The Effects of the Acquisition of Conditioned Reinforcement for Adult Faces and/or Voices on the Rate of Learning and Attention to the Presence of Adults for Children with Autism Spectrum Disorder

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ABSTRACT

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I conducted two experiments to test the effects of the acquisition of conditioned reinforcement for observing adult faces and conditioned reinforcement for listening to adult voices on rate of learning and attention to the presence of adults using a delayed multiple probe design across participants and behaviors. In Experiment 1, two participants with autism spectrum disorders (ASD) participated and the dependent variables were: (1) learn-units-to-criterion across speaker and listener programs based on 1000 learn units respectively (2) attention to the presence of adults prior to and following pre- and post-intervention probe sessions. The independent variable was the acquisition of conditioned reinforcement for observing the human face and the acquisition of conditioned reinforcement for listening to adult voices using the conjugate stimulus-stimulus pairing protocol. In Experiment 2, there were four participants in this study diagnosed with ASD. The dependent variables were learn units to criteria across speaker and listener programs, observing responses, and verbal operants emitted by the participants across three settings. In Experiment 1, the results showed Participant A’s rate of learning accelerated after the first intervention and decreased after the second intervention. Participant A’s attention to the presence of adults increased after the first
intervention and slightly decreased after the second. For Participant B when the acquisition of conditioned reinforcement for faces and conditioned reinforcement for listening to voices were in repertoire rate of learning and attention to the presence of adults accelerated. In Experiment 2, the results indicated that the acquisition of conditioned reinforcement for observing adult faces and/or voices increased rate of learning, attending to adults present in the environment, and verbal operants for all four participants.
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DEDICATION

This paper is dedicated to the loves of my life, Nickey and Michael.
Chapter I
Introduction and Review of the Literature

One of the first and earliest forms of social contact occurs when an infant looks at
his or her mother’s face. Observing faces is the beginning of social contact or
communication. Direct eye contact also affects an individual’s perception, cognition, and
attention (Senju, Kikuchi, Hasegawa, Tojo, & Osanai, 2008). According to Massaro and
Bosseler (2006), research has shown that observing the human face improves speech
production and effective communication. Listening to adult voices alone may be
sufficient, but observing the movement of the lips, tongue, face, and jaw helps with the
auditory messages (Massaro & Bosseler, 2006). Responding to human voices is also
important in acquiring listener and speaker repertoires (Greer, Pistoljevic, Cahill, & Du,
submitted 2010; Keohane, Pereira-Delgado, & Greer, 2009). Consequently, when these
verbal developmental cusps are missing, related learning may be delayed or not possible.

Some researchers have shown that the stimulus-stimulus pairing procedure was
effective in conditioning vocalizations, conditioning new reinforcers, and expanding an
individual’s community of reinforcers (Greer, Becker, Saxe, & Mirabella, 1985; Greer,
Dorow, Wachhaus, & White, 1973; Longano & Greer, 2006; Miguel, James, Carr, &
Michael, 2002; Nuzzolo-Gomez, Leonard, Ortiz, Rivera, & Greer, 2002; Pereira-
Delgado, Greer, Speckman, & Goswami, 2009; Rheingold, Gerwirtz, & Ross, 1959;
1973; 1985; Smith, Michael, & Sundberg, 1996; Sundberg, Michael, Partington, &
Sunberg, 1996; Tsai & Greer 2006; Yoon & Bennett, 2000). In addition, researchers
have reported that conjugate reinforcement has been effective in conditioning new stimuli
as reinforcers (Cotter & Spradlin, 1971; Dunst, Storch, Hutto, & Snyder, 2007; Lindsley, 1956; Lovitt, 1968; Rovee & Rovee, 1969).

The purpose of the following research was to test the effects of the acquisition of conditioned reinforcement for observing adult faces and/or listening to adult voices on the rate of learning and attention to the presence of adults using the conjugate stimulus-stimulus pairing procedure. These are important pre-verbal developmental cusps and this research sought to determine whether when in repertoire, students would meet curricular objectives at a faster rate as well as respond as an observer of their environment.

**Definition of Terms**

**Autism Spectrum Disorder (ASD)**

According to Heward (2006), ASD refers to a “Group of five related developmental disorders that share common core deficits or difficulties in social relationships, communication, and ritualistic behaviors; differentiated from one another primarily by the age of onset and severity of various symptoms; includes autistic disorder, Asperger syndrome, Rett syndrome, childhood disintegrative disorder, and pervasive developmental disorder not otherwise specified (PDD-NOS)” (G-2).

**Autoclitic Operant**

The autoclitic is a verbal operant, which modifies the effect of other verbal operants (Greer & Ross, 2008). The autoclitic can strengthen the response of the listener (Skinner, 1957; Greer & Ross, 2008). The autoclitic can affirm, negate, indicate possession, quantify, and specify the mand and tact functions (Skinner, 1957; Greer & Ross, 2008). That is, the autoclitic can increase the probability of reinforcement and decrease the probability of possible punishment. For example, a child mands for a crayon
by saying, “blue crayon.” The word blue functions as an autoclitic and specifies a particular crayon.

**Conjugate Reinforcement**

Conjugate reinforcement refers to “A schedule of reinforcement in which reinforcement is continuously present (e.g., the opportunity to eat) as long as a specified response is maintained at a criterion rate. Failure to maintain responding results in the discontinuance of reinforcement (e.g., the removal of the food dish) until responding again at criterion level” (White, 1971, p. 137).

**Conversational Unit**

Skinner (1957) described a conversational unit as a verbal episode. A conversational unit is “comprised of interlocking intraverbals between at least two people during which each person functions as both a listener and a speaker in a rotated episode” (Greer & Ross, 2008, p. 290). The individual emitting conversational units is reinforced as both a speaker and listener. The individual engages in interlocking verbal operants both as a speaker and listener in which he or she alternates both functions. Consequently, the individual is reinforced as a listener and as a speaker by the behavior of the listener (Greer & Ross, 2008).

**Higher Order Operant**

Higher order operants “occur when previously independent responses to a stimulus, such as the independence of listener and speaker responses to a stimulus, come to jointly control both listener and speaker responding” (Greer & Ross, 2008, p. 293). For example, if a child has acquired generalized imitation as a capability, the child will be able to emit the novel behavior of a model without direct instruction and reinforcement.
Learn Unit

“Consists of a three-term contingency for the student and two or more three-term contingencies for the teacher in which the response of the student occasions a reinforcement or correction operation from a teacher or teaching device” (Greer, 2002, p. 313). “Learn units measure the behavior of the teacher, teaching device, or experimenter; responses to learn units are measures of a student or experimental participant. The components of learn units are: (a) instructional presentations by a teacher, experimenter, automated operant chamber presentation, or teaching device in which the antecedent stimulus presentation is unambiguous, the participant is attending to the antecedent stimulus, and the experimenter-teacher is not providing unwitting prompts; (b) the participant had an opportunity to respond (i.e., a 3-s intraresponse period); (c) correct responses are followed by reinforcement derived from an individual’s instructional history; and (d) incorrect responses are followed by a correction operation” (Greer & Ross, 2008, pp. 294-295). If the student emits an incorrect response, the teacher, teaching device, or experimenter represents the unambiguous antecedent while the student is attending and the child emits a correct response to the antecedent. The student is not reinforced for emitting the correct response (Greer & Ross, 2008).

Learn Unit to Criterion

“The mean numbers of learn units required by a student to obtain mastery criterion of an instructional repertoire” (Greer & Ross, 2008, p. 295). The mean number of learn units to criterion are a measure of a teacher or experimenter’s instructional skills (Greer & Ross, 2008). When a teacher becomes more skilled, fewer number of learn
units are required to achieve instructional objective as a result of implementing evidence based tactics and verbal developmental protocols (Greer & Ross, 2008).

**Mand Operant**

The mand is a verbal operant that specifies its reinforcer under motivational conditions (Greer & Ross, 2008; Skinner, 1957). The mand could be in the form of a verbal, gestural, written, or sign response. An impure mand is under the control of a verbal stimulus (Greer & Ross, 2008). A pure mand is under the control of a non-verbal stimulus. For example, if a teacher holds up a cookie and the student says, “cookie,” then the teacher gives the cookie to the student. This is an example of an impure mand. On the other hand, if a cookie is not in the student’s presence and the student asks for a cookie, this is a pure mand. Mands are reinforced by the listener.

**Observing Responses**

“Observing responses are acquired environment-behavior relations whose primary function is to affect the sensing of stimuli, which then function as conditioned reinforcers for those relations” (Donahoe & Palmer, 2008, p. 360). In other words, observing responses are responses that are selected out by their consequences (Keohane, Luke, & Greer, 2008). For example, if a child looks when his name is called, someone enters a room and says, “Hello,” and a child looks at who is entering. If the child responds, he is responding as an observer.

**Repertoire**

Repertoire is referred to as a range of behaviors that are possible when cusps and capabilities are present (Greer, 2008; Greer & Speckman, 2009). For example, the
attainment of the first mand is a cusp. The addition of new mands constitutes building the repertoire.

**Sequelic Operant**

A sequelic is a verbal operant that occurs when an individual responds as a listener and a speaker to intraverbals (Greer & Ross, 2008). The sequelic is one aspect of a conversational unit. A sequelic occurs when an individual responds to a speaker, but does not continue after the listener responds. For example, a student says to his peer, “Hi, how are you?” and the peer responds, “fine”; The verbal episode ends.

**Tact Operant**

The tact is a verbal operant, which has direct contact with the environment, and it also identifies the environment (Greer & Ross, 2008; Skinner, 1957). The listener or reader reinforces the speaker or writer with generalized reinforcement (Greer & Ross, 2008; Skinner, 1957). Therefore, a student may see, hear, smell or taste something that is present in the environment and emit a verbal response which is reinforced. An impure tact is under the control of the verbal antecedent. An example of an impure tact occurs when a teacher holds up a pen and says, “What is this?” and the student says, “pen,” and the teacher says, “very good.” An example of a pure tact is if a student saying, “car” after seeing a car drive by. Tacts are important because when the student has many tacts in his repertoire, he will be able to identify the world; thus, communicate with others.

**Verbal Developmental Cusps and Capabilities**

The term “behavioral cusp” has been more commonly used in behavior analysis to incorporate language and is defined by Rosales-Ruiz and Baer (1996) as follows:

A cusp is a change (in the capability of the child) that (1) is often difficult, tedious, subtle, or otherwise problematic to accomplish, yet (2) if not made,
means little or no further development is possible in its realm (and perhaps in several realms); but (3) once it is made, a significant set of subsequent developments suddenly becomes easy or otherwise highly probable which (4) brings the developing organism into contact with other cusps crucial to further, amore complex, or more refined development in a thereby steadily expanding, steadily more interactive realm. (p. 166).

A behavioral cusp allows a child to come in contact with experiences resulting in new learning that he or she could have not prior to their attainment. New experience teaches new operants and conditions new reinforcers and punishers (Greer & Speckman, 2009). For example, a child learns a new behavior such as crawling which enables her to cruise, which then allows her to walk. Another example is an individual reading a book on how to use a computer program. Learning to use the computer program then allows him to access the internet.

A capability is a developmental stage that is induced incidentally or through direct instruction (Greer & Ross, 2008). A cusp does not always result in a new way of learning and when it does, it is a capability. For example, if a child acquires speech, the child can learn to mand and tact both of which are cusps of verbal development.

The difference between a cusp and capability is that learning after a cusp is acquired still requires direct instruction and reinforcement and a capability allows one to learn without direct instruction. Consequently, a cusp results in new opportunities to learn and a capability is a cusp that allows one to learn differently without direct reinforcement. Therefore, all verbal capabilities are cusps, but not all cusps are capabilities (Greer & Keohane, 2005; Greer & Ross, 2008; Greer & Speckman, 2009; Greer & Longano, 2010). The identification and induction of verbal cusps and capabilities are needed to help children progress and address educational goals.
**Verbal Operants**

There are six types of verbal operants identified; echoic, mand, tact, intraverbal, textual, and audience relation (Skinner, 1957). Verbal operants are behaviors that are mediated by others (Greer & Ross, 2008). The listener mediates between the speaker and the environment. Verbal operants work to gain outcomes through mediation of others for the speaker or writer (Greer & Ross, 2008). The advantage of the listener or reader is that the listener’s senses are expanded by the behaviors of the speaker and writer (Greer & Ross, 2008). Skinner’s original verbal operants are now referred to as speaker verbal operants and the listener operants have been added to the speaker operants providing a more complete analysis according to Greer and Longano (2010), relational frame theory (Barnes-Holmes, Barnes-Holmes, & Cullinan, 1999) and Naming theorists (Horne, Hughes, & Lowe, 2006; Horne & Lowe, 1996; Horne, Lowe, & Randle, 2004).

The areas of research related to the topic of investigation are: (1) conjugate reinforcement; (2) conditioned reinforcement; and (3) the stimulus-stimulus pairing procedure. The focus of the experiments are: (4) the effect of conditioned reinforcement on learning; (5) conditioned reinforcement to listen to adult voices; (6) conditioned reinforcement for adult faces; and finally, (7) the Verbal Behavior Developmental Theory (VBDT; Greer & Keohane, 2005; Greer & Ross, 2008; Greer & Speckman, 2009; Greer & Longano, 2010) will also be outlined. In addition, the importance of the preverbal developmental cusps which are conditioned reinforcement for adult voices and conditioned reinforcement for adult faces will be discussed.

**Conjugate Reinforcement**

**Definition of Conjugate Reinforcement**
Lewis (1973) described conjugate reinforcement as a measure of a participant’s attention to a stimulus that was developed in experimental psychology. According to Lewis (1973) “in conjugate reinforcement, the duration of the stimulus varies directly and immediately with the subject’s rate of response” (p. 1). Conjugate reinforcement was also defined as a procedure whereby subjects demonstrate their attention by continuously pressing a key at a certain rate to keep the stimuli present (Lewis, 1973).

Developmental psychologists, Rovee-Collier and Capatides (1979) defined conjugate reinforcement as “an FR-1 schedule with the added feature that the intensity of the reinforcing event is proportionally controlled by the intensity (vigor, rate) of responding. Thus, the subject can control two dimensions of the reinforcement, i.e., frequency and magnitude” (p.16).

According to Dunst et al. (2007), “conjugate reinforcement paradigms involve the availability of stimulus in amounts proportional to the strength of operant responding” (p. 1). More recent literature, Tsai and Greer (2006) described conjugate reinforcement with the use of an apparatus: “conjugate apparatus is one that provides the necessary experimental control for measuring alternative stimuli such that location and other variables are controlled and allows the experimenter to assess responding as “free operant responding” (p. 36). Tsai and Greer (2006) reported that during the sixties and seventies conjugate reinforcement was measured using instrumentation to test the reinforcement control of episodic stimuli. Episodic stimuli consisted of music, speech, television, and motion pictures. These episodic stimuli were stimuli that varied from moment to moment. Episodic stimuli were referred to the continuous change of stimuli. Therefore, laboratory instrumentation was used to provide precise measures of reinforcement in relation to
duration of the selected out stimuli. In other words, it was a direct measure of reinforcement value.

According to Rapp (2008), “a conjugate reinforcement schedule is a variant of a continuous reinforcement (CRF) schedule where the rate, amplitude, or intensity of the reinforcer is proportional to the target response. For example, fast and forceful responding in a conjugate schedule produces a more intense stimulus (i.e., a higher magnitude reinforcer) than slow and minimal threshold responding” (p. 113).

**The Evolution of Conjugate Reinforcement Experiments**

The use of conjugate reinforcement has evolved since its initial development. For example, Lindsley (1956) used conjugate reinforcement as a procedure to increase the target behaviors of individuals with psychiatric diagnoses. Since Lindsley’s introduction of this procedure, many variations of the procedure and instrumentation have developed in last 50 years.

Morgan and Lindsley (1966) compared verbal and operant listening preferences for stereophonic or monophonic music. The research showed that although stereophonic music was discriminated from and verbally preferred to monophonic music by all four participants, stereophonic music was chosen by only two of the participants.

Lovitt (1968) stated that “during conjugate schedules the stimulus is always available; its intensity, however, is a direct and continuous function of the response behavior of the subjects. This contingency, then is particularly suitable for the analysis of preference for complex stimuli-visual or auditory-that cannot be offered in an episodic manner without considerable loss of reinforcing value” (Lovitt, 1968, p. 361).
Researchers in developmental psychology used conjugate reinforcement and conducted studies on behaviors of infants using these reinforcement procedures. Rovee and Rovee (1969) stated, “conjugate reinforcement provides a continuously available reinforcing event, the intensity of which is a direct consequence of response rate” (p. 34). An increase in rapid responding produces more a reinforcing value (Rovee & Rovee, 1969). In addition, “not only does the schedule sustain responding longer and at higher rates than the more typical episodic schedules, but it also permits a continuous record of the efficacy of a reinforcer sensitive to both organismic state changes and learning” (Rovee & Rovee, 1969, p. 34).

Rovee and Rovee (1969) tested the effects of conjugate reinforcement on infant foot thrusts. The participants of this study were eighteen 10-week-old infants that were divided into an experimental and control group. The experimental group had an ankle cord that activated a mobile with 7 to 10 brightly colored wooden figures suspended above the infants’ heads when the infants kicked. Rapid kicking produced movement of the wooden figures. Thus, conjugate reinforcement was provided by means of an ankle cord. The control group did not have a cord attached to their ankles, but observed the wooden figures move non-contingently by the experimenter. The results indicated that all infants who received the conjugate reinforcement procedure emitted more foot kicks than the control group who received identical, but non-contingent visual stimulation and without an ankle cord.

Rovee-Collier and Capatides (1979) tested the effects of positive behavior contrast using conjugate reinforcement schedules on infant feet kicks and cooing during two experiments. When the infants kicked their foot, an overhead mobile was activated
according to the intensity and rate of the kicks. The results indicated that multiple
schedules of conjugate reinforcement increased the babies’ cooing and when they took
away reinforcement, cooing decreased and the babies began to fuss or cry.

Dunst et al. (2007) summarized the effects of episodic and conjugate
reinforcement on child operant learning. In this research synthesis of 35 studies, the
participants were 573 typically developing children and 99 were children with disabilities
or delays. During these studies, conjugate or episodic reinforcement was implemented as
one of the independent measures. The results showed that both types of reinforcement
were effective, but episodic reinforcement increased more behaviors such as arm pulls,
leg kicks, vocalizations, head turns, or leg movements.

The instrumentation used to deliver conjugate reinforcement has evolved over the
last few decades. The earlier researchers measured target behaviors using conjugate
reinforcement measuring with rate. Then later studies focused on rate related to
magnitude, intensity, or vigor. The more recent research measured the target behaviors in
terms of duration of observing. Some researchers tested conjugate reinforcement using
infant participants. The conjugate reinforcement apparatus’s included infant mobile
activators as described earlier (Rovee & Rovee, 1969; Rovee-Collier & Capatides, 1979),
or high amplitude sucking (Spence & DeCasper, 1987).

Preference Assessment

Some studies in the 1950s and 1960s tested the effects of responding to continued
music (Barret, 1962; Cotter, 1970; Jeffrey, 1955). These studies, however, did not
indicate the reinforcing effects of one type of music over the other. In the 1960s and
1970s studies were conducted testing the reinforcing effects of music and the preference
for different kinds of music. For example, Morgan and Lindsley (1966) tested the effects of one-operandum and two-operanda switches on verbal and operant preference for monophonic or stereophonic music in four typically developed adults. The results indicated that even though stereophonic music was discriminated from and verbally preferred to monophonic music by all four adults, stereophonic music was operantly preferred by only two of the adults.

Lovitt (1968) tested the effects of conjugate reinforcement on musical preferences and on the time spent in listening to the music in two experiments. The participants were given headsets and a hand switch so that the participants were able to select the music of choice. The hand-switch responses were graphically recorded that measured the quantitative amount of listening to music and the music preference. In other words, duration was used as a measure of reinforcement. The results indicated that one musical selection was preferred over another. Hence, here we see it is a measure of conditioned reinforcement.

Cotter and Spradlin (1971) also tested the effects of a conjugate reinforcement as a procedure for studying music preference. The participants of the study were 66 children with intellectual delays. They measured the percentage of time that the participants pressed one of the four keys resulting in two types of music, or white noise, or silence. A key-press operated a micro-switch and resulted in presentation of auditory stimuli for the duration of time the key was pressed. The results indicated that 59 of the 66 subjects preferred music to white noise and silence during each session. Also, 59 subjects preferred one type of music to the other.
Subsequently, conjugate reinforcement apparatus’s were used to determine music preference. The apparatus’s measured the duration of auditory stimuli. As a result, the researchers were able to conclude that the participants of their studies preferred music selection to other auditory stimuli (Lovitt, 1968; Cotter & Spradlin, 1971; Morgan & Lindsley, 1966).

**Conditioned Reinforcement**

According to Williams (1994) conditioned reinforcement is acquired when “stimuli paired with primary reinforcers acquire reinforcement properties in their own right (p. 457).” Donahoe and Palmer (2004) define conditioned reinforcers as “stimuli that function as reinforcers in operant procedures as a result of having been paired with other reinforcers” (p. 355). In recent behavior analytic literature, conditioned reinforcers are reinforcers that occur because of pairings with unconditioned reinforcers or other conditioned reinforcers (Greer & Ross, 2008). When an individual acquires conditioned reinforcers, these are referred to as an individual's community of conditioned reinforcers for certain behaviors (Greer & Ross, 2008). Greer (2002) found that when pairing approval and unconditioned reinforcers with listening to non-preferred music, individuals would then choose to listen to the music as a result of the pairing procedure. In order for an individual to acquire an enlarged community of reinforcers, positive reinforcement is necessary. Additionally, once conditioned reinforcement for observing responses is acquired, the individual learns at a faster rate of learning new stimulus discriminations (Greer & Ross, 2008). Conditioned reinforcers are important because conditioned reinforcers may displace other reinforcing behavior (Greer, Saxe, Becker, & Mirabella, 1985; Longano & Greer, 2006; Greer, Pistoljevic, Cahill, & Du, in press; Nuzzolo-
Gomez, Leonard, Ortiz, Rivera-Valdes, & Greer, 2002).

**Stimulus-Stimulus Pairing Procedure**

The stimulus-stimulus pairing procedure has been used to expand on children’s community of reinforcers, by teaching them to prefer initially non-preferred stimuli (Greer et al., in press). It has been used extensively to condition non-preferred reinforcers that have resulted in new responses (e.g., looking at books, listening to music, and playing with puzzles). In addition, the stimulus-stimulus pairing procedure has also been used to condition vocalizations and verbalizations.

**Early Stimulus-Stimulus Pairing Experimental Studies**

Rheingold, Gerwirtz, and Ross (1959) tested the effects of the delivery of conjugate reinforcement on three-month-old infants’ vocalizations. During the treatment condition, the experimenter smiled and touched the infant and emitted vocal sounds. The results showed that infant vocalizations increased during the pairing sessions.

In the early 1970s, the stimulus-stimulus pairing procedure was used to condition non-preferred music as newly conditioned reinforcers. For example, Greer, Dorow, Wachhaus, and White (1973) tested the effects of adult approval on students’ music selection. The participants of this study were 110 fifth graders of low socioeconomic status. During pre and post-intervention probes, the music selection behaviors were measured using a conjugate apparatus. The students were randomly assigned to five groups with four of the groups receiving different instructional treatments and one control group. During the intervention, two groups received high approval versus low approval and clinician-artist presentation and two groups received high approval versus low approval during repeated listening. The results indicated that the students who received
listening to music paired with high approvals selected significantly more of the music that was taught than students who were taught with low-approvals. There were no differences between live presentation pairings and repeated listening lessons. The order of group preference during pre-intervention probes from most to least preferred was rock music, electronic or jazz, music classics, and white noise. During the post-intervention probes the order of group preference from most to least preferred were rock music, electronic music, jazz, music classics, and white noise.

**Expanded Community of Reinforcers**

The first applied experiment to conditioning non-preferred stimuli that resulted in new responses that resulted in decreases in stereotypy was conducted by Greer et al. (1985). Greer et al. (1985) tested the effects of the stimulus-stimulus pairing procedure on toys as conditioned reinforcers and stereotypy. Two experiments were conducted with five developmentally disabled participants. The participants in Experiment 1 were two students who displayed a history of playing with preferred toys and were not noted as emitting stereotypy. They were observed with toys and without toys to determine if the participants emitted stereotypy during either condition. Probes were conducted after five and six months following the post-conditioning intervention probes and the results showed that when the toys were removed, the participants emitted stereotypy and when the toys were given to the participants, stereotypy did not occur. In Experiment 2, three young adults who emitted low rates of toy play and high rates of stereotypy were selected for the study. During the treatment sessions, the participants playing with toys were conditioned. Probes were conducted six months later without access to playing with toys. Five probes sessions were conducted with toys with each of the participants. The results
showed that the participants emitted less stereotypy and emitted more instances of toy play when toys were present. When toys were not present, the participants emitted stereotypy.

In the other behavior analytic studies, the stimulus-stimulus pairing procedure was implemented to expand participants’ community of reinforcers. For example, Nuzzolo-Gomez et al. (2002) used the stimulus-stimulus pairing procedure to teach children with ASD to prefer books or toys to stereotypy and passivity in two experiments. The participants of this study were one preschooler and three elementary school children with autism. The results indicated that passivity and stereotypy decreased and play interactions increased as a function of the book conditioning procedure.

Longano and Greer (2006) tested the effects of a stimulus-stimulus pairing procedure on the acquisition of conditioned reinforcement on observing and manipulating stimuli by young children with ASD. In Experiment 1, the participant of the study was a five-year-old male. During the intervention, the stimulus-stimulus pairing procedure was used using continuous 5-s whole interval recording in 5-min sessions. Data were collected on appropriate play, stereotypy, or passivity. Experiment 2 tested the effects of the stimulus-stimulus pairing procedure on independent work by two participants with autism. The dependent measures were intervals of the participants working independently, percentage of correct responses, and worksheet completion. The results indicated that during both experiments, the participants all emitted significant increases in target behaviors and decreases in stereotypy and passivity.

**Vocalization**
Research has also been conducted using the stimulus-stimulus pairing procedure to condition vocalizations and verbalization with children with developmental disabilities. For instance, Smith, Michael, and Sundberg (1996) tested the effects of the pairing procedure on infant vocal behavior. The participants were two female infants aged 11 and 14 months. During the treatment, the experimenter emitted vocal responses which were paired with reinforcement (e.g., bubbles or tickles). One of the participants also observed an experimenter emit vocal responses that were paired with a neutral stimulus and an experimenter emitting vocal responses that were paired with a mild aversive stimulus. The results showed that after the reinforcing pairing, the infants’ vocal behavior increased in 75% of the sessions. During the neutral condition, vocal behavior remained constant, but decreased significantly during the pairing with the mild aversive stimulus.

Sundberg, Michael, Partington, and Sundberg (1996) tested the effects of pairing vocal sounds with a reinforcing event on the number of mands, tacts, echoics, and intraverbals emitted by the participants. The participants in this study were five children between the ages of two and four. Four of the participants had severe to moderate language delays and one was a typically developing child. During the intervention, a pairing procedure was used where a target sound, word or phrase was paired with reinforcement. The results showed that the participants’ vocalizations increased without direct reinforcement and all participants acquired new vocal and verbal responses.

Miguel, Carr, and Michael (2002) tested the effects of the stimulus-stimulus pairing procedure on one-syllable utterances of three children diagnosed with ASD. During baseline, target sounds of the participants were recorded without the experimenter
interacting with the participants. During the treatment condition, the experimenter’s vocal model was paired with the delivery of the preferred item. The results showed that during the pairing condition there was an increase in target sounds for two of the participants.

Yoon (1998) tested the effects of the stimulus-stimulus pairing procedure as an antecedent on vocal sounds and on the acquisition of mands. The participants of the study were seven preschoolers with educational disabilities. The results showed that the pairing procedure used with the preschoolers with echoics developed mand functions.

Yoon and Bennett (2000) tested the effects of a stimulus-stimulus pairing procedure on vocal sounds as reinforcers in two experiments. Four preschoolers with severe language and communication delays participated in this study. In Experiment 1, vocal sounds emitted by the participant were paired with a reinforcing event. The results indicated that the stimulus-stimulus pairing was effective in conditioning the target vocal sounds as reinforcers and increased these vocalizations. In Experiment 2, the effects of the pairing procedure were compared to echoic training. The results indicated that the pairing procedure was more effective than the echoic training in conditioning vocal sounds.

The Effects of Conditioned Reinforcement on Learning

In recent behavior analytical literature, researchers tested the effects of conditioned reinforcement on rate of learning. Results indicated that rate of learning accelerated as a function of conditioned reinforcement. For example, Tsai and Greer (2006) tested the effects of the stimulus-stimulus pairing to condition looking at books as a reinforcer until the books were preferred stimuli in free play settings for four
preschoolers. The children were given the options to choose to play with toys or look at books. The results indicated that the students’ textual responding was accelerated as a function of the conditioning procedure.

Pereira-Delgado, Greer, Speckman, and Goswami (2009) tested the effects of conditioning reinforcement for print stimuli on match-to-sample responding in preschoolers. The stimulus-stimulus pairing procedure was used to condition observing responses for two-dimensional stimuli. The results indicated that when the two-dimensional stimuli became conditioned reinforcers, the participants accelerated their learning on visual match-to-sample curricular instruction for all of the participants.

Greer et al. (in press) tested the effects of conditioning voices as reinforcers for listener responses in preschoolers with ASD. The dependent variables included selecting to listen to adults tell stories in free play settings, rate of learning of listener curricular objectives, observing voices and the presence of adults across three settings, and intervals of stereotypy while listening to recordings of voices. The independent variable was conditioned reinforcement for voices. The results indicated that all three children’s learning accelerated significantly in which two children increased observing responses in three settings and two children selected to listen to stories. In addition, one child emitted no stereotypic behaviors and two children emitted fewer stereotypic behaviors.

Keohane et al. (2008) found that a series of rotated protocols resulted in the emergence of cusps. One of these protocols included conditioning reinforcement for listening to adult voices. The participants in this study were three elementary aged students between the ages of six and seven diagnosed with ASD. The results indicated an effect on rate of learning and a range of increase in the students’ observing responses.
**Conditioned Reinforcement to Listen to Voices**

**Typical Development**

According to Keohane, Pereira-Delgado, and Greer (2009), responding to human voices is an important component of the acquisition of listener and speaker repertoires. This repertoire occurs early in typically developing infants (Keohane et al., 2009). Research has shown that even newborns are able to discriminate human language sounds (Keohane et al., 2009; Novak & Pelaez, 2004). DeCasper and Spence (1987) suggest that mothers’ voices are conditioned reinforcers at birth. Some theorists suggest that the conditioning process occurs in utero in which the nutrients are paired with the mothers’ voice (DeCasper & Spence, 1987; Greer & Keohane, 2009; Greer & Speckman, 2009; Spence & DeCasper, 1987). In addition, DeCasper and Spence (1987) hypothesize that newborns prefer their own mother’s voice because of prenatal experience with her voice.

According to DeCasper and Spence (1987), human newborns preferred to hear acoustic passages that were recited by their mothers while in utero compared to passages that were not recited. This suggests that prenatal experience with the mother’s voice can have an effect on the preference of the mother’s voice after the infant is born (Spence & DeCasper, 1987). Spence and DeCasper (1987) also tested the effects of infant prenatal exposure with low-frequency maternal-voice sounds on neonatal perception of maternal voice sounds. The results indicated that prenatal exposure with low-frequency characteristics of mother’s voices had an effect on postnatal perception of maternal voice sounds.

For children with disabilities, voices often do not serve as conditioned reinforcers for listening. Conditioned reinforcement for listening is a cusp needed for language and
social development (Keohane et al., 2009). Several studies suggest that the human voice or music used as reinforcement increases operant behavior.

**Auditory Reinforcement Experiments**

Todd and Palmer (1968) tested the effects of social auditory reinforcement (human voice) on infant babbling. The participants of this study were 16 infants with a mean age of 85 days. The first group of infants received auditory reinforcement with an adult present and the second group received auditory reinforcement without an adult present. The results indicated that all infants emitted vocalizations, but the infants who received reinforcement with an adult present emitted more vocalizations when compared to the infants who received reinforcement without an adult present.

According to Darcheville, Madelain, Buquet, Charlier, and Miossec (1999), visual smooth pursuit is an oculomotor response, which is not completely adequate at birth. Adult oculomotor responses are different from infants (Darcheville et al., 1999). Darcheville et al. (1999) believe that the difference between adult and infant oculomotor responses is that an infant may be able to emit oculomotor movements slower than an adult. Therefore, Darcheville et al. (1999) tested the effects of auditory stimuli on oculomotor responses.

The participants of this study were 30 full term infants aged one to seven days old. Each of the infants was divided into three groups. The independent variable for one group was the delivery of music during half of the total time of the trials when the infants emitted eye movements. The second group's independent variable was the delivery of reinforcement when the infants emitted slow eye movements. The last group's independent variable was the delivery of no music when slow eye movements were
emitted.

The results of this study showed that enhancement of eye movement with the delivery of music reinforcement was possible at birth (Darcheville et al., 1999). The data showed that the group that was reinforced with music when the infants emitted eye movements increased the rate of movement when compared to baseline. The participants who received the music randomly or no music at all increased less than the group that was reinforced contingent upon eye movement.

Darcheville, Boyer, and Miossec (2004) tested the effects of using infants’ mothers’ voices as a reinforcer in infant reaching. The participants of this study were infants younger than two months old. Two experiments were conducted and during Experiment 1, the infants exact positioning of the hand led to the contingent presentation of the mother’s voice. During the Experiment 2, random non-contingent presentation of the mother’s voice was used and the results indicted that only contingent presentation of the mother’s voice increased reaching.

**Conditioned Reinforcement for Looking at Faces**

Cleveland, Kobiella, and Striano (2006) argue that the eyes are important for social communication early on in life. Others agree that eye gaze is also important for infant-adult interaction, socialization, and cognitive development (Senju et al., 2008; Symons, Hains, & Muir, 1998). Also, newborns look at an individual’s face with direct eye gaze for a longer period of time when compared to averted eye gaze and at a face with eyes opened when compared to a face with eyes closed according to a report by Cleveland et al. (2006).

**Still-Face Paradigms**
Some research has been conducted on still-face paradigms, which is a way to assess what infants observe, and their expectations of others (Striano & Bertin, 2004). The still-face paradigm usually consists of an adult interacting with an infant in a normal face-to-face interaction. Then the adult will pose in a neutral or still-face. When the mothers or experimenters of studies interacted without the still face, the participants emitted behaviors such as cooing, smiling, or kicking. When the still-face was implemented, the participants’ behaviors decreased.

There have been many variations in different studies. Some studies used social reinforcement such as smiling, playing, touching, eye contact, and used a face on a computer screen as the dependent measures (Cleveland et al., 2006; Ellsworth, Muir, & Hains, 1993; Escalona, Field, Nadel, & Lundy, 2002; Goldstein, King, & West, 2003; Hains & Muir, 1996; Massaro & Bosseler, 2006; Nadel, Croue, Mattlinger, Canet, Hudelot, Lecuyer, & Martini, 2000; Pelaez-Nogueras, Field, Hossain, & Pickens, 1996; Pelaez-Nogueras, Gerwitz, Field, Cigales, Malphurs, Clasky, & Sanchez, 1996; Reeve, Reeve, & Poulson, 1993; Symons, Hains, & Muir, 1998). Consequently, the face plays an important role in early social expectations (Striano & Bertlin, 2004).

**Experimental Studies**

Ellsworth et al. (1993) tested the effect of the still-face procedure on infant behavior toward people and interactive objects. The participants of this study were 32 infants aged three to six months who were presented with an object and a person. The person was either the infant’s mother or a female stranger who emitted a still face. The results indicated that infants smiled at people, but “hardly” at the object. During Experiment 2, 12 three-month-olds were presented with four stimuli. These stimuli
included a female stranger and four objects that were all similar to a smiling face. The results indicated that the infants smiled at people.

Reeve et al. (1993) tested the effects of delayed reinforcement on infant vocalizations. Six infants ages two to six months participated in two experiments. In Experiment 1, there were three experimental conditions: a schedule of differential reinforcement of behavior other than vocalizations, a 3-s delayed reinforcement for vocalization, and non-contingent reinforcement. Reinforcement consisted of the infants mothers’ making eye contact and playing with their babies. During Experiment 2, the independent variable was comparing un-signaled 5-s delayed reinforcement to 3-min components of Differential Reinforcement of Other Behavior (DR0) and 3-min components of a non-treatment baseline. The results of Experiment 1 showed an increased rate of vocalizations during the un-signaled 3-s delayed reinforcement condition, compared to the DRO condition and no contingent reinforcement. During Experiment 2, each infant increased vocalization rate during the un-signaled 5-s delayed reinforcement condition when compared to the DRO condition and baseline.

In a study by Pelaez-Nogueras et al. (1996), the effects of depressed mothers touching their infants were measured. The participants were 48 depressed and non-depressed mothers and their three-month-old infants. Four treatments were implemented: normal play, still face no touch, still face with touch, and normal play. The infants of the depressed mothers emitted more smiles and vocalizations and looked more at their mothers’ hands when touched than compared to the non-depressed mothers. The non-depressed mothers’ babies grimaced, cried or looked away from their mothers’ faces more often.
Pelaez-Nogueras et al. (1996) tested the effects of infant’s preference for touch stimulation during face-to-face interactions. The participants were 10 1.5 to 3.5 month-old infants. The two treatment conditions consisted of touch and no touch. During the touch treatment, when the infant made eye contact with the adult, the adult smiled, cooed, and rubbed the infant’s legs and feet. During the no-touch condition, the infant eye contact was followed by contingent adult smiling and cooing. The results showed that during the touch condition, the infants emitted more eye contact, smiles, and vocalizations. In addition, the infants cried less when compared with the no touch condition. The results also showed that the infants emitted eye contact more when the adult touched the infants.

Hains and Muir (1996) tested the effects of adult eye direction on infant gaze, smiling, and grimacing over closed circuit television during Experiment 1 and in person in Experiment 2. The experimental group received four periods of interactions for 1-min. During Periods 1 and 3, eye contact was maintained and during Periods 2 and 4, eye contact was averted. The control group received eye contact during all four periods. The results indicated that the experimental group emitted fewer smiles when adults shifted their eye gaze and their visual attending decreased during all four periods. The control group did not show a change in eye contact or smiles.

Symons et al. (1998) tested the effects of infants’ sensitivity to small shifts of gaze. The participants of this study were 45 five-month-olds. During the face-to-face interactions, infants were in infant seats approximately 65 cm away from an adult. Two adult females interacted with the infants and then shifted their eyes five degrees horizontally or vertically while continuing to interact with the infants. The results
indicated that attention and smiling decreased when the adult’s averted their eyes horizontally, but not vertically.

Nadel et al. (2000) tested the effects of a modified still face procedure in whether children with ASD can have expectancies of social behavior of unfamiliar people. In the study, eight low functioning and non-verbal children with ASD were presented with the “still face” procedure (Nadel et al., p. 133). The “still face” procedure consisted of a stranger emitting a still face, imitative interaction in which an adult imitated the activity of the child, and a still face again. The children ignored the stranger when the stranger emitted the first still face. During the second still face, there was an increase in social gestures, close proximity, touch and look at the person, and negative facial expressions. The authors argue that the low functioning children with autism do not form generalized expectancy with unfamiliar individuals. The low functioning children did not show interest in the still behavior emitted by the stranger during the first phase of the still face. However, when the stranger emitted a still face in the second phase, the children did respond suggesting that the children showed interest only after recognizing the adult.

Escalona et al. (2002) reported the effects of imitation on children with ASD. The participants of this study were 20 children with ASD with a mean age of five years. Ten children were randomly assigned to an imitation interaction group and ten children were randomly assigned to a contingently responsive interaction group. The sessions consisted of four phases lasting 3-min each; the child walked into a room that was furnished with an adult in the room sitting like a statue (still-face condition), the adult either imitated the child or contingently responded to the child, the adult sat still again, and the adult spontaneously interacted with the child. The results showed that during the second still-
face condition, the children in the imitation group emitted fewer gross motor activities and they touched the adult more suggesting that the children tried to emit social interactions.

Goldstein et al. (2003) tested the effects of infant social interaction with their mothers on vocal behavior. The participants of this study were 30 infants ages 6 months to 10 months and their mothers. Infants were assigned to the experimental condition (contingent) and the yoked-control condition. During a 10-min baseline, the mother and infant engaged in unstructured play while the experimenter measured infant vocalizations and the mothers responses’ to vocalizations emitted by the infants. Then during a 10-min social response condition, mothers were asked to respond to vocalizations with smiles, close proximity, and touching their infant. In the experimental group, the mothers were told to respond instantly to infant vocalization and half of the yoked-control group was told to respond to infant vocalizations based on schedules established by the experimental control group mothers. During the last 10-min extinction condition, mothers and infants engaged in play without given instructions. During all three conditions, the number of vocalizations to which mothers responded, the total number of infant vocalizations, and “infraphonological” parameters of the infants’ sounds were measured. The results indicated that the experimental group of infants emitted significantly more vocalizations in the social condition and their sounds were more mature when compared to baseline. The yoked-contingency infant group emitted frequent vocalizations, but did not show a change in maturity of babbling.

Cleveland et al. (2006) tested the effects of a sudden still-face on infants’ gazing and smiling. The participants of this study were 32 four-month-old infants placed in 16
dyads. During the intervention, an adult posed a still-face at one of the two infants. The results indicated that infants gazing and smiling decreased during the still-face condition.

Massaro and Bosseler (2006) tested the effects of the face in a computer-animated tutor, Baldi on learning vocabulary. The participants of this study were five children diagnosed with ASD. The experimenter assessed how much the face facilitated learning vocabulary versus the voice alone. The two conditions were compared in which each participant received the two learning conditions that were counterbalanced. The computer animated tutor consisted of the presentation of a vocabulary lesson which included the identification of pictures and the production of spoken words. The results indicated that the rate of learning vocabulary was faster and the retention was better with the face.

**Verbal Behavior Developmental Theory**

The Verbal Behavior Developmental Theory (VBDT) is a developmental approach to the evolution of verbal milestones presented in the behavior analytic framework (Geer & Keohane, 2005; Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009). The VBDT consists of how verbal developmental cusps and capabilities develop within the individual (Greer & Ross, 2008). This approach is proposed with nine verbal developmental milestones and the effects they have on independent functioning. The three terms used to clarify certain verbal stages that accrue from experience are cusp, capabilities, and repertoires. Based on Rosales-Ruiz and Baer’s definition of critical behavioral stages, verbal developmental cusps that are verbal capabilities have been identified (Greer & Ross, 2008). The identification of missing
cusps and capabilities are important in order to help students move from one level of verbal capability to the next (Greer & Keohane, 2005).

According to Greer and Keohane (2005), research findings in verbal behavior in CABAS® schools led to the categorization of children’s repertoires of verbal behavior or verbal capabilities for instructional purposes. In other words, curriculum and instruction are organized by levels of verbal behavior development rather than age or developmental norms (Greer & Ross, 2008). The categorization was based on Skinner’s analysis of verbal behavior (Greer & Keohane, 2005).

The categorization arrangement includes pre-listener, listener, speaker, speaker listener exchanges, speaker as own listener, reader, writer, writer as own reader (self editor) and verbally governed behavior for problem solving. Each level determines the child’s dependency on the teacher or parent (Greer & Ross, 2008). The verbal capabilities are stages or steps towards independence.

**The Importance of Looking at Human Faces and Listening to Adult Voices**

According to Senju et al. (2008), eye contact is important for communication and social interaction with others. Eye contact also affects individual’s perception, cognition and attention (Senju et al., 2008) as well as play an important role in infant-adult interaction (Ellsworth et al., 1993; Hains & Muir, 1996). Many individuals who are classified with ASD or communicative disorders fail to develop mutual gaze (Senju et al., 2008). According to Keohane et al. (2009) responding to human voices is an important cusp associated with language development. Children with language delays often do not have this cusp in repertoire. Therefore, since adult voices are not a conditioned reinforcer, pre-listener skills may not develop (Keohane et al., 2009). Consequently,
children who fail to make eye contact or look at human faces as well as listen to adult voices are missing some pre-foundational developmental cusps necessary to develop skills.

In Experiment 1, the method, results, and a brief discussion will be presented. A delayed multiple probe design across participants was used to test the effects of conditioned reinforcement for observing human faces and or conditioned reinforcement for listening to adult voices using the conjugate stimulus-stimulus pairing procedure on changes in learn-units-to-criterion and changes in observing responses. For the purpose of this study, conjugate reinforcement is defined as the delivery of continuous moment to moment novel reinforcement contingent upon the participants looking at the experimenter’s face. The participants of this study were two students diagnosed with ASD.

Furthermore, the acquisition of conditioned reinforcement for adult faces and/or voices are pre-verbal developmental cusps, but I propose they are foundational or prerequisites to becoming verbal. Consequently, in order to test whether the acquisition of conditioned reinforcement for observing adult faces and/or voices are pre-verbal developmental cusps, something had to have changed in learning. Therefore, Experiment 1 and Experiment 2 sought to answer the following research questions: (1) What is the effect of the acquisition of conditioned reinforcement for faces and voices on rate of learning? (2) What is the effect of conditioned reinforcement on observing the presence of adults in the environment?
Chapter II

General Method

Overview

The dependent variables for Experiment 1 and Experiment 2 were learn units to criterion across speaker and listener programs and observing responses. The acquisition of conditioned reinforcement for adult faces and/or voices served as the independent variable in both experiments. The intervention used in both experiments was the conjugate stimulus-stimulus pairing procedure. A delayed multiple probe design was implemented in Experiments 1 and 2.

In Experiment 1, the participants were two males ages five and six diagnosed with ASD. The experiment took place in a suburban classroom 40 miles outside of a major city that implemented the CABAS® model. The participants in Experiment 2 were four males ages four to eight diagnosed with ASD. Experiment 2 took place in a private publicly funded preschool 20 miles outside of a major city and a suburban classroom in a public school 40 miles outside of a major city that implemented the CABAS® model. The independent variable for both experiments was the acquisition of conditioned reinforcement for adult faces and/or voices using the conjugate stimulus-stimulus pairing procedures. The dependent variables measured in this experiment were learn units to criterion across speaker and listener programs based on 1000 learn units in pre- and post-intervention probes. In addition, four observing responses were measured during pre- and post-intervention probes. The dependent variables measured in Experiment 2 were learn units to criterion across speaker and listener programs based on 2000 learn units in pre- and post-intervention probes. Experiment 2 measured 10 observing responses during
pre- and post-intervention probes. Another dependent variable measured in Experiment 2 which was not measured in Experiment 1 was verbal operants emitted by the participants across three settings. The materials in both experiments were the same except in Experiment 1, one electronic switch was used during the pre- and post-intervention probes. Also, in Experiment 1, when the participant pressed the electronic switch the voice on the recording was reading a scientific book. In Experiment 2, two switches were used during the pre- and post-intervention probes. When one electronic switch was depressed, the voice on the recording was reading a children’s story while the other switch did not emit a voice when depressed.

**Experiment 1**

**Participants**

Two participants diagnosed with ASD were chosen to participate in the study. The participants attended self-contained CABAS® classrooms in a public school in a suburban of a large metropolitan area (Greer, 2002). Participants were chosen for the study because they emitted low numbers of correct responses to learn units across listener and speaker programs and emitted low levels of attention to the presence of adults. See Tables 1, 2, and 3 for a full description of the participants.
Table 1
Participants’ Descriptions in Experiment 1

<table>
<thead>
<tr>
<th>Participant</th>
<th>A</th>
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<tbody>
<tr>
<td>Age</td>
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</tr>
<tr>
<td>Grade Level</td>
<td>Kdg</td>
<td>Kdg</td>
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</tbody>
</table>

Levels of Verbal Behavior
- Pre-listener/Pre-speaker;
- Pre-reader/Pre-writer
- Listener/Emergent Speaker;
- Emergent Reader/
- Pre-writer

Table 2
Participants’ Standardized Test Scores in Experiment 1

<table>
<thead>
<tr>
<th>Standardized Test Scores</th>
<th>Participants</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td><strong>Goldman Fristoe 2: Speech Articulation</strong></td>
<td>SS=94</td>
</tr>
<tr>
<td><strong>Stanford-Binet Intelligence Scale:</strong></td>
<td>SS=64; 70; 61</td>
</tr>
<tr>
<td>Full Scale IQ; Non-Verbal IQ; Verbal IQ</td>
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</tr>
<tr>
<td><strong>Auditory Comprehension of Language-3:</strong></td>
<td>SS=4</td>
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<tr>
<td><strong>Vocabulary Preschool Language Scale 4:</strong></td>
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<tr>
<td>Auditory Comprehension; Expressive</td>
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<tr>
<td>Communication; Total Language Score</td>
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</table>
Table 3

Participants’ Verbal Developmental Cusps and Capabilities Present during the Onset of the Experiment 1

<table>
<thead>
<tr>
<th>Verbal Cusps/Capabilities</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Presence Results in Instructional Control over Child</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Conditioned Reinforcement for Voices</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Conditioned Reinforcement 3D Objects/Visual Stimuli on Desktop</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Capacity for Sameness across Senses (i.e., smell, taste, touch, hear)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Match 2D and 3D Objects</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Generalized Imitation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Listener Literacy (i.e., hear-do; consonant-vowel sounds of others controls responding)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Auditory Matching (i.e., selection response to match spoken words)</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Echoic-to-Mand (i.e., mand function of repeating word sounds)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Echoic-to-Tact (i.e., generalized reinforcement for at least two tacts)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Independent Mands: (1) presence of stimuli; (2) absence of stimuli</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Transformation of Establishing Operations (i.e., learning mand or tact results in untaught function also)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Speaker Component of Naming</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Full Naming</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Say-Do in Speaker-as-Own-Listener Function</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Self-Talk (i.e., rotating speaker and listener roles within own skin)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Book Stimuli as Conditioned Reinforcement for Observing</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Setting

All pre-intervention probe sessions and post-intervention probe sessions were conducted in a room in the participants’ school that had one table, two small student chairs, and wood paneled walls. The walls were bare and the room had one window. The intervention took place in the participants’ classrooms in a corner separate from where
instruction was taking place. The rest of the students in the class continued with regular
instruction in another area in the classroom.

Materials

During the first pre-and post conditioned reinforcement for observing faces probe, the materials included two children sized chairs, a timer that counted forwards, and a data collection sheet. During the conditioned reinforcement for listening to adult voices probe, the materials used were a timer that counted forwards, data collection form, and an electronic switch. The switch was connected to a tape recorder and when the participant depressed the switch, the tape recorder was activated. When the participant stopped pressing the switch, the voices ceased. The voice on the tape was that of the experimenter reading a scientific textbook aloud.

During the observing responses probe sessions, the materials included a data collection form. Furthermore, in collecting the learn units to criterion data, the materials consisted the participants’ curricular program binder and individualized materials for the programs. The program materials varied across participants.

Dependent Variables

Learn Units to Criterion. Learn units to criterion across speaker and listener programs were based on 1000 learn units collected prior to and following the intervention. The learn units probes were based on 500 learn units from speaker and listener programs respectively.

Observing Responses. Observing responses probes included 20 trials respectively: (a) if the participant was looking at the face of the adult who was looking at the participant, but not speaking, for at least one second; (b) if the participant was looking
at the face of the adult who was talking to the participant for one second; (c) if the participant was looking at the face of the adult who was speaking to another adult for one second; and (d) if the participant was looking at the face of the adult who was sitting with another adult, but not speaking for one second (see Table 4).

**Tests of the Independent Variable.** The independent variable was the acquisition of conditioned reinforcement for observing adult faces and/or voices, using the conjugate stimulus-stimulus pairing procedure. Probes were conducted respectively to determine if adult faces without voices and if voices without faces were conditioned reinforcers. During a 5-min session, 5-s partial interval recording was used to determine if faces without voices were a conditioned reinforcer. During the probe session, the experimenter spoke to participant without emitting sound. Data were collected on the number of intervals in which the participant looked at the experimenter’s face. At the time of the probe, two independent individuals who were trained in the procedure recorded the data for interobserver agreement. The individuals who recorded the data sat in view of the participant’s face. The individuals who were recording the data used a stop watch, and a data sheet to record the data.
### Table 4

**Observing Responses for Experiment 1**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description of Conditions for Testing Observing Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Participant is with experimenter (sitting or standing beside) and no exchange of communication occurs. A 3rd party walks into the room and approaches the experimenter and participant. The 3rd person engages in conversation with the experimenter. Does the participant orient to the adult? (i.e., look in the direction of the 3rd person or experimenter; make eye contact with 3rd person or experimenter). “Orient” refers to the participant making eye contact or looking at the face of the experimenter or 3rd party for a minimum of 1 s.</td>
</tr>
<tr>
<td>B</td>
<td>Participant is with experimenter (i.e., sitting or standing beside) and no exchange of communication occurs. A 3rd party walks into the room and approaches the experimenter and the participant. No verbal communication is made between the 3rd person and the experimenter. Does the participant orient towards the 3rd party or experimenter?</td>
</tr>
<tr>
<td>C</td>
<td>Experimenter and participant are sitting across from each other and the experimenter engages in communication with the participant in the form of positive statements (e.g., “the weather is great!” or “I love the color blue”). Does the participant orient towards the experimenter?</td>
</tr>
<tr>
<td>D</td>
<td>Experimenter and participant are sitting across from each other and the experimenter is looking at the participant, but does not engage in any communication with the participant. Does the participant orient towards the experimenter?</td>
</tr>
</tbody>
</table>

During the second probe, the participant sat in front of a tape recorder with an electronic switch that activated the recording of an individual reading from a scientific textbook. Data were collected on the number of intervals in which the participant pushed
the switch that activated the pre recorded voice. During this 5-min 5-s whole interval recording probe, two individuals trained in the procedure recorded data for interobserver agreement. The individuals who were recording the data sat in view of the participant’s hand. The individuals who were recording the data used a stop watch, a data sheet, and a pen to record the data.

Data Collection

Probes. Conditioned reinforcement for observing adult faces and conditioned reinforcement for listening to adult voices probes were conducted with each participant. These probes were implemented to determine if faces and/or voices were already conditioned reinforcers. During the conditioned reinforcement for observing adult faces probe session, a 5-min probe using 5-s partial interval recording was used in which the experimenter looked at the participant without talking, but moved her mouth and face in animated expressions. The experimenter sang, recited a poem or a passage from a book for example without using her voice. During this probe session, data were collected on the number of intervals the participants selected to look at the experimenter’s face. If at any moment in the 5-s interval the participant looked at or in the direction of the experimenter a plus (+) was recorded on the data sheet. If during the 5-s interval the participant did not look at or look in the direction of the experimenter a minus (-) was recorded on the data sheet. However, if the participant looked away and looked back toward the experimenter’s face within 1-s, then it was recorded as a (+). At the end of the 5-min session, the pluses and minuses were tallied.

During the conditioned reinforcement for listening to adult voices sessions, an electronic switch was used that was attached to a tape recorder. During this condition,
the participants sat at a table with the switch attached to a tape recorder. The switch activated the recording of an individual reading from a scientific textbook. The participant was required to push and hold down the switch in order to hear the voice on the tape, but did not have a face to look at while listening. The pre-recorded voice read a passage from a textbook with a normal speaking voice. A 5-min probe using 5-s whole interval recording was used. During the 5-s whole interval recording, if the participant listened to the recording for the entire 5-s interval then a plus (+) was recorded on the data sheet. If during the 5-s interval the participant did not listen to the recording a minus (-) was recorded on the data sheet. At the end of the 5-min session the pluses and minuses were tallied.

Data were collected for learn units to criterion in speaker and listener programs. Learn units to criterion were calculated by taking the number of learn units for speaker programs (500) and dividing it by the number of criteria. For example, 500 learn units divided by five criteria equals 100 learn units to criterion. The same procedure was used to calculate the number of learn units required for listener programs.

Data were also collected on the participants’ observing responses. During all observing responses probe sessions, data were collected on the number of times the participants looked at or in the direction of the second experimenter when the second experimenter engaged in one of the four observing responses scenarios. The participants were given 10 opportunities to respond to each of the four observing responses. A plus (+) was recorded if the participant looked at or in the direction of either experimenter within 1-s and a minus (-) was recorded if the participant did not look at or in the
direction of either experimenter within 1-s. Figure 1 describes the sequence of the pre-
and post-intervention probes.

**Intervention.** Prior to the intervention four experimenters were trained in
implementing the intervention. The experimenters alternated delivering the intervention
as well as serving as independent observers. Interobserver agreement (IOA) sessions
were conducted by at least one of the individuals during a portion of the intervention to
insure procedure fidelity.

At the onset of the intervention, the experimenter obtained the participant’s
attention by using nonverbal communication (e.g., stick tongue out and blow, click
tongue, blow bubbles with bubble gum, roll tongue) and vocal sounds (e.g., make sounds
such as “la, la, la, la” or “da, da, da”, make sounds with gum; e.g., crack gum while in
mouth). The sounds changed moment to moment in order to obtain the participant’s
attention. Once the experimenter got the participant to look at her face, she used a digital
timer to measure how many cumulative seconds (i.e., without looking away) the
participant actually looked at the experimenter’s face. During this intervention, the
experimenter delivered two different types of reinforcement (i.e., vocal verbal
reinforcement; and tactile touch reinforcement) in a random order depending on the
effectiveness of the reinforcement for the participant.

**Vocal Verbal Reinforcement.** While the participant was looking at the
experimenter’s face, the experimenter sang, recited nursery rhymes with much animation
or anything that was reinforcing for the participant. The types of reinforcement varied
depending on the participant’s preference and interests; therefore, the vocal verbal
reinforcement delivered by the experimenter changed moment to moment.
**Tactile Touch Reinforcement.** In addition to vocal verbal reinforcement, tactile touch reinforcement was used. For example, while the participant was looking at the experimenter’s face, the experimenter gently rubbed the participant’s cheeks, arms, hands, hair, and etc. The tactile touch was also moment to moment. The experimenter simultaneously used the vocal verbal reinforcement with the tactile touch. For example, the experimenter sang a song while rubbing the participant’s cheek.
Figure 1. Procedure for the pre- and post-intervention probes for conditioned reinforcement for adult faces and voices, awareness of adults presence (see Table 4 for a detailed description of awareness of adults presence), and the rate of learning for speaker and listener programs (i.e., learn units to criterion) in Experiment 1.

**Interventions for Independent Variables:**
Conditioning reinforcement for faces and voices using a conjugate stimulus-stimulus pairing procedure to condition adult voices and faces as reinforcement (see Figure 7 for a detailed description for the procedure)

**Post-Intervention Probes**
(Same procedure as pre-intervention probes were used)
As soon as the participant looked away, the timer stopped instantly. However, if the participant looked away for 1-s and looked immediately back at the experimenter’s face, the timer was not stopped (i.e., continued measurement). It was also important to note that looking at the experimenter’s face did not necessarily mean maintaining eye contact. Looking at faces referred to the participant looking at any part of the experimenter’s face (e.g., experimenter’s forehead, nose, chin, hair, cheek, etc.).

The cumulative seconds was calculated by adding the trial seconds (e.g., $1+1+2+3+4+9+10+9+15+17+1+2+3+6+7+4+1+3+2+1=101$; i.e., 101 cumulative seconds). The experimenter continued with this intervention until the participant met the long term objective which was 160 cumulative seconds for one session (see Figure 7).

After each participant reached the mastery of 160-cumulative seconds during a 20-trial session, all probe sessions were conducted again. Probe sessions were conducted to determine if the number of learn units required to reach criterion decreased and if there were changes in attending to the presence of adults.

**Interobserver Agreement**

**Probes.** IOA was collected during all pre- and post-intervention probe sessions for each participant. IOA for Participant A was conducted for 100% of sessions with a mean agreement of 96% and a range of 72-100%. IOA for Participant B was conducted for 92% of sessions with a mean agreement of 99% and a range of 95-100%.

**Intervention.** During intervention, IOA was collected for Participant A and B. IOA was calculated on a point-to-point basis for 83% of intervention sessions for Participant A with a mean of 87% and a range of 74-96%. IOA was calculated on a
point-to-point basis for 60% of sessions for Participant B with a mean of 95% and a range of 85-95%.

**Results**

Figure 2 shows the data collected during the conditioned reinforcement for observing adult faces and conditioned reinforcement for listening to adult voices probes for Participants A and B. Participant A, prior to intervention, emitted a total of 20 intervals out of 60 (5-min total probe with 5-s intervals) during the conditioned reinforcement for observing adult faces probe session. This is equivalent to saying that the participant looked at the experimenter 33% of the time in 5-min when the experimenter moved her face in animated ways or moved her lips talking, but without her voice. During the conditioned reinforcement for listening to adult voices probe, Participant A emitted a total of 21 intervals out of 60 (35%). It was determined that the participant did not have either face or voice as a conditioned reinforcer in repertoire. Therefore, the conjugate stimulus-stimulus pairing procedure was implemented for Participant A. Following the intervention, conditioned reinforcement for observing faces and conditioned reinforcement for listening to adult voices probes were conducted. The results showed an increase to 25 intervals out of 60 (42%) for the conditioned reinforcement for observing faces probe and 57 intervals out of 60 (95%) for the conditioned reinforcement for listening to adult voices probe. Participant A acquired voices as a conditioned reinforcer; however, did not acquire the face as a conditioned reinforcer. Therefore, the conjugate stimulus-stimulus pairing procedure was implemented for a second time. Following the intervention, the results of the post-intervention probes showed that voices was still conditioned as a reinforcer in which
Participant A emitted 60 intervals out of 60 (100%) and that faces became conditioned as a reinforcer in which the participant emitted 48 intervals out of 60 (80%).

After the first intervention was conducted for Participants A, Participant B began pre-intervention probe sessions. Participant B, prior to intervention emitted a total of 25 intervals out of 60 (42%) during the conditioned reinforcement for observing faces probe; whereas, he emitted a total of 56 intervals out of 60 (93%) during the conditioned reinforcement for listening to adult voices probe. Consequently, Participant B had voices in repertoire as a conditioned reinforcer and therefore, the intervention was implemented to condition the face as a conditioned reinforcer. Following the intervention, post-intervention probes were conducted. The results showed that Participant B emitted 41 out of 60 intervals (68%) during the conditioned reinforcement for observing adult faces probe. The participant emitted 54 intervals out of 60 (90%) during the conditioned reinforcement for listening to voices. Therefore, the conditioned reinforcement for listening to voices probe showed that voices remained as a conditioned reinforcer. Since the face alone was not a conditioned as a reinforcer, a second intervention phase using the conjugate stimulus-stimulus pairing procedure was implemented. Following the intervention, Participant B increased his attention to the experimenter during the conditioned reinforcement for observing adult faces probe and he emitted 50 intervals out of 60 (83%) indicating that faces became conditioned as a reinforcer and voices was still conditioned with 56 intervals out of 60 (i.e., 93%; see Figure 2).

Figure 5 represents the intervention data for Participant A showing that he required 12 sessions for the first intervention and only one session for the second intervention. Figure 5 represents the intervention data for Participant B showing that he
required 11 sessions for the first intervention and seven sessions for the second intervention.
Figure 2. Pre- and post-acquisition of adult faces and/or voices intervention probes using a conjugate stimulus-stimulus pairing procedure are shown for Participants A and B in Experiment 1.
Figure 3 represents the number of learn units to criterion for Participant A and B prior to and after all intervention phases. Prior to the first intervention for Participant A, he required 500 plus learn units to reach criterion for speaker programs and 250 learn units to criterion for listener programs. After the first intervention, the number of learn units required for Participant A decreased to 250 learn units to criterion for speaker programs and 125 learn units to criterion for listener programs (see Figure 3). After the second intervention, Participant A required 500 learn units to criterion for speaker and 166 learn units to criterion for listener programs, Figure 3.

The number of learn units to criterion prior to intervention for Participant B were 100 learn units to criterion for speaker programs, and 167 learn units to criterion for listener programs, Figure 3. Following the intervention, Participant B’s learn units to criterion decreased to 71 learn units to criterion for speaker programs and 83 learn units to criterion for listener programs. During the second post-intervention, Participant B’s learn units to criterion decreased to 55 learn units to criterion for speaker programs and 71 learn units to criterion for listener programs; see Figure 3).

Figure 4 shows the data collected for observing responses prior to and after each intervention for Participant A and B. Prior to intervention, Participant A emitted 0 responses out of 40. During the first post-intervention probe, Participant A emitted 7 out of 40 observing responses. During the second post-intervention probe, Participant A emitted 3 out of 40 observing responses. Prior to intervention, Participant B emitted 15 out of 40 observing responses. During the first post-intervention probe, Participant B emitted 32 out of 40 observing responses. During the second post-intervention probe, Participant B emitted 36 out of 40 observing responses (see Figure 4).
Figure 3. The numbers of learn units required to acquire the criterion for speaker and listener programs (i.e., learn units to criterion) for Participants A and B during prior to the implementation of the intervention and the following the conditioning reinforcement for observing faces and voices intervention using a conjugate stimulus-stimulus pairing procedure in Experiment I.
Figure 4. Cumulative numbers of intervals for four observing responses (i.e., adults talk to each other; adults stare at each other; adult talks to participant; and adult stares at participant; see Table 4) during pre- and post-conditioning reinforcement for observing faces and voices intervention probes (i.e., a total of 40 opportunities) for Participants A and B in Experiment 1.
Figure 5. Number of cumulative seconds emitted for observing the experimenter’s face during intervention sessions for Participants A and B in Experiment 1.
Discussion

The data support the notion that the acquisition of conditioned reinforcement for observing adult faces and/or voices can improve children’s attention to vocal instruction, as seen through the learn units to criterion which decreased for Participant A in listener instruction and Participant B accelerated his rate of learning in speaker and listener instruction, one of the criteria set forth by Rosales-Ruiz and Baer (1996) for a developmental cusp. It is likely that the acquisition of conditioned reinforcement for adult faces and/or voices using the conjugate stimulus-stimulus pairing procedure made it possible for the participant to come into contact with parts of his environment that he could not before.

From the applied perspective, the procedure showed potential utility. The amount of instruction required for Participant A to achieve listener objectives and Participant B to achieve both listener and speaker related educational objectives decreased. This means that considerably less instructional time was required for these participants to learn.

Prior to intervention, Participant A did not have conditioned reinforcement for adult faces and conditioned reinforcement for listening to adult voices as conditioned reinforcers. The participant acquired the voice as a conditioned reinforcer first through the conjugate stimulus-stimulus pairing procedure. It is possible that the acquisition of conditioned reinforcement for voices, after the first intervention, made it possible for him to master what he could not before acquiring conditioned reinforcement for voices. In addition, slight increases were made in observing responses after the first intervention. However, after the second intervention, learn units to criterion increased and observing responses decreased. A possible explanation is that voices were not truly conditioned. In
addition, the device used to condition voices consisted of a tape recorder and one switch. The participant wasn’t given the option to choose from another switch with no noise when activated. Consequently, it was unknown whether the participant was choosing to listen to the activated voice or just simply pushing the switch.

Prior to intervention, Participant B already had voices as a conditioned reinforcer, however, he did not have faces as a conditioned reinforcer. Following the intervention, the amount of time Participant B looked at the experimenter increased dramatically during the conditioned reinforcement for observing faces probe. After the second intervention, he acquired faces as a conditioned reinforcer, and the data suggest that the increase in responses can be attributed to an increase in observing responses with this participant, in addition to a decrease in learn units to criterion.

The VBDT proposed that conditioned reinforcement for observing adult faces and conditioned reinforcement for listening to voices were pre-verbal developmental cusps. A behavioral cusp allows a child to come in contact with experiences resulting in new learning. Therefore, if faces and voices became conditioned reinforcers and it resulted in a new opportunity to learn, then they were truly pre-verbal developmental cusps. For Participant B, his rate of learning increased and his observing responses increased as a result of the intervention, however, Participant A did not have the same results. Therefore, it is unknown if conditioned reinforcement for observing faces and conditioned reinforcement for listening to adult voices were pre-verbal developmental cusps.

Therefore in Experiment 2, I tested the effects of the acquisition of conditioned reinforcement for observing adult faces and/or voices on rate of learning, observing
responses, and verbal operants with more participants. In addition, during the voice conditioning probe, the materials included a tape recorder and two electronic switches. When the participant activated the switch by pushing down on it, a voice reading a children’s story was activated while the other switch emitted no sound when pushed. This was to ensure that the participant preferred listening to adult voices. In Experiment 1, the voice on the recording was reading a passage from a scientific textbook. If voices were not a conditioned reinforcer, then the participants would not listen to any spoken words. Therefore, a children’s story was chosen for Experiment 2. Finally, in Experiment 1 there were only four observing responses with a total of 40 opportunities. In Experiment 2, there were 10 observing responses measured with a total of 100 opportunities.

In Chapter III, the method, results, and discussion for Experiment 2 will be presented. Experiment 2 was implemented to test the effects of the acquisition of conditioned reinforcement for adult faces and the acquisition of conditioned reinforcement for listening to adult voices on the participants’ rate of learning, general awareness of the presence of adults, and verbal operants in three non-structured settings.

Therefore, Experiment 2 sought to answer the following questions: (1) What is the effect of the acquisition of conditioned reinforcement for faces and voices on rate of learning?; (2) What is the effect of conditioned reinforcement on observing the presence of adults in the environment?; and (3) What is the effect of conditioned reinforcement on the emission of verbal operants in three non-instructional settings?
Chapter III

Experiment 2

Method

Participants

Four participants were chosen for the study based on the fact that conditioned reinforcement for observing the adult face and/or conditioned reinforcement for listening to adult voices were not in repertoire, the participants emitted low numbers of correct responses to learn units across listener and or speaker programs, emitted low levels of observing responses, and emitted low levels of verbal operants. Participants were selected from a suburban classroom 40 miles outside of a major city that implemented the CABAS® model. Participants ranged in age from four to eight years old. The participants were diagnosed with ASD. The pool of participants consisted solely of boys (see Tables 5, 6, and 7 for full descriptions of the participants).
Table 5

**Participants’ Descriptions in Experiment 2**

<table>
<thead>
<tr>
<th>Participant</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
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<td>4</td>
<td>5</td>
<td>8</td>
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<tr>
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<td>Male</td>
<td>Male</td>
<td>Male</td>
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<td>Autism</td>
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<tr>
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<td>Pre-K</td>
<td>Kdg</td>
<td>3rd</td>
</tr>
<tr>
<td>Levels of Verbal</td>
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<td>Speaker/</td>
<td>Speaker/</td>
<td>Speaker/</td>
</tr>
<tr>
<td>Behavior</td>
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<td>Pre-listener;</td>
<td>Pre-listener;</td>
<td>Emergent</td>
</tr>
<tr>
<td></td>
<td>Listener;</td>
<td>Pre-reader/</td>
<td>Pre-reader/</td>
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</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>Pre-writer</td>
<td></td>
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</tr>
</tbody>
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Table 6

Participants’ Standardized Test Scores in Experiment 2

<table>
<thead>
<tr>
<th>Standardized Test Scores</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td><strong>Goldman Fristoe 2: Speech Articulation</strong></td>
<td>SS=97</td>
</tr>
<tr>
<td><strong>Stanford-Binet Intelligence Scale:</strong></td>
<td>SS=86;</td>
</tr>
<tr>
<td>Full Scale IQ; Non-Verbal IQ; Verbal IQ</td>
<td>75; 98</td>
</tr>
<tr>
<td><strong>Wechsler Pre-School Primary Scale of Intelligence:</strong></td>
<td>NA</td>
</tr>
<tr>
<td>Full Scale IQ; Verbal IQ; General Language Composite</td>
<td>65; 73</td>
</tr>
<tr>
<td><strong>Preschool Language Scale 4: Auditory Comprehension; Expressive Communication; Total Language Score</strong></td>
<td>SS=99;</td>
</tr>
<tr>
<td></td>
<td>108; 104</td>
</tr>
</tbody>
</table>
Table 7

*Participants’ Verbal Developmental Cusps and Capabilities Presented during the Onset of the Experiment 2*

<table>
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</tr>
<tr>
<td>Auditory Matching (i.e., selection response to match spoken words)</td>
<td>No</td>
</tr>
<tr>
<td>Parroting (i.e., speaking words or components of words as automatic reinforcement)</td>
<td>Yes</td>
</tr>
<tr>
<td>Echoic-to-Mand (i.e., mand function of repeating word sounds)</td>
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</table>
Setting

All pre- and post-intervention probe sessions and the intervention were conducted outside of the participants’ classroom for Participants C, D, and E. The hallway was quiet and the walls were bare. There was a child size desk and two to three child sized chairs in the hallway for the participant and the individuals collecting the data. While the pre-and post-intervention probe sessions and the intervention were taking place, the other students were involved in small group or one-to-one instruction in the classroom. All pre- and post conditioned reinforcement for faces and voices probe sessions and the intervention were conducted in Participant F’s home in a quiet room. This was to ensure procedural fidelity. The room consisted of a dining room table, chairs, and bare walls. The pre- and post observing response probe sessions and the pre- and post verbal operant probe sessions were conducted in Participant F’s classroom.

Materials

During the observing responses probe sessions, the materials were a data collection forms. When learn units to criterion were measured, a data collection form, the participants’ independent program binders, and individualized materials for the programs were used. The program materials varied across participants. Furthermore, during the last probe condition of verbal operants in three settings, the materials were a data collection sheet and a timer that counts forward.

During the conditioned reinforcement for observing faces probe session, two children sized chairs were used, a timer that counted forwards, and a data collection sheet. During the conditioned reinforcement for listening to adult voices probe session, the materials used were a timer that counted forwards, data collection form, and two
electronic switches. The switches were connected to a tape recorder and when the participant pushed one switch, the tape recorder played a previously recorded voice reading a children’s story. When the other switch was pressed, no voices were emitted. Given that the participants had higher levels of verbal behavior than the participants in Experiment 1, children’s stories were chosen. In addition, it was not naturalistic to listen to passages from a scientific textbook.

**Dependent Variables**

The dependent variables measured were: (1) learn units to criterion across speaker and listener programs based on 2000 learn units in pre- and post-intervention probes. The learn units were based on 1000 learn units each in the speaker programs and listener programs; (2) Observing Responses: Pre- and post-intervention probes included 10 trials (see Table 8); and (3) the number of cumulative verbal operants emitted during three 10-min non-instructional settings.

**Tests of Independent Variable**

The independent variable was the acquisition of conditioned reinforcement for adult faces and/or listening to adult voices using the conjugate stimulus-stimulus pairing procedure. During the conditioned reinforcement for observing adult faces and conditioned reinforcement for listening to adult voices probes, data were collected on the number of intervals the participants selected to look at the experimenter or listen to the adult voice. The conditioned reinforcement for observing adult faces probe consisted of a 5-min session divided into 5-s intervals in which partial interval recording was used to record whether the participant observed the experimenter’s face. During the conditioned reinforcement for listening to adult voices probe session, a 5 min probe session using 5-s
intervals recording was used to record whether the participant listened to the recorded voice.

**Procedure**

**Probes.** Conditioned reinforcement for observing adult faces and conditioned reinforcement for listening to adult voices probes were conducted with each participant. These probes were implemented to determine if faces and/or voices were already conditioned reinforcements. During the conditioned reinforcement for observing adult faces, a 5-min probe using 5-s partial interval recording was used in which the experimenter looked at the participant without talking, but moved her mouth and face in animated expressions. The experimenter sang, recited a poem or a passage from a book for example without using her voice. If at any moment in the 5-s interval the participant looked at or in the direction of the experimenter a plus (+) was recorded on the data sheet. If during the 5-s interval the participant did not look at or look in the direction of the experimenter a minus (-) was recorded on the data sheet. However, if the participant looked away and looked back toward the experimenter’s face within 1-s, then it was recorded as a (+). At the end of the 5-min session, the pluses and minuses were tallied.

During the conditioned reinforcement for listening to adult voices probe session, two switches were used that were attached to a tape recorder. During this condition, the participants sat at a table with two switches attached to a tape recorder. One of the switches activated the recording of an individual reading a story while the other switch did not activate a voice. This was necessary in order to determine if the participant preferred to listen to the voice recording. The participant was required to push and hold down the switch in order to hear the voices on the tape, but did not have a face to look at
while listening. The experimenter also rotated the position of the switches so that the participant had to then find the active switch and depress it again. This rotation occurred on a variable schedule of 10 intervals. The pre-recorded voices read a passage from a children’s book with a normal speaking voice. During the 5-s whole interval recording, if the participant listened to the recording for the entire 5-s interval then a plus (+) was recorded on the data sheet. If during the 5-s interval the participant did not listen to the recording a minus (-) was recorded on the data sheet. At the end of the 5-min session the pluses and minuses were tallied. Two switches were used in that when one switch was depressed a voice reading a story was activated and when the other switch when pressed no voice was activated.

During all observing responses probe sessions, data were collected on the number of times the participants looked at or in the direction of the second experimenter when the second experimenter engaged in one of the 10 observing responses scenarios (see Table 8). The participants were given 10 opportunities to respond to each of the 10 observing responses. A plus (+) was recorded if the participant looked at or in the direction of either experimenter within 1-s and a minus (-) was recorded if the participant did not look at or in the direction of either experimenter within 1-s.
Table 8

*Observing Responses for Experiment 2*

<table>
<thead>
<tr>
<th>Antecedent and Opportunity for Observing Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant orients toward a speaker when his name is called in a moderate, but detectable volume from a distance of 0.5-1.5 meters. “Orients” refers to the participant making eye contact or looking at the face of the experimenter or 3rd party for a minimum of 1 s.</td>
</tr>
<tr>
<td>Participant orients toward a speaker when name is called in a moderate, but detectable volume from 1.5-2.5 meters.</td>
</tr>
<tr>
<td>Participant orients toward a speaker when the child is given a 1-step direction in a moderate, but detectable volume from 0.5-1.5 meters.</td>
</tr>
<tr>
<td>Participant orients toward a speaker when the child is given a 1-step direction in a moderate, but detectable volume from 1.5-2.5 meters.</td>
</tr>
<tr>
<td>The participant orients toward speaker when the child is spoken to in a moderate, but detectable volume from a distance of 0.5-1.5 meters.</td>
</tr>
<tr>
<td>The participant orients toward a speaker when another child is spoken to in a moderate, but detectable volume from 1.5-2.5 meters.</td>
</tr>
<tr>
<td>Participant orients toward an adult rearranging the child’s materials on desk.</td>
</tr>
<tr>
<td>Participant orients toward an adult removing the child’s materials from desk.</td>
</tr>
<tr>
<td>Participant orients toward an adult entering the room who is speaking in a moderate, but detectable volume.</td>
</tr>
<tr>
<td>Participant orients toward an adult entering room who is not speaking.</td>
</tr>
</tbody>
</table>
The next probe conducted was on the number of learns to criterion for 2000 learn units across speaker and listener programs (i.e., 1000 learn units from speaker programs and 1000 learn units from listener programs). The speaker programs consisted of five different tact programs (i.e., animals, instruments, flowers, reptiles, or frogs). Pre-intervention probe sessions were conducted to determine if the tacts were in the participants’ repertoire. In the listener programs, the teacher selected target commands and nonsense commands which were divided into sets which consisted of five responses each; four commands and one nonsense command (see Table 9). The commands were presented four times during a 20 learn unit session. Each set was taught separately. If the student responded correctly, the student was reinforced with edibles or praise. For nonsense commands, the student was reinforced for not responding and for corrections, the teacher paused, looked away, and ignored the response. These instructional sets were taught until the student met criterion. Criterion consisted of the students emitting 90% accuracy for two consecutive 20 learn unit sessions or 100% accuracy for one session.
Table 9

*Set Stimuli Used during Pre- and Post-Intervention Probes for Listener Programs in Experiment 2*

<table>
<thead>
<tr>
<th>Set</th>
<th>Commands</th>
<th>4 Target</th>
<th>1 Nonsense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set 1</td>
<td>Clap hands</td>
<td></td>
<td>La la la</td>
</tr>
<tr>
<td></td>
<td>Stomp feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Raise hand</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Touch shoulder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set 2</td>
<td>Tap table</td>
<td></td>
<td>Ga ga ga</td>
</tr>
<tr>
<td></td>
<td>Jump</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Touch nose</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stick out tongue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set 3</td>
<td>Blow kiss</td>
<td></td>
<td>Da da da</td>
</tr>
<tr>
<td></td>
<td>Open mouth</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Touch toes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Close eyes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set 4</td>
<td>Shout hurray</td>
<td></td>
<td>Bla bla bla</td>
</tr>
<tr>
<td></td>
<td>Touch ears</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tap head</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shake head</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set 5</td>
<td>Rub hand</td>
<td></td>
<td>Surf surf</td>
</tr>
<tr>
<td></td>
<td>Cover ears</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wiggle fingers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set 6</td>
<td>Smack lips</td>
<td></td>
<td>Zippy zippy</td>
</tr>
<tr>
<td></td>
<td>Touch forehead</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wiggle knees</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thumbs up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set 7</td>
<td>Shrug shoulders</td>
<td></td>
<td>Doo doo doo</td>
</tr>
<tr>
<td></td>
<td>Point</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>March</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set 8</td>
<td>Rub your belly</td>
<td></td>
<td>Wokka wokka wokka</td>
</tr>
<tr>
<td></td>
<td>Touch your cheek</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cross your legs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hi-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set 9</td>
<td>Smile</td>
<td></td>
<td>Gabba gabba</td>
</tr>
<tr>
<td></td>
<td>Touch your neck</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peace</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hands together</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 6. Procedure for the pre-and post-intervention probe sessions for conditioned reinforcement for adults faces and voices, awareness of adults presence (see Table 8 for a detailed description of awareness of adult presence), the rate of learning for speaker and listener programs (i.e., learn units to criterion), and the verbal operants emitted during three 10-minute probe sessions in Experiment 2.

**Independent Variables:** (1) Conditioned Reinforcement for Adult Voices; and (2) Conditioned Reinforcement for Adult Faces

**Intervention:** Conditioning reinforcement for faces and voices using a conjugate stimulus-stimulus pairing procedure to induce the preverbal foundational cusps (i.e., conditioned reinforcement for voices and faces; see Figure 9 for a detailed description for the procedure)

**Dependent Variables:**
(1) Attention to presence of adults; (2) Learn units to criterion for speaker programs; (3) Learn units to criterion for listener programs; and (4) Verbal operants
**Intervention.** The intervention used in Experiment 1 was the same intervention used in Experiment 2. Figure 7 outlines in-depth, step-by-step instructions for the conjugate stimulus-stimulus pairing procedure. During the intervention, learn units were held constant throughout the day. The participants continued working on curricular programs that were not involved in the learn units to criterion probes. The participants received a predetermined number of learn units based on the participants' level of verbal behavior. For example, the participants received constant a 400 learn units a day, 200 learn units were from curricular programs, and 200 learn units from the intervention.

After each participant reached the mastery of 160-cumulative seconds during a 20-trial session, all probe sessions were conducted again. Probe sessions were conducted to determine if the number of learn units required to reach criterion decreased, if there were changes in the number of verbal operants, and if there were changes in attending to presence of adults.
**Figure 7.** The Conjugate Stimulus-Stimulus Pairing Procedure for Experiment 1 and Experiment 2.

**Conjugate Stimulus-Stimulus Pairing Procedure**

**Getting Participant to Look at Face:**
Use non-verbal vocal sounds or instruments noise maker sounds: blow raspberries, stick tongue out and blow, click tongue, blow bubbles with bubble gum, make sounds with gum (i.e., crack gum while in mouth), press lips together and blow, blow a harmonica, blow a kazoo, roll tongue, make sounds such as “la, la, la, la” or “da, da, da.” The sounds are moment to moment in order to get the participant’s attention.

**There are two categories of reinforcement delivered:** Verbal reinforcement; and tactile touch. Use any reinforcement that is keeping the participant attending to the face.

**Verbal Reinforcement:**
While the participant is looking at the experiment’s face, the experiment can sing, recite nursery rhymes with much animation or anything that holds the participant’s attention. Loud opera singing can also be used if it helps participant looking at the experiment’s face. Again, the use of reinforcement is moment to moment. The participant may not enjoy songs and instead the participant may be reinforced for looking at the experiment’s face with soft soothing tone of voice. It is very important to note that you do anything that it takes to keep participant looking at your face. The verbal reinforcement can change from being loud animated singing to soft soothing music.

**Tactile Touch:**
In addition to verbal reinforcement, tactile touch may be used. For example, while the participant is looking at the experiment’s face, the experiment can gently rub the participant’s cheeks, arms, hands, hair, and etc. The tactile touch is also moment-to-moment. The experiment can simultaneously use the verbal reinforcement with the tactile touch. For example, the experiment can sing a song while rubbing the participant’s cheek.

Once 20 trials are completed, calculate the sum across all trials (e.g., $1 + 1 + 2 + 3 + 4 + 9 + 10 + 9 + 15 + 17 + 1 + 2 + 3 + 6 + 7 + 4 + 1 + 3 + 2 + 1 = 101$ cumulative seconds).

Graph each session with a line graph. Keep running the sessions until the participant meets the long-term objective, which is 160 cumulative seconds for one session (i.e., the measure of faces and/or voices as a conditioned reinforcer).

As soon as the participant looks away, the timer stops instantly. However, if the participant looks away for one second and looks immediately back at the experiment’s face, keep timing. It is also important to note that looking at the experiment’s face does not necessarily mean maintaining eye contact. Looking at faces refers to the participant looking at any part of the experiment’s face (i.e., experiment’s forehead, nose, chin, hair, cheek, etc.).
Interobserver agreement

**Probes.** Interobserver agreement (IOA) was collected during all pre- and post-intervention probe sessions for each participant. IOA for Participant C was conducted for 37% of sessions with a mean agreement of 94% with a range of 89-100%. IOA for Participant D was conducted for 39% of sessions with a mean agreement of 95% and range of 87-98%. IOA for Participant E was conducted for 34% of sessions with a mean agreement of 99% with a range of 95-100%. IOA for Participant F was conducted for 64% of sessions with a mean agreement of 97% with a range of 93-100%.

**Intervention.** During intervention, IOA was collected for Participants C, D, E, and F. IOA was calculated on a point-to-point basis for 100% of intervention sessions for Participant C with a mean of 95% and a range of 87-98%. IOA was calculated on a point-to-point basis for 43% of sessions for Participant D with a mean agreement of 99% and a range of 99-100%. IOA was calculated on a point-to-point basis for 57% of intervention sessions for Participant E with a mean of 98% and a range of 94%-100%. IOA was calculated on a point-to-point basis for 50% of intervention sessions for Participant F with a mean of 89% and a range of 85%-93%.

**Results**

Figure 8 shows the data collected during the pre- and post conditioned reinforcement for observing human faces and conditioned reinforcement for listening to adult voices probes for Participants C, D, E, and F. Participant C, prior to intervention, had a total of 38 intervals out of 60 (5-min total probe with 5-s partial interval recording) for observing faces without voices. This is equivalent to saying that the participant looked at the experimenter 63% of the time in 5-min probe session when the
experimenter moved her face in animated ways or moved her lips while talking but without words (see Figure 8). During the conditioned reinforcement for observing human faces pre-intervention probe, Participant C emitted a total of 58 intervals out of 60 in total (i.e., 97%; see Figure 8). It was determined that the participant did not have faces as a conditioned reinforcer in repertoire; however, he did have voices as a conditioned reinforcer in repertoire. Following the intervention, the conditioned reinforcement for observing human faces and conditioned reinforcement for listening to adult voices were conducted and the results showed an increase to 52 intervals out of 60 in total (i.e., 87%) for observing faces without voices and 60 intervals out of 60 in total (i.e., 100%) for listening to adult voices (see Figure 8). Therefore, Participant C acquired voices as a conditioned reinforcer.

After the intervention was conducted for Participant C, Participant D began pre-intervention probe sessions. Participant D, prior to intervention emitted a total of 56 intervals out of 60 in total (i.e., 93%) for the conditioned reinforcement for observing faces; whereas, he emitted a total of 5 intervals out of 60 in total (i.e., 8%) for listening to adult voices (see Figure 8). Participant D had faces as a conditioned reinforcer in repertoire, but did not have listening to adult voices as a conditioned reinforcer. Therefore, the intervention was conducted. After Participant D met the long-term objective of the intervention, conditioned reinforcement for observing adult faces and conditioned reinforcement for listening to adult voices probe sessions were conducted. The results indicated that during the test for conditioned reinforcement for listening to voices, Participant D emitted 46 out of 60 intervals in total (i.e., 77%) which remained in repertoire (see Figure 8). The results of the post-intervention probe for conditioned
reinforcement for observing adult faces showed that conditioned reinforcement for observing the adult face became a conditioned reinforcer in which the participant emitted 49 intervals out of 60 in total (i.e., 82%; see Figure 8). Once Participant D completed his first intervention, Participant E began pre-intervention probe sessions. Participant E, prior to intervention emitted a total of 9 intervals out of 60 in total (i.e., 15%) during the conditioned reinforcement for observing faces probe; whereas, he emitted a total of 49 intervals out of 60 in total (i.e., 82%) for the conditioned reinforcement for listening to adult voices (see Figure 8). Therefore, Participant E did not have looking at adult faces as a conditioned reinforcer and had listening to adult voices as a conditioned reinforcer. Consequently, the intervention was conducted and after Participant E met the long term objective post-interventions probe sessions were implemented. The results showed that Participant E emitted a total of 48 intervals out of 60 in total (i.e., 82%) during the conditioned reinforcement for observing faces probe and the participant emitted a total of 50 intervals out of 60 in total (i.e., 83%) during the conditioned reinforcement for listening to adult voices. The results showed that after the intervention was completed, conditioned reinforcement for observing faces became conditioned and conditioned reinforcement for listening to adult voices was still in repertoire.

After the intervention was conducted for Participant E, Participant F began pre-intervention probe sessions. Participant F, prior to intervention, emitted a total of 26 intervals out of 60 in total (i.e., 43%) for conditioned reinforcement for observing adult faces probe; whereas, he emitted a total of 20 intervals out of 60 in total (i.e., 33%) during the conditioned reinforcement for listening to voices probe (see Figure 8). Following the intervention, the conditioned reinforcement for observing adult faces and
conditioned reinforcement for listening to adult voices were conducted and the results showed an increase to 58 intervals out of 60 in total (i.e., 97%) for observing faces and 48 intervals out of 60 in total (i.e., 80%) for listening to adult voices (see Figure 8). Therefore, Participant F acquired faces and listening to voices as a conditioned reinforcer.

Figure 9 represents the number of learn units to criterion for Participants C, D, E and F prior to and after all intervention phases. Prior to the first intervention for Participant C, he required 167 learn units to reach criterion for speaker programs and listener programs were in repertoire prior to the study (see Figure 9). The results showed that after the post-intervention probe, the number of learn units required for Participant C decreased to 111 learn units to criterion (see Figure 9).

The number of learn units to criterion prior to intervention for Participant D were 143 learn units for speaker program and listener programs were in repertoire (see Figure 9). The results of the post-intervention probe showed that Participant D’s learn units to criterion decreased to 111 learn units to criterion for speaker programs (see Figure 9).

Prior to the intervention for Participant E, he required 333 learn units to reach criterion on speaker programs and 1000 learn units for listener programs (see Figure 9). During the post-intervention probe, Participant E’s learn units to criterion decreased to 143 learn units to criterion for speaker programs and decreased to 200 learn units to criterion in listener programs.

The number of learn units to criterion prior to intervention for Participant F were 200 learn units for speaker programs and 143 learn units to criterion in listener programs (see Figure 9). The results of the post-intervention probe showed that Participant F’s
learn units to criterion decreased to 90 learn units to criterion for speaker programs and
77 learn units to criterion for listener programs (see Figure 9).
Figure 8. Pre- and post-intervention results for conditioned reinforcement for observing faces and conditioned reinforcement for listening to adult voices for Participants C, D, E, and F in Experiment 2
Figure 9. Pre- and post-intervention learn unit to criterion results for Participants C, D, E, and F in Experiment 2.
Figure 10. Cumulative numbers of intervals for the attention to the presence of adults (see Table 8) during pre- and post-conditioning reinforcement for observing faces and voices intervention probes (i.e., a total of 100 opportunities) for Participants C, D, E, and F in Experiment 2.
Figure 10 shows the data collected for observing responses prior to and after each intervention for Participants C, D, E, and F. Prior to the onset of the intervention, Participant C emitted 24 observing responses out of 100 opportunities. Following the intervention, Participant C emitted 39 observing responses out of 100 opportunities.

Observing responses prior to intervention for Participant D were 18 out of 100 opportunities. Following the intervention, Participant D emitted 35 observing responses out of 100 opportunities. Prior to intervention, Participant E emitted 12 observing responses out of 100 opportunities. Following the intervention, Participant E emitted 48 observing responses out of 100 opportunities. Prior to intervention Participant F emitted a total of 32 out of 100 observing responses. The results of the post-intervention probe showed that Participant F’s observing responses increased to 100 out of 100 observing responses.

Figure 11 shows the data for pre- and post-intervention on the numbers of verbal operants emitted during non-instructional settings. Participant C prior to intervention emitted a cumulative total of 4 mands, 13 tacts, 12 sequelics and 0 conversational units across all three settings for a total duration of 30 minutes. During post-intervention, the cumulative mands emitted were 1, 6 for tacts, 9 for sequelics, and 5 conversational units (see Figure 11). Prior to intervention Participant D emitted 1 tact, 2 mands, 0 sequelics and conversational units. During the post-intervention probe session, Participant D emitted 2 mands, 20 tacts, 4 sequelics and 0 conversational units. Pre-intervention probe data showed that Participant E emitted 0 tacts, 4 mands, 0 sequelics and 0 conversational units. During post-intervention, the participant emitted 50 tacts, 46 mands, 19 sequelics, and 0 conversational units. Participant F prior to intervention emitted a cumulative total
of 3 mand, 3 tacts, 1 sequelics, and 0 conversational units. During the post-intervention probe session, Participant F emitted a cumulative total of 12 mands, 1 tact, 0 sequelics, and 0 conversational units.

Figure 12 represents the intervention data for Participants C, D, E, and F. Participant C required five sessions for the intervention. Both Participants D and E required seven sessions to achieve the mastery criterion during the intervention sessions. Participant F required four sessions for the intervention.
Figure 11. Pre- and post-conditioning reinforcement for voices and faces intervention probes for the emission of verbal operants during non-instructional setting for Participants C, D, E, and F in Experiment 2.
Figure 12. Intervention results for Participants C, D, E, and F in Experiment 2.
Discussion

The results of this study indicated that the acquisition of conditioned reinforcement for observing adult faces and/or voices had an effect on rate of learning, attending to adults present in the environment, and verbal operants for the participants. Before the onset of the study, listener probes were conducted with Participants C and D. The participants were able to emit all commands and nonsense commands in each set and therefore listener learn units to criterion were not measured. However, these participants were kept in the study because Participant C did not have faces as a conditioned reinforcer and Participant D did not have voices as a conditioned reinforcer.

Participant E did not have conditioned reinforcement for faces as a conditioned reinforcer, but had conditioned reinforcement for listening to adult voices as a conditioned reinforcer. Participant F did not have conditioned reinforcement for faces or voices as conditioned reinforcers prior to the onset of the study. After the intervention was implemented, all of the participants acquired conditioned reinforcement for observing adult faces and/or voices.

Much research has shown that conditioned reinforcers are acquired because of pairings with unconditioned reinforcers or other conditioned reinforcers (Greer et al., 1973; Greer, 2002; Greer et al., in press; Greer et al., 1985; Keohane et al., 2008; Longano & Greer, 2006; Miguel et al., 2002; Nuzzolo-Gomez et al., 2002; Pereira-Delgado et al., 2009; Rheingold et al., 1959; Smith et al., 1996; Sundberg et al., 1996; Yoon, 1998; Yoon & Bennet, 2000). Researchers have also reported that conjugate reinforcement has been used in conditioning new stimuli as reinforcers (Cotter & Spradlin, 1971; Dunst, et al., 2007; Lindsley, 1956; Lovitt, 1968; Rovee & Rovee, 1969).
Social conditioned reinforcement was used in Experiment 2 in which continuous novel moment to moment reinforcement was paired contingent upon the participants looking at the experimenter’s face. Novelty was key in the pairings that took place. Consequently, novel moment to moment continuous social conditioned reinforcement was paired with the participant looking at the experimenter’s face in order for the participants to acquire observing faces and/or listen to adult voices.

It was critical for those delivering the intervention to find what was reinforcing for the participant in order for the participant to continuously observe the experimenter’s face. The task of determining the novel moment-to-moment reinforcement was difficult. For example, one participant responded to loud singing and in the next instance enjoyed soft spoken nursery rhymes. Therefore, the experimenters needed to respond flexibly to the behaviors of the participant. If the delivery of vocal and facial events did not reinforce attention for the participant, the participant looked away and the contingencies and timing were ceased. Thus, the experimenters who implemented the intervention required a sophisticated level of expertise. It was extremely important that the individuals who deliver the intervention be well trained. If the individual is not adequately trained, the results may be wanting.

The results showed that all of the participants’ rate of learning accelerated, attending to the presence of adults increased, and verbal operants increased or emerged as a function of the acquisition of conditioned reinforcement for observing adult faces and voices. The VBDT proposed that the acquisition of conditioned reinforcement for observing adult faces and/or listening to adult voices were pre-verbal developmental cusps. The data from Experiment 2 showed that there was a change in learning and
therefore, supports the notion that the acquisition of conditioned reinforcement for observing the adult face and/or listening to voices are pre-verbal developmental cusps.
Chapter IV

General Discussion

Major Findings and Possible Explanations

The findings of Experiments 1 and 2 demonstrated that the acquisition of conditioned reinforcement for faces and/or voices increased rate of learning to some degree for all six participants. Also, attending to the presence of adults were measured and the results indicated that five out of the six participants emitted more instances for observing adults in the environment.

In Experiment 2, verbal operants were also measured as a dependent variable and the results indicated that to some degree the participants emitted more verbal operants following the acquisition of conditioned reinforcement for faces and/or voices. In Experiment 2, Participant C emitted fewer mands and tacts during the post-intervention probe sessions, but he emitted nine sequelics and five conversational units; the latter are indicators of social verbal reinforcement. The participant did not emit these verbal operants during pre-intervention probe sessions. During pre-intervention probe sessions, Participant D emitted zero sequelics and during post-intervention probe sessions, he emitted four sequelics. The results for Participant D showed that he emitted significantly more mands during post-intervention probe sessions and tacts and sequelics emerged during post-intervention probes. Participant F emitted more mands during post-intervention probe sessions as well.

Children with ASD often do not look at adult faces. Research has shown that communication is improved when an individual looks at faces during speech production (Mossaro, 1998). The voice alone is sufficient, but observing parts of the face (e.g., lips,
jaw, tongue, and face) helps with auditory messages (Mossaro & Bosseler, 2006). Observing a speaker’s expressions can also affect an individual’s communication (Massaro, 1998). Therefore, once the cusp of observing the adult face is in repertoire, the image of the face will select out observing; thus learning may accelerate and communication may be more effective.

According to Greer and Ross (2008), typically developing infants respond to and discriminate familiar and unfamiliar voices. Spence and DeCasper (1987) suggest that mothers’ voices are preferred by their infants as a result of prenatal experience. Greer and Keohane (2009) and Greer and Speckman (2009) also suggest that the process begins in utero. Some theorists believe that the mother’s voice is paired with in-utero nutrients (DeCasper & Spence, 1987; Greer & Keohane, 2009; Greer & Speckman, 2009; Spence & DeCasper, 1987). This pairing conditions the mother’s voice as a reinforcer for listening. Children with disabilities often do not have listening to voices as a conditioned reinforcer. Once this cusp is in repertoire, we can expect to see that children attend to voices, including instructional presentations, and rate of learning is accelerated.

According to the VBDT, the acquisition of pre-verbal developmental cusps allow a child to come in contact with new experiences that result in new opportunities to learn (Greer & Keohane, 2005; Greer & Keohane 2009; Greer & Ross, 2009; Greer & Speckman, 2009; Greer & Longano, 2010). Rosales-Ruiz and Baer (1996) identified behavioral developmental cusps as a somewhat difficult change and once made, significant developments occur that help a child come in contact with other cusps. The child learns from direct contact with new contingencies that he or she could not come in contact with prior to the acquisition of the cusp (Greer & Keohane, 2005; Greer &
Keohane, 2009; Greer & Ross, 2009; Greer & Speckman, 2009; Greer & Longano, 2010). Consequently, these cusps allow a child to acquire educational goals and accelerate rates of learning that were not possible prior to the attainment of the cusps.

As proposed in the VBDT, the acquisition of conditioned reinforcement for observing adult faces and/or listening to adult voices are pre-verbal developmental cusps. If they indeed are pre-verbal developmental cusps, then the results should show a change in learning. Based on the results in Experiments 1 and 2, the acquisition of conditioned reinforcement for observing faces and conditioned reinforcement for listening to adult voices were necessary in order to accelerate the participant’s rate of learning. Since there was a change in learning, the acquisition of observing faces and the acquisition of listening to adult voices were determined to be cusps.

**Research Question 1.** What is the effect of the acquisition of conditioned reinforcement for faces and voices on rate of learning?

In Experiment 1, Participant A did not have conditioned reinforcement for observing adult faces and listening to adult voices as a conditioned reinforcer. Participant B did not have conditioned reinforcement for faces as a reinforcer, but did have conditioned reinforcement for listening to voices as a conditioned reinforcer. In Experiment 2, Participant C had conditioned reinforcement for listening to voices as a conditioned reinforcer, but did not have conditioned reinforcement for observing the adult face. Participants D and E had conditioned reinforcement for observing the adult face as a conditioned reinforcer before the onset of the intervention, but did not have conditioned reinforcement for listening to voices as a reinforcer. Participant F did not have conditioned reinforcement for observing adult faces or conditioned reinforcement
for listening to voices in repertoire. In Experiment 1 after the intervention was implemented, learn units to criterion decreased in listener programs for Participant A and learn units to criterion decreased in listener and speaker programs for Participant B. In Experiment 2, Participants C and D required fewer learn units to criteria in speaker programs and Participants E and F required fewer learn units to criteria in both speaker and listener programs. These data suggest that the acquisition of conditioned reinforcement for adult faces and conditioned reinforcement for listening to adult voices were both needed in order for the participants to learn at a quicker rate. In other words, having only one of these cusps in repertoire required more instructional time for these participants to acquire speaker and/or listener objectives.

Accelerated rate of learning was a function of conditioned reinforcement for attending to the adult who was presenting instruction. In recent behavioral literature, researchers tested the effects of conditioned reinforcement on rate of learning. Specifically, when voices were conditioned or text was conditioned rate of learning of tasks associated with those stimuli increased (Greer et al., in press; Keohane et al., 2008; Pereira-Delgado et al., 2009; Tsai & Greer, 2006).

**Research Question 2.** What is the effect of conditioned reinforcement on observing the presence of adults in the environment?

The results indicated that the number of intervals for attending to the presence of adults increased for all participants. In Experiment 1, the data showed slight increases in attending to the presence of adults for Participants A and Participant B emitted significant increases in attending to the presence of adults compared to pre-intervention probe sessions. In Experiment 2, Participant C emitted 24 intervals for attending to the
presence of adults during pre-intervention probe sessions and after the intervention his responses increased to 39. Participant D nearly doubled his responses during post-intervention probes and there was a significant increase in responding to the presence of adults for Participants E and F.

Therefore, if faces became a conditioned reinforcer, the image of the face selected the observing response. For example, one of the scenarios created in Experiment 2 consisted of an adult entering the room who was not speaking. If faces were a conditioned reinforcer for the participant, the presence of the adult served as a discriminative stimulus for the participant to orient towards the adult. If voices became a conditioned reinforcer, the sound of the voice served as the discriminative stimulus for the participant to listen to someone speaking.

Research Question 3. What is the effect of conditioned reinforcement on the emission of verbal operants in three non-instructional settings?

Research has shown that the implementation of the stimulus-stimulus pairing procedure has been used to condition non-preferred reinforcers that have resulted in new responses and the procedure has been used to condition non-preferred stimuli as reinforcers (Greer et al., 1973; Greer et al., 1985; Longano & Greer, 2006; Miquel et al., 2002; Nuzzolo-Gomez et al., 2002). Additionally, the use of the stimulus-stimulus pairing procedure has been used to condition vocalizations and verbalizations (Smith et al., 1996; Yoon, 1998; Yoon & Bennet, 2000). The conjugate stimulus-stimulus pairing procedure was implemented during the intervention of Experiments 1 and 2. That is, a continuous schedule of novel moment to moment reinforcement was delivered contingent upon the participants observing the experimenter’s face. Failure to maintain responding
resulted in the discontinuance of novel moment to moment reinforcement. When the participant observed the experimenter’s face again, the procedure continued.

During Experiment 2, verbal operants were measured in pre-and post-intervention probe sessions. After the acquisition of conditioned reinforcement for observing adult faces and/or listening to adult voices, verbal operants emerged for three of the participants. Post-intervention probe data showed that Participant C emitted fewer sequelics, but emitted more conversational units. According to Greer and Keohane (2005) conversational units are measures of social behavior and their presence is a developmental milestone in the evolution of verbal behavior. In addition, these data support Mossaro (1998) in that observing an individual’s lips, jaw, tongue and face helps with communication. During post-intervention probe sessions, Participant D emitted more tacts and emitted sequelics. Participant E emitted significantly more mands, tacts, and sequelics during post-intervention probe sessions. In addition, Participant E emitted tacts and sequelics during post-intervention probe sessions which were not emitted in pre-intervention probe sessions. Finally, Participant F emitted significantly more mands during post-intervention probe sessions.

For children with language delays, voices do not serve as reinforcers for listening. Keohane et al. (2009) suggest that listening to adult voices is one of the earliest cusps that are associated with language development and socialization. Therefore, the data in Experiment 2 support Keohane et al.’s (2009) work in that when the cusp, conditioned reinforcement for listening to adult voices is acquired, language emerges. In addition, gaze is an important component for social interaction. In other words, observing the adult face is important for socialization.
The results of Experiment 2 indicated that Participant C emitted conversational units with his peers during post-intervention probes and Participants D and E emitted more sequelics with his peers. Participant F requested more items in his environment during post-intervention probes. Therefore, the data support the notion that the acquisition of conditioned reinforcement for observing the adult face and conditioned reinforcement for listening to adult voices was crucial for language and social interaction.

**Limitations**

Limitations of Experiment 1 were discussed in Chapter II of this paper. Experiment 2 was designed to eliminate as many limitations of Experiment 1 as possible. However, there were some limitations in Experiment 2 also. One possible limitation of Experiment 2 was that Participants C and D had all of the sets of the listener commands in repertoire (i.e., commands and nonsense commands). Therefore, the learn units to criterion were not measured for these participants for listener programs. A possible alternative could have been to measure the participant’s learn units to criterion across listener curricular programs. This measurement may have shown the effects of conditioned reinforcement for observing faces and/or listening to adult voices on rate of learning in the listener programs.

These participants were retained in the study because Participant C did not have faces as a conditioned reinforcer and Participant D did not have listening to voices as a conditioned reinforcer. Therefore, the participants continued to receive the treatment to see if the acquisition of faces and/or voices had an effect on speaker programs, observing responses, and verbal operants.
A second limitation of Experiment 2 was that there were only four participants. An experimenter can test for generality and validity of the research findings when experiments are replicated. When experiments are replicated in which the conditions are the same with new participants, the participants should perform as expected. Therefore, more participants would have helped the study.

In addition, IOA was very difficult to calculate during the intervention. The individuals who recorded IOA needed to watch the experimenter and the participant at all times. This was necessary because as soon as the participant observed the experimenter’s face, the timer started. Often, during the intervention, the individual recording IOA was off by a few seconds because she did not start her timer at the same time as the experimenter. Therefore, videotaping the intervention would have been a better way of calibrating IOA.

The design implemented in both experiments was a delayed multiple probe design. Perhaps, a more valid design that could have been implemented was a full multiple probe design. According to Johnston and Pennypacker (1993), a multiple baseline design refers to as “an arrangement of control and experimental conditions in which two or more combinations of subjects, response classes, or settings permit, not only sequential comparisons for each combination, but comparisons across combinations or baseline” (p. 368). A delayed multiple probe design ruled out instructional history, but a non-delayed probe design would also have tested for maturation and history.

**Future Research**

The two experiments reported in this paper found that rate of learning accelerated and attending to the presence of adults increased as a function of the acquisition of
conditioned reinforcement for observing adult faces and/or listening to adult voices. In Experiment 2, verbal operants emitted by the participants increased or verbal operants emerged as a function of the acquisition of conditioned reinforcement for observing adult faces and conditioned reinforcement for listening to adult voices. The results showed a change of learning, therefore, the acquisition of conditioned reinforcement for adult faces and/or listening to voices are pre-verbal developmental cusps, as supported by the VBDT. Although the two experiments provide strong evidence that the acquisition of these pre-verbal developmental cusps accelerate learning, it is important for this protocol to be replicated.

The purpose of conditioning voices as a reinforcer is that the familiar and unfamiliar voices will select out listening. However, during the conditioned reinforcement for listening to adult voices pre- and post-intervention probe sessions, it would be interesting to conduct an additional probe. During the pre-and post intervention probes for Experiment 2, the recordings used the voice of the experimenter reading a children’s story. Perhaps, there should be a 5-min probe using 5-s whole interval recording using a voice reading a children’s story and another 5-min probe using 5-s whole interval recording using a voice reading from textbook (e.g., a scientific textbook). The children’s story would include a voice using animation and inflection and when the textbook is read, the voice would read a passage from the book in normal speaking voice. It would be interesting to see if there are differences during these probe sessions.

According to Greer and Keohane (2009) and Greer and Ross (2009), voices are not a conditioned reinforcer when vowel consonant blends are not functioning as discriminative stimuli. Greer and Keohane (2009) and Greer and Ross (2009) described
research that consisted of conditioning voices using the stimulus-stimulus pairing procedure. During these studies, auditory devices were used that contained recordings of the mother’s and teachers’ voices reading nursery rhymes or stories. It would be interesting to see more research conducted in this area and see if there is a difference between listening to a mother’s voice and the voice of the teacher.

Based on the results of this study, observing parts of the experimenter’s face as well as listening to the voice of the experimenter had an effect on the emergence of verbal operants. More research should also be conducted on measuring verbal operants when observing faces and listening to adult voices are conditioned reinforcers. In Experiment 2, when these cusps were in repertoire, the participants emitted more verbal operants and in some cases verbal operants emerged as a function of the induction of the cusps.

Furthermore, research should be conducted on the implementation of the conjugate stimulus-stimulus pairing procedure. The stimulus-stimulus pairing procedure has been used extensively in expanding children’s community of reinforcers, by teaching them to prefer non-preferred stimuli, to condition non-preferred reinforcers that have resulted in new responses, and to condition vocalizations and verbalizations. However, conjugate reinforcement implemented in this study consisted of the delivery of continuous novel moment to moment reinforcement. More behavior analytical research should be conducted in this area to further investigate the mechanism responsible for the conditioning.

Conclusion
No Child Left Behind mandates that teachers use practices that work (Odom, Brantlinger, Gersten, Horner, Thompson, & Harris, 2005). The law requires that educators use scientific practices (Odom et al., 2005). Behavioral research aims in improving learning by implementing evidence based practices. In addition, behavioral research aims at developing more effective teaching methods. Experiments 1 and 2 contribute to the literature of behavioral science in that the effects of the acquisition of conditioned reinforcement for observing faces and/or voices had an educationally significant effect on learning.

In review, I have identified the possible explanations for the effects of the acquisition of conditioned reinforcement for observing faces and/or listening to adult voices on accelerated rate of learning across speaker and listener programs, increases in attending to the presence of adults, and increases in verbal operants or the emergence of verbal operants. The first possible explanation for accelerated rate of learning across listener and/or speaker programs was that the acquisition of both pre verbal developmental cusps allowed the stimuli of the face or voice to function as discriminative stimuli for observing. Therefore, the participants were better able to attend to instruction.

Verbal operants increased or emerged as a function of the acquisition of conditioned reinforcement for faces and listening to adult voices. The data also suggested that the acquisition of both cusps was needed for the increase of verbal operants or the emergence of verbal operants. Finally, the explanation for the increase in attending to the presence of adults was a function of conditioned reinforcement for adult faces and conditioned reinforcement for listening to voices. In other words, once
observing faces or listening to adult voices was a conditioned reinforcer, the presence of an adult speaking or not, selected observing responses.

In summary, the acquisition of both of the pre-verbal developmental cusps was necessary in order for the participants to learn at faster rate. Observing adult faces and listening to voices made it possible for them to attend the experimenter’s antecedents when delivering instruction. Therefore, the participants were able to meet objectives at a faster pace. In addition, by acquiring these pre-verbal developmental cusps, the participants became aware of when adults were present. Finally, verbal operants increased or emerged which helped the participants communicate with the adults and peers in their environment. Consequently, results from Experiments 1 and 2 showed evidence of a scientifically tested procedure that can contribute to the behavior analytic scientific literature.
References


Appendix A

*Picture of conditioned reinforcement for listening to adult voices during pre-and post-intervention sessions*
Appendix B

*Picture of conditioned reinforcement for looking at faces probe session during pre-and post-intervention sessions*
Appendix C

*Picture of the conditioned reinforcement for looking at adult faces probe session during pre-and post-intervention probes in which two other observers recorded data independently while the third experimenter conducted the assessment*