot dog
9	slide broom	jump rain	tickling crawling	citrus ginger	castle reptile	muffin sandwich

In each cell, the stimulus listed on top, was the first stimulus targeted for that set, whereas, the stimulus listed on the bottom, was the second stimulus targeted for that set. Sophia, Jonathan, Liam, and Luis were taught to discriminate common nouns, Francis was taught to discriminate site words, and Elijah was taught to discriminate verbs.

Each learning session consisted of 10 trials and mastery was deemed when the participant had correctly and independently responded 80% of the time or higher across two consecutive sessions. Approximately three to five training sessions could occur on a given day per participant. For all trials across all phases, the position of the picture cards was counterbalanced quasi-randomly to prevent a position bias or faulty stimulus control from developing.

Simple/Conditional Procedure. The purpose of this phase was to determine the number of sessions required to learn how to receptively identify a stimulus using a "no distracter" step. Training with this procedure, also known as Procedure A, began by teaching one of the two target cards in isolation (without a distracter present), and asking the participant to "touch [target]." Correct responses were defined as the participant touching the card the therapist had named independently. Prompted responses were defined as the participant being prompted to make the correct response. Data was collected on the type of response (independent or prompted) emitted by the child on a given trial. Reinforcement was provided on a variable ratio schedule (VR2). However, praise was provided on a continuous schedule of reinforcement (e.g., after each trial). Sessions continued until the participant reached mastery in identifying the presented target card (80% correct, or better, across two consecutive sessions). The second step involved presenting the target card along-side one of the unknown distracter cards for

each trial. Sessions continued until mastery was reached (80% correct, or better, across two consecutive sessions). After the first target was mastered, steps one and two were be repeated with the second target card. Once the participant reached mastery for the second target card, the conditional discrimination training phase of two previously taught cards was introduced to determine the number of sessions necessary to teach a conditional discrimination using two previously taught picture cards. During this phase, the participants were instructed to receptively identify one of the two cards. Across trials, the correct target varied quasi-randomly. For instance, suppose that the first target was a picture card of a dog and the second target was a picture card of a bird. For the first trial, the therapist might say “Touch dog”; for the second trial, the therapist might say “Touch bird;” For the third trial, the therapist might say “Touch bird” again and so forth until the child had been asked to touch each of the two stimuli a total of five times each (10 trials per session). For any given session, the therapist did not ask the participant to identify the same stimulus more than three times in a row. Sessions continued until the participant reached mastery (80% correct, or better, across two consecutive sessions).

Conditional Only Procedure. In the second training procedure, also known as Procedure B, the initial (no distracter) step was eliminated in order to determine the number of sessions it took to learn a discrimination using a procedure in which the distracter was present at the start of training. Training began by presenting a target card along-side a distracter card and instructing the participant to “touch [target].” Once the participant mastered the first target card, the second target card was taught to mastery. The final step was to teach conditional discrimination using the two previously taught picture cards to mastery (80% correct, or better, for two consecutive sessions). As was

previously stated, during this step, the two previously taught picture cards were presented alongside each other for ten trials and the participant was asked to receptively identify one of the two cards during a given trial. The correct target card varied quasi-randomly so that the participant was asked to touch each of the two target stimuli a total of five times each (10 trials total). Additionally, position of the correct target card varied quasi-randomly across trials. Sessions were conducted until mastery was reached (80% correct, or better, across two consecutive sessions).

Conditional Discrimination of Two Target Cards Procedure. In the third training procedure, also known as Procedure C, discrimination training occurred with both target cards simultaneously, thus eliminating not only the initial (no distracter) step, but the step with distracters as well. During the pre-treatment assessment, only two unknown cards were identified. Once two unknown cards were identified, training began by presenting both of the target cards (i.e., unknown cards) along-side each other and requiring the participant to "touch [target]." The correct target card alternated in a random order across trials. The session ended after 10 trials had been run. Sessions were run until mastery was reached (80% correct, or better, across two consecutive sessions).

All three procedures differed in the number of steps implemented to teach receptive discrimination. Procedure A (simple/conditional) required three steps: (1) teaching each stimulus in isolation, (2) teaching each stimulus with a distracter present, and (3) teaching both stimuli simultaneously within the same session. Procedure B (conditional only) entailed two steps: (1) teaching each stimulus with a distracter present, and (2) teaching both stimuli simultaneously within the same session. Finally, Procedure C (conditional discrimination of two target cards) entailed one step: (1) teaching to

identify both stimuli simultaneously within the same session. The same therapist ran all of the sessions for a given child and the same picture cards were used across each trial during each training session.

Maintenance and Generalization Probes. Maintenance and generalization probes were conducted approximately one month following the completion of training for each pair of stimuli to evaluate the maintenance across time of discriminations taught using all three procedures. Generalization across therapists and stimulus generalization were also tested. The purpose of this phase was to evaluate if one training procedure resulted in better maintenance and generalization compared to the other procedures. The procedures of the maintenance and generalization probes were identical to those used in training except that only one session (10 trials) was conducted per pair of stimuli, the therapist did not provide any prompting, and no reinforcement was provided contingent on correct responses. However, like in the pre-assessment phase, reinforcement was provided contingent on some other irrelevant responses in order to prevent the participants' rate of responding from diminishing.

Response Maintenance. During the response maintenance session, the same stimuli used during the original training sessions were used and the session was run by the same therapist who ran the original training sessions.

Generalization across Therapists. During the session to test generalization across therapists, the same stimuli used during the original training sessions were used but a therapist with no history of training the participant ran the session.

Stimulus Generalization. Lastly, during the session to test stimulus generalization, the session was conducted by the same therapist who ran the original

training sessions but different stimuli (within the same stimulus class) were used. The stimuli used to probe stimulus generalization varied slightly in color and size. For example, if one of the stimuli taught was a green parakeet, for generalization probes, a picture card of a yellow parakeet a little larger (or smaller) in size would have been used.

Dealing with Problem Behaviors

Children with autism often engage in escape behaviors (i.e., problem behaviors) during teaching situations (Smith, 2001). In order to maximize learning opportunities, training sessions only began if the child was displaying behaviors conducive to learning (i.e., not having a tantrum). If the child was crying or exhibiting other problem behaviors (e.g., kicking, screaming) the session was put on hold until the child calmed down and appeared ready to work. Lovaas (2003) pointed out that tantrum behaviors are initiated by frustration. Considering that an errorless learning technique was implemented in which the child was prevented from emitting incorrect responses, the participant had very frequent access to reinforcers minimizing the possibility of tantrums or problem behaviors, particularly during sessions that lasted less than five minutes total. In fact, one of the biggest benefits to using this technique is that it thwarts the emotional responses that come about from trial-and-error learning (Terrace, 1963).

Reliability

Calculating interobserver agreement (IOA) is the primary means of assessing the reliability of behavioral data (Cooper et al., 2007). IOA is the degree to which two independent observers agree on the measurement of the same event. One method of assessing IOA is using a point-by-point agreement method in which agreements on each instance of behavior (per trial) is assessed (Cooper et al., 2007). This method is

appropriate when there are discrete opportunities for the behavior to occur (e.g., discrete trial training).

Interobserver agreement was assessed for a minimum of 33.3% of all the sessions across all phases and conditions for each participant. Two independent observers assessed how many trials resulted in an independent response (as opposed to a prompted response) in a given session. The number of agreements in a session was divided by the number of total trials (number of agreements plus number of disagreements). The proportion was then converted into a percentage.

For all six participants, there was 100% agreement during pre-assessment phase for all cards used at target cards and distracter cards. In other words, two independent observers agreed 100% of the time that the cards identified as “unknown” and used as target cards or distracter cards in subsequent training sessions were not correctly identified by the participant during baseline for three out of the five baseline trials.

Reliability observations were conducted for 36.3% of Sophia’s treatment sessions and for 37.7% of Francis’ treatment sessions. Mean interobserver agreement was 99.2% (range, 90.0-100.0) and 100.0%, respectively. Furthermore, reliability observations were conducted for 38.6% of Elijah’s treatment sessions. Mean interobserver agreement was 99.6% (range, 90.0-100.0). Reliability observations were also conducted for 38.1% of Jonathan’s treatment sessions and for 37.3% of Liam’s treatment sessions. Mean interobserver agreement was 99.6% (range, 90.0-100.0) and 99.2% (range, 90.0-100.0), respectively. Lastly, reliability observations were conducted from 38.1% of Luis’ treatment sessions. Mean interobserver agreement was 98.3% (range, 90.0-100.0).

Reliability observations were also conducted during follow-up on 33.3% of sessions for all six participants. Mean interobserver agreement for Sophia was 97.8% (range, 90.0-100.0) and 100% for Francis. Mean interobserver agreement for Elijah was 95.6% (range, 80.0-100.0) and 100% for Jonathan. Lastly, mean interobserver agreement for Liam was 97.8% (range, 90.0-100.0) and 100% for Luis.

Treatment Fidelity

Treatment fidelity was assessed for a minimum of 25% of treatment sessions for all participants by an independent observer. The independent observer watched video-recorded sessions and took data on the extent to which the experimenter (i.e., therapist) implemented the procedures as specified by the research protocol. To assess treatment fidelity, this observer recorded the experimenter's implementation on each trial. The coder indicated whether the therapist conducting the given session engaged in the following behaviors: (a) obtained the participant's attention, (b) presented the S^D ("Touch [blank]"); (c) prevented the participant from making errors; (d) delivered a tangible reinforcer within 2 seconds of the response (when appropriate); and (e) delivered praise after each trial contingent on correct responding.

A trial was scored correct if the experimenter engaged in all of the five behaviors indicated by the research protocol. A trial was scored incorrect if one or more of the treatment integrity measures were violated. The percentage of correctly implemented trials was calculated by dividing the number of correct trials by the total number of trials in the session (10) and multiplying by 100. For Sophia, treatment fidelity was assessed for 25.5% of all treatment sessions and averaged 95.8% (range, 80.0-100.0). For Francis, treatment fidelity was assessed for 32.8% of treatment sessions and averaged 99.0%

(range, 90.0-100.0). For Elijah, treatment fidelity was assessed for 25.7% of treatment sessions and averaged 100.0%. For Jonathan, treatment fidelity was assessed for 25.4% of treatment sessions and averaged 96.9% (range, 80.0-100.0). For Liam, treatment fidelity was assessed for 29.9% of treatment sessions and averaged 98.0% (range, 90.0-100.0). Lastly, treatment fidelity was assessed for 30.2% of Luis' treatment sessions averaging 97.9% (range, 80.0-100.0).

Results

The current study aimed to: (a) further evaluate the effectiveness of the two previously evaluated procedures (simple/conditional and conditional only); (b) evaluate whether is it more advantageous and efficient to teach two targets at the same time and eliminate both the first (no distracter) step and the distracter phase as well; (c) evaluate differences between procedures regarding measures of response maintenance, as well as different measures of generalization (e.g., across therapist and within stimulus class); and (d) provide some insight as to whether different children with different characteristics and learning abilities differ in which procedure is most effective and efficient in teaching receptive discrimination.

Visual analysis of line graphs within phases, bar graphs including descriptive statistics (means and standard deviations), learning curves for each participant, and chi-square tests were used to answer the research questions and determine which of the three procedures was most efficient and more effective for teaching receptive discriminations to children with ASD. Additionally, the visual analysis of the line graphs, as well as bar graphs including descriptive statistics, were used to investigate whether one of the three

procedures resulted in better response maintenance, generalization across therapists, and stimulus generalization at one-month follow-up compared to the other two procedures.

It is important to note that although the design for the current study was a within-subject, multiple treatments design, the line graphs appear to depict data of an alternating treatments design. Instead of displaying individual session data, typical of multiple treatments design, what is displayed in the current graphs is the total number of sessions required to reach mastery for three different procedures across three rounds of treatment. The data are presented in this manner for comparison purposes.

Visual Analysis

Discrimination Training. Figure 1 displays the number of sessions required to master receptive discrimination of untrained stimuli using each of the three procedures evaluated: (a) Procedure A (simple/conditional), (b) Procedure B (conditional only), and (c) Procedure C (conditional discrimination of two target cards).

The numbers on the horizontal axis correspond to the target stimuli. For example, the 1 and the 2 on the horizontal axis of Sophia's graph represent the first two target stimuli trained using Procedure A: bird and goat, respectively; whereas, the 1 and the 2 on the horizontal axis of Jonathan's graph represent the first two target stimuli trained using Procedure B: basket and clock, respectively. Additionally, the 3 and the 4 on the horizontal axis of Sophia's graph represents the next set of target stimuli taught using Procedure B: bowl and clock, respectively, and so forth. Table 6 displays the complete list of the target stimuli for each participant. The vertical axis in Figure 1 displays the total number of sessions to mastery, from start to finish. Notice that the range of values

on the vertical axis is constant across participants, with the exception of the graph displaying Sophia's data.

Figure 1. Discrimination Training

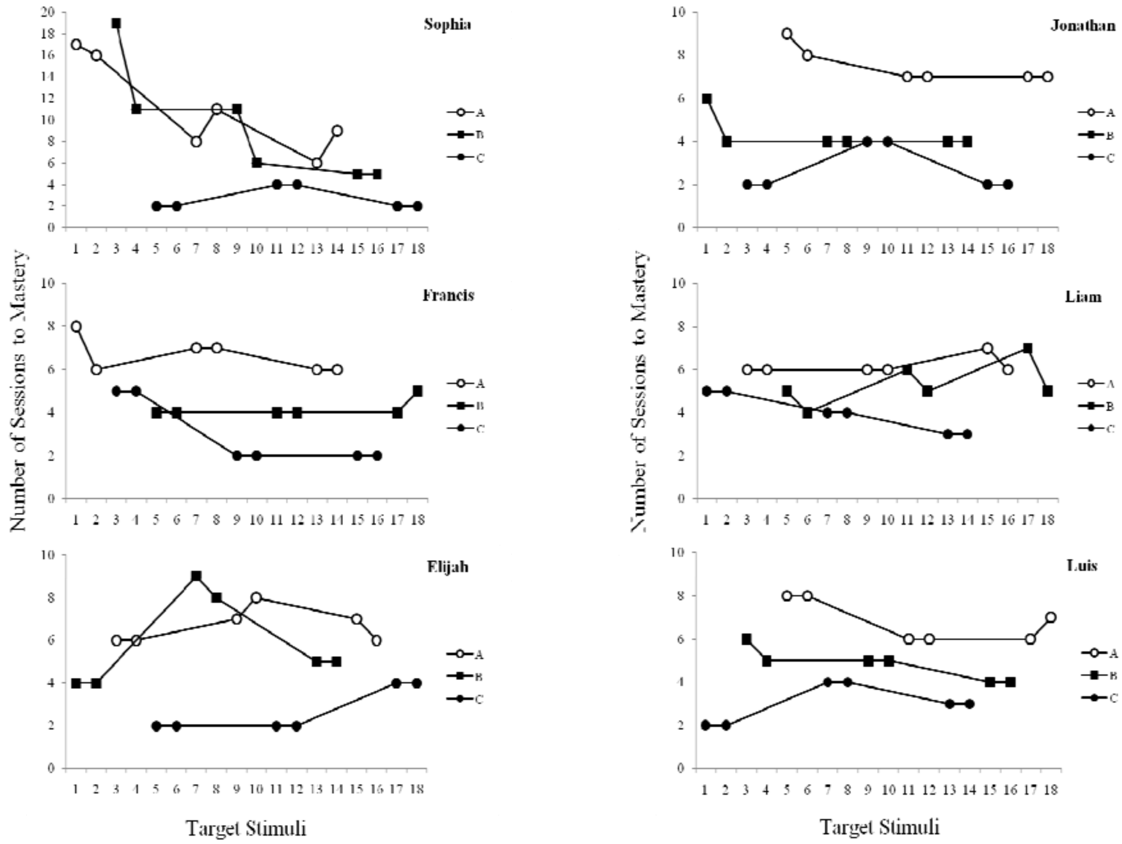

Figure 1. Number of sessions required to master untrained stimuli.

Figure 1 shows that, from start to finish, more training sessions were required to master receptive discrimination of untrained stimuli with Procedure A than Procedure B; this was true for all six participants. In other words, when target cards were taught in isolation, followed by a distracter card, more training sessions were required than when participants initiated training with a distracter card. Additionally, for all of the participants, more training sessions were required to master receptive discrimination of untrained stimuli with Procedure A than Procedure C. That is, when target cards were

taught in isolation, followed by a distracter card, more training sessions were required than when participants were taught to discriminate two target stimuli at the onset of training. Lastly, for most participants, mastery of untrained stimuli during Procedure B generally required the same or more sessions than untrained stimuli during Procedure C. That is, when target cards were paired with distracter cards at the beginning of training, more sessions were required than when participants were taught to discriminate two target stimuli at the onset of training.

Overall, Procedure C appeared to be more efficient than both Procedure A (simple/conditional) and Procedure B (conditional only) in that it took participants less training sessions to master each target stimulus. Nevertheless, it remains unclear, based on this graph alone, whether the difference in sessions to mastery across procedures resulted from the extra steps inherent in Procedure A and Procedure B or whether these extra training steps resulted in slower acquisition.

Conditional Receptive Discrimination. In order to better investigate whether the alone phase and the distracter phase were necessary to facilitate the acquisition of condition receptive discriminations, the number of sessions required to master conditional discriminations once the two target cards were presented alongside each other were graphed. These data are displayed in Figure 2.

The horizontal axis displays the training set number (e.g., “1” for the first training set, “2” for the second, and so forth), while the vertical axis displays the number of sessions to mastery. In this graph, the number of sessions to mastery does not include the sessions conducted in the first two steps of Procedure A nor the first step of Procedure B. In other words, it does not include the number of sessions it took participants to master

the “no distracter” phase included in Procedure A, nor does it include the number of sessions it took the participants to master the “distracter” phase included in Procedures A and B.

Figure 2. Conditional Receptive Discrimination

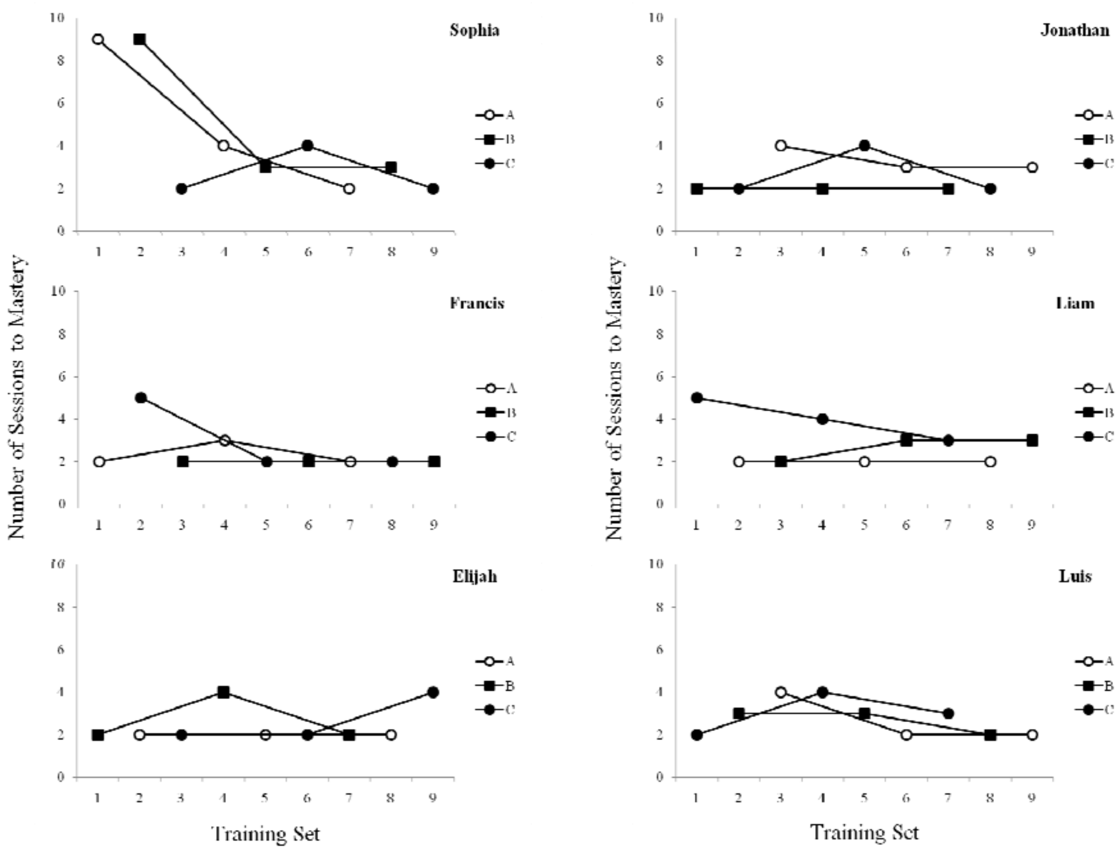

Figure 2. Number of sessions required to master conditional receptive discriminations once the two target cards were presented alongside each other.

Sophia. For Sophia, training sets taught with Procedure C generally required less sessions before mastery of conditional receptive discriminations were reached than training sets taught with both Procedure A and Procedure B. For the first round of treatment, the first two sets of stimuli taught with the latter procedures (Set 1 and Set 2) required nine sessions each before mastery was reached. However, by the second and

third round of treatment, Sophia required approximately the same number of sessions using Procedure A and Procedure B as Procedure C.

Francis. For Francis, Procedure B consistently required the minimum number of sessions (i.e., two) required to master conditional receptive discriminations. Even so, both Procedure A and C required the minimum number of sessions for two out of the three rounds of treatment. For all three procedures, the number of sessions to mastery ranged from two to five sessions.

Elijah. For Elijah, Procedure A consistently required the minimum number of sessions required to master conditional receptive discriminations. On average, Procedure B and C did not differ in this regard. In fact, two out of the three rounds of treatment using Procedure B and Procedure C also required only the minimum number of sessions required to reach mastery. Consequently, there was not much variation across the three different procedures used overall. For all procedures, the range of sessions to mastery was two to four sessions.

Jonathan. For Jonathan, Procedure B consistently required the minimum number of sessions required to master conditional receptive discriminations across the three rounds of treatment, whereas Procedure A required slightly more sessions. Procedure C, however, required the minimum sessions necessary to master conditional receptive discrimination for two out of the three rounds of treatment (Set 2 and Set 8). Nevertheless, for all procedures, the range of sessions to mastery was two to four sessions. Consequently, there was not much variation across the three different procedures used overall.

Liam. For Liam, Procedure A consistently required the minimum number of sessions required to master conditional receptive discriminations. Slightly more sessions were required using Procedure C; however, there was not much variation across the three different procedures used overall. Each time Procedure C was introduced, the number of sessions to mastery decreased by one. For all three procedures, the range of sessions to mastery was two to five sessions.

Luis. For Luis, the number of sessions required to master conditional receptive discriminations did not vary much across the three different procedures used. For all procedures, the range of sessions to mastery was two to four sessions.

Figure 3 shows the average number of sessions required to master conditional receptive discriminations once the two target cards were presented alongside each other. For Francis, Elijah, and Luis, the average number of sessions required to master conditional discriminations across all three procedures did not differ by more than one session. More specifically, Procedures A, B, and C required, on average, 2.33, 2, and 3 sessions to mastery for Francis, 2, 2.67, and 2.67 sessions to mastery for Elijah, and 2.67, 2.67, and 3 sessions to mastery for Luis. For Jonathan, on average, Procedure A required 3.33 sessions, Procedure B required 2 sessions, and Procedure C required 2.67 sessions. For Liam, on average, Procedure A required 2 sessions, Procedure B required 2.67 sessions, and Procedure C required 4 sessions. Lastly, for Sophia, on average, Procedure A and B required 5 sessions to mastery, while Procedure C required 2.67 sessions. Overall, the average numbers of sessions required to master conditional discriminations across all three procedures did not differ by more than three sessions for any of the participants in the study.

Figure 3. Average Number of Sessions Required to Master Conditional Receptive Discrimination

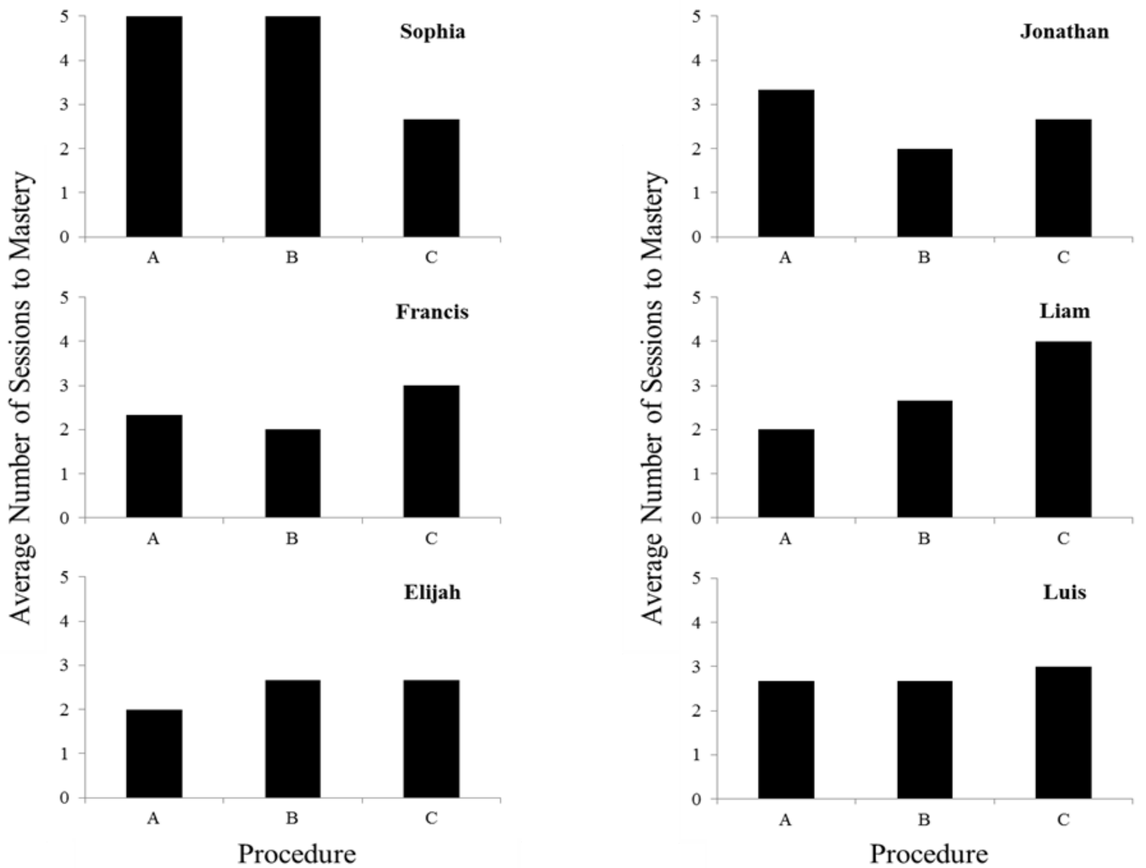

Figure 3. Average number of sessions required to master conditional receptive discriminations once the two target cards were presented alongside each other.

Overall, Figures 2 and 3 suggest that for all participants a similar number of sessions to mastery were required once conditional discrimination training began regardless of the training procedure used to teach the target stimuli.

Total Sessions to Mastery. Figure 4 displays the total number of sessions to master each training set. This is different from Figure 2, which only displays the number of sessions required to master conditional receptive discriminations once the two target cards were presented alongside each other. In this graph, the number of sessions to mastery does include the sessions conducted in the first two steps of Procedure A and the

first step of Procedure B. In other words, it includes the number of sessions it took participants to master the “no distracter” phase included in Procedure A, as well as the number of sessions it took the participants to master the “distracter” phase included in Procedures A and B. The horizontal axis displays the training set number, while the vertical axis displays the total number of sessions to mastery. Once again, the range of values on the vertical axis differs for the graph displaying Sophia’s data.

Figure 4. Total Sessions to Mastery

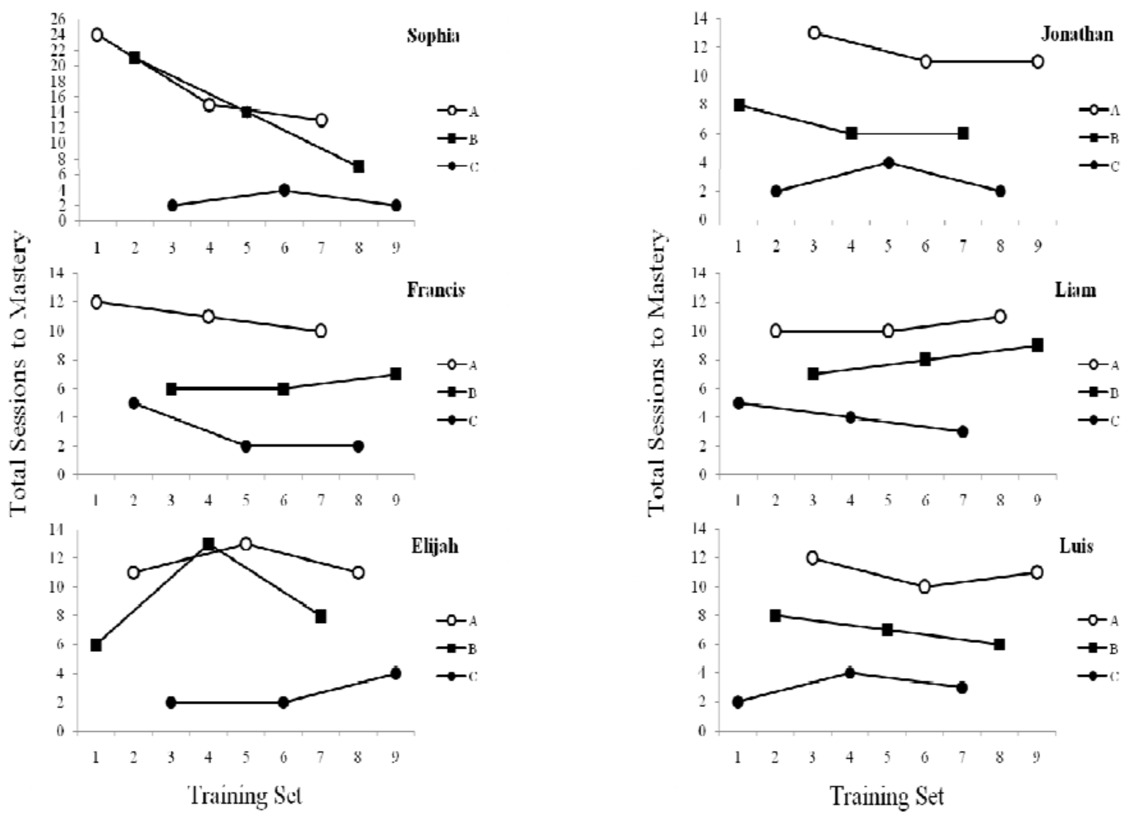

Figure 4. Total number of sessions required to master conditional receptive discriminations for each training set.

Figure 4 shows that for all six participants, Procedure C required less sessions overall than both Procedure A and Procedure B. Additionally, Procedure B generally required less sessions overall than Procedure A.

Sophia. For Sophia, not only did Procedure C require the least number of sessions to master conditional receptive discriminations when compared to Procedure A and Procedure B (Figure 2), Figure 4 confirms that Procedure C also required the least number of sessions overall.

Francis. For Francis, even though Procedure B consistently required the minimum number of sessions required to master conditional receptive discriminations, Procedure C consistently required the least number of training sessions overall.

Elijah. Elijah's case was similar to that of Francis. Even though Procedure A consistently required the minimum number of sessions required to master conditional receptive discriminations when compared to the other two procedures, Procedure C required the least number of sessions overall.

Jonathan. Jonathan's data shows the same pattern observed with Francis and Elijah. Procedure C always required less sessions overall, despite the finding that Procedure B consistently required only two sessions to master the conditional respective discrimination of the two target stimuli.

Liam. Despite the fact that Procedure C and Procedure A consistently required the most number and the least number of sessions, respectively, Procedure C once again required less sessions overall.

Luis. For Luis, Procedure C was also more efficient than Procedure A and Procedure B, requiring less total sessions to mastery overall.

Figure 5 displays the average number of sessions required to reach mastery across all three procedures for each of the participants.

Figure 5. Average Number of Total Sessions to Mastery

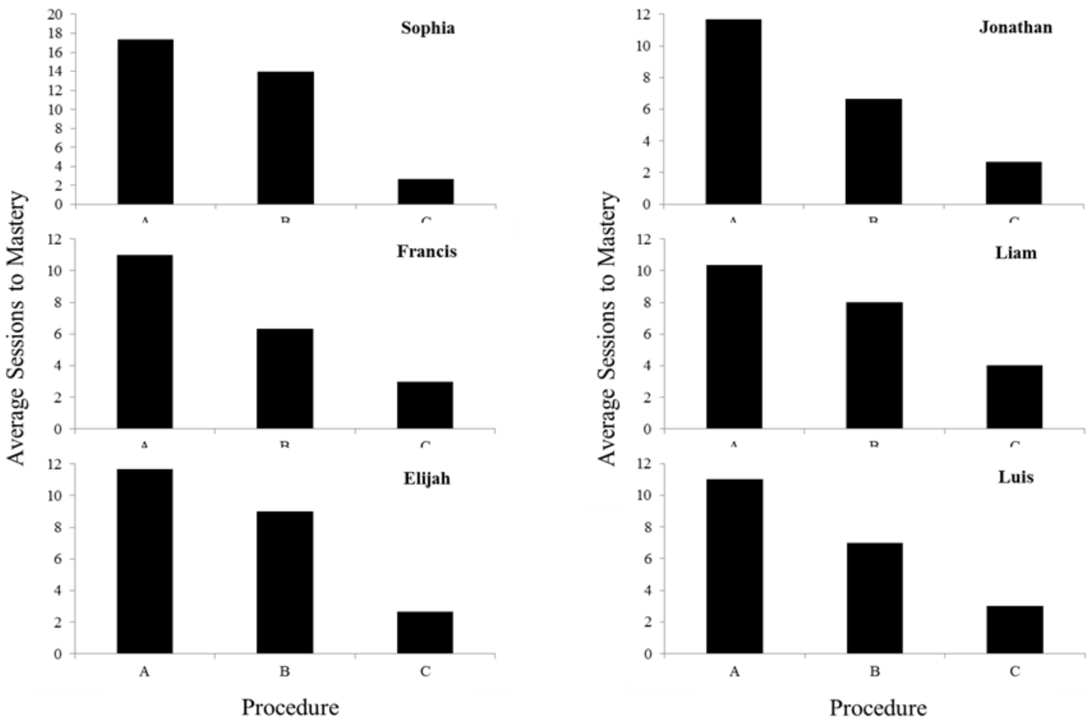

Figure 5. Average number of sessions required to reach mastery for Procedures A, B, and C.

Sophia. For Sophia, the average number total of sessions to mastery with Procedure A, B and C were 17.33, 14.00, and 2.67, respectively. Although the average number of sessions required to master training sets with Procedure A and B did not differ by more than one standard deviation (*SD* = 8.09), there was a difference of more than one standard deviation between Procedure A and C, as well as between Procedure B and C.

Francis. For Francis, the average number of total sessions to mastery with Procedure A, B and C were 11.00, 6.33, and 3.00, respectively. Despite that the average number of sessions necessary to master training sets with Procedure B and C did not differ by more than one standard deviation (*SD* = 3.63), there was a difference of more

than one standard deviation between Procedure A and B, as well as between Procedure A and C.

Elijah. For Elijah, the average number of total sessions to mastery with Procedure A, B and C were 11.67, 9.00, and 2.67, respectively. There was a difference of more than one standard deviation (*SD* = 4.47) between Procedure A and C, as well as between Procedure B and C. However, the average number of sessions required to master training sets with Procedure A and B did not differ by more than one standard deviation.

Jonathan. For Jonathan, the average number of total sessions to mastery with Procedure A, B and C were 11.67, 6.67, and 2.67, respectively. Although the average number of sessions required to master training sets with Procedure B and C did not differ by more than one standard deviation (*SD* = 4.03), there was a difference of more than one standard deviation between Procedure A and B, as well as between Procedure A and C.

Liam. For Liam, the average number of total sessions to mastery with Procedure A, B and C were 10.33, 8.00, and 4.00, respectively. Even though the average number of sessions required to master training sets with Procedure A and B did not differ by more than one standard deviation (*SD* = 2.88), there was a difference of more than one standard deviation between Procedure A and C, as well as between Procedure B and C.

Luis. For Luis, the average number of sessions necessary to reach mastery with Procedure A, B and C were 11.00, 7.00, and 3.00, respectively. There was a difference of more than one standard deviation (*SD* = 3.57) between all three procedures.

Response Maintenance of Conditional Receptive Discriminations at One-Month Follow-Up. Figure 6 displays response maintenance data at one-month follow-up sessions. The horizontal axis shows the training set number, while the vertical axis

displays the percentage correct during conditional receptive discriminations taught using all three procedures.

Figure 6. Response Maintenance at One-Month Follow-Up

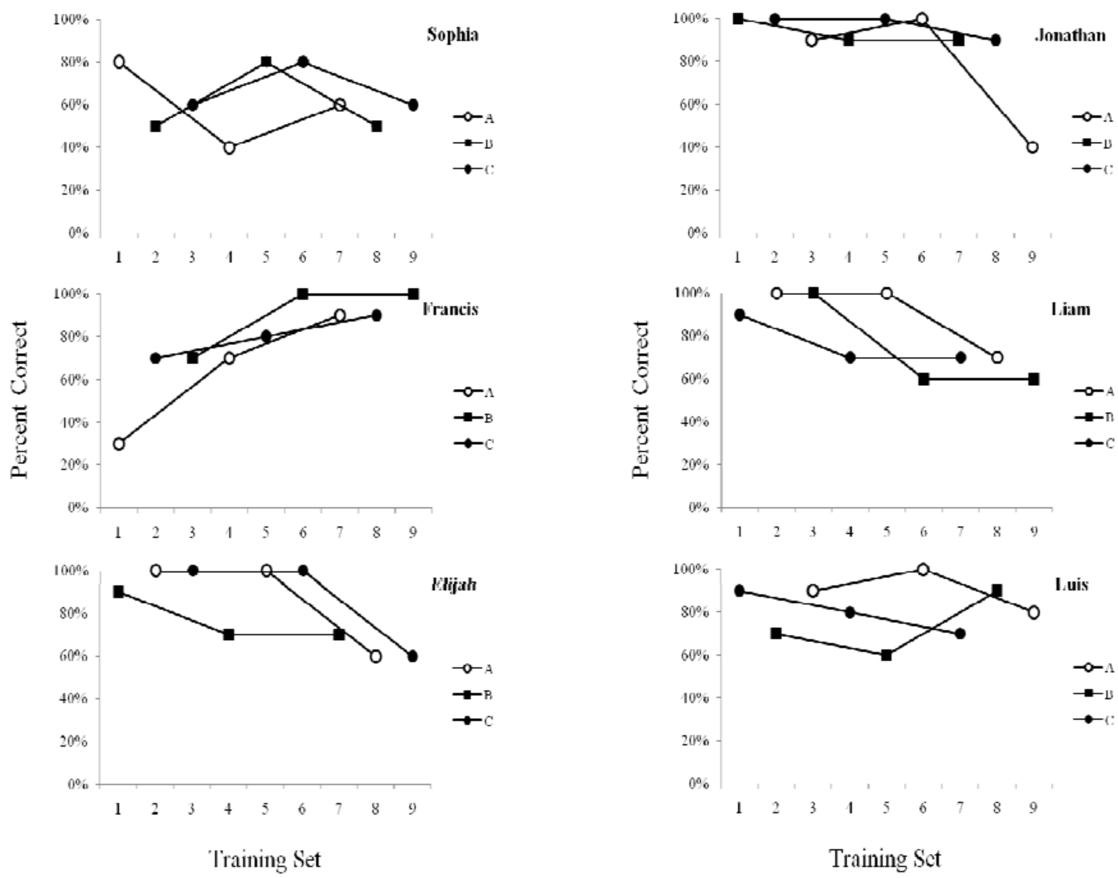

Figure 6. Percent correct responses during conditional receptive discriminations taught using each procedure at one-month follow-up.

Sophia. For Sophia, three of the nine training sets were maintained at mastery levels (80% accuracy) at the one-month follow-up visit. These training sets were not specific to a particular training procedure. In fact, one of the sets (Set 1) was taught using Procedure A, the second set (Set 5) was taught using Procedure B, and the third set (Set 6) was taught using Procedure C.

Francis. For Francis, five of the nine training sets were maintained at mastery levels (80% to 100% accuracy) at the one-month follow-up visit. One of the five sets (Set 7) was taught using Procedure A, two of the five sets (Set 6 and Set 9) were taught using Procedure B, and two of the five sets (Set 5 and Set 8) were taught using Procedure C.

Elijah. For Elijah, five of the nine training sets were maintained at mastery levels (80% to 100% accuracy) at the one-month follow-up visit. Two of the five sets (Set 2 and Set 5) were taught using Procedure A, one of the five sets (Set 1) was taught using Procedure B, and two of the five sets (Set 3 and 6) were taught using Procedure C.

Jonathan. The greatest number of training sets maintained at mastery level at the one-month follow-up visit occurred with Jonathan. Eight out of the nine training sets were maintained at mastery levels (90% to 100% accuracy). The only set that did not maintain over time at follow-up was Set 9, which was taught with Procedure A.

Liam. For Liam, four out of the nine training sets were maintained at mastery levels (80% to 100% accuracy) at the one-month follow-up visit. Two of the four sets (Set 2 and Set 5) were taught using Procedure A, one of the four sets (Set 3) was taught using Procedure B, and one of the four sets (Set 1) was taught using Procedure C.

Luis. For Luis, six out of nine training sets were maintained at mastery level (80% to 100% accuracy) at the one-month follow-up visit. In his case, all of the training sets taught with Procedure A were maintained, only one of the training sets taught with Procedure B was maintained (Set 8), and two of the training sets taught with Procedure C were maintained (Set 1 and Set 4).

Overall, it appears that no particular procedure resulted in significantly better or worse response maintenance across all participants. This finding is especially evident in Figure 7, which shows the average percentage correct responses at one-month follow-up during conditional discriminations taught using Procedures A, B, and C.

Figure 7. Average Percent Correct of Response Maintenance Probes at One-Month Follow-Up

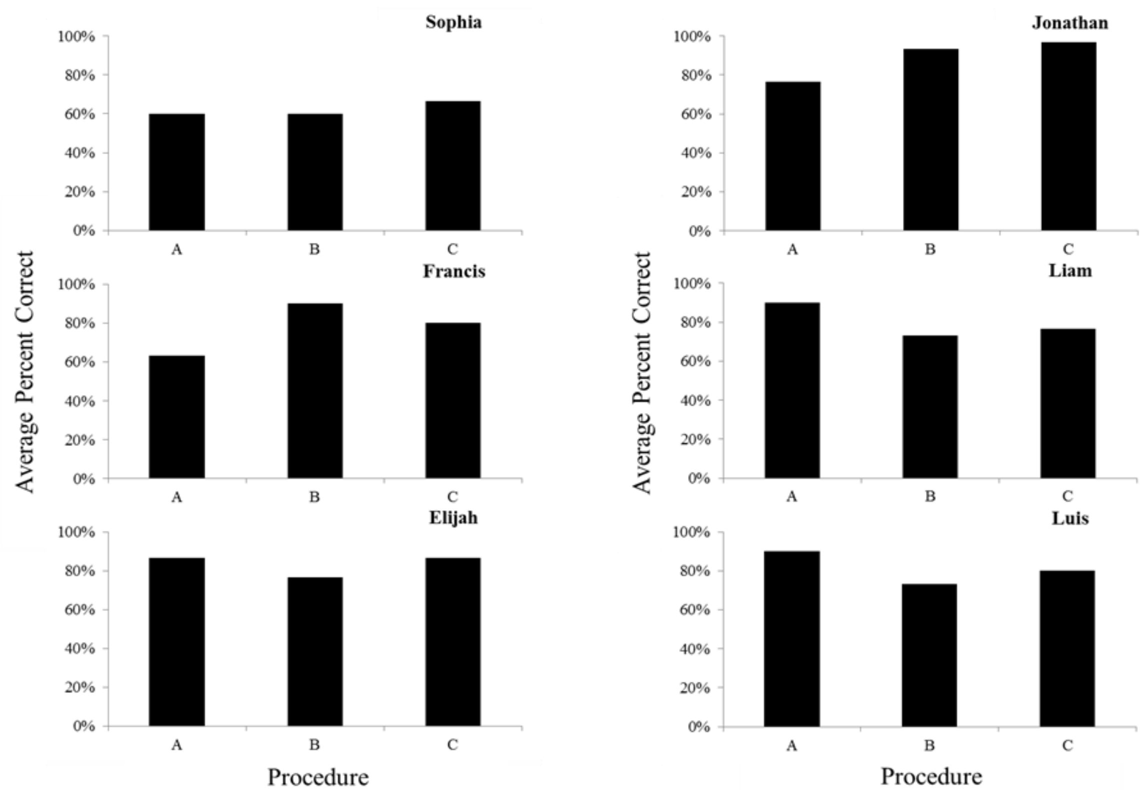

Figure 7. Average percent correct responses during conditional receptive discriminations taught using each procedure at one-month follow-up.

At the one-month follow-up, Procedures A, B, and C yielded average levels of response maintenance of 60%, 60%, and 67% correct for Sophia. Accuracy for Procedure C differed by more than one standard deviation (*SD* = 4.04) from the other two procedures, with Procedure C resulting in better response maintenance. Meanwhile, for both Liam and Luis, Procedure A resulted in better response maintenance on average.

Procedures A, B, and C yielded average levels of response maintenance of 90%, 73%, and 77% (*SD* = 8.89) for Liam and 90%, 73%, and 80% (*SD* = 8.54) for Luis. For both Francis and Jonathan, like for Liam and Luis, the difference between Procedure A and the other two procedures was more than one standard deviation; however, in this case, Procedure A resulted in worse response maintenance. Procedures A, B, and C yielded average levels of response maintenance of 63%, 90%, and 80% (*SD* = 13.65) for Francis and 77%, 93%, and 97% (*SD* = 10.58) for Jonathan. Finally, at follow-up, level of response maintenance for Procedures A, B, and C averaged 87%, 77%, and 87% for Elijah. The difference between Procedure B and the other two procedures was more than one standard deviation (*SD* = 5.77), with Procedure B resulting in the worst level of response maintenance.

Generalization across Therapists at One-Month Follow-Up. Figure 8 displays data for the generalization across therapists probe at the one-month follow-up visit. The horizontal axis shows the training set number, while the vertical axis displays the percentage correct during conditional receptive discriminations taught using all three procedures. In these sessions, the stimuli presented were the same ones used in the original training, however, the therapist conducting the follow-up session was someone with whom the child had no training history.

Sophia. For Sophia, none of the nine training sets were maintained at mastery levels (80% to 100% accuracy) when a novel therapist conducted the session at the one-month follow-up visit – regardless of the training procedure used to teach the set.

Francis. For Francis, seven out of the nine training sets were maintained at mastery levels (80% to 100% accuracy) when a novel therapist conducted the session at

the one-month follow-up visit. All three of the sets taught using Procedure A, two of the sets (Set 6 and Set 9) taught using Procedure B, and two of the sets (Set 5 and Set 8) taught using Procedure C generalized across therapists at one-month follow-up.

Figure 8. Generalization across Therapists at One-Month Follow-Up

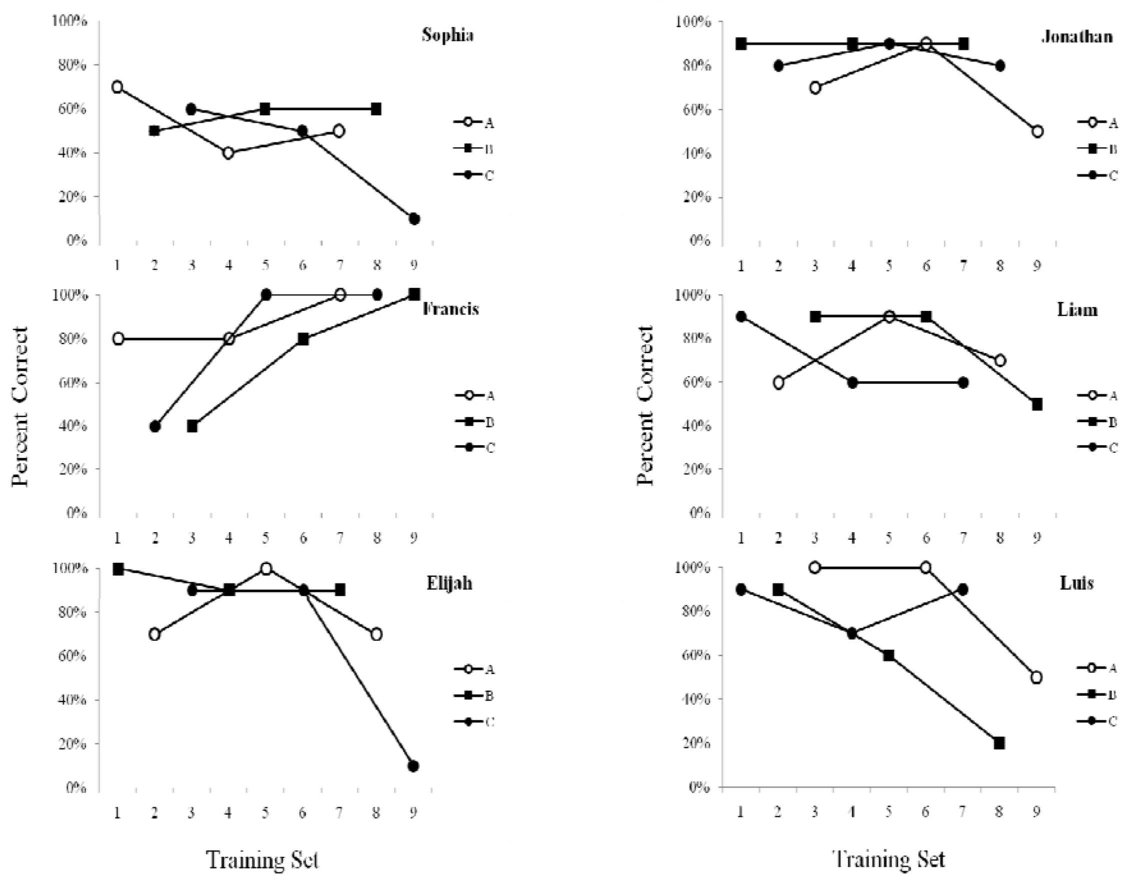

Figure 8. Percent correct responses during conditional receptive discriminations taught using each procedure by a novel therapist at one-month follow-up.

Elijah. For Elijah, six of the nine training sets were maintained at mastery level (90% to 100% accuracy) when a novel therapist conducted the session at the one-month follow-up visit. Only one of the six sets (Set 5) was taught using Procedure A and two of the six sets (Set 3 and Set 6) were taught using Procedure C. All three of the sets taught

using Procedure B (Set 1, Set 4, and Set 7) generalized across therapists at one-month follow-up.

Jonathan. For Jonathan, seven of the nine training sets were maintained at mastery level (80% to 100% accuracy) when a novel therapist conducted the session at the one-month follow-up visit. The two sets that did not generalize were Set 3 and Set 9, both of which were taught using Procedure A.

Liam. For Liam, four of the nine training sets were maintained at mastery level (90% accuracy) when a novel therapist conducted the session at the one-month follow-up visit. One of the four sets (Set 5) was taught with Procedure A, two of the four sets (Set 3 and Set 6) were taught with Procedure B, and one of the four sets (Set 1) was taught with Procedure C.

Luis. For Luis, five out of the nine training sets were maintained at mastery level (90% to 100% accuracy) when a novel therapist conducted the session at the one-month follow-up visit. Of the five, two sets (Set 3 and Set 6) were taught with Procedure A, another two sets (Set 1 and Set 7) were taught with Procedure C, but only one of the training sets (Set 2) was taught with Procedure B.

Figure 9 shows the average percentage correct responses during conditional discriminations taught using Procedure A, B and C by a novel therapist at the one-month follow-up visit.

Average percent correct across Procedures A, B, and C were 53%, 57%, and 40%, respectively, for Sophia (*SD* = 8.89); 87%, 73%, and 80% for Francis (*SD* = 7.00); 80%, 93%, and 63% for Elijah (*SD* = 15.04); 70%, 90%, and 83% for Jonathan (*SD* = 10.15);

73%, 77%, and 70% for Liam (*SD* = 3.51); and 83%, 57%, and 83% for Luis (*SD* = 15.01).

Figure 9. Average Percent Correct of Generalization across Therapist Probes at One-Month Follow-Up

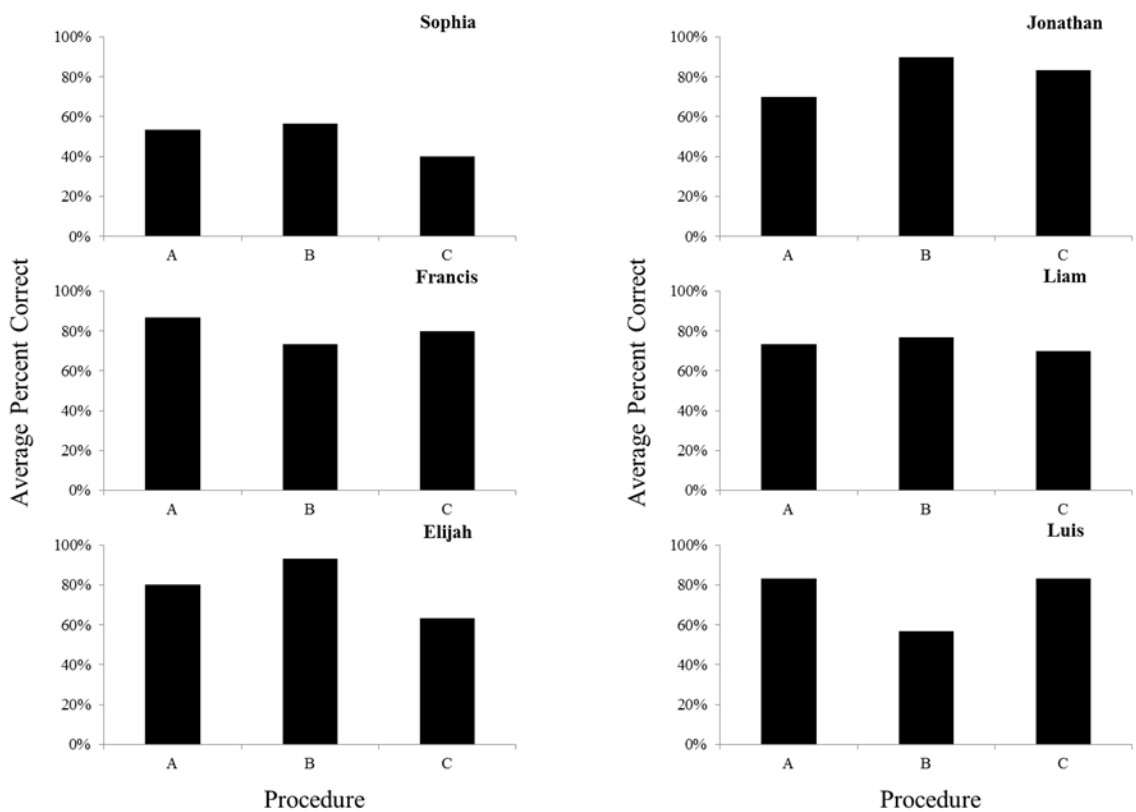

Figure 9. Average percent correct responses during conditional receptive discriminations taught using each procedure by a novel therapist at a one-month follow-up.

For both Sophia and Elijah, accuracy for Procedure C differed by more than one standard deviation from the other two procedures, with Procedure C resulting in worse generalization across therapist. For Francis, Procedures A and B differed from each other by more than one standard deviation with Procedure A resulting in the highest level of average accuracy and Procedure B resulting in the lowest. However, for Jonathan, Procedure A resulted in worse accuracy during this probe. Procedure B differed in accuracy by more than one standard deviation for Liam and Luis; however, for Liam,

Procedure B resulted in the best performance, whereas, for Luis, Procedure B resulted in the worst performance. As with the data for response maintenance, it appears that no particular procedure resulted in significantly better or worse generalization across therapists across all participants.

Stimulus Generalization at One-Month Follow-Up. Figure 10 displays stimulus generalization at one-month follow-up.

Figure 10. Stimulus Generalization at One-Month Follow-Up

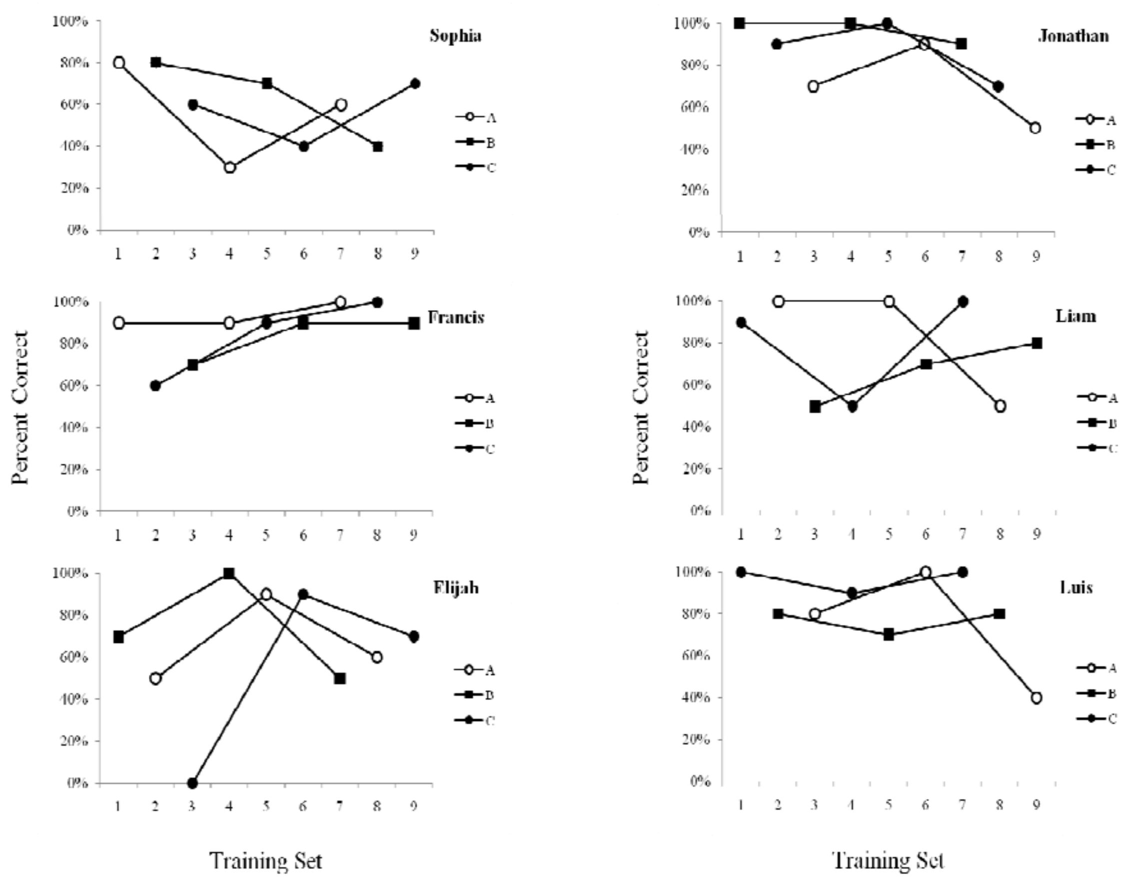

Figure 10. Percent correct responses during conditional receptive discriminations taught using each procedure with similar but different stimuli at one-month follow-up.

The horizontal axis shows the training set number, while the vertical axis displays the percentage correct during conditional receptive discriminations taught using all three

procedures with stimuli similar but different from those used in the original training sessions.

Sophia. For Sophia, only two of the nine training sets were maintained at mastery level (80% accuracy) when similar but different stimuli to the original training stimuli were used at the one-month follow-up visit. One of the two sets (Set 1) was taught using Procedure A, while the other (Set 2) was taught using Procedure B. None of the sets taught using Procedure C generalized within stimulus class for Sophia.

Francis. For Francis, seven of the nine training sets were maintained at mastery level (90% to 100% accuracy) during the stimulus generalization probe conducted one-month following training. All three of the sets taught using Procedure A, two of the sets (Set 6 and Set 9) taught using Procedure B, and two of the sets (Set 5 and Set 8) taught using Procedure C generalized within stimulus class.

Elijah. For Elijah, three of the nine training sets were maintained at mastery levels (90% to 100% accuracy) during the stimulus generalization probe conducted one-month following training. These training sets were not specific to a particular training procedure. In other words, one of the sets (Set 4) was taught using Procedure B, the second set (Set 5) was taught using Procedure A, and the third set (Set 6) was taught using Procedure C.

Jonathan. For Jonathan, six of the nine training sets were maintained at mastery levels (90% to 100% accuracy) during the stimulus generalization probe conducted one-month following training. One of the six sets (Set 6) was taught using Procedure A and two of the six sets (Set 2 and Set 5) were taught using Procedure C. Moreover,

generalization within stimulus class occurred for all three of the sets trained with Procedure B.

Liam. For Liam, five of the nine training sets were maintained at mastery levels (90% to 100% accuracy) during the stimulus generalization probe conducted one-month following training. Two of the five sets (Set 2 and Set 5) were taught using Procedure A, one of the five sets (Set 9) was taught using Procedure B, and two of the five sets (Set 1 and Set 7) were taught using Procedure C.

Luis. For Luis, seven of the nine training sets were maintained at mastery levels (90% to 100% accuracy) during the stimulus generalization probe conducted one-month following training. Two of the five training sets (Set 3 and Set 6) taught with Procedure A generalized within stimulus class, another two of the five sets (Set 2 and Set 8) taught with Procedure B generalized within stimulus class, and all three of the training sets taught with Procedure C generalized within stimulus class.

Once again, it does not appear that one procedure resulted in significantly better or worse results across all participants. The finding that no one procedure results in better stimulus generalization is particularly apparent in Figure 11, which shows the average percentage correct responses at one-month follow-up during the stimulus generalization probe for stimuli taught using Procedures A, B, and C.

Average percent correct across Procedures A, B, and C were 57%, 63%, and 57%, respectively, for Sophia (SD = 3.46); 93%, 83%, and 83% for Francis (SD = 5.77); 67%, 73%, and 53% for Elijah (SD = 10.26); 70%, 87%, and 97% for Jonathan (SD = 13.65); 83%, 67%, and 80% for Liam (SD = 8.50); and 73%, 77%, and 97% for Luis (SD = 12.86).

Figure 11. Average Percent Correct of Stimulus Generalization Probes at One-Month Follow-Up

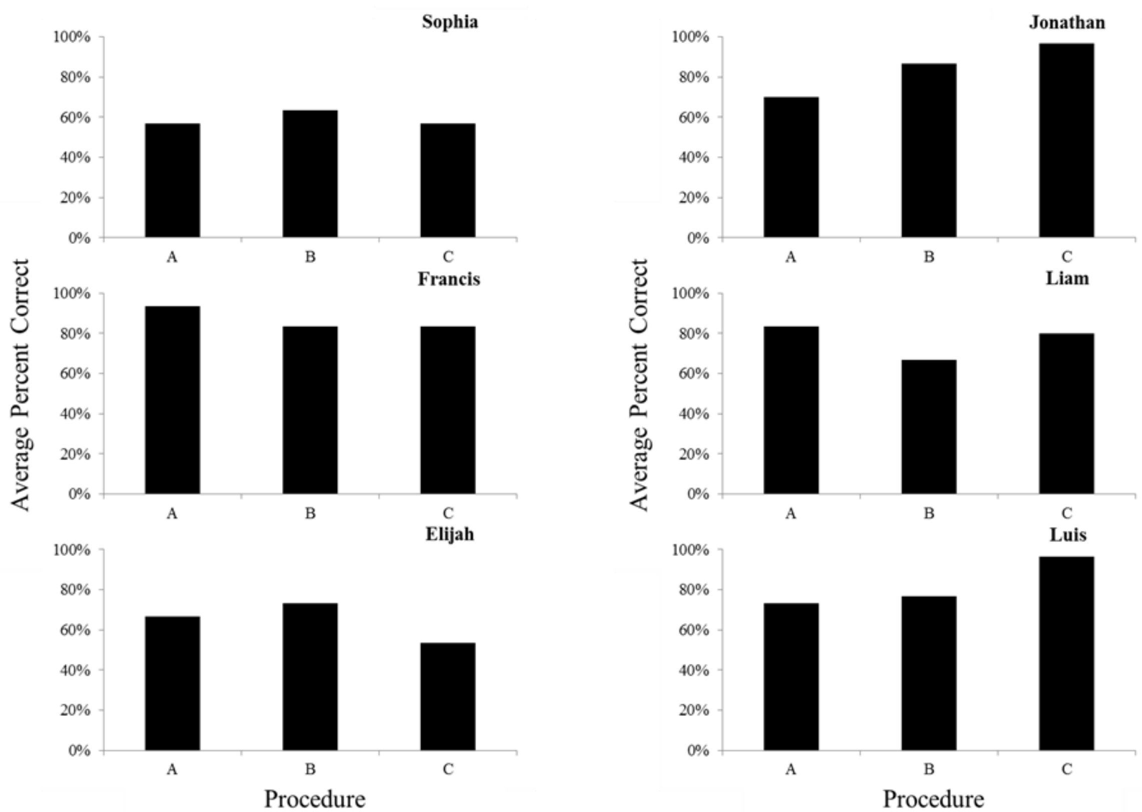

Figure 11. Average percent correct responses during conditional receptive discriminations taught using each procedure with similar but different stimuli at one-month follow-up.

For Sophia and Liam, Procedure B differed in accuracy by more than one standard deviation from Procedures A and C; however, for Sophia, Procedure B resulted in better accuracy, whereas for Liam, Procedure B resulted in worse accuracy. For Francis and Jonathan, Procedure A differed in accuracy by more than one standard deviation from Procedures B and C; however, for Francis, Procedure A resulted in better accuracy, whereas for Jonathan Procedure A resulted in worse accuracy. Finally, performance with stimuli trained using Procedure C differed by more than one standard

deviation during the stimulus generalization probe for Elijah and Luis; however, for Elijah, Procedure C resulted in worse accuracy, whereas for Luis, Procedure C resulted in better accuracy.

Learning Curves

Figure 12 demonstrates the cumulative number of sessions required to master conditional discrimination of the two targets, from start to finish, for each procedure.

Figure 12. Learning Curve for Total Sessions to Mastery

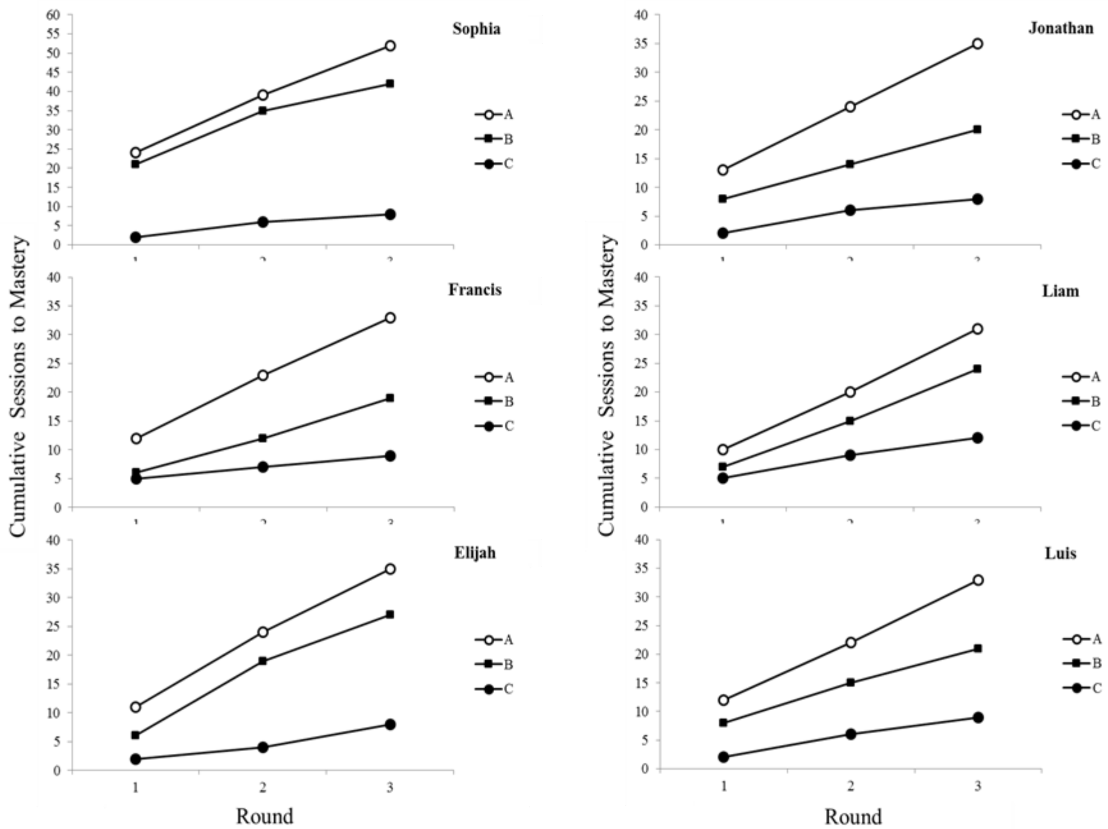

Figure 12. Cumulative number of sessions required to master training sets.

For all six participants in the study, Procedure A required more sessions overall than both Procedure B and C. Moreover, Procedure B required more sessions overall then Procedure C. These findings are not particularly surprising as Procedure A

inherently requires more sessions than Procedure B, as well as Procedure C. Likewise, Procedure B inherently requires more sessions than Procedure C.

One the other hand, Figure 13 demonstrates the cumulative number of sessions required to master discrimination of the two targets once they were placed alongside each other for each procedure.

Figure 13. Learning Curves for Conditional Receptive Discrimination

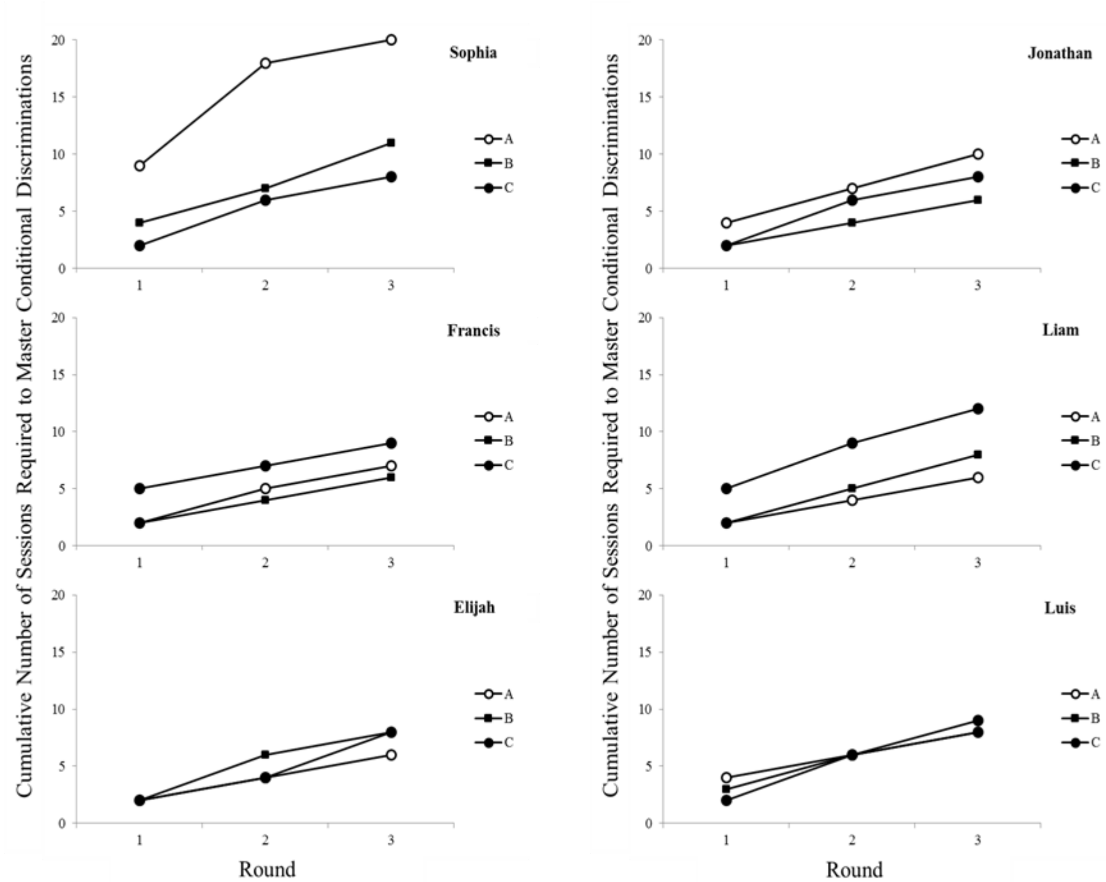

Figure 13. Cumulative number of sessions required to master conditional discriminations across the three procedures.

The graphs depicted in Figure 13 provide useful information as they do not take into consideration the extra training steps inherent in both Procedure A and Procedure B. In this case, Procedure C did not always result in the least number of training sessions

required to reach mastery across the three rounds of treatment. In fact, this was only the case for Sophia. For Francis and Jonathan, Procedure B required less conditional discrimination training sessions than Procedure A and Procedure C. However, for Elijah and Liam, it was Procedure A that required the least number of sessions when compared to the other two procedures. Finally, for Luis, Procedures A and B did not differ in the number of sessions required across the three rounds; both required eight sessions, while Procedure C required nine.

Aside from providing information on the cumulative number of sessions required to master each training set, learning curves also provide information on learning over time for each participant. Specifically, a steeper trend line of a given procedure indicates more sessions required to master conditional discriminations across the three procedures; on the other hand, a shallower trend line, indicates a smaller increase in sessions required to master conditional discriminations across the three rounds of treatment. For instance, Figure 13 shows that Procedure A had the shallowest slope for Elijah, Liam, and Luis across the three rounds of treatment, but the steepest slope for Sophia and Francis. For Jonathan, Procedure A tied with Procedure C for the steepest slope, while Procedure B resulted in the shallowest slope across the three rounds of treatment. For Sophia, Procedure C resulted in the shallowest slope; whereas, it resulted in the steepest slope for Liam and Luis. Finally, Procedure B and C tied for shallowest slope for Francis, but steepest slope for Elijah.

Chi-square Tests

To further examine whether Procedures A, B, and C differed statistically in sessions to mastery, two types of chi-square tests were conducted: (a) chi-square test for

independence, and (b) chi-square test for equality of proportions. The chi-square test for independence is a non-parametric test used to evaluate the relationship between two categorical variables (Pallant, 2010). In this case, the variables were: (a) the procedure (i.e., A, B or C) and (b) the round of treatment (i.e., 1, 2 or 3). This test compares the observed frequency in each of the categories. For the present study, the observed frequencies refer to the number of sessions or trials required to reach mastery for each pair of stimuli. The chi-square test for equality of proportions is a non-parametric test used to evaluate whether or not a set of proportions are equal (Cox & Key, 1993). In this case, the proportion of sessions or trials required to reach mastery for each Procedure are compared within each round of treatment.

Given that the chi-square test is a nonparametric test, it is not bound by the same assumptions as parametric tests: (a) normality, (b) homogeneity of variance, and (c) independent errors (Barlow et al., 2009). However, one important assumption made is that at least 80% of the cells must have an expected frequency of 5 or more (Pallant, 2010). Trials to mastery were used for the chi-square tests, instead of sessions to mastery, to meet this important assumption because Procedure C was usually mastered in less than five sessions. One session is comprised of 10 trials.

Two chi-square tests for independence were conducted for each participant. One chi-square test examined whether Procedure A, B, and C differed statistically in total trials to mastery. The other chi-square test examined whether Procedure A, B, and C differed statistically in the number of trials required to master conditional receptive discrimination once the two target cards were placed alongside each other. The null hypothesis for both tests was that there is no relationship among the three procedures

across the three rounds of implementation and the alternative hypothesis was that there is a relationship.

Additionally, six chi-square tests for equal proportion were conducted for each participant to test the proportion of trials to mastery across the procedures within each round of treatment were differed. For three of the six tests, we compared the proportion of total trials necessary to reach mastery for each round, whereas for the other three tests, we compared the proportion of trials necessary to master conditional discriminations for each round.

Figure 14. Chi-square Tests

	Round of Treatment		
Procedure	1	2	3
A			
B			
C			

	1
A	
B	
C	

	2
A	
B	
C	

	3
A	
B	
C	

Figure 14. Chi-square tests used to test the relationships between the three procedures and three rounds of treatment.

Chi-square tests for equal proportions were used, instead of chi-square tests for independence, to discover any differences across the procedures within each round of treatment separately because chi-square tests for independence require a minimum of two levels for both categorical variables. The null hypothesis for the chi-square tests for equal

proportion is that the proportion of trials to mastery for Procedure A, Procedure B, and Procedure C were equal for a given round of treatment, whereas the alternative hypothesis was that at least one of the proportions across procedures differed for that same round of treatment.

Chi-square Tests for Total Trials to Mastery. For each of the six participants, one chi-square tests of independence and three chi-square tests for equal proportion were conducted to test if the three procedures (Procedure A, Procedure B, and Procedure C) differed in total trials to mastery across the three rounds of treatment. It is important to note, however, that although chi-square tests permit us to make statements regarding whether there is a relationship among variables, it does not give us information regarding the nature or strength of that relationship (Pallant, 2001). In other words, a chi-square test can indicate whether the procedure used mattered (in terms of trials to mastery) for a participant, but cannot tell us *how* it mattered. Likewise, the chi-square test does not specify which where the differences in procedures lie. Nevertheless, Table 7 displays the total trials to mastery for each participant for the three procedures across the three rounds of treatment.

Sophia. A chi-square analysis of independence found that there was a relationship in the total trials to mastery between the three procedures across the three rounds of treatment, X^2 (4, n = 1130) = 47.76, p < .001. Moreover, a chi-square test for equal proportions revealed that there was a difference in the proportion of total trails to mastery across the three procedures for the first round of treatment, X^2 (2, n = 580) = 33.45, p < .001, the second round of treatment, X^2 (2, n = 360) = 31.67, p < .001, and the third round of treatment, X^2 (2, n = 190) = 108.42, p < .001.

Table 7

Total trials to mastery for Procedure A, B, and C across the three rounds of treatment

		Round of Treatment		
Participant	Procedure	1	2	3
Sophia	A	240	150	130
	B	210	140	40
	C	130	70	20
Francis	A	120	110	100
	B	60	60	70
	C	50	20	20
Elijah	A	110	130	110
	B	60	130	80
	C	20	20	40
Jonathan	A	130	110	110
	B	80	60	60
	C	20	40	20
Liam	A	100	100	110
	B	70	80	90
	C	50	40	30
Luis	A	120	100	110
	B	80	70	60
	C	20	40	30

Francis. A chi-square analysis of independence found that there was a relationship in the total trials to mastery between the three procedures across the three

rounds of treatment, X^2 (4, n = 610) = 16.83, p = .002. Moreover, a chi-square test for equal proportions revealed that there was a difference in the proportion of total trails to mastery across the three procedures for the first round of treatment, X^2 (2, n = 230) = 37.39, p < .001, the second round of treatment, X^2 (2, n = 190) = 64.21, p < .001, and the third round of treatment, X^2 (2, n = 190) = 51.58, p < .001.

Elijah. A chi-square analysis of independence found that there was a relationship in the total trials to mastery between the three procedures across the three rounds of treatment, X^2 (4, n = 700) = 22.84, p < .001. Moreover, a chi-square test for equal proportions revealed that there was a difference in the proportion of total trails to mastery across the three procedures for the first round of treatment, X^2 (2, n = 190) = 64.21, p < .001, the second round of treatment, X^2 (2, n = 280) = 86.43, p < .001, and the third round of treatment, X^2 (2, n = 230) = 32.17, p < .001.

Jonathan. A chi-square analysis of independence found that there was a relationship in the total trials to mastery between the three procedures across the three rounds of treatment, X^2 (4, n = 630) = 12.22, p = .02. Moreover, a chi-square test for equal proportions revealed that there was a difference in the proportion of total trails to mastery across the three procedures for the first round of treatment, X^2 (2, n = 230) = 79.13, p < .001, the second round of treatment, X^2 (2, n = 210) = 37.14, p < .001, and the third round of treatment, X^2 (2, n = 190) = 64.21, p < .001.

Liam. A chi-square analysis of independence found that there was no significant relationship in the total trials to mastery between the three procedures across the three rounds of treatment, X^2 (4, n = 670) = 7.79, p = .10. However, a chi-square test for equal proportions revealed that there was a difference in the proportion of total trails to mastery

across the three procedures for the first round of treatment, X^2 (2, n = 220) = 17.27, $p <$ .001, the second round of treatment, X^2 (2, n = 220) = 25.46, $p < .001$, and the third round of treatment, X^2 (2, n = 230) = 45.22, $p < .001$.

Luis. A chi-square analysis of independence found that there was a relationship in the total trials to mastery between the three procedures across the three rounds of treatment, X^2 (4, 630) = 10.20, $p = .04$. Moreover, a chi-square test for equal proportions revealed that there was a difference in the proportion of total trails to mastery across the three procedures for the first round of treatment, X^2 (2, n = 220) = 69.09, $p < .001$, the second round of treatment, X^2 (2, n = 210) = 25.71, $p < .001$, and the third round of treatment, X^2 (2, n = 200) = 49.00, $p < .001$.

Chi-square Tests for Trials to Mastery of Conditional Receptive Discrimination. For each of the participants, one chi-square tests of independence and three chi-square tests for equal proportion were conducted to test if the three procedures differed in how many trials were necessary to reach mastery once both target cards were placed alongside each other.

It is critical to remember, however, that although a chi-square test can reveal whether the procedure used mattered (in terms of trials to mastery) for a participant, the test cannot specify *how* it mattered. Likewise, the chi-square test of equal proportions cannot specify which procedures differ in their proportion of trials to mastery; the test can only indicate that at least one of the proportions differ from the rest. Nevertheless, Table 8 displays the number of trials necessary for each participant to master conditional discriminations of target stimuli for the three procedures across the three rounds of treatment. In most cases, Procedure C required the least number of trials to mastery.

Table 8.

Trials to mastery of conditional receptive discriminations for Procedures A, B, and C across the three rounds of treatment

		Round of Treatment		
Participant	Procedure	1	2	3
Sophia	A	90	40	20
	B	90	30	30
	C	20	40	20
Francis	A	20	30	20
	B	20	20	20
	C	50	20	20
Elijah	A	20	20	20
	B	20	40	20
	C	20	20	40
Jonathan	A	40	30	30
	B	20	20	20
	C	20	40	20
Liam	A	20	20	20
	B	20	30	30
	C	50	40	30
Luis	A	40	20	20
	B	30	30	20
	C	20	40	30

Sophia. A chi-square analysis of independence found that there was a relationship in the trials to mastery between the three procedures across the three rounds of treatment,

X^2 (4, n = 380) = 35.56, p < .001. Furthermore, there was a difference in proportion of trials necessary for mastery between procedures across the first round of treatment, X^2 (2, n = 200) = 49.00, p < .001. However, no significant difference was found for the second round of treatment, X^2 (2, n = 110) = 1.82, p = .40 or the third round of treatment, X^2 (2, n = 70) = 2.86, p = .24.

Francis. A chi-square analysis of independence found that a relationship in the proportion of trials to mastery between the three procedures across the three rounds of treatment, X^2 (4, n = 220) = 15.19, p = .004. However, further analysis indicates that there was a difference in proportion of trials necessary for mastery between procedures across the first round of treatment, X^2 (2, n = 90) = 20.00, p < .001 but no significant difference for the second round of treatment, X^2 (2, n = 70) = 2.86, p = .24 or the third round of treatment, X^2 (2, n = 60) = 0.00, p = 1.00.

Elijah. A chi-square analysis of independence found that there was a relationship in the trials to mastery between the three procedures across the three rounds of treatment, X^2 (4, n = 220) = 15.28, p = .004. Moreover, there was a difference in proportion of trials to mastery between the three procedures across the second round of treatment, X^2 (2, n = 80) = 10.00, p = .01, and third round of treatment, X^2 (2, n = 80) = 10.00, p = .01, but not the first round of treatment, X^2 (2, 60) = 0.00, p = 1.00.

Jonathan. A chi-square analysis of independence found no relationship in the trials to mastery between procedures across the three rounds of treatment, X^2 (4, n = 240) = 8.97, p = .06. However, further analysis indicates that there was a difference in proportion of trials necessary for mastery between procedures across the first round of treatment, X^2 (2, n = 110) = 10.00, p = .01 and the second round of treatment, X^2 (2, n =

90) = 6.67, $p = .04$. Nevertheless, no significant difference was found across the third round of treatment, X^2 (2, n = 80) = 2.86, $p = .24$.

Liam. A chi-square analysis of independence found no significant relationship in the trials to mastery between procedures across the three rounds of treatment, X^2 (4, n = 260) = 6.77, $p = .15$ or difference in the proportion of trials to mastery between the procedures across the third round of treatment, X^2 (2, n = 80) = 2.50, $p = .29$. However, the results indicate that there was a difference between procedures across the first and second round of treatment, X^2 (2, n = 90) = 20.00, $p < .001$ and X^2 (2, n = 90) = 6.67, $p = .04$, respectively.

Luis. A chi-square analysis of independence found that there was a relationship in the number of trials to mastery between the three procedures across the three rounds of treatment, X^2 (4, n = 250) = 15.10, $p = .004$. Moreover, there was a difference in the proportion of trials to mastery between the three procedures across the first round of treatment, X^2 (2, n = 90) = 6.67, $p = .04$ and the second round of treatment, X^2 (2, n = 90) = 6.67, $p = .04$. However, no significant difference was found across the third round of treatment, X^2 (2, n = 70) = 2.86, $p = .24$.

All in all, chi-square analyses conducted to test whether the three procedures differed significantly in proportion of total trials to mastery revealed that there was a difference between the three procedures across all three rounds of treatment for all six participants. While chi-square analyses cannot specify the nature of a statistical relationship or difference, Procedure C consistently required less trials to mastery than both Procedures A and B; this was true for each round of treatment and for all six participants.

Discussion

In the current study, six children diagnosed with autistic disorder were taught receptive discriminations using three different discrete trial training procedures: (a) simple/conditional procedure, (b) conditional only procedure, and (c) conditional discrimination of two target cards procedure.

One of the primary goals of the study was to compare the simple/conditional and conditional only receptive discrimination procedures evaluated by Gutierrez and colleagues (2009). As predicted, the findings of the present study replicate the findings of Gutierrez et al. and Terrace (1963). Specifically, we found that the simple discrimination step (presenting the target card in isolation) did not considerably improve any of the participants' ability to learn how to receptively discriminate between two previously taught stimuli. In fact, the data suggest that, for most participants, including the no distracter training phase disadvantaged the learner by exposing them to seemingly unnecessary learning trials, which reduces the amount of time the learner has to engage in other educational tasks.

However, it is possible that these extra learning trials could initially benefit some learners but become unnecessary as training progresses. For instance, Sophia received the simple/conditional procedure first in the sequence. For her first training set, this procedure required nine additional sessions to reach mastery once the two target cards were presented alongside each other. Subsequently, Sophia received the conditional only procedure (Set 2) and here this procedure also required nine additional sessions to reach mastery once the two target cards were presented alongside each other. Thereafter, however, the number of sessions required for mastery of conditional receptive

discriminations decreased significantly for each training set regardless of the procedure used. One possible explanation is that during training for the first two sets of stimuli, she learned how to attend to the relevant visual and auditory stimuli required to respond accurately. As a result, by the time she was exposed to the conditional discrimination of two target cards procedure for Set 3, and all three procedures in the second and third round of treatment, she was able to reach mastery with a fewer number of sessions (sometimes with the minimum number of sessions required). Even so, it is worthy to note that for Elijah, Jonathan, and Luis, conditional discriminations were mastered within the minimum two sessions the first time Procedure C was implemented and in Luis' case, Procedure C was the first procedure in his training sequence.

A second goal of the current study was to investigate whether eliminating the "no distracter" step, and also the "distracter" step, is more beneficial and efficient for teaching children with autism how to receptively discriminate between two previously taught stimuli. Contrary to our original hypothesis, but in line with the findings of Grow et al. (2011), the distracter step was not necessary to teach receptive discriminations. Eliminating the distracter step and attempting to teach two target stimuli at once did not result in significantly more training sessions before mastery was reached. Although there were a few instances in which it took the participant more sessions with Procedure C to reach mastery, when compared to the other two procedures, Procedure C never took more than five sessions for any of the participant. This is important to note as even with the minimum number of sessions to mastery with Procedures A and B, there are a minimum of total sessions of ten and six sessions, respectively, because of the extra required

training steps. As a result, Procedure C always resulted in the least number of sessions from start to finish (see Figure 4).

Furthermore, chi-square analyses conducted to test whether the three procedures differed in proportion of trials necessary to master conditional discriminations revealed that, for all participants, there was at least one round of treatment where the proportion of trials to master conditional discriminations did not differ across the three procedures; specifically, Rounds 2 and 3 for Sophia, Rounds 2 and 3 for Francis, Round 1 for Elijah, Round 3 for Jonathan, Round 3 for Liam and Round 3 for Luis. Additionally, for some participants where a difference was found, the data show that in these cases Procedure C required less trials to mastery; namely, Round 1 for Sophia, Round 2 and 3 for Elijah, Round 1 for Jonathan, and Round 1 for Luis. However, there were also some instances where a difference was found and Procedure C required more trials to master conditional discriminations; this was the case for the first round of treatment for Francis, the second round of treatment for Jonathan, the first and second round of treatment for Liam, and the second round of treatment for Luis. Nevertheless, chi-square analyses conducted to test whether the three procedures differed significantly in proportion of total trials to mastery revealed that, for all participants, there was a difference between the three procedures across all three rounds of treatment. Although chi-square analyses cannot specify the nature of a statistical relationship or difference, Procedure C always required less trials to mastery than both Procedures A and B for each round of treatment; this was true for all six participants.

One reason that Procedures A and B may have resulted in consistently more trials to mastery than Procedure C may be because these procedures foster inaccurate stimulus

control. Grow et al. (2001) found that the simple/conditional and conditional only methods were associated with error patterns because some of the “extra” steps included in these procedures promote faulty stimulus control. For instance, the phase in which the target card is presented in isolation, without a distracter, does not require the learner to attend to relevant visual and auditory stimuli required to make conditional discriminations. Likewise, the phase in which the target card is presented with a distracter, may require the learner to attend to relevant visual stimuli, but not to relevant auditory stimuli. Their findings coincide with Green’s (2001) notion that these extra steps encourage overselectivity to the visual aspect the stimulus by exposing the learner to mass trials of simple discriminations, rather than conditional discriminations in an array of two or more target cards.

A third goal of the current study was to evaluate whether one of the three procedures led to better response maintenance and generalization (e.g., across therapist and within stimulus class) at one-month follow-up. With regards to response maintenance at one-month follow-up, the hypothesis that accuracy in responding at one-month follow-up would be best with stimuli taught using conditional only procedure was not supported by the data. Overall, the data suggest that no particular procedure resulted in significantly better or worse response maintenance for any of the participants. Likewise, the hypothesis that the conditional only procedure would result in better generalization, both across therapist and within stimulus class, at one-month follow-up, was not supported. Like response maintenance, the data suggest that no one procedure resulted in significantly better or worse generalization for any of the participants. In other words, more training sessions, as evident with the simple/conditional and conditional only

procedures, did not facilitate accurate responding or generalization one-month following training. What is more, the standard deviations were usually large indicating very variable data. This variability may suggest that there are other factors, aside from simple procedural differences, that contribute to performance during follow-up probes. Ultimately, these findings were true for all six participants independent of their scores on the ADOS-2 and the Mullen Scales of Early Learning. The finding that no one procedure resulted in significantly better or worse generalization across all participants adds to the argument that generalization should be deliberately programmed regardless of the receptive discrimination procedure used.

A fourth and final goal of the current study was to investigate whether children varying in their initial level of receptive language differ in which procedure for teaching receptive discrimination is more effective and efficient for them. Because all six participants were categorized as “very low” on the Visual Reception Scale and Receptive Language scale of the Mullen Scales of Early Learning, it was not possible to make conclusions as to whether a participant who scored higher on receptive skills as indicated by the Mullen Scales of Early Learning, and would be more likely to generalize the discriminations across therapists and within stimulus class at one-month follow-up. In fact, Munson et al. (2008) found that Mullen subscale T-scores commonly yield a floor score with this sample. In their sample of 456 children with autism spectrum disorders; 59% yielded a floor score on the Visual Perceptive Scale, 72% yielded a floor score on the Fine Motor Scale, 80% yielded a floor score on the Receptive Language Scale, and 76% yielded a floor score on the Expressive Language Scale.

Limitations

One possible limitation of the current study was the lack of a formal reinforcer assessment for each participant. Although the literature supports the use of preference assessments as a quick and convenient method of identifying possible reinforcers (Roane et al., 1998), preference assessments do not guarantee that a stimulus will function as a reinforcer for a given behavior. Because the stimulus used as a reinforcer for a given session depended on whether the learner approached the item during the preference assessment, it is very possible that once the learner contacted the item, the function of the stimulus changed. Without a functioning reinforcer, it is possible that the learner's performance was negatively affected. It is also possible that the reinforcing value of the stimulus was not strong enough to keep the child engaged in the task, especially when the task was repetitive and uninteresting (such as mass trials of touching the same picture card). During the "no distracter" and "distracter" phases of the simple/conditional and conditional only procedures, the learner was presented with the same instruction ten times for a minimum of two sessions; for this reason, learner fatigue may be a second possible limitation of the current study. However, sessions were conducted throughout the day with breaks in between to minimize learner fatigue. Additionally, reinforcers were varied frequently within and across sessions and delivered on an intermittent schedule of reinforcement to avoid satiation.

A third limitation to this study was the use of two of more different settings. For instance, Sophia began participating in the current study while she was attending FIU's Early Intensive Behavioral Intervention Program. The room in which this program took place had a maximum of eight children in the room at a given time. However, by the time

of her follow-up sessions for training sets 8 and 9, she was enrolled in FIU's Summer Treatment Program. Although both programs took place in the same building, the set up for the rooms differed in a number of ways. First, there were more children in the room at summer camp (13) and the room was much larger. This change of settings may have made the new room louder and/or more distracting, affecting Sophia's performance at follow-up. Similarly, Francis, Jonathan, Liam, and Luis, began participating in the current study while attending the summer treatment program. However, by the time of many, if not all, of their follow-up sessions, the program ended and these sessions had to take place in a small session room where the only people present were the experimenter, a research assistant, and the child. There were no learning stations in these rooms and significantly less toys. As a result, response maintenance probes did not necessarily occur in the same training conditions, and generalization probes did not necessarily occur in a situation which differed from the original training situation with the exception of one aspect (i.e., different therapist or different stimuli). Consequently, these environmental changes may have affected learners' performance at follow-up.

A fourth limitation to this study was a lack of baseline conducted with the novel therapist conducting the generalization across therapist probes, as well as a lack of baseline conducted with the novel stimuli used in the stimulus generalization probes. Because performance with a novel therapist was never measured during baseline, it can be argued that the generalization across therapist probes were not a true measure of generalization. Likewise, because performance with similar yet different stimuli was never measured during baseline, it can be argued that the stimulus generalization probes

were also not a true measure of generalization. Instead, these probes might, at best, only suggest generalization.

A fifth limitation to this study was participants' ability to discriminate between phases. In other words, some participants appeared to learn when they were in "baseline" and when they were in "treatment." The lack of prompting and the therapist responding by saying "thank you" after each response the learner emitted appeared to have facilitated this discrimination. When participants learned that they were in a baseline phase, they often developed side biases, responding by touching the card always placed either to the left or to the right. This limitation poses a serious concern as it becomes unclear whether the learner was attending to the relevant auditory and visual stimuli being presented to them prior to responding during baseline. In other words, it is possible that had they attended to these relevant stimuli, they would have correctly identified stimuli during baseline that later would not have been used as target cards. Nevertheless, baseline phases were conducted under extinction to prevent training from occurring, and it is possible that responding haphazardly is how individuals respond before they have learned the appropriate way of responding.

A sixth, and final, limitation to this study is related to the stimuli used for the within-class generalization probes at one-month follow-up, particularly for Elijah. Four of the six participants (i.e., Sophia, Jonathan, Liam, and Luis) were taught how to discriminate between different common nouns. However, Elijah was taught how to discriminate between different common verbs. It was significantly easier to find stimuli that differed in one or two features (e.g., color and size) for common nouns that it was for common verbs. For example, if one common stimulus was "car," it was relatively easy to

find a picture of that same car in a different color and manipulate the size of the picture. However, if one of the target verbs was “eating,” it was more challenging because it is not very likely that two action cards would differ in only one or two features; the individuals in the picture may be different, the background is also likely to differ significantly, as well what the individual was eating, and how they were eating. As a result, the follow-up stimuli for Elijah may have been inherently more difficult than for Sophia, Jonathan, Liam, and Luis resulting in lower accuracy at one-month follow-up or an unequal comparison of the procedures during this probe. Furthermore, Francis, whose receptive and expressive language was more advanced than the other five participants, was taught to discriminate site words. For the stimulus generalization probes, the font-type of the target words was altered. Francis often performed more accurately at follow-up during the stimulus generalization probe than the response maintenance probes. Initially, this appears to be an unexpected finding because performance should probably be best when the learner is presented with the stimuli he was trained with. Anecdotally, however, Francis verbally expressed that he found the new fonts “funny,” which facilitated his attending behavior to the stimuli.

Future Directions

Future studies should continue to investigate the one-size-fits-all approach to treatment for individuals with ASD. Unfortunately, conclusions about what type of individual would benefit from Procedures A or Procedure B versus Procedure C were hampered by the fact that all six participants landed in the same descriptive category of “very low” on the Visual Reception Scale and Receptive Language scale of the Mullen Scales of Early Learning, as well as in regards to their Early Composite Score. The

participants were not matched by age; consequently, it was difficult to compare one participant to the other in terms of where they land developmentally. Additionally, Munson et al. (2008) found that floor scores on the Mullen Scales of Early Learning are extremely common within the autism population and Akshoomoff (2006) stated that it is difficult to interpret T-scores that fall at or below 20, leaving us with little information regarding how the six participants in the current study truly differed in their skill level. Nevertheless, although all participants scored at floor level on the Visual Reception Scale and Receptive Language scale of the Mullen, the seemingly more difficult procedure (conditional discrimination of two target cards) appeared to be the most efficient procedure for all of the participants.

Future studies should also continue to identify discrepancies in the methods used to teach certain skills, in addition to receptive discriminations, in early intensive behavioral intervention programs and to evaluate what is the most effective and efficient way to teach these skills. Additionally, future research should also investigate whether the error patterns discussed by Lovaas (2003), and witnessed by Grow et al. (2011), occur even when an errorless learning procedure is implemented. The current study did not examine error patterns that may have been exhibited by participants, however, Grow et al. (2011) points out that perhaps an errorless learning procedure, like the one used in the current study, may prevent these error patterns from occurring. This is particularly important because the use of errorless learning methods are used by many early intensive behavioral intervention programs (Love et al., 2009).

What is more, future studies should directly address some of the limitations of the current study. For example, in the future, researchers should modify the baseline phase to

make it more difficult for participants to discriminate between phases. Instead of asking the child to engage in a completely irrelevant behavior to maintain behavioral momentum (e.g., give me five, touch your head), learners can be asked to identify picture cards, similar to the ones used in training, that they can already identify; prompting and reinforcement can be made available for those responses instead. Additionally, baseline should be conducted with the novel therapist conducting the generalization across therapist probes, as well as with the novel stimuli used in the stimulus generalization probes. Establishing that the novel therapist(s) and stimuli used in follow-up were also unknown initially would allow for more convincing conclusions to be made about generalization.

Moreover, more research is needed to identify other developmental assessments better suited to identify “fast learners” within the ASD population. This would allow research to better explore whether one method of teaching a skill is better suited for these types of learners versus others. Furthermore, formal reinforcer assessments should be conducted to ensure that that preferred stimuli are in fact functioning as reinforcers and more control should be exercised over the stimuli used in the stimulus-generalization probes at one-month follow-up. Likewise, more control should be exercised to ensure the maximum level of similarity between the training conditions and the conditions at follow-up sessions.

Conclusion

The current study has contributed to the literature by evaluating three methods of teaching receptive discrimination within a discrete trial training paradigm to young children with autism. The findings of the current study replicate and extend upon the

findings of past studies evaluating receptive discrimination procedures (Grow et al, 2011; Gutierrez et al., 2009). The fact that the data suggests that the “no distracter” step and the “distracter” step are not necessary to facilitate acquisition of receptive discriminations, means that practitioners and therapists can spend less time engaging in these seemingly futile training steps, and more time offering learners productive learning opportunities. Uncovering efficient and effective ways of teaching young children with autism how to receptively discriminate is significant as numerous studies have found that receptive language skills are strongly associated with better outcomes and adaptive behaviors within this population (Helt et al., 2008; Park et al., 2012; Paul, 2005; Venter et al., 1992).

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Appendices

A. Informed Consent

B. Data Sheets

C. Sample Picture Cards

Appendix A: Informed Consent

PARENTAL CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Evaluating The Effectiveness Of Discrete Trial Procedures For Teaching Receptive Discrimination To Children With Autism Spectrum Disorders

PURPOSE OF THE STUDY

You are being asked to give your permission for your child to be in a research study. The purpose of this study is to evaluate the effectiveness of different discrete trial procedures for teaching receptive discriminations.

NUMBER OF STUDY PARTICIPANTS

If you agree to allow your child to participate in this study, he/she will be one of 15 people in this research study.

DURATION OF THE STUDY

Your child's participation will require 1-2 visits per week for an hour for approximately 6-8 weeks. Additionally, we will contact you at 1-month intervals after the completion of the study to assess skill maintenance, for up to 3 months.

PROCEDURES

If your child participates in this study, we will ask you and your child to do the following things:

Your child will receive training in 3 different ways during the receptive identification training involving the treatment phases described below.

- In sequence A, participants will be taught receptive identification starting with treatment phase 1, followed by phase 2 and then phase 3.
- In sequence B, participants will be taught receptive identification starting with treatment phase 2, and then followed by phase 3.
- In sequence C, participants will be taught receptive identification using only phase 3.

Exposure to all three training sequences will be repeated at least twice before conducting follow-up sessions.

1. Pre-assessment: Your child will be evaluated and observed to get information on his/her social, language, play, and nonverbal cognitive skills (or the ability to solve problems that don't involve any language). This testing will take approximately 1½ to 3 hours, which can be divided over multiple days as needed.
2. Baseline: The purpose of the baseline phase is to identify target pictures that your child is not currently able to receptively identify to be taught in subsequent phases of this study. Your child will be asked to identify each of the target pictures by pointing or handing the picture to the examiner (e.g. "give me red "point to the square").

Pictures your child does not identify correctly on 3 trials will be used in subsequent phases of the study

3. Treatment phase 1: Teaching without distracters: The purpose of this phase is to teach your child to receptively identify target pictures (e.g., colors, shapes, etc.). During this phase, your child will be presented with a target picture that they will be asked to receptively identify 10 times during each session. If the student does not touch the card they will be prompted to touch the red card and then given praise.
4. Treatment phase 2: Teaching using distracters: The purpose of this phase is to teach your child to receptively identify target pictures (e.g., colors, shapes, etc.) versus distracter pictures. Correct responses will be rewarded and incorrect responses will receive help from the examiner (e.g., no, this is red) and will have the opportunity to try again.
5. Treatment phase 3: Teaching 2 targets at once: The purpose of this phase is to teach your child to receptively identify 2 target pictures (e.g., colors, shapes, etc.) at the same time. Correct responses will be rewarded and incorrect responses will receive help from the examiner (e.g., no, this is red) and will have the opportunity to try again.
6. Phase 4: Maintenance: At 1-month intervals after the completion of the study we will contact you to invite you and your child to return for a follow-up visit. The purpose of the maintenance phase is to determine if the receptive identification skill has maintained over time following the teaching phase.

RISKS AND/OR DISCOMFORTS

The following risks may be associated with your child’s participation in this study:
We anticipate no more than a minimal risk in participating in this study. During the course of the study, children may become annoyed during the teaching trials. However, these are behaviors that occur typically outside of the experimental setting. Sessions will be discontinued if behavior presents a risk of injury to the child or anyone else in the study or if the parent feels the child is not comfortable.

BENEFITS

The following benefits may be associated with your child’s participation in this study:
As a result of the study, your child may learn new receptive discriminations.

ALTERNATIVES

There are no known alternatives available to your child other than not taking part in this study. However, any significant new findings developed during the course of the research that may relate to your child’s willingness to continue participation will be provided to you.

CONFIDENTIALITY

The records of this study will be kept private and will be protected to the fullest extent provided by law. In any sort of report we might publish, we will not include any information that will make it possible to identify your child as a subject. Research records will be stored securely and only the researcher team will have access to the records. However, your child’s records may be reviewed for audit purposes by authorized University or other agents who will be bound by the same provisions of confidentiality.

If we learn about serious harm to you or someone else, we will take steps to protect the person endangered even if it requires telling the authorities without your permission. If we have reason to believe that your child is being abused, we will report this to the Florida Abuse hotline. In these instances, we would only disclose information to the extent necessary to prevent harm.

COMPENSATION & COSTS
Your child will not receive any compensation for participating in this study. Your child will not be responsible for any costs to participate in this study beyond the cost to park at the center.

RIGHT TO DECLINE OR WITHDRAW
Your child's participation in this study is voluntary. Your child is free to participate in the study or withdraw his/her consent at any time during the study. Your child's withdrawal or lack of participation will not affect any benefits to which he/she is otherwise entitled. The investigator reserves the right to remove your child from the study without your consent at such time that they feel it is in the best interest.

RESEARCHER CONTACT INFORMATION
If you have any questions about the purpose, procedures, or any other issues relating to this research study you may contact Dr. Anibal Gutierrez at AHC-1 room 237, (305) 348-0042, anibal.gutierrez@fiu.edu.

IRB CONTACT INFORMATION
If you would like to talk with someone about your child's rights of being a subject in this research study or about ethical issues with this research study, you may contact the FIU Office of Research Integrity by phone at 305-348-2494 or by email at ori@fiu.edu.

VIDEOTAPING
By signing this section you give permission for your child to be videotaped during this study. <u>Please read the following statements regarding use of video/still images and check ALL of the boxes that apply:</u>

[ ] Videos/still pictures may be used for teaching purposes and conference presentations.

[ ] Videos/still pictures may be used in the media for study purposes.

__________________________________ ________________
Signature of Participant Date

__________________________________ ________________
Signature of person obtaining consent Date

PARTICIPANT AGREEMENT

I have read the information in this consent form and agree to allow my child to participate in this study. I have had a chance to ask any questions I have about this study, and they have been answered for me. I understand that I am entitled to a copy of this form after it has been read and signed.

________________________________ ____________________

Signature of Parent/Guardian Date

____

Printed Name of Parent/ Guardian

____

Printed Name of Child Participant

________________________________ ____________________

Signature of Person Obtaining Consent Date

Appendix B: Data Sheets

Participant:
Condition: Baseline
Prompting Procedure: None
Targets for Procedure (circle one): A B C
Target Criterion: 3/5 incorrect responses

Date:		Date:		Date:		Date:		Date:	
S^D:		S^D:		S^D:		S^D:		S^D:	
Trial	Response	Trial	Response	Trial	Response	Trial	Response	Trial	Response
1	C I N	1	C I N	1	C I N	1	C I N	1	C I N
2	C I N	2	C I N	2	C I N	2	C I N	2	C I N
3	C I N	3	C I N	3	C I N	3	C I N	3	C I N
4	C I N	4	C I N	4	C I N	4	C I N	4	C I N
5	C I N	5	C I N	5	C I N	5	C I N	5	C I N
% Correct:		% Correct:		% Correct:		% Correct:		% Correct	

Date:		Date:		Date:		Date:		Date:	
S^D:		S^D:		S^D:		S^D:		S^D:	
Trial	Response	Trial	Response	Trial	Response	Trial	Response	Trial	Response
1	C I N	1	C I N	1	C I N	1	C I N	1	C I N
2	C I N	2	C I N	2	C I N	2	C I N	2	C I N
3	C I N	3	C I N	3	C I N	3	C I N	3	C I N
4	C I N	4	C I N	4	C I N	4	C I N	4	C I N
5	C I N	5	C I N	5	C I N	5	C I N	5	C I N
% Correct:		% Correct:		% Correct		% Correct:		% Correct:	

Date:		Date:		Date:		Date:		Date:	
S^D:		S^D:		S^D:		S^D:		S^D:	
Trial	Response	Trial	Response	Trial	Response	Trial	Response	Trial	Response
1	C I N	1	C I N	1	C I N	1	C I N	1	C I N
2	C I N	2	C I N	2	C I N	2	C I N	2	C I N
3	C I N	3	C I N	3	C I N	3	C I N	3	C I N
4	C I N	4	C I N	4	C I N	4	C I N	4	C I N
5	C I N	5	C I N	5	C I N	5	C I N	5	C I N
% Correct:		% Correct:		% Correct		% Correct:		% Correct:	

Participant:	
Procedure (circle one): A B C	Target 1: ____________ Distracter 1: ____________
Prompting Procedure: Errorless (Most to Least)	Target 2: ____________ Distracter 2: ____________
Sequence of Procedures:	
Mastery Criterion: 80% Independent (I) responses across 2 consecutive sessions	

Date:		Date:		Date:		Date:		Date:	
S^D:		S^D:		S^D:		S^D:		S^D:	
Trial	Response	Trial	Response	Trial	Response	Trial	Response	Trial	Response
1	I P	1	I P	1	I P	1	I P	1	I P
2	I P	2	I P	2	I P	2	I P	2	I P
3	I P	3	I P	3	I P	3	I P	3	I P
4	I P	4	I P	4	I P	4	I P	4	I P
5	I P	5	I P	5	I P	5	I P	5	I P
6	I P	6	I P	6	I P	6	I P	6	I P
7	I P	7	I P	7	I P	7	I P	7	I P
8	I P	8	I P	8	I P	8	I P	8	I P
9	I P	9	I P	9	I P	9	I P	9	I P
10	I P	10	I P	10	I P	10	I P	10	I P
% Correct:		% Correct:		% Correct:		% Correct:		% Correct	

Date:		Date:		Date:		Date:		Date:	
S^D:		S^D:		S^D:		S^D:		S^D:	
Trial	Response	Trial	Response	Trial	Response	Trial	Response	Trial	Response
1	I P	1	I P	1	I P	1	I P	1	I P
2	I P	2	I P	2	I P	2	I P	2	I P
3	I P	3	I P	3	I P	3	I P	3	I P
4	I P	4	I P	4	I P	4	I P	4	I P
5	I P	5	I P	5	I P	5	I P	5	I P
6	I P	6	I P	6	I P	6	I P	6	I P
7	I P	7	I P	7	I P	7	I P	7	I P
8	I P	8	I P	8	I P	8	I P	8	I P
9	I P	9	I P	9	I P	9	I P	9	I P
10	I P	10	I P	10	I P	10	I P	10	I P
% Correct:		% Correct:		% Correct		% Correct:		% Correct:	

Appendix C: Sample Picture Cards

VITA

DESIREE JASMIN SEPULVEDA

	Born, New York, New York
2004-2008	B.A., Psychology Florida International University Miami, Florida
2008-2009	Behavior Therapist Children's Center for Development and Behavior Sunrise, Florida
2009	Volunteer Teaching Assistant Course: Introduction to the Experimental Analysis of Behavior Florida International University Miami, Florida
2009-2014	McKnight Doctoral Fellowship (Florida Education Fund)
2012	M.S., Psychology Florida International University Miami, Florida
2012-2013	Teaching Assistant Course: Principles and Theories of Behavior Modification Florida International University Miami, Florida
2013	Assistant Supervisor Early Intensive Behavior Intervention Program Florida International University Miami, Florida
	Assistant Supervisor Autism Spectrum Disorder Summer Treatment Program Florida International University Miami, Florida
2013-2014	Teaching Assistant Course: Research Methods in Psychology

	Florida International University Miami, Florida
2014	Supervisor Autism Spectrum Disorder Summer Treatment Program Florida International University Miami, Florida
2014-2015	Teaching Assistant Courses: Introduction to the Experimental Analysis of Behavior; Principles and Theories of Behavior Modification Florida International University Miami, Florida

PUBLICATIONS AND PRESENTATIONS

Espinal, D. J. (2012). Caretaker-child Interactions at Bedtime: A bidirectional view of noncompliant bedtime behavior. Paper presented at Florida Association for Behavior Analysis in Jacksonville, Florida.

Sepulveda, D. J., & Gutierrez, A. (2014). Evaluating the Effectiveness of Discrete Trial Procedures for Teaching Receptive Discrimination to Children with Autism Spectrum Disorders. Paper presented at the 40th Annual Association for Behavior Analysis International Conference in Chicago, Illinois.

Sepulveda, D. J., & Gutierrez, A. (2014). McKnight doctoral fellows at the Behavior Analysis Autism Research lab at Florida International University. *Florida Association for Behavior Analysis Observer, 9*(2), 7-8.

Sepulveda, D. J., & Gutierrez, A. (2014). Treating Bedtime Struggles and Nighttime Awakenings. Parent training workshop presented at Center for Autism and Related Disabilities in Orlando, Florida.