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Using Discrimination Training to Establish Conditioned Reinforcers: A Replication and Test of Maintenance

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A Replication and Test of Maintenance

by

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Abstract

Using Discrimination Training to Establish Conditioned Reinforcers: A Replication and Test of Maintenance

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A stimulus becomes a conditioned reinforcer when it acquires reinforcing properties by virtue of being paired with a primary reinforcer. Researchers have evaluated different methods to condition reinforcers for children diagnosed with autism because this population often does not respond to social reinforcers in the way their typically developing peers do. One method of establishing a conditioned reinforcer is the conditioned reinforcement of a discriminative stimulus (S^D) procedure. The discrimination training procedure involves a neutral stimulus being established as an S^D by reinforcing a specific response in its presence. Then, the established S^D is tested as a conditioned reinforcer by delivering a primary reinforcer contingent upon a response and comparing responding before and after discrimination training. The purpose of the current study was to (1) replicate the Taylor-Santa et al. (2014) study by evaluating discrimination training to establish conditioned reinforcers under a more controlled setting, (2) extend the Taylor et al.

study by interspersing the S^D and S-Delta to identify a more efficient procedure, and (3) assess the extent to which discrimination training booster sessions increases or maintains the strength of a conditioned reinforcer. Overall, results indicated discrimination training was not an effective procedure for all three participants.
KEYWORDS: autism, conditioned reinforcers, discrimination training, pairing

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Dedication

"Be stubborn about your goals, but flexible about your methods."

I dedicate my thesis first and foremost to myself, I never thought in a million years I would get to this place. To my parents, Richard and Melissa Moore, for believing in me every step of the way and to never letting me give up. To my brother, Nicholas Moore, for giving me the inspiration and motivation. To Pam and James Holz, for supporting me and having my back. To Samantha, for everything. Most importantly, thank you for being by my side through it all. To my all friends, old and new, for encouraging me to continue.

"For all those who encouraged me to fly toward my dreams: Let's soar."

Using Discrimination Training to Establish Conditioned Reinforcers: A Replication and Test of Maintenance

Oxygen, food, warmth, and sexual stimulation are examples of unconditioned reinforcers (also known as primary reinforcers). These are stimuli that do not require a learned history to function as a reinforcer. Praise, television, money, shopping, emotions, and good grades are just some of the consequences that can affect an organism's behavior depending on the historical effects of conditioning. Conditioned reinforcers (also known as secondary reinforcers) are vital to increasing or decreasing specific behaviors in all organisms. For example, conditioned reinforcers can be used to increase vocalizations by children with disabilities or establish a light as a signal for food in non-human animals. Mazur (2013) defines a conditioned reinforcer as "a previously neutral stimulus that has acquired the capacity to strengthen responses because it has been repeatedly paired with a primary reinforcer." Bouton (2007) refers to a conditioned reinforcer as "a stimulus that has acquired the capacity to reinforce behavior through its association with a primary reinforcer." Catania (2013) states a conditional reinforcer (or conditioned reinforcer) is "a stimulus that functions as a reinforcer because of its contingent relation to another reinforcer." Although the definitions are slightly different, they all involve a stimulus acquiring reinforcing properties via pairing with primary reinforcers. For example, a child raises his hand to answer a teacher's question and receives praise for the correct answer. Over time praise is conditioned as a reinforcer to that individual; therefore, the likelihood of the child raising his hand in the future will increase if it is followed by praise. Even something as simple as social approval can function as a conditioned reinforcer; if you dress nicely and receive compliments on your clothing, the likelihood you'll dress nicely more often will increase due to the social approval you get from others.

Individuals diagnosed with Autism Spectrum Disorder (ASD) often do not respond to social reinforcers the same way as their typically developing peers. The Diagnostic and Statistical Manual of Mental Disorders (5th Edition) states that individuals with ASD tend to have communication deficits, such as responding inappropriately in conversations, and an inability to build friendships with their peers (American Psychiatric Association, 2013). In fact, one of the main characteristics of individuals with autism is a lack of social skills, likely because social interactions do not function as reinforcers. Therefore, behavior analysts working with children diagnosed with autism often must explicitly condition social interactions as a positive reinforcer to increase appropriate behaviors in the future. For example, a behavior technician working with a child diagnosed with ASD pairs an edible with smiles when the child engages in appropriate behaviors (e.g., sitting nicely in their chair, engaging in eye contact, attending to the technician, etc.). The behaviors that were previously reinforced using edibles increase over time and smiles are conditioned as a reinforcer through a learned history.

Recent research has evaluated different methods to condition reinforcers with children diagnosed with autism. The purpose of this paper is to (a) provide a review of the literature on methods to condition reinforcers, specifically with individuals diagnosed with autism and (b) to describe an extension of research on the use of discrimination training to establish a neutral stimulus as a conditioned reinforcer in a controlled setting.

Methods to Condition Reinforcers

Traditionally, researchers have been concerned with whether a previously nonreinforcing (i.e., neutral) stimulus can become a reinforcer through various pairing procedures (Gollub, 1977). To evaluate these procedures, researchers repeatedly present a neutral stimulus with one or more conditioned or unconditioned reinforcers. In general, after repeated pairings or presentations, researchers test, using various procedures, to determine whether the neutral stimulus attained the reinforcing capability of the reinforcer with which it had been paired (Cooper, Heron, & Heward, 2007).

Methods similar to those used during Pavlovian conditioning have been used to condition reinforcers (Field, 2006; Greer, Singer-Dudek, Longano, Zrinzo, 2008; Harris, Patterson, & Gharaei, 2015; Lancioni, Coninx, & Smeets, 1989; Rescorla, 1973). For years, researchers have been using stimulus-stimulus pairing, also known as the S-S procedure of conditioned reinforcement (Carroll & Klatt, 2008; Dozier, Iwata, Thompson-Sassi, Worsdell, & Wilson, 2012; Esch, Carr, & Michael, 2005; Esch Carr, & Grow, 2009; Pierce & Chaney, 2008; Yoon & Feliciano, 2007). Pairings between conditioned and unconditioned stimuli, also known as Pavlovian conditioning, consists of a neutral stimulus that is followed by a salient stimulus that *elicits* an unconditioned response or a reflexive response. In other words, a neutral stimulus such as a bell (the conditioned stimulus) is followed by a salient unconditioned stimulus such as meat powder delivered to the mouth, which elicits the salvation (unconditioned) response. After enough pairings with the meat powder, the bell will also elicit salvation even when it is presented in the absence of the meat powder (Cooper, Heron & Heward, 2007). When used to condition a reinforcer, S-S pairing involves presenting the neutral stimulus immediately prior to an already established reinforcer. After repeated pairings, the neutral stimulus takes on the reinforcing properties of the reinforcer with which it was paired. The neutral stimulus is said to be a conditioned reinforcer if rates of responding increase when it is delivered contingently in the absence of any other reinforcer (Pierce & Cheney, 2008).

Dozier et al. (2012) evaluated whether stimulus pairing of neutral praise statements and edible reinforcers could be used to condition praise as a reinforcer. Study 1 first determined whether highly preferred edibles functioned as reinforcers. Secondly, Dozier et al. (2012) assessed whether a target response would occur in the absence of reinforcement (i.e., during baseline) or when the delivery of praise statements was provided. The authors paired praise statements with preferred edible items for five consecutive 10-min sessions and then tested the effectiveness of praise in increasing and maintaining the target response. Stimulus pairing was not effective in conditioning praise as a reinforcer for most individuals involved in the study.

Carroll and Klatt (2008) evaluated the effect of a stimulus-stimulus pairing procedure to increase vocalizations with two young children diagnosed with autism. The purpose of this study was to assess the effects of stimulus-stimulus pairing on frequency of vocalizations emitted by the participants. The procedures involved pairing a vocal sound with a preferred stimulus (e.g., a toy) to condition stimuli as automatic reinforcers. The authors conducted pre-session and post-session observations immediately before and after pairings were completed. The stimulus-stimulus pairing procedures consisted of 20 trials. Trials were conducted in which the experimenter emitted a target sound three times, then presented the target response again two more times while simultaneously giving the participant a preferred item. The pairing procedure used was successful to increase a vocalization for only one of the participants. Thus, stimulus-stimulus pairing may not be the most effective way to condition reinforcers.

Another pairing procedure used to condition reinforcers is known as response-stimulus (R-S) pairing. During R-S pairing, a previously neutral stimulus is delivered with an unconditioned reinforcer, contingent upon a response. Similar to S-S pairing, after repeated pairing trials, researchers test the effects of the conditioning procedure by discontinuing the presentation of the unconditioned reinforcer to determine whether the previously neutral stimulus results in maintenance of the already established response (Dozier et al., 2012). For example, Skinner (1938) describes a study in which experimenters used an audible clicking sound immediately prior to the delivery of food to rats on a time-based schedule. During a second phase, a lever was introduced and lever pressing resulted in the delivery of the audible clicking sound, but food was no longer delivered. Results indicated that contingent on the audible clicking sound the rats exhibited increased lever pressing.

In Study 2, Dozier et al. (2012) evaluated the response-stimulus pairing procedure, and modeled it after Kelleher and Gollub (1962). Contingent on a target response, edible items were delivered to give the participant a history of pairings between neutral praise and the edible. Praise conditions consisted of “Praise” and “Food plus praise.” The “Praise” condition consisted of the target response resulting in the delivery of 1 of 10 praise statements (in quasi-random order). The “Food plus praise” condition consisted of the target response resulting in simultaneous delivery of 1 of 10 praise statements (also in quasi-random order) and one of the three preferred edible items. Results suggested that response-stimulus pairing was effective in conditioning praise as a reinforcer for 50% of subjects and increased the occurrence of additional target responses for those individuals. These results indicate that response-stimulus pairings may be a more effective way to condition a reinforcer relative to a stimulus-stimulus pairing procedure (Carroll and Klatt, 2008; Dozier et al., 2012, Study 1). Although response-stimulus pairings were more effective than stimulus-stimulus pairings there may be a more effective way to condition a reinforcer, such as discrimination training.

A third procedure to condition stimuli as reinforcers is the discriminative-stimulus (S^D) account of conditioned reinforcement (Holth, Vandbakk, Finstad, Gronnerud, & Sorensen, 2009; Pierce & Chaney, 2008; Taylor-Santa, Sidener, Carr, & Reeve, 2014). This procedure of conditioned reinforcement suggests that an S^D may become a conditioned reinforcer by virtue of its pairing with a primary reinforcer. That is, the neutral stimulus is conditioned as a reinforcer and then may function as a reinforcer to increase other responses. However, it does not maintain its reinforcing effects over time. It is often difficult to distinguish between the S-S account of conditioned reinforcement and discriminative-stimulus account of conditioned reinforcement because in most situations procedures that establish an unconditioned stimulus as an S^D also result in that same stimulus becoming a conditioned reinforcer (Pierce & Cheney, 2008). Taylor-Santa et al. (2014) recently evaluated this model, termed the discrimination training procedure to condition reinforcers, with children diagnosed with autism.

In this procedure, standard discrimination training involves a neutral stimulus that is first established as a discriminative stimulus (S^D) by reinforcing a specific response in its presence. Next, the new established S^D is tested as a conditioned reinforcer by delivering that S^D contingent upon a response and comparing responding before and after discrimination training (Taylor-Santa et al. 2014). Lovaas (1966) was one of the first researchers to evaluate the use of the S^D method to establish a previously neutral stimulus as a discriminative stimulus and test the extent to which it functioned as a conditioned reinforcer. Using two participants diagnosed with Schizophrenia, Lovaas included two phases: (1) establishing a social stimulus as a discriminative stimulus for food and (2) testing the social stimulus for any reinforcing properties it might have attained during the first phase. The social stimulus consisted of one researcher patting one of the participants on the back and another researcher saying “good” to that participant. Lovaas used three steps to establish a social event such as a pat on the back paired with the phrase, “Good,” as a signal that food was available with 2 experimenters (E1 and E2). First, the child was taught to approach the experimenter (E1). This started with the child sitting in front of E1 and next to E2. On a variable interval schedule, E1 would say “good” and raise their hand to show an edible was in their hand, while at the same time E2 would pat the child on the back. Once the child consumed the edible, E2 would move the child away to teach the next step. Step 2 consisted of the child being taught to only approach E1 when the social stimulus (pat on the back) was completed by E2. Finally, the child was taught to approach E1 when the social stimulus was presented, even though the child’s behavior was reinforced on an intermittent schedule of reinforcement rather than a fixed ratio of one response (i.e., every time the child approached E1 an edible was delivered). Results showed that the social stimulus acquired reinforcing properties for the two participants, and if the social stimulus was maintained as a discriminative stimulus for food, the social stimulus showed no signs of losing its acquired reinforcing properties. However, Lovaas also suggested that, eventually these reinforcers would likely lose their value as a discriminative stimulus for food. This would most likely occur over time without any re-introduction to the discrimination training procedures.

Using a discrimination training procedure to establish smiles and nods as conditioned reinforcers for tasks based on turn-taking, Isaksen and Holth (2009) found that all children made significant progress when responding and initiating joint attention skills. Joint attention is defined as two individuals actively sharing attention with one another to an event or object, while also monitoring each other's interests (Adamson & Bakeman, 1984; Bruner, 1975). The authors developed a training protocol of 10 tasks based on the joint attention literature (e.g., Baldwin, 1995; Baron-Cohen, 1995; Hobson, 1993) and behavioral interventions which were organized into three main parts designed to establish each of the following skills: (1) responding to joint attention, (2) engaging in turn-taking activities, and (3) initiating joint attention. Tasks 1-4 involved the child and trainer seated on the floor engaging with toys and activities. The goal of these tasks was to establish a response (e.g., child looking at the trainer) to receive a toy. Here the trainer would introduce new toys using different prompts (e.g., tapping their finger on the toy, moving the child's hand off the toy, pushing items on the floor, etc.). During these interactions, the trainer controlled the toys and the child was required to look at the trainer. If the child did not look, the attempt was stopped, that is, the toy was removed and another trial began. Tasks 5-8 were designed to establish adult social responses (i.e., smiles and nods) as discriminative stimuli. During Task 5, the child and trainer were seated at a table upon which toys and edibles were placed in front of the child. The child was only allowed access to the toys when the trainer smiled and nodded. If the trainer did not smile and nod, the attempt was physically blocked. Later the trainer asked the child, "Give me that one, please" by pointing to the desired item. If the child did not look back to the trainer for confirmation, then the trainer said, "ah-ah" to give a cue to the child to look at the trainer. Once the child looked at the trainer, the trainer smiled, and nodded, and confirmed that the item was correct based on what the child pointed to. Tasks 9 and 10 consisted of the child and trainer taking turns with the preferred items. All four participants completed the training successfully and made significant progress in responding and initiating joint attention skills. At a 1-month follow up, parents reported that their children would engage in joint attention skills in different environments and seemed to enjoy doing so.

Holth et al. (2009) compared a S-S pairing procedure to a discrimination training procedure. The purpose of the study was to determine whether new stimuli are most effectively established as reinforcers using classical conditioning or being established as discriminative stimuli for responses that produce an unconditioned reinforcer (operant discrimination training) in eight children of varying age and ability (some had autism, some were typically developing, and some had an intellectual disability). Seven out of eight participants completed both the discrimination training procedure and the S-S pairing procedure. Of the seven, five emitted a higher number of responses in the discrimination training procedure rather than the S-S pairing procedure. That is, discrimination training procedures were more effective in conditioning reinforcers than S-S pairing procedures. However, there are two flaws to this study which should be noted. First, the stimuli identified as neutral were sequentially assigned to the S^D and pairing procedures. Thus, the "neutral stimuli" may have not been equally "neutral" across procedures. In other words, during pre-experimental procedures two different neutral stimuli were assigned to each procedure (i.e., S^D and pairing), therefore, one of the two stimuli chosen may have been more valuable than the other, causing a higher number of responses during the test of neutral stimuli in one procedure over the other. Additionally, the S^D procedure and the corresponding test of conditioned reinforcers were conducted before the pairing procedure and its corresponding test was conducted in extinction, with no programmed reinforcing consequences. Therefore, the effect of an extinction history during the test following the S^D procedure may have generalized to the test during the S-S pairing procedure that followed.

Taylor-Santa et al. (2014) addressed these limitations using a multiple-probe design across stimulus/response sets to evaluate the effects of a discrimination training procedure on the reinforcing effectiveness of neutral stimuli for three children diagnosed with autism. For all three participants, responding in the S^D condition increased during posttest evaluations and remained low in the S-delta condition. The discrimination training procedure was effective for establishing stimuli as S^Ds and S-deltas for all participants. These results are important because they support the literature suggesting that discrimination training is an effective way to condition a neutral stimulus as a reinforcer. However, all neutral stimuli may have not been equally neutral. There was no control stimulus used, and prior pairing conditions could have produced a carryover effect.

Prior to the study, a survey was given to caregivers that asked about their child's preference for edibles, food allergies, and approval to restrict access to high-preference items for experimental sessions. Eight items were assessed in a multiple stimulus (without replacement) preference assessments (DeLeon & Iwata, 1996). The five highest ranked items were selected. Next, a response assessment was conducted to identify nine low-rate responses that could later be used during discrimination training and pre-/posttest sessions. Responses were selected that the participant could easily be prompted to perform and had no previous exposure to. Then, the stimulus assessment was conducted to identify neutral stimuli to be established as S^Ds and S-deltas during the study as well as reinforcing stimuli to be used during discrimination training. It was important to have an S-delta stimulus to ensure that similar items (i.e., any card) would not also function as a conditioned reinforcer; only the paired stimulus would function as a conditioned reinforcer.

Neutral stimuli (pictures) to which participants likely had no history of exposure, were used.

Experimental procedures included pre-/posttest sessions and discrimination training sessions. Pre-/posttest sessions were conducted in quasi-random order. At the beginning of each pretest session, the response was prompted twice with the neutral stimulus. After the second prompt, the participant was told, “Do whatever you like, but please stay in your chair.” Then the neutral stimulus was delivered for 2-4 s contingent upon every response. Sessions lasted for 5 min, and sessions were conducted until responding stabilized across five sessions for each condition. The purpose of discrimination training sessions was to establish one stimulus as an S^D and one stimulus as an S-delta. Each session consisted of 10 trials. First, a neutral stimulus was established as an S^D. An apparatus, with a light and light switches, was placed in front of the participant. The experimenter presented the neutral stimulus for 2 to 4 s and then placed the neutral stimulus behind the apparatus. If the target response did not occur the participant was prompted to engage in the response and a reinforcer (e.g., edible) was delivered. Incorrect responses were blocked and the participant’s hands were guided back to the table. The participant was then manually prompted to engage in the response one time with a reinforcer being delivered contingently. After 100% correct independent responding occurred for two consecutive sessions across two days, a different stimulus was established as an S-delta. Differential reinforcement was arranged such that responding was reinforced in the presence of the stimulus from the first step (S^D) and not reinforced in the presence of the new stimulus. S^D trials were then interspersed with S-delta trials with both stimuli being present. Criterion for beginning posttest sessions was two consecutive sessions with 100% correct independent responding during the S^D and 0% independent responding during the S-delta trials across two days.

Taylor-Santa and colleagues attempted to address limitations stated previously by adding S^D and S-delta trials to provide a comparison to demonstrate a differential increase in responding during the S^D trials. Another difference from previous studies was that the response did not produce direct reinforcement because preexperimental assessments were conducted to control for those variables. Direct reinforcers are immediate reinforcers that result from completing a task. However, there are limitations to Taylor-Santa et al. (2014), including scheduling consistency and the fact that stimuli did not maintain as conditioned reinforcers over time. This is important because reinforcers that maintain their effectiveness over extended periods of time are better than those which last only a short period of time. Although the initial increase in posttest sessions suggest conditioned reinforcement, these effects are not maintained and after approximately four sessions responding drops back down to baseline levels. Finally, it is important to note that discrimination training may not be efficient when running S^D and S-delta training separately rather than teaching simultaneously. Alternating S^D and S-delta trials may increase the stimulus salience and offer an advantage. That is, less time is required to teach an individual two different stimuli.

To summarize, there is a dearth of research evaluating discriminative training methods for conditioning reinforcers, especially with children diagnosed with autism. Of the studies that do exist, it is difficult to determine the effectiveness of procedures with social stimuli. This led to Taylor-Santa et al. (2014), which was one of the few published studies that did not use social stimuli. Unfortunately, the aforementioned limitations of this study make interpretation of the data difficult. Therefore, the purpose of the current study is to (1) replicate the Taylor-Santa et al. study by evaluating discrimination training to establish conditioned reinforcers in a more controlled setting, (2) extend the Taylor et al. study by interspersing the S^D and S-Delta to identify a more efficient procedure, and (3) assess maintenance by examining the extent to which discrimination training booster sessions increases or maintains the strength of a conditioned reinforcer.

Methods

Participants

Three children participated in the current study. Two children were diagnosed with Autism Spectrum Disorder: Hunter (4-years-old, male) and Charlotte (5-years-old, female). One child was diagnosed with Down Syndrome: Aria (4-years-old, female). Participants were selected based on the following: (a) having a diagnosis of an intellectual disability; (b) having no history of escape-maintained problem behavior when asked to complete tasks; (c) tolerating manual/physical prompts to complete tasks; and (d) being able to sit in a chair for up to 5 minutes. This information was gathered from direct observation of the participant and/or during a caregiver interview. All participants had a history of intensive applied behavior analysis (ABA) services. All three participants were recruited from different facilities within the Melbourne, Florida area and had a moderate vocal verbal behavior repertoire (i.e., could use three to five word sentences).

The *Behavioral Language Assessment* (BLA) was conducted with each participant by the lead experimenter. The BLA is an alternative standardized language assessment used for individuals (especially children diagnosed with autism) who have a weak vocabulary repertoire. The BLA contains a total of 12 different sections related to a variety of skills exhibited in young children. On each section the individual can receive a score ranging from 0 (does not have a skill) to 5 (has the full skill). Hunter scored 50 out of 60. Charlotte scored 53 out of 60. Aria scored 40 out of 60. It was reported by all parents that edible reinforcers were used most often when working with the participants and caregivers were interested in having their children respond to tangible and social reinforcers.

Materials and Setting

Charlotte and Aria's sessions were conducted in their homes. Charlotte's sessions were conducted in a private room with child sized chairs and a table. Sessions for Aria were conducted at an adult sized table in the kitchen. Both participants sat directly next to the lead experimenter. A minimum of four sessions were conducted weekly. No distractors were present during sessions (i.e., the environment was quiet). A minimum of four 1-hour sessions were conducted for all participants. Hunter's sessions took place approximately two to three times per week, while Charlotte and Aria's sessions took place once per week.

Hunter's sessions were conducted at a behaviorally based treatment center for individuals diagnosed with autism. The treatment room contained a large wooden cubby holder for backpacks and opaque bins with toys, a wooden table, 4 chairs, various books, and a white board.

Materials for the study included a video camera, object permanence boxes (a small ball is dropped into a hole in a box, the ball rolls out of the box into an attached tray, thus allowing the individual to continuously engage in a response), a laptop for data collection, a poster board with Velcro, 2 neutral stimuli to be used for the S^D and S-delta abstract cards, preferred edibles, pen/pencil, and sheets of paper for notes. Table 1 depicts the responses used during the reinforcer/neutral stimulus assessment, pre-/posttest, and discrimination training procedures for Hunter, Charlotte, and Aria. Table 2 depicts the stimuli used during the S^D and S-delta sessions for Hunter, Charlotte, and Aria.

Pre-experimental Procedures

Caregiver interview. Prior to any experimental sessions, caregivers and case managers determined a list of edibles and possible neutral stimuli to include in the preassessments. First, each caregiver and/or case manager was asked to provide a list of the child's preferred edibles, nonpreferred edibles, and any food allergies. Based on the interviews, four edibles were chosen to include in the reinforcer assessment to ensure the edibles functioned as reinforcers to use during discrimination training.

Next, caregivers and/or case managers were asked to rank a variety of stimuli using a Likert-type scale from 1 to 5, with 1 indicating the child would be very interested and 5 indicating the child would be very uninterested. Four of the stimuli caregivers ranked as neutral and/or uninteresting (i.e., a rating of 3, 4, or 5) were selected for the reinforcer assessment to ensure the neutral stimuli did not function as a reinforcer. The purpose of the stimulus assessment was to identify neutral stimuli that could be established as the S^D and S-delta during discrimination training. Neutral stimuli were abstract pictures found online that participants were not likely to encounter daily.

Response assessment. The purpose of the response assessment was to identify three neutral responses that the lead experimenter could easily prompt the participant to perform during the reinforcer assessment, discrimination training, and pre-/posttest sessions. One response was used for the reinforcer assessment, another was used for discrimination training procedures, and lastly, one response was used for pre-/posttest sessions. At the beginning of each response assessment session, the child was manually prompted to engage in the target response. Following the two pre-exposure trials for the target response, the lead experimenter provided the instruction, “You can do as much or as little as you want, but you have to stay in your chair.” The 3-minute long sessions began immediately after the lead experimenter provided the rule and said “3, 2, 1, Start.” No programmed consequences were delivered if the child engaged in the target response. The lead experimenter graphed one probe per response in an alternating treatment design. Three responses were identified out of a total of six different responses. The three lowest responses were used for the study. Selected target responses included, but were not limited to; putting a ball in a box, putting a cylinder in a box, putting a coin in a slot, touching an answer buzzer, stringing beads, and hammering a ball in a box.

Reinforcer/Neutral Stimulus assessment. During this assessment, the reinforcing value of both edibles and potential neutral stimuli identified by the caregivers and/or case managers was examined. Across all conditions and stimuli, sessions were 3 minutes long and began with two pre-exposure trials during which the lead experimenter prompted the individual to engage in a discrete, arbitrary response (e.g., putting a block in a bucket, hitting a ball with a hammer, stringing beads, etc.) and delivered the relevant stimulus (e.g., edible or neutral stimulus) immediately following the prompted response. The lead experimenter then provided the instructions, "You can do as much or as a little as you want, but you have to stay in your chair." Using a reversal design embedded with an alternating treatment design, the lead experimenter collected data on the participant's frequency of responding during each session.

Prior to assessing the reinforcing value of the stimuli, baseline sessions were conducted. During baseline sessions, no programmed consequences were delivered contingent on the target response. Next, the reinforcing value of both edibles and neutral stimuli (e.g., pictures) were compared with a different stimulus delivered contingent upon the target response in each session. That is, sessions were conducted in series of eight (four edibles and four neutral stimuli) in quasi-random order. Once the data were differentiated and stable, the lead experimenter reversed back to baseline. Two stimuli were determined as neutral and used during experimental procedures if response rates were at or below baseline levels. The edibles that produce increased rates of responding relative to baseline were selected as reinforcers. S^D/S-delta pairs were established by pairing stimuli with similar frequencies of responding during the reinforcer assessment and then block-randomizing them as S^D or S-delta for each child.

Procedures for the use of Discrimination Training to Condition Reinforcers

Experimental design. A multiple element design embedded within a non-concurrent multiple baseline across participants was used to evaluate the effects of the discrimination training procedure on responding. Pre- and posttest data were evaluated and compared to determine whether the procedure was successful at establishing a neutral stimulus as a conditioned reinforcer. S^D and S-delta stimuli were randomly selected based on the results of the reinforcer/neutral stimulus assessment, described above.

Response measures and data collection. The primary dependent variable was the rate of the target response during pre- and posttest sessions. During pretest and posttest sessions, data were collected using a computer software data collection program. Data were collected on the frequency of responses and converted to a rate measure by dividing the number of responses by the session time (3 minutes). A target response was operationally defined individually for each participant depending on the response being used. Data were collected during session (in vivo) by the lead experimenter and by video recordings for reliability.

During discrimination training sessions, trial-by-trial data were collected on independent responding. An independent response was defined as the occurrence, or nonoccurrence, of the target response within 3 s of the presentation of the S^D or S-delta in the absence of any prompts. These data were summarized as the percentage of independent responding to the S^D and S-delta conditions separately.

Interobserver agreement (IOA) data during pre-experimental assessments and pretest and posttest phases was calculated using the exact frequency per interval agreement method (the number of 10-s interval agreements divided by the number of 10-s interval agreements plus disagreements multiplied by 100). An agreement was defined as each data collector scoring the same number of responses during a 10-s interval. At least 33% of randomly selected sessions were scored during each assessment and during the pre-/posttests for each participant.

IOA for Hunter from the response assessment ranged from 86.5% to 100%. Hunter's mean IOA score was 93.3%. IOA for Charlotte from the response assessment ranged from 77.8% to 100%. Charlotte's mean IOA score was 91.7%.

IOA for Aria from the response assessment ranged from 76.5% to 100%. Aria's mean IOA score was 90.3%. IOA for Hunter from the reinforcer/neutral stimulus assessment ranged from 66.7% to 100%. Hunter's mean IOA score was 95%. IOA for Charlotte from the reinforcer/neutral stimulus assessment ranged from 83% to 100%. Charlotte's mean IOA score was 97.2%. IOA for Aria from the reinforcer/neutral stimulus assessment ranged from 64% to 100%. Aria's mean IOA score was 91.9%. IOA for Hunter from the pretest was 100%. Hunter's mean IOA score was 100%. IOA for Charlotte from the pretest ranged from 83.3% to 100%. Charlotte's mean IOA score was 97.6%. IOA for Aria from the pretest ranged from 87% to 100%. Aria's mean IOA score was 98.5%. IOA for Hunter from the posttest was 100%. Hunter's mean IOA score was 100%. IOA for Charlotte from the posttest was 100%. Charlotte's mean IOA score was 100%. IOA for Aria from the posttest ranged from 83% to 100%. Aria's mean IOA score was 97.2%.

Trial-by-trial IOA data were collected during discrimination training sessions by dividing the number of agreements in a session by the number of agreements plus disagreements multiplied by 100. Data were collected during at least 33% of all sessions across all conditions for each participant. At least 33% of randomly selected sessions were scored during discrimination training procedures across all participants.

IOA for Hunter from discrimination training was 100%. IOA for Charlotte from discrimination training was 100%. IOA for Aria from discrimination training was 100%.

Pretest. All pretest sessions were 3 minutes long. S^D and S-delta sessions were conducted in block-randomized order (i.e., randomly selecting the order of S^D and S-delta sessions to prevent a bias). At the beginning of each session, the free-operant target response was prompted twice with the neutral stimulus and presented for 2-4 s contingent upon each response. After the second prompted response, the lead experimenter provided the instruction, "You can do as much or as little as you want, but you have to stay in your chair." Sessions started after the lead experimenter said, "3, 2, 1, Start." The neutral stimulus was delivered for 2-4 s contingent upon the completion of each target response. Sessions were conducted until responding stabilized across at least three sessions.

Discrimination training. The purpose of discrimination training was to establish one of the target neutral stimuli as an S^D and another stimulus as an S-delta (for each participant). Each discrimination training session consisted of 20 trials (10 S^D trials and 10 S-delta trials). During discrimination training, a response different from pre-/posttest sessions and the reinforcer assessment was used. The participant sat at a table with the lead experimenter sitting next to the participant. Before each session, the lead experimenter conducted a brief multiple stimulus without replacement (MSWO) preference assessment (Carr, Nicolson, & Higbee, 2000) with the edibles identified as reinforcers during the reinforcer assessment. Once the highest preferred edible was identified, the foamed poster board was placed in front of the participant. An observing response, defined as an operant that introduces an individual to a discriminative stimulus before engaging in a target response (Escobar & Bruner, 2009), was required from participants before session began. If the participant did not look at the stimulus, a visual tracking prompt was provided; after two attempts and no looking, the lead experimenter continued with the session.

The neutral stimulus associated with the relevant condition was presented for 2 to 4 s on the foamed poster board. During trials in which the card was associated with the S^D condition, if the participant emitted the target response while the card was present, the lead experimenter delivered the preferred edible. If the target response did not occur within 3 s of presenting the S^D card, the lead experimenter prompted the participant using a full physical to emit the target response, and the reinforcer was delivered. Prompts were systematically faded across trials by manually prompting for two trials. If at any point a prompt was insufficient to produce the response, the previous prompt level was implemented for two additional trials. If the participant engaged in multiple responses or if he/she attempted to engage in an incorrect response, the response was blocked, and the participant's hand was manually guided to the table for 2 s. The participant was then manually prompted to engage in the target response one time with a reinforcer being delivered contingently.

Sessions for the S-delta trials were conducted in the same manner with two exceptions: 1) responses were not reinforced in the presence of the S-delta card, and 2) the lead experimenter did not prompt the participant to respond. After 3 consecutive sessions with 100% independent responding during the S^D trials and 0% independent responding during the S-delta trials across two days, participants began the posttest condition.

Posttest. All posttest sessions were conducted identically to the pretest sessions. Posttest sessions were continued until either (a) rates decreased to baseline levels, (b) there was undifferentiated responding between the S^D and the S-delta, or (c) at least 10 sessions with elevated levels of responding during the S^D condition only were observed. The same free-operant response used during the pretest was also used for the posttest sessions.

Maintenance. During posttest sessions, if rates decreased to baseline levels or showed undifferentiated responding between the S^D and the S-delta condition, discrimination training booster sessions were initiated. The lead experimenter continued conducting discrimination training sessions until responding reached mastery as stated in the discrimination training procedures. After mastery, participants were reintroduced to posttest sessions. Again, posttest sessions were conducted until (a) rates decreased to baseline levels, (b) undifferentiated responding was observed between the S^D and S-delta, or (c) at least 10 sessions with elevated levels of responding during the S^D condition only were observed. If rates decreased again, the lead experimenter reintroduced discrimination training booster sessions once more in the same manner as described above. If responding decreased during the posttest following the second discrimination training booster sessions, lead experimenters ceased sessions. The lead experimenter used the data from the maintenance condition to determine how often discrimination sessions should be conducted. Specifically, the lead experimenter averaged the number of sessions conducted before deterioration in responding was observed during posttest sessions and subtracted one session from that total. For example, if elevated levels of responding occurred during posttest sessions for eight sessions before decreasing to baseline levels, and then again for six sessions following booster training, then every seventh posttest session a booster discrimination training session was conducted for the remaining of the maintenance condition. The purpose of doing this was to see if booster sessions would maintain the reinforcing value of the conditioned reinforcer by intermittently pairing that stimulus with the unconditioned stimulus through discrimination training sessions.

Treatment Integrity

During preexperimental assessments, the pretest sessions, and the posttest sessions, treatment integrity data were collected on the following: (1) initial prompting of response, (2) delivery of a rule, and (3) delivery of the stimulus contingent upon subsequent correct, independent responding. Data were collected using 10-s interval recording and summarized as the percentage of intervals with correct implementation of procedures. Treatment integrity data were collected for 50% of response assessment sessions, 33% of reinforcer/neutral stimulus assessment sessions, and 33% of pre-/posttest sessions for all participants.

Treatment integrity for Hunter's sessions from the response assessment was 100%. Hunter's mean treatment integrity score was 100%. Treatment integrity for Charlotte's sessions from the response assessment was 100%. Charlotte's mean treatment integrity score was 100%. Treatment integrity for Aria's session from the response assessment was 100% across all sessions. Aria's mean treatment integrity score was 100%. Treatment integrity for Hunter's sessions from the reinforcer/neutral stimulus assessment ranged from 92.5% to 100%. Hunter's mean treatment integrity score was 98.7%. Treatment integrity for Charlotte's sessions from the reinforcer/neutral stimulus assessment ranged from 66.7% to 100%. Charlotte's mean treatment integrity score was 96.8%. Treatment integrity for Aria's session from the reinforcer/neutral assessment ranged from 87% to

100%. Aria's mean treatment integrity score was 98.5%. Treatment integrity for Hunter's sessions from the pretest ranged from 92.5% to 100%. Hunter's mean treatment integrity score was 98.7%. Treatment integrity for Charlotte's sessions from the pretest ranged from 92.5% to 100%. Charlotte's mean treatment integrity score was 98.7%. Treatment integrity for Aria's session from the pretest was 100%. Aria's mean treatment integrity score was 100%. Treatment integrity for Hunter's sessions from the posttest was 100%. Hunter's mean treatment integrity score was 100%. Treatment integrity for Charlotte's sessions from the posttest was 100%. Charlotte's mean treatment integrity score was 100%. Treatment integrity for Aria's session from the posttest was 100%. Aria's mean treatment integrity score was 100%.

During discrimination training sessions, treatment integrity data were collected on the following: (1) presentation of the neutral stimulus, (2) observational response of participant to the neutral stimulus, (3) prompting of the response, (4) delivery of the reinforcer contingent on the response during S^D trials, and (5) non-delivery of the reinforcer during S-delta trials. These data were collected on a trial-by-trial basis and summarized as the percentage of trials with correct implementation of procedures. Treatment integrity data were collected for 33% of all sessions across all participants.

Treatment integrity for Hunter's sessions from discrimination training was 100%. Treatment integrity for Charlotte's sessions from discrimination training was 100%. Treatment integrity for Aria's session from discrimination training was 100%.

Results

Figure 1 depicts data from the response assessment for Hunter. Three of the lowest responding free-operant target responses were selected for each participant. For Hunter, the bead object permanence box, stringing beads, and a hammer object permanence box were selected. Hunter put the ball in the box 38 times, touched a piece of paper 20 times, hammered the ball 16 times, strung beads 16 times, put the coin in a slot 20 times, and put the bead in the box 12 times.

Figure 2 depicts response assessment data for Aria. For Aria, stringing beads, touching an answer buzzer, and placing a coin in an object permanence box were the tasks in which she responded the least. However, it should be noted during the study the lead experimenter noticed stringing the beads was a skill Aria was not able to engage in independently; therefore, this response was not used and hammering a ball in the object permanence box became the third free-operant response used in the study. Aria put the ball in the box 40 times, touched the buzzer 7 times, hammered the ball 19 times, put the coin in a slot 9 times, and put the bead in the box 21 times. Aria did not string the beads at all during the response assessment.

Figure 3 depicts data from the response assessment for Charlotte. Charlotte responded at low frequencies for stringing the beads, placing a coin in an object permanence box, and hammering a ball in the object permanence box. It should be noted that Charlotte's data were not conducted as probes due to a treatment integrity error. Charlotte put the ball in the box 33 to 54 (M=43.5) times, touched the buzzer 33 to 67 (M=40) time, hammered the ball 8 to 22 (M=15 times), strung beads 4 to 7 (M=5.5) times, put the coin in a slot 19 times, and put the bead in box 15 to 37 (M=26) times.

During the reinforcer/neutral stimulus assessment, Hunter and Aria engaged in similar responding. As seen in figures 4 and 5, Hunter and Aria engaged in minimal responding when no programmed consequences were delivered (i.e., baseline). Figure 4 depicts Hunter's data. During baseline, Hunter's mean responding was 4 with a range from 0 to 20 responses. From the Caregiver Interview the lead experimenter tested four different edibles and four different arbitrary stimuli (Card #*X*) in the reinforcer/neutral stimulus assessment. Items included: Cheese ITZ ™, Oreos™, bacon, donuts, Card #4, Card #5, Card #11, and Card #16. Hunter's mean responding to Card #4 was 0. Hunter's mean responding to Card #11 was 0. Hunter's mean responding to Card #5 was 0.3 with a range from 0 to 1 response. Hunter's mean responding to Oreos™ was 1 with a range from 0 to 3 responses. Hunter's mean responding to Cheese ITZ™ was 4 with a range from 1 to 6 responses. Hunter's mean responding to Card #16 was 4.3 with a range from 0 to 13 responses. Hunter's mean responding to bacon was 5.3 with a range from 4 to 7 responses. Hunter's mean responding to donuts was 5.6 with a range from 4 to 8 responses.

Figure 5 depicts Aria's data. During baseline, Aria's mean responding was 2 with a range from 0 – 9 responses. From the Caregiver Interview the lead experimenter tested four different edibles and four different arbitrary stimuli (Card #*X*) in the reinforcer/neutral stimulus assessment. Items included: apple sauce, goldfish, chicken, grapes, Card #12, Card #13, Card #15, and Card #16. Aria's mean responding to Card #12 was 0. Aria's mean responding to Card #15 was 0. Aria's mean responding to Card #13 was 0.3 with a range from 0 to 1 response. Aria's mean responding to grapes was 0.7 with a range from 0 to 1 response. Aria's mean responding to Card #16 was 1 with a range from 0 to 3 responses. Aria's mean responding to apple sauce was 7.3 with a range from 1 to 13 responses. Aria's mean responding to chicken was 8 with a range from 6 to 10 responses. Aria's mean responding to goldfish was 8.3 with a range from 6 to 10 responses.

When arbitrary stimuli were delivered contingent upon the free-operant target response, Hunter and Aria's rate of responding remained relatively low. Hunter's mean responding was 1.2 with a range from 0 to 13 responses. Aria's mean responding was 0.3 with a range from 0 to 3 responses. When edibles were delivered contingent upon the free-operant target response, Hunter and Aria's responding increased substantially above arbitrary-stimulus levels. Hunter's mean responding was 12 with a range from 0 to 8 responses when edibles were delivered. Aria's mean responding was 6.1 with a range from 0 to 13 responses when edibles were delivered.

Figure 6 presents the reinforcer assessment for Charlotte. Charlotte's responding was variable and initially high when no programmed consequences were delivered (i.e., baseline). Charlotte's mean responding was 9.7 with a range from 1 to 47 responses. When arbitrary stimuli were delivered contingent upon the free-operant target response, her rate of responding was relatively moderate and eventually decreased to lower levels. Charlotte's mean responding was 8.9 with a range from 0 to 21 responses. When edibles were delivered contingent upon the free-operant target response, Charlotte's responding increased above arbitrary-stimulus levels. Charlotte's mean responding was 17 with a range from 5 to 36 responses.

From the Caregiver Interview the lead experimenter tested four different edibles and four different arbitrary stimuli (Card #x) in the reinforcer/neutral stimulus assessment. Items included: Skittles™, Doritos™, goldfish, red seedless grapes, Card #2, Card #3, Card #4, and Card #8. Charlotte's mean responding to Card #2 was 5.8 with a range from 0 to 15 responses. Charlotte's mean responding to Card #3 was 9.2 with a range from 3 to 19 responses. Charlotte's mean responding to Card #4 was 9.2 with a range from 1 to 19 responses. Charlotte's mean responding to Card #8 was 11.7 with a range from 3 to 21 responses. Charlotte's mean responding to red seedless grapes was 13.2 with a range from 5 to 20 responses. Charlotte's mean responding to goldfish was 17.3 with a range from 8 to 36 responses. Charlotte's mean responding to Skittles™ was 17.6 with a range from 14 to 24 responses. Charlotte's mean responding to Doritos™ was 19.8 with a range from 16 to 23 responses.

Pre-/posttest and discrimination training data for all participants are depicted in Figure 7. The top panel represents Hunter's data, the middle panel represents Charlotte's data, and the bottom panel represents Aria's data. Along the x-axis are sessions, along the primary y-axis is rate of responding per minute, and along the secondary y-axis is percentage of independent responding. Pre-/posttest sessions are depicted along the primary y-axis and discrimination training sessions are depicted along the secondary y-axis. The closed black circles represent the S^D conditions while the open squares represent the S-delta conditions.

All three participants had similar patterns of responding during the pretest condition. Rates of responding were relatively low and on decreasing trends. Initial responding for all participants was respectfully high; however, responding did decrease before implementing discrimination training. Hunter's mean responding during the pretest in the S^D sessions was 6 with a range from 2 to 13.

During the S-delta sessions, Hunter's mean responding was 5.7 with a range from 1 to 13. Charlotte's mean responding during pretest in the S^D sessions was 6.3 with a range from 4 to 8. During the S-delta sessions, Charlotte's mean responding was 7.8 with a range from 2 to 11. Aria's mean responding during pretest in the S^D sessions was 7.7 with a range from 2 to 15. During the S-delta sessions, Aria's mean responding was 7 with a range from 3 to 13.

Discrimination training sessions are depicted on the secondary y-axis. All participants met mastery in an average of 19 sessions (16 for Hunter, 11 for Charlotte, and 30 for Aria). All participants required an intervention to reach the mastery criteria. For example, Hunter was blocked from engaging in a response during an S-delta trial (depicted in the graph as stars). After the initial block, Hunter met mastery in five sessions. The lead experimenter only blocked his response once. Charlotte was given a rule to distinguish when to respond and when not to respond by the lead experimenter. The rule was "When you are nodding your head yes, you can hit the ball with the hammer, and when you are nodding your head no, you can just sit there." First, the lead experimenter gave the rule. Next, the lead experimenter said, "3, 2, 1, start." Once the rule was provided, Charlotte met mastery within six sessions. Aria was not discriminating across the two arbitrary stimuli (S^D or S-delta); therefore, the S^D card was placed on a black poster board while the S-delta card was placed on a white poster board. After the implementation of the colored poster board, Aria met mastery in 12 sessions. Once all participants reached the mastery criteria, each moved into the initial posttest phase.

Posttest sessions are depicted on the primary y-axis using responses per minute. Hunter was the only participant to respond at higher rates in the initial posttest condition with differentiation in the data. However, his responding did not maintain and during the next sessions it decreased to below pretest levels. Hunter's mean responding during the initial posttest in the S^D sessions was 7.3 with a range from 1 to 20. Hunter's mean responding during the S-delta sessions was 7.3 with a range from 1 to 19. Charlotte also responded at higher rates in the initial posttest condition; however, there was no differentiation in her data. That is, her responding was similar in both the S^D and S-delta conditions. Charlotte's mean responding during the S^D sessions was 9 with a range from 6 to 11. Charlotte's mean responding during the S-delta sessions was 7.8 with a range from 5 to 11. Aria did not respond at higher rates during the initial posttest compared to the pretest. Aria's mean responding during the S^D sessions was 2.7 with a range from 0 to 7. Aria's mean responding during the S-delta sessions was 2 with a range from 0 to 6. In fact, Aria's responding significantly decreased from the pretest condition.

All participants went back into discrimination training and immediately met mastery criteria during the first three trials. Following the second discrimination training, another posttest was conducted; responding was similar to the initial posttest. Hunter's mean responding during the second posttest in the S^D sessions was 1 with a range from 0 to 3. Hunter's mean responding during the S-delta sessions was 0. Hunter was also exposed to a discrimination training probe as well as an S^D and S-delta probe to see if responding would increase above pretest levels; however, responding decreased to near zero levels. Charlotte's mean responding in the S^D sessions was 6.7 with a range from 5 to 8. Charlotte's mean responding in the S-delta sessions was 7 with a range from 4 to 10. Aria's mean responding during the S^D sessions was 7 with a range from 1 to 17. Aria's mean responding in the S-delta sessions was 0.

Discussion

The current study attempted to replicate Taylor-Santa et al. (2014) by evaluating the effectiveness of a discrimination training procedure with children diagnosed with autism. Overall, the discrimination training procedure was not effective to establish neutral stimuli as conditioned reinforcers for these three participants. That is, the results of Taylor-Santa were not replicated. All three participants' responding during the pretest condition decreased over time in both the S^D and S-delta sessions. Hunter and Aria both responded at higher rates in the pretest during the S^D sessions; however, Charlotte responded at higher rates in the S-delta condition. Although responding decreased across all participants in the pretest condition in both the S^D and S-delta sessions, one participant had higher rates of responding in the S-delta sessions relative to the S^D sessions.

The discrimination training procedure was relatively quick (approximately seven to 15 minutes) in duration and in trials to criterion. All participants met mastery in an average of 19 sessions. Taylor-Santa et al. (2014) reported that it took four to six sessions for participants to meet mastery; however, that does not include the number of sessions it took to meet mastery when mass trialing the S^D stimulus before interspersing the S-delta stimulus. Simultaneously teaching both the S^D and S-delta sessions may have been more effective than teaching the S^D and

S-delta sessions separately. That is, interspersing trials of the S^D and S-delta may have saved more time and been more beneficial for the participants because it may have prevented satiation of edibles. If the lead experimenter conducts multiple sessions, there is a higher likelihood that the participant will become satiated on the edible being presented. Even though an MSWO preference assessment was conducted prior to running sessions, this may not prevent satiation. The more trials, the less likely that a powerful reinforcer is available to pair with the neutral stimulus.

Programmed consequences in Taylor-Santa et al. (2014) were contingent on the stimulus presented. For instance, when the S^D was presented and if the participant responded independently, an edible was paired with the neutral stimulus using discrimination training. However, if the participant responded when the S-delta was presented, the experimenters ignored the response and no programmed consequences were delivered. In the current study, across all participants a teaching procedure had to be implemented in order for participants to discriminate between the two different stimuli (cards). For example, the lead experimenter gave a rule to Charlotte which then changed her responding so that she was able to discriminate among two cards and perform the behavior she should engage in following the stimulus.

Two out of three participants (Hunter and Charlotte) never showed differentiation in their responding to the S^D and S-delta sessions; however, one participant (Aria) did show differentiation in her responding. Aria initially had higher levels of responding to the S^D sessions when in the posttest conditions. Although initially her responding was high, during the second S^D session responding immediately dropped to S-delta levels of responding. That is, Aria's responding during the S-delta sessions in the posttest sessions decreased initially and maintained at zero levels of responding in both the initial posttest and the second posttest. Aria's responding was more similar to the results of Taylor-Santa et al. (2014) in several of the sets participants were exposed to in the previous study.

Six pretest sessions were conducted before Hunter moved into discrimination training (three S^D sessions and three S-delta sessions). Responding initially was high at a rate of 4.3 per minute during the initial S^D session and remained high during the initial S-delta session at 4.3 per minute. This is consistent with at least one stimulus/response set across all three participants in Taylor-Santa et al. (2014). That is, responding was initially high in the S^D session; however, responding was not high during the S-delta sessions. Once Hunter's responding was on a consistent decreasing trend, Hunter was exposed to the discrimination training procedure. Recall discrimination training consisted of 20 trials (10 S^D and 10 S-delta trials). During discrimination training sessions Hunter was exposed to blocking when he attempted to engage in the target response after the S-delta was presented. On session 11 of discrimination training, the lead experimenter mistakenly blocked the response. However, Hunter's responding to the S-delta stimulus immediately decreased post blocking and within five sessions he met mastery. During the first 10 sessions of discrimination training, Hunter consistently and independently responded to the S^D. He also consistently responded independently to the S-delta stimulus at a range of 60 to 100% of opportunities. Hunter was the only participant that responded above pretest levels in the initial posttest condition; however, his responding did not maintain. In fact, after the first two posttest sessions (i.e., S^D then S-delta) his responding drastically dropped to near zero levels. Hunter's rate of responding was 0.3 per minute following the first two posttest sessions. It should be noted that Hunter was exposed to discrimination probes following the second posttest condition to ensure differentiation in responding still remained. As depicted in Figure 7, Hunter responded to the S^D during 100% of opportunities, and 0% of opportunities in the presence of the S-delta. He was also exposed to one more S^D session and one more S-delta session after the discrimination training probe was conducted. Hunter's rate of responding in the S^D was 0.3 per minute and his rate of responding in the S-delta was 0 per minute. Discrimination training was not an effective method to condition a reinforcer for Hunter.

Charlotte was exposed to eight sessions in the pretest condition before moving into discrimination training (four S^D and four S-delta). Charlotte's rate of responding was higher in the S-delta (3.7 per minute) relative to the S^D (2.7 per minute). S^D sessions were consistently lower than the S-delta sessions during the pretest condition. Once responding was on a decreasing trend, discrimination training was introduced. Charlotte also required a rule to help her discriminate among two different stimuli. Mastery was met after a total of 11 sessions; however, it's important to note that once the rule was given Charlotte met mastery in six sessions. Charlotte engaged in minimal responding during the discrimination training procedure but the rule increased her responding. One interesting point is Charlotte's vocal verbal behavior when a stimulus was presented. For example, when the S^D stimulus was presented she would say, "yes," but not engage in the target response. When the S-delta stimulus was presented she would say, "no," and remain in her chair until the next trial began. After mastery, Charlotte was exposed to the initial posttest condition in which her responding did not differentiate to either the S^D or S-delta stimulus. It should be noted that her responding was elevated from the pretest condition; however, due to no differentiation, discrimination training was not an effective method to condition a reinforcer. To ensure these findings were accurate, Charlotte was exposed to the discrimination training procedure again. After three sessions, Charlotte met mastery and returned to the posttest where her responding did not differentiate again and levels were more consistent with pretest levels.

Aria was also exposed to six sessions of the pretest conditions, just as Hunter (three S^D and three S-delta). Hunter's initial rate of responding in the S^D condition was 5 per minute, while his rate of responding in the S-delta condition was 4.3 per minute. Once Aria's responding was on a decreasing trend she was introduced to the discrimination training procedure. As with the other two participants (Hunter and Charlotte), Aria also needed a form of treatment to assist her in discriminating among the two different stimuli. A color board was introduced to assist Aria; the S^D stimulus was presented on a black foam poster board while the S-delta stimulus was presented on a white foam poster board. Aria met mastery criteria after a total of 30 sessions in discrimination training; however, once the color board was introduced she met mastery within 12 sessions. It should be noted that immediately following the color board Aria's responding showed a drastic difference. Three consecutive sessions following the poster board, Aria responded to the S-delta one out of 10 opportunities and responded to the S^D 10 out of 10 opportunities. During the second posttest, Aria's responding dropped below pretest levels and remained low. Upon returning to the discrimination training procedure, Aria met mastery immediately and when she moved back into the posttest sessions, her responding varied. Initially, Aria responded at higher levels in the S^D condition, while during the S-delta condition she ceased responding. Sessions were then discontinued due to the immediate decrease in responding for both the S^D and S-delta conditions.

Specific procedures were used from previous studies (Holth et al., 2009; Taylor-Santa et al., 2014) to ensure novel responses, and novel stimuli. In addition, preexperimental assessments were used appropriately along with modifications to enhance those procedures (i.e., interspersing the S^D and S-delta trials and use of different responses per conditions). For two of the three participants in the current study, responding in the S^D condition did not increase during the posttest evaluations and remained low and on a decreasing trend. These results are similar to the S-delta condition for all participants in the current study. Taylor-Santa et al. (2014) found similar results across three participants in that responding decreased within one to four sessions following the discrimination training procedure. The difference in the current study and Taylor-Santa et al. (2014) was that Taylor-Santa et al. used sets of stimuli across three participants. It should be noted that in their study not all stimuli functioned as a conditioned reinforcer following the discrimination training procedure; however, at least one set of stimuli maintained (for a short period of time) as a conditioned reinforcer.

Another difference between previous literature (Holth et al. 2009; Lovaas et al. 1966) and the current study is that two experimenters were not present and participated when conducting pairing procedures to condition reinforcers. Previous studies used two experimenters and participated in the pairing procedures to condition reinforcers. Perhaps if two experimenters were used in the current study results may have differed. That is, one experimenter could have prompted the child and implemented additional interventions while the second experimenter delivered the reinforcer. In doing this, the lead experimenter may condition herself as a reinforcer due to being paired with food. It could also allow the participant to contact contingencies more quickly, which could result in strengthening the pairings between the neutral stimulus and a preferred edible.

Another difference in the current study was that the discrimination training procedure differed from the majority of the previous literature in that the reinforcer used was not a direct reinforcer. Direct reinforcers are reinforcers an individual acquires as a result of completing a task. For example, Holth et al. (2009), had the participant engage in a response that directly provided reinforcement to which the experimenters could pair a preferred item (e.g., highly preferred toys) with a neutral stimulus (e.g., smiles and nods). Therefore, the behavior of grabbing a preferred item results in a reinforcer for the child immediately. This direct access to reinforcement could have an effect to maintain conditioned reinforcers for future studies.

In the current study, during discrimination training trials, a few notable anecdotal observations were made. Charlotte would engage in vocal verbal behavior, saying, “yes,” and nod her head yes as the S^D stimulus was presented. She would also say, “no,” and nod her head no as the S-delta stimulus was presented. Although Charlotte would vocally respond correctly she did not engage in the target response correctly (thus why the rule was put into place). Interestingly, Aria would also vocally say “yes” or “no” when the respected stimulus was presented. These observations are important to note because participants with high vocal verbal language skills may respond differently than a non-verbal individual. Taylor-Santa et al. recruited participants who were able to mand for at least five items and demonstrated matching and imitation skills. While the current study used individuals, who were able to mand using full sentences and had strong listener repertoires.

A second noteworthy observation refers to the posttest; after discrimination training was mastered all participants immediately asked for their preferred item. For example, Hunter would look at the lead experimenter and say, “Bacon! I want bacon, please.” When the preferred item was not given, responding ceased for the remainder of the session. This brings into question whether discrimination training conditions a neutral stimulus as a reinforcer or if it strengthens the availability of reinforcement. That is, strengthening the signal to an organism that reinforcement is available in the near future.

One limitation of the current study is that, due to scheduling issues, sessions were conducted approximately once per week with several days in between. This could have an effect during discrimination training and during the posttest sessions because more time elapses before the next sessions are conducted. This may increase the likelihood that the pairings completed during the prior sessions are not maintained over time (Lovaas et al., 1966). Taylor-Santa et al. (2014) conducted sessions approximately four times per week, thus the participant contacted the contingencies more frequently than the participants in the current study. Future researchers should consider conducting sessions more often throughout the week, perhaps even several times per day.

Another limitation is that during the preexperimental assessments and pre-/posttest sessions, time was not paused out while the preferred item was delivered contingent upon participants' responses. This is important because sessions are three minutes long and several seconds elapse while the participant receives reinforcement. Potentially, responding could have increased in the preexperimental assessments or pre-/posttest sessions as well. Especially in the pre-posttest sessions, participants have more time to engage in the target response during S-delta sessions relative to the S^D sessions.

A third limitation was the use of multiple responses within the current study (i.e., string beads, hammer object permanence box, coin object permanence box). Using a different response in the Pre-/posttest than in discrimination training could potentially require a different amount of physical effort. For example, stringing beads could require more response effort than putting a coin in a slot. Therefore, the comparisons may not be similar and this may have skewed the data. Using a new response could also signal the onset of extinction to the participant, causing them to cease responding.

Finally, all three participants had a long history with early and intensive behavioral intervention (EIBI). Due to this history, it is possible that responding was skewed in the S-delta condition and during the preexperimental assessments. For example, Charlotte's baseline during the reinforcer/neutral stimulus assessment was variable and although during a few sessions she said, "I don't want to do this anymore," she would still respond and continue responding even after the lead experimenter told her, "you don't have to do it if you don't want to. You can just sit there if you want." Even though the experimenter gave a rule, the participant did not have to respond; however, they still engaged in the target response. Based on the results of the BLA, and the change in behavior during discrimination training, the participant should have ceased responding when a new rule was provided. The participant may have continued to respond because of a history with early intervention and discrete trial teaching.

Future researchers should consider evaluating the effects of discrimination training on punishing a response using an S-delta stimulus. During discrimination training, once mastery was met across all participants responding to the S-delta ceased. Even if participants returned to discrimination training from the posttest, their responding did not increase. Rather, it remained at zero for an extended period of time. Future researchers could test the effects of the discrimination training procedure on conditioning a punisher. In the current study, discrimination training was not effective to condition a reinforcer, but future research should test the effects of conditioning a punisher.

Another consideration for future researchers is to use the first and third reinforcers from the MSWO preference assessment during discrimination training. The first reinforcer should only be delivered to the participant when independent responding occurs, while the third reinforcer should be delivered to the participant for prompted responses. In the current study, when the lead experimenter prompted the participant to engage in the targeted response the participant received the highest preferred item. Even if the participant independently engaged in the target response, the participant received the highest preferred item. Using conjugate reinforcement could be more beneficial when teaching individuals to discriminate between two different stimuli. Conjugate reinforcement is a schedule of reinforcement in which the intensity is determined by the level of responding.

Finally, future researchers should also consider an exclusion criteria for neutral responses tested during the response assessment. Although the lead experimenter used the three lowest responses in the response assessment, frequency of responses was relatively high. For instance, Hunter's lowest responding was 12, Charlotte's lowest responding was 4, and Aria's lowest responding was 7. Recall, Charlotte experienced each response twice due to a treatment integrity error; therefore, the lowest mean response was 5.5. Future researchers including an exclusion criteria could possibly eliminate higher levels of responding during assessments conducted as well as pretest sessions.

Although the current study did not replicate Taylor-Santa's findings it did provide researchers with future studies to conduct. Discrimination training may not be an effective procedure to condition reinforcers; however, it could potentially condition punishers more effectively. Future researchers should study other procedures that are effect in conditioning reinforcers for children diagnosed with autism. For example, praise often does not function as a reinforcer for children on the autism spectrum; however, praise does seem to function as a reinforcer for their typically developing peers. This could be due to a biological influence but without future research it cannot be determined. In finding ways to condition reinforcers, practitioners could condition social reinforcers to help bridge the gap for children on the autism spectrum with similar deficits.

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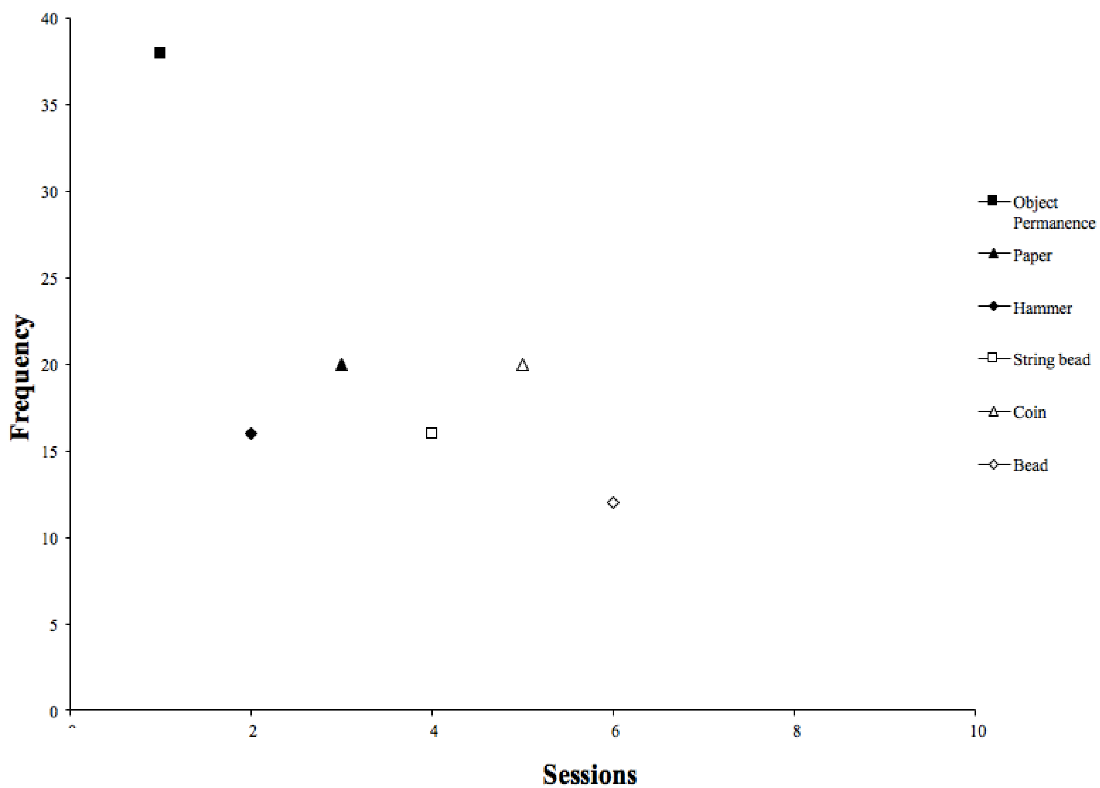


Figure 1. Response assessment data for Hunter.

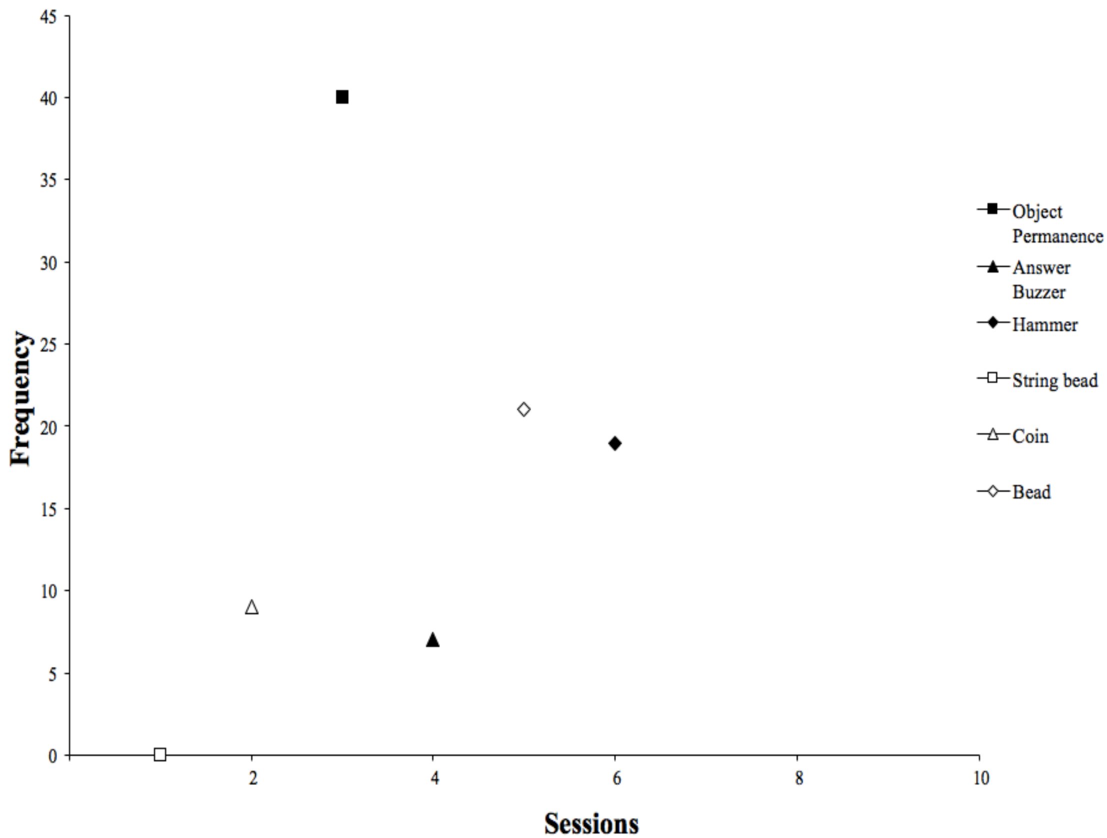


Figure 2. Response assessment data for Aria.

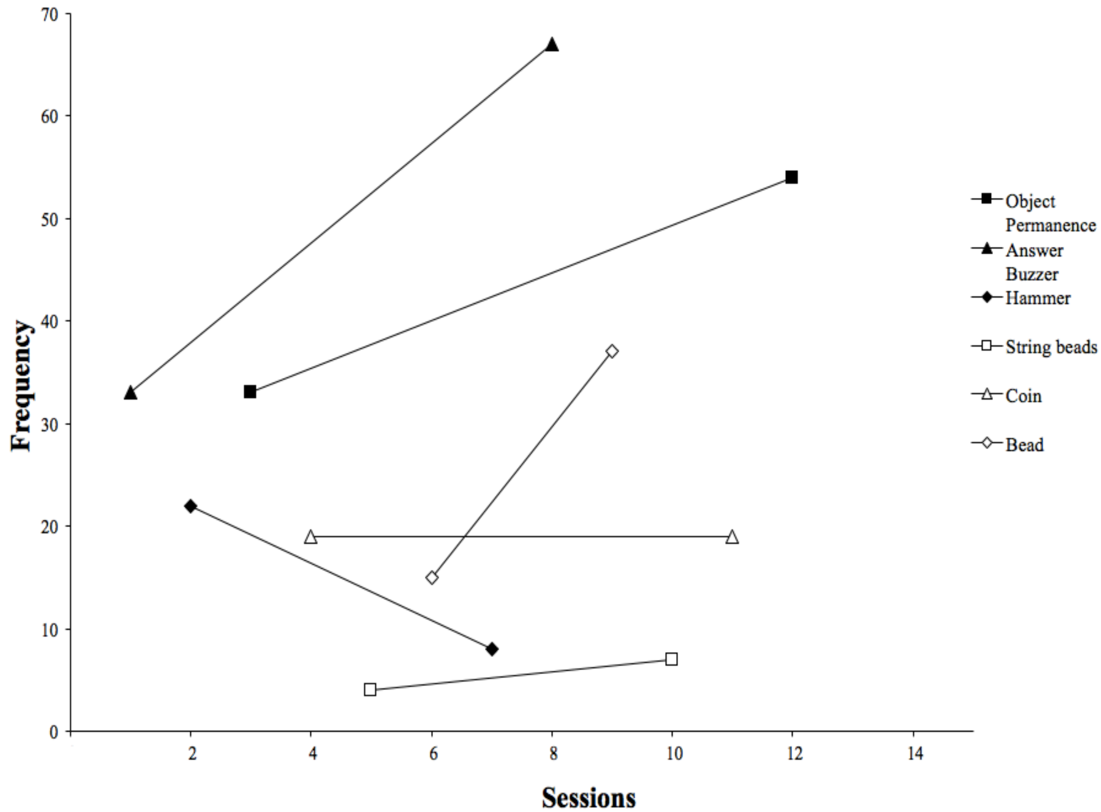


Figure 3. Response assessment data for Charlotte.

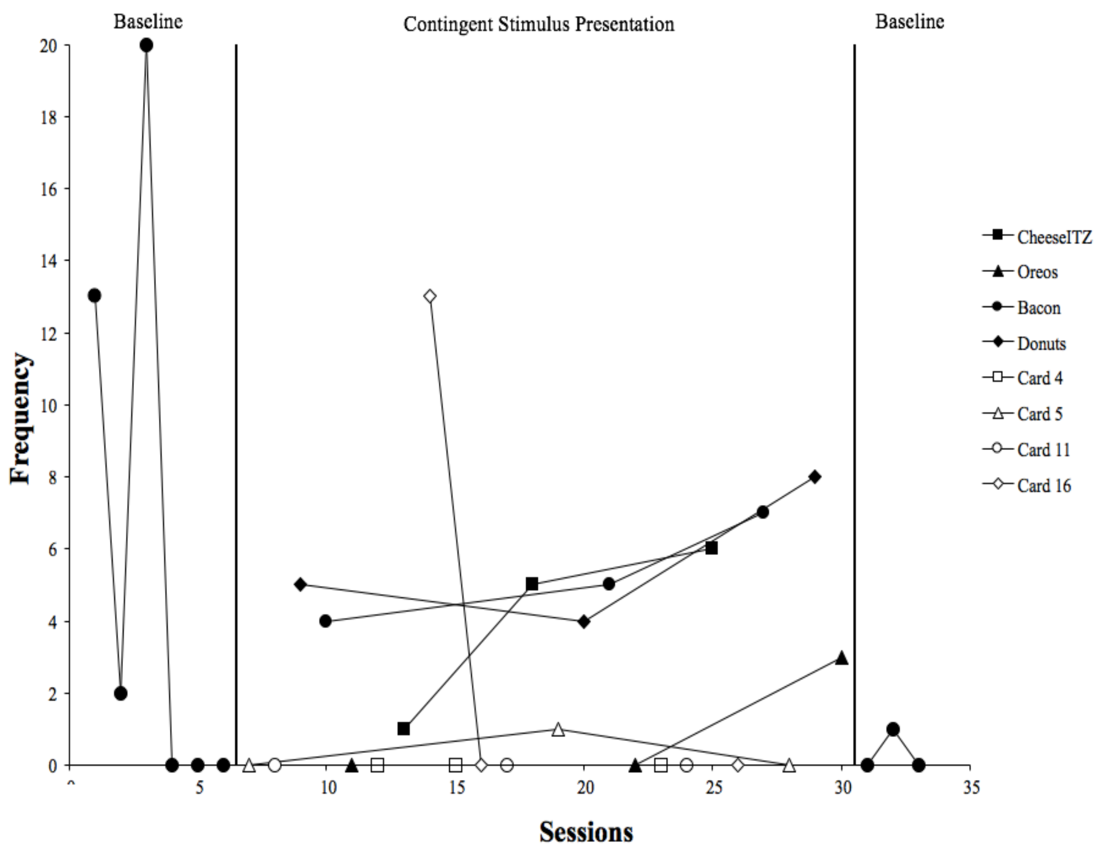


Figure 4. Reinforcer/Stimulus assessment for Hunter.

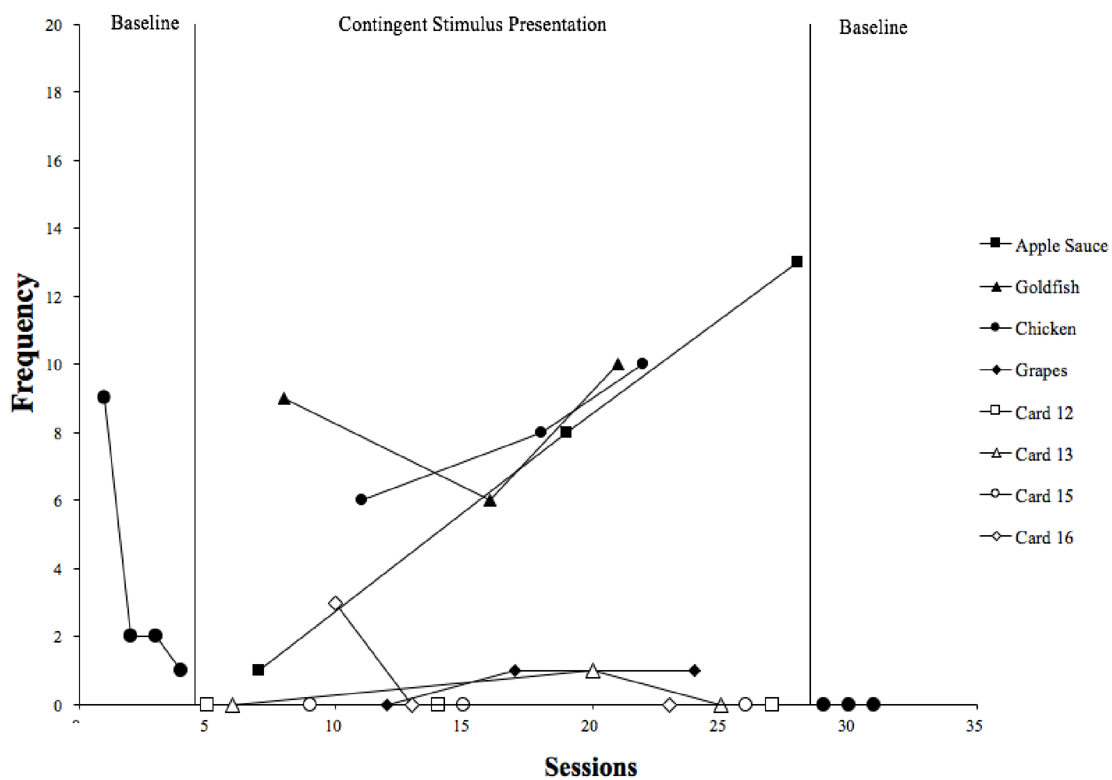


Figure 5. Reinforcer/Neutral Stimulus Assessment for Aria.

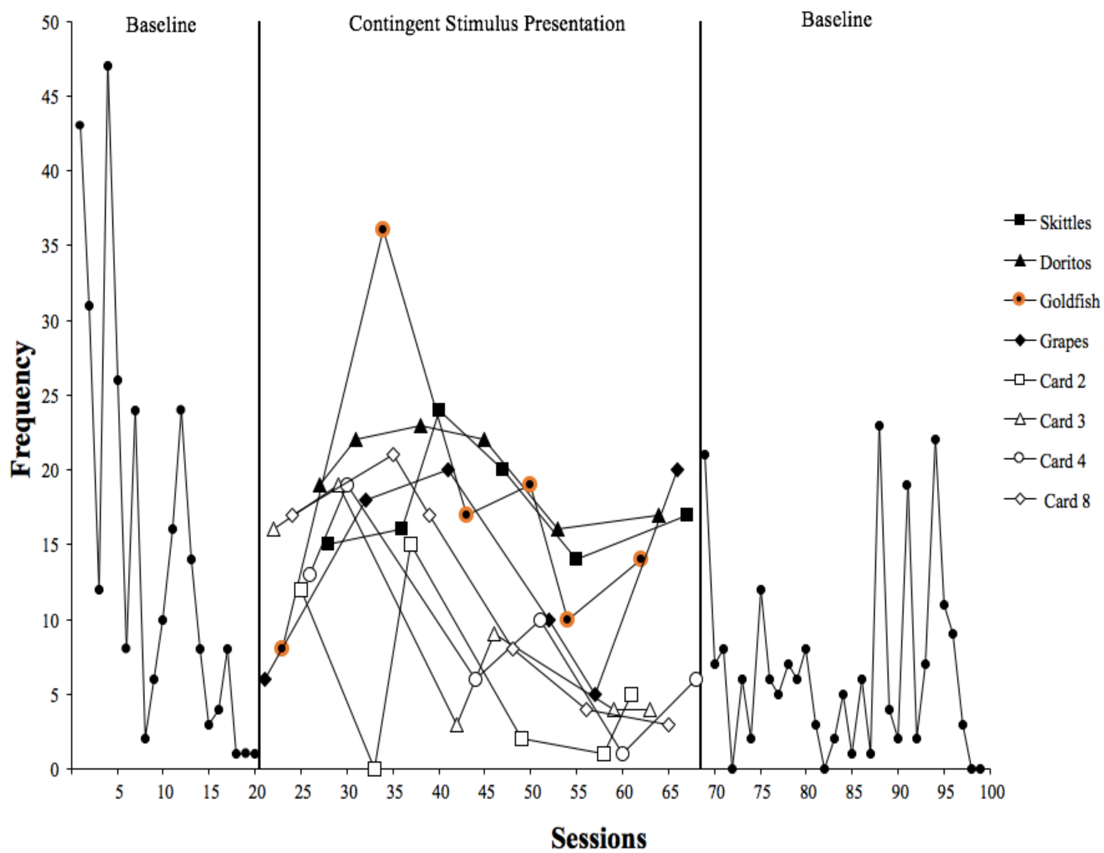


Figure 6. Reinforcer/Stimulus assessment for Charlotte.

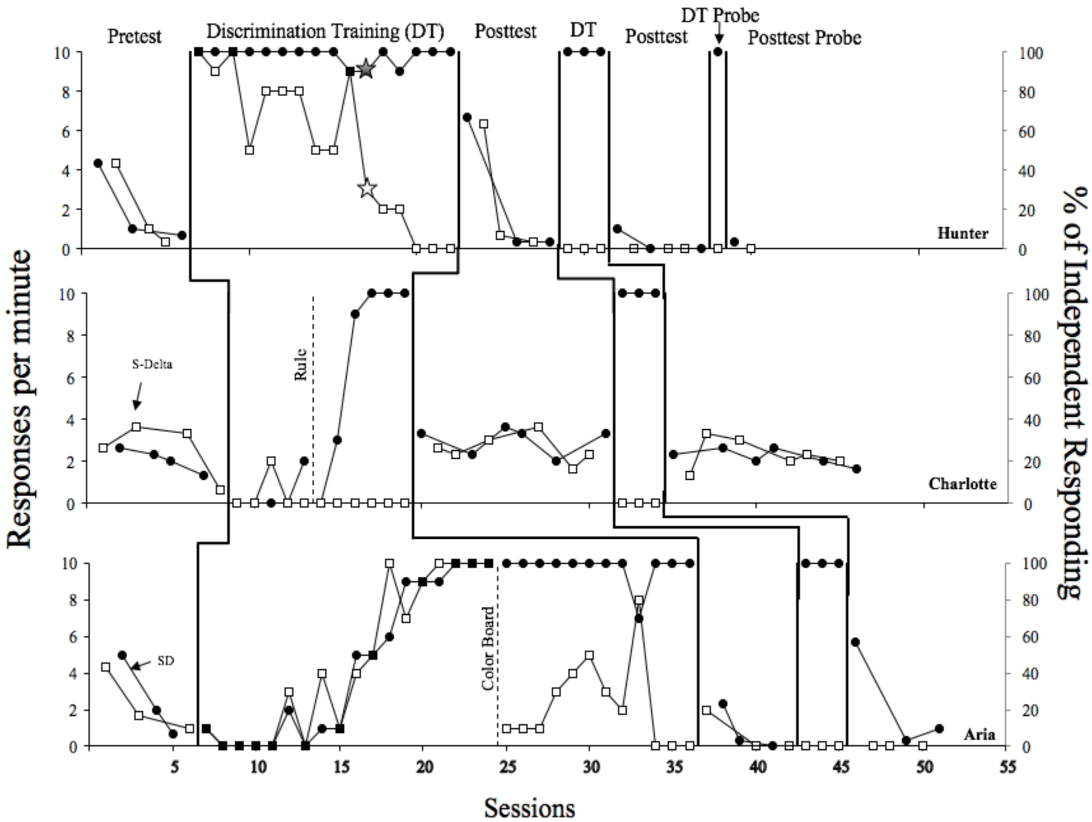


Figure 7. Pre-Posttest and Discrimination Training sessions for Hunter, Charlotte, and Aria.

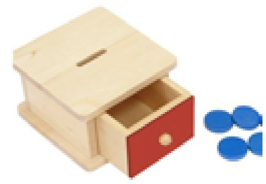
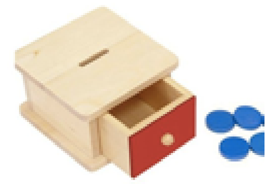
	Hunter	Charlotte	Aria
Reinforcer / Neutral Stimulus Assessment			
Pre-/Posttest			
Discrimination Training			

Table 1. Target responses for Hunter, Charlotte, and Aria

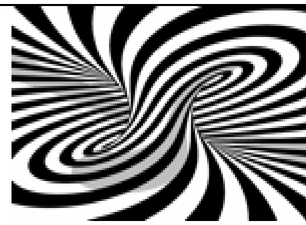
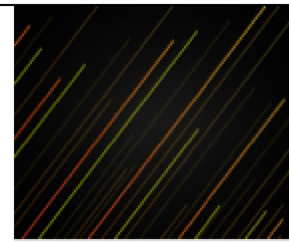
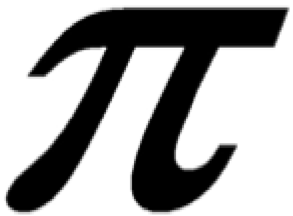
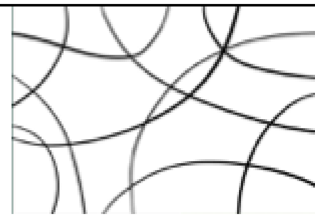
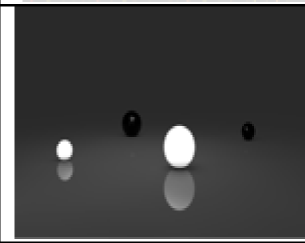
	Hunter	**Charlotte**	**Aria**
S^D			
S-delta			

Table 2. Neutral Stimuli for Hunter, Charlotte, and Aria