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Establishing conditioned reinforcers in children with autism spectrum disorder

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Establishing Conditioned Reinforcers in Children with Autism Spectrum Disorder

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Abstract

People with Autism Spectrum Disorder (ASD) often demonstrate restricted, repetitive patterns of behaviors, interests, and activities, often involving preoccupations with one or more stereotyped and restricted patterns of interest and an inability to adjust to changes in daily routines and schedules. Academic achievement and skill acquisition present a challenge in children with ASD, often times due to a lack of reinforcer options resulting from these deficits. The current study examines the use of free-operant stimulus preference assessments, progressive-ratio schedule reinforcer analyses, and a Pavlovian conditioning procedure in order to evaluate the establishment of new reinforcers that may be used to increase responding on tasks in children with ASD. The results of the study strongly support the claim that restricted and repetitive patterns of interests and behaviors are prevalent in people with ASD, validating the importance in establishing new reinforcers to be used in the classroom setting. Although other variables may need to be considered, such as pairing schedules and stimulus classes, the data do suggest that changes in stimulus value may be achievable via response-independent conditioning procedures. Furthermore, the results of this study highlight the importance of utilizing each individual assessment in the development and implementation of a conditioning procedure.

Keywords: conditioned reinforcement, preference assessment, progressive ratio reinforce analysis

Establishing Conditioned Reinforcers in Children with Autism Spectrum Disorder

Conditioned reinforcement often refers to the principle that a neutral stimulus may be presented in conjunction with another stimulus already known to have reinforcing value and, in turn, change the value of the previously neutral stimulus (Skinner, 1938; Cooper, Heron, & Heward, 2007). Conditioned reinforcement can be viewed in terms of both operant behavior and respondent behavior (Pear & Manitoba, 1984; Rehfeldt & Hayes, 1998). The processes that underlie classical (respondent) conditioning and operant conditioning are most often considered to be independent phenomena. Catania (1986) defines an operant as a behavior that can be modified by its consequences and defines respondent as a class of responses that can be determined through the stimuli that consistently produce them. Furthermore, operant conditioning is often discussed in terms of the presentation of consequences contingent upon an occurrence of a response, while classical conditioning is discussed in terms of establishing correlations between unconditioned stimuli and neutral stimuli (Rescorla, 1967).

In Rescorla's paper on Pavlovian (classical) and instrumental (operant) conditioning, he addresses two major questions; are there two different acquisition processes involved in Pavlovian and instrumental conditioning? And, does the conditioning process serve a mediating function in the control of operant responses? Rescorla concludes that although it is arguable that there may be two different acquisition processes involved in each type of conditioning, that any response-dependent pairing situation has the potential for the development of respondent behavior (p. 164). While

making the distinction between both accounts of conditioning may be important in terms of remaining technological and conceptually systematic, at the same time, it can also be argued that stimulus-response connections are formed in any event in which learning occurs, and therefore, these concepts should not be kept entirely exclusive. Although classical conditioning does not depend upon a specific response from the subject/participant for presentation of stimuli, it is inevitable that some behavior preceding the onset of stimuli may be reinforced. In the same vein, respondent behaviors may become established during response-dependent conditioning procedures, as well (Kimble, 1971).

What appears to carry the most weight in any conditioning procedure, is the correlation of stimuli (Rescorla, 1967). The predictability between the onsets of two stimuli is most important in the establishment of both conditioned responses and a change in stimulus value. In classical conditioning, when two stimuli are presented, simultaneously, the organism establishes a relationship and the newly conditioned stimulus may elicit the original response. In operant conditioning, when two stimuli (one known to have reinforcing value and one known to be neutral) are presented simultaneously, contingent upon a response, the originally neutral stimulus may come to reinforce the operant being observed, on its own.

In order to establish control and a clear demonstration that stimulus changes are the result of pairings, the implementation of a control procedure is necessary (Rescorla, 1967). By using both paired stimuli procedures and explicitly unpaired stimuli procedures (in which stimuli are presented the same number of times as paired stimuli procedures,

but on separate schedules), it can be observed that relationships are formed under paired-stimuli conditions, but not under explicitly unpaired conditions, further demonstrating that it is the correlation of stimuli, not solely the number of presentations, that work to establish this change in stimulus value.

Conditioned reinforcement has important applications in terms of people who have ASD, as people with ASD often demonstrate restricted repetitive patterns of behaviors, interests, and activities, often involving preoccupations with one or more stereotyped and restricted patterns of interest and an inability to adjust to changes in daily routines and schedules (DSM V, 2012). Research on both response-dependent conditioning and response-independent conditioning in human participants demonstrates that different types of pairing procedures may be used to establish new, conditioned reinforcers (Dozier et al., 2012; Gomez et al., 2002; Sundberg, Michael, & Partington, 1996). Specifically, in an applied setting, conditioned reinforcement may be an effective means for establishing new stimuli that in turn may be used to teach new skills to people with developmental disorders, specifically, ASD.

Determining preferred and reinforcing stimuli is a crucial part of the process of conditioned reinforcement as well as a key component for effective and successful implementation of treatment programs, particularly in the classroom setting, where resources are limited. In order to determine which stimuli may be used for reinforcement, preference assessments can be implemented (Roscoe, Iwata, & Kahng, 1999). There are two important parts in performing this type of assessment. The first part is the stimulus preference assessment in which preferred items are identified through choices made relative to other items available or time engaged with an item relative to other items

available. The second part of the preference assessment is the reinforcer preference assessment, in which preferred stimuli, as determined through the stimulus preference assessment, are tested for their reinforcing value by presenting the stimuli contingent upon responding.

There are several ways to conduct a stimulus preference assessment as a means of determining these preferred and/or reinforcing stimuli. The first is to conduct an interview. Parents, caregivers, and teachers may be asked which items the student most often interacts with as a means of determining reinforcing stimuli. Interviews are a quick and time-effective method for determining potential reinforcers, but, anecdotal data from parents and caregivers can often times be misleading and inaccurate, as they may be biased and based on opinion, rather than quantifiable data (Cote, Thompson, Hanley, & McKerchar, 2007). Trial-based (restricted operant) formats including paired-stimuli, multiple stimuli, and single-stimulus, are effective methods of determining reinforcing stimuli, as items are presented to the student systematically and choices are recorded quantitatively (Ortiz & Carr, 2000). Trial-based methods give a depiction of which items are more preferred in relation to other choices available in the moment. A limitation of trial-based methods is that they can be very time consuming. Also, choices are only made in comparison to other available stimuli, which only determines preferred stimuli relative to others available in the moment.

A third type of preference assessment, a free-operant preference assessment, measures the total duration in which a person engages with a stimulus from a larger array. During a free-operant preference assessment, time spent with each item is recorded. Researchers note that a free-operant preference assessments yield the least amount of

aberrant behavior during assessment, due to the lack of restriction and removal of desired items. Free operant preference assessments are also more time and resource efficient, making them more practical to be used in the applied setting (Roane, Vollmer, Ringdahl, & Marcus, 1998).

It is important to note that not all stimulus preference assessments are going to produce stimuli that are both preferred and can also be used as reinforcers. The value of the item during preference assessments do not always reliably predict reinforcer efficacy. To alleviate this issue, reinforcer preference analyses should be conducted after stimulus preference assessments. The reinforcer preference assessment will determine whether the stimuli chosen during the stimulus preference assessment actually hold reinforcer efficacy (Pace, Ivancic, Edwards, Iwata, & Page, 1985).

There are several ways of conducting a reinforcer preference assessment. Concurrent-schedule reinforcer assessments, multiple-schedule reinforcer assessments, and progressive-ratio schedule reinforcer assessments are three ways in which reinforcer efficacy can be tested. In a concurrent schedule reinforcer assessment, two or more stimulus presentations occur independently and simultaneously for two or more behaviors. These types of schedules will essentially demonstrate how schedules of reinforcement effect responding, comparatively. In a multiple schedule reinforcer assessment, there are two or more schedules of reinforcement for one response, but only one schedule is in place at a time and a discriminative stimulus signals the start to each new schedule. Finally, a progressive-ratio schedule reinforcer assessment allows researchers to determine the relative effectiveness of a stimulus as response effort increases (Roane, 2008). A progressive-ratio schedule reinforcer assessment will enable

researchers to determine how thin the schedules of reinforcement can get before responding stops and the stimulus is no longer deemed as reinforcing in relation to the response requirement.

Progressive-ratio reinforcer analyses may be the most practical and beneficial in an applied setting, as they more accurately mimic instruction in the classroom. Researchers in one particular study examined whether stimuli of different preference levels would have different reinforcing values depending on response-effort, as determined through progressive-ratio breakpoints, in participants with behavior disorders (DeLeon, Frank, Gregory, & Allman, 2009). A paired-choice stimulus preference assessment was implemented in order to establish preferred stimuli to be evaluated during the next phase, a progressive-ratio analysis. During the progressive-ratio analysis, response requirements increased after completion of each schedule and preferred stimuli were presented contingent upon responding. In each of the four participants, preferred stimuli, as determined through the preference assessment, demonstrated higher mean break points on the progressive ration analysis than the lesser preferred stimuli. The results suggest that participants may complete more responses, overall, when higher preferred items are used as consequences than they would when less preferred stimuli are used as consequences.

As previously stated, the research demonstrates that using preference assessments may be an efficient method for determining effective reinforcers to be used in the classroom setting. Other literature, more specifically on conditioned reinforcement, shows that there are multiple pairing procedures to choose between when establishing conditioned reinforcers, after reinforcer analyses have revealed effective stimuli. In one

study, researchers compared the two different types of pairing procedures used to establish conditioned reinforcers (Dozier, Iwata, Thomason-Sassi, Worsedell, & Wilson, 2012). In the first condition, operant conditioning procedures were implemented and pairings occurred contingent upon responding on a task. Pairings occurred on an FR 1 schedule, where each response resulted in the presentation of paired stimuli. Researchers then compared this response-dependent pairing procedure to a Pavlovian procedure, where presentations of pairings were not dependent upon responding. In this comparison group, pairings occurred on an FT-15 s schedule for 10-minute sessions, equaling 40 total pairings over the course of the session. The results of the study demonstrated more effective conditioning through the use of response-dependent (operant) pairing, meaning that the paired stimuli yielded more reinforcer efficacy in post pairing analyses when stimuli were presented together, contingent upon a target response.

Although the Dozier et al (2012) study yielded results in support of using a response-dependent pairing procedure, other studies *have* effectively demonstrated the use of response-independent pairing procedures, in both the experimental and applied literature. For example, Brown and Jenkins (1968) demonstrated the use of response-independent pairing procedures to autoshape a pigeon's key-peck. Researchers performed a series of 4 experiments demonstrating the effects of response-independent forward-pairing and backward-pairing procedures on responding in pigeons. Although the presentation of stimuli were not dependent on responding, responding did increase. Researchers give a possible explanation for the effectiveness of this pairing procedure. The first explanation is that classical conditioning could produce the response through "stimulus substitution." In other words, the conditioned stimulus (the light), after being

paired with food, evokes the unconditioned response (the peck) which was originally elicited by the unconditioned stimulus (the food). Another way of looking at this is that the neutral stimulus acquires reinforcing value and can be used to alter behaviors that were once associated with the original, reinforcing stimulus. The results of this study demonstrate that it may be possible to implement a response-independent pairing procedure in order to teach and maintain new behaviors.

Other research on response-independent pairing procedures have yielded successful results in the applied setting as well. Several applied studies have demonstrated the use of Pavlovian pairing procedures to establish new vocal responses in participants with language delays (Carroll & Klatt, 2008; Miguel et al., 2002; Sunderberg et al., 1996; Yoon & Bennet, 2000). Other studies have also successfully implemented pairing procedures to condition reinforcers to increase appropriate behaviors in children with developmental delays (Gomez et al., 2002).

Sundberg et al. (1996) investigated the effects of using response-independent procedures to pair an emitted vocalization with the delivery of a reinforcing stimulus on participant vocal-verbal behavior in 5 children with language delays. Researchers compared pre and post-pairing measures of emitted target vocalizations in participants. Pairing procedures occurred response-independently, meaning that both stimuli (vocalizations and tickles) were presented simultaneously on a fixed time schedule, and presentations were not dependent on a response from the participant. For all participants in the study, the pairing procedures resulted in spontaneous emissions of the responses that were used in the pairing procedure.

Overall, it is arguable that a response-independent pairing procedure demonstrates much more consistency in the procedural implementation than a response-dependent procedure. In response-dependent pairing procedures, pairings are only presented when the participant or subject engages in a target behavior. For participants that emit low numbers of a target behavior, the opportunity to present pairings is much more limited than if pairings were to occur on a response-independent pairing schedule. The inconsistency in the number of pairings for each participant in a response-dependent pairing procedure may attribute to individual differences in responding for each participant, which cannot be controlled for, as demonstrated in the literature (Dozier et al, 2012). For the purposes of consistent implementation of the intervention in the classroom, it may be more beneficial to utilize a response-independent pairing procedure.

Expanding the interests and options for potential reinforcers in children with ASD will make for a much more effective and successful learning environment in which educators are not limited in their choice options for effective rewards. This intervention might also be an opportunity for the development of more age appropriate interests and activities, having positive social implications. While the literature demonstrates the effectiveness of using different types of preference assessments, reinforcer assessments, and pairing procedures on their own as a means of determining reinforcers that may be used in the classroom, there appears to be lack of discussion about the combination of each of these procedures as a means of successfully establishing new, conditioned reinforcers. Each procedure, on its own, reveals valuable information in regards to reinforcer preference and efficacy on the individual level. However, further research on these items in conjunction might demonstrate a clearer perspective on the individual and

combined importance of such procedures. The purpose of the current study will be to use a combination of research based procedures (free-operant preference assessment, progressive-ratio schedule reinforcer assessment, and a response-independent pairing procedure) to establish new reinforcers that can be used by educators in the classroom setting to increase work completion, expand interests, and create more reinforcer options in students with ASD.

Method

Participants and Procedure

Participants

Participants for this study were four students (Joe, Sam, George, and Doug) in an exceptional learner's classroom, in an elementary school in Virginia. Participants were between 6 and 11 years of age and all have diagnoses for Autism Spectrum Disorder.

Setting

Sessions took place in an exceptional learner classroom at an elementary school in a rural community in Virginia. The classroom setting contained desks, tables, and chairs, as well as a shelf containing toys and games that were out of reach to the participants. Other students, the head teacher, paraprofessionals, and two observers were also present in the room during sessions. The head classroom teacher was responsible for implementing discrete trial procedures and observers recorded data throughout sessions.

Materials

Materials included data sheets, stop-watches, pencils, one desk, four chairs, six different stimuli (toys chosen for preference and reinforcer assessments by the classroom teacher), a set of "sorting bears" and containers, as well as a bag of photos for matching.

Experimental Design

This study utilized an AB (pre-post) design within participants. Phase A included the pre-pairing stimulus preference assessment (6 stimuli) and the pre-pairing reinforcer assessment for 3 stimuli, chosen from the preference assessment. During phase B, pairing procedures took place and stimuli were presented simultaneously on a VT 30 schedule for 15 pairings. In other words, stimuli were presented, on average, every 30 seconds, for a total of 15 pairings. In the random control procedure, stimuli were presented on a VT 30 schedule for 15 pairings, each, but the stimuli are alternated in presentations. The second phase (B) included a post-pairing stimulus preference assessment (the same 6 stimuli) and post-pairing reinforcer assessments (the same 3 stimuli) used in pairing procedures.

Data Collection

Observers recorded data throughout each session (see IOA). During the stimulus preference assessment, observers recorded time spent engaging with each of the six chosen items using stop watches, for 30 minutes. Observers calculated time spent with each item into a percentage. The data represent the percentage of time the participant engaged with each item during the session. During the progressive-ratio schedule reinforcer assessment, the teacher presented the task in a discrete trial format (placing sorting bears into a cup (array of 1) or matching photos (array of 3)) and observers

recorded responses per trial. The data were calculated into a total number of responses, per assessment. The progressive ratio analysis established a breakpoint in which responding completely stopped as response requirements increased. The investigator ran three different progressive-ratio analyses for each participant, individually. The most preferred item and two least preferred items (as determined from the preference assessment) were used in each analysis.

Inter-Observer Reliability

Total count IOA between two observers occurred for 50% of sessions with 97% agreement. Total count compares the total count recorded by both observers per session. A percentage of agreement between the total number of responses recorded by both observers was calculated by dividing the smaller number by the larger number and multiplying by 100.

Procedures

Stimulus Preference Assessment. The first session consisted of a free operant stimulus preference assessment in which an array of 6 items, chosen by the head classroom teacher, were presented and preferred items were determined by the amount of time in which the child engages with the item. The array of items for Joe were a hula hoops, a dancing bird, a toy guitar, a toy cow, a toy giraffe, and a toy car. The array of items for Sam were straws, a koosh ball, a toy pig, a card with a preferred picture on it, a puzzle, and a dancing bird. The array of stimuli chosen for Doug were a shape sorter, a koosh ball, a puzzle, a dancing bird, a toy pig, and a book. The array of items chosen for the final participant, George, were a toy dog, a koosh ball, a toy pig, a toy guitar, a

puzzle, and a toy turtle. The teacher chose three items that were observed to be preferred and three items that were observed to be neutral. The total duration in which the student engaged with each item was recorded and calculated into a percentage of time. All other toys and activities were removed from the area during this time. The observers and head teacher remained in the area, while other students continued to work away from the area, as to not interfere with assessment.

Pre-Pairing Progressive Ratio Reinforcer Assessment. A pre-pairing progressive-ratio schedule reinforcer assessment was implemented to each participant, individually, for three different stimuli. The purpose of this assessment was to determine the reinforcing value of the item as response requirements to obtain the item gradually increased. In the first progressive ratio analysis, consequences were preferred stimuli (as determined by the preference assessment). In the second and third analyses, lesser preferred stimuli were used.

During progressive-ratio analyses, 3 out of the 4 participants were asked to engage in a fine motor task in which they were told to put small parts of an activity into a container (sorting bears). This task was chosen on the basis that students possess this skill in their current repertoire, but it is not typically a preferred activity. The fourth participant had a different skill repertoire and as a result, was asked to engage in a more complex, yet similar task, in which the student was asked to match cards from an array of 3. The tasks were all presented in a discrete trial format. The direction was presented, “put it in!”, or “show me ____”, and contingent upon responding, stimuli were presented for 30 seconds. The reinforcer schedule began on an FR1 schedule. The response requirements increased after completion of each requirement (FR1, FR2, FR3, FR4, FR5…).

Responses were recorded and calculated into a percent of responding on each schedule. The data demonstrates the progressive ratio break-point, in which the student stopped responding. This method will determine how thin the schedule of reinforcement can get before responding stops.

In order to determine breakpoint, a prompting procedure was put into place. Upon the presentation of the discriminative stimulus, "put it in!" or "show me _____", the researcher counted 5 seconds. If the student did not respond within 5 seconds, the researcher prompted the instructor to re-present the discriminative stimulus and another 5 seconds was counted. If the student did not respond after this prompt, the activity ended, and breakpoint was determined. If the student got up and left the work area, the teacher followed the student and gently prompted them back to the work area; "come back to the table, please!" If the student did not respond within 5 seconds, another prompt was given. If the student did not respond within this 5 seconds, the task was terminated and breakpoint was determined. If students began to engage in self-injurious behaviors, other potentially harmful behaviors, and/or showed signs of increasing frustration and aggression, the task was terminated and breakpoint was determined.

Pairing Procedures. The most reinforcing stimulus and the least reinforcing stimulus were used in pairing procedures, while the second least reinforcing stimulus was used in control procedures. For Joe, the most preferred stimulus, as determined by the preference assessment, was a hula hoop. His two least preferred items were a dancing bird (used for pairing) and a toy guitar (used for control procedure). For Sam, the most preferred stimuli were straws. The least preferred stimuli were a puzzle (used) and the dancing bird (used for control procedure). Doug's most preferred stimulus was a shape

sorter. His two least preferred items were a picture book (used for pairing) and a koosh ball (used for control procedure). Finally, George's most preferred item was a toy dog. His least preferred items were the koosh ball (used for pairing) and a puzzle (used for control procedure).

Of the three stimuli chosen from the stimulus preference assessment, the most preferred item and one of the neutral items were paired together using a response-independent pairing procedure. A random control procedure, utilizing a third, neutral stimulus, was implemented immediately following pairing procedures. During the pairing procedure, a VT30 schedule was used to present the most preferred and least preferred stimuli, simultaneously. Presentations occurred every 30 seconds, on average. Upon presentation of the stimuli to the participant, the timer was stopped, and the student was allotted 30 seconds of engagement time with the items before they were removed and the schedule time started again. This schedule occurred over the course of 30 minutes, with 15 total pairings.

Immediately following the contingent-stimuli pairing procedure, the random control procedure was implemented. The random control procedure also followed a VT30 schedule. Under this schedule, the reinforcing stimulus (as used in the first pairing procedure) and the third stimulus were presented, independently, for 15 presentations of each stimulus. Upon presentation of the single stimulus, the timer was stopped, and the student was allotted 30 seconds of engagement with the item before it is removed and the schedule time started again.

Post-Pairing Preference Assessment. A second, free operant, preference assessment was administered after pairing procedures were completed. The post-pairing free operant preference assessment mimicked that of the pre-pairing free operant preference assessment. The data were again calculated into a percentage of time spent with each item relative to the other available items. The data provide information in regards to any preferences that may have changed over the course of the pairing procedures.

Post-Pairing Reinforcer Assessment. A second series of progressive-ratio schedule reinforcer assessments were implemented following the second free-operant preference assessment. The procedures for the post-pairing progressive-ratio schedule reinforcer assessments were identical to those of the first one. The data demonstrate whether or not the newly conditioned stimulus has obtained reinforcing value and can be used to effectively increase responding on the task.

Results

Figures 1 through 4, presented below, represent the data for all preference assessments (pre and post) and all reinforcer analyses (pre and post). Figure 1 represents the data for Joe. During the pre-pairing reinforcer assessment, Joe engaged with the hula-hoop for 92% of the time, making this the most preferred item from the array. There was little to no interaction with any other stimuli from the array. After pairing procedures, there was little change in preference assessment results. The hula-hoop remained the most preferred item, while the other stimuli remained relatively untouched. During progressive ratio analyses, the student emitted a total of 378 responses. Both the bird and

the guitar were less reinforcing, comparatively, as the participant only engaged in cumulative total of 28 responses for the bird and 66 responses for the guitar. The bird and the hula-hoop were presented simultaneously during pairing procedures, for 15 total simultaneous presentations. During the control procedure, the hula hoop and the guitar were presented, separately, for 15 total presentations each. Post-pairing progressive-ratio assessments convey that the hula hoop still maintained reinforcing value, as the student still engaged in 253 total responses when the hula hoop was in place as a consequence. The participant increased responding for the paired stimulus (bird), engaging in a total of 36 responses under this condition. Finally, responding under the un-paired stimulus condition also increased to 105 responses, after pairing procedures were implemented.

The second participant (figure 2), Sam, engaged with straws for 87% of the pre-pairing preference assessment. Sam did not engage with any other items for a significant amount of time during this assessment. Following pairing procedures, Sam engaged with straws again for 98% of the assessment. During the pre-pairing progressive-ratio analyses, Sam engaged in a total of 80 responses under the condition in which straws were a consequence. He engaged in 21 total responses under the condition in which the puzzle was a consequence and engaged in 36 responses in the condition in which the bird was a consequence for responding. The puzzle and the straws were used in pairing procedures, while the bird was used in the control procedure. Following pairing procedures, Sam engaged in a total of 55 total responses for straws. His responding more than quadrupled for the newly conditioned item (puzzle), totaling 84 responses, while responding under the controlled stimulus (bird) condition remained exactly the same, at 36 responses.

The third participant (figure 3), Doug, engaged with the shape sorter for 19% of the time allotted for the pre-pairing preference assessment. He also engaged with the puzzle for about 15% of the pre-pairing preference assessment. The shape sorter was chosen as the most preferred stimulus. The participant did not interact with any other available items. Following pairing procedures, the student did not engage with any of the items for the entire duration of the assessment. During the pre-pairing progressive-ratio analysis, Doug was asked to engage in a different task than other participants. Rather than engaging in the "bear" task, he was asked to perform a matching task. This task was chosen as a result of this participant's current skill repertoire. The student engaged in 24 total responses under the condition in which the most preferred stimulus, the shape sorter, was a consequence for responding. Under the conditions in which both the book or the koosh ball were presented contingent upon responding, the student engaged in no responses. During pairing procedures, the shape sorter and the book were paired together while the koosh ball was the control stimulus. After pairing procedures, the student responded a total of 15 times for access to the shape sorter, 8 times for access to the book, and 7 times for access to the koosh ball.

The final participant (figure 4), George, engaged with the toy dog for 89% of the assessment time during the pre-pairing preference assessment. This item was chosen as the most reinforcing item and was used in pairing procedures. Following pairing procedures, the participant engaged with the toy dog for 88% of the assessment time and his engagement with the puzzle increased from no engagement to .9%. During the pre-pairing progressive-ratio analyses, the student emitted a total of 136 responses for access to the dog. Under the condition in which the koosh ball was presented, the student

engaged in 78 total responses. Under the condition in which the puzzle was presented, the student engaged in 11 total responses. During pairing procedures, the koosh ball and the dog were paired together and the puzzle served as a control stimulus. Results demonstrate an increase in total responding under all three stimulus conditions over all for this participant. Following pairing procedures, the student's responding under the dog condition increased to a total of 406 responses. Responding under the koosh ball condition (paired stimulus), responding increased to 108 responses. Finally, the student engaged in 28 total responses under the puzzle (control/unpaired) condition.

Discussion

The current study sought to demonstrate the potential implications for using conditioning procedures to establish new reinforcers that may be used in the classroom setting for students with ASD. The study utilized a free-operant preference assessment, a progressive-ratio analysis, and response-independent pairing procedures as a means of establishing conditioned reinforcers. The results of the study encourage future research in response-independent pairing procedure and furthermore, convey the importance of utilizing each individual component when implementing a conditioning procedure.

As demonstrated by previous literature, using response-independent pairing procedures often yield successful results in terms of conditioning new reinforcers in both the experimental and applied settings (Brown & Jenkins, 1968; Sunderberg, Michael, & Partington, 1996; Yoon & Bennet, 2000; Miguel, Carr, & Michael, 2002; Carroll & Klatt, 2008). Expanding the interests and options for potential reinforcers to be used during

instruction with children with ASD has the potential to create a much more effective learning environment in which educators are not limited in their options for age appropriate reinforcers.

Overall, this study yielded variable findings both within and between participants. Although the results of the study show variation across participants as a whole, there are several individual differences in the data and other variables that need to be considered. For the first participant, Joe, the data demonstrate an increase in responding with the newly paired stimulus, supporting the notion that conditioning was successful. However, this participant also demonstrated an increase in responding under the unpaired (control) condition. This phenomenon suggests that perhaps this increase in responding in the paired stimulus condition was not due to the pairing of items, but perhaps can be attributed to some other variables, to be discussed.

Doug's data yield similar results to those of the previously mentioned participant. Responding under the originally reinforcing stimulus (shape sorter) decreased slightly after pairing procedures, but still remained the most reinforcing stimulus relative to responding under the other conditions. Responding under the paired stimulus (book) condition increased from no responses to eight total responses after pairing procedures were implemented. This increase in responding demonstrates that the book may have acquired some reinforcing value via pairing procedures. However, much like the results for the first participant, Doug's responding also increased under the condition with the control stimulus (koosh ball), suggesting once again that other variables, which will be discussed later, may have effected responding. The data for George also follow a similar pattern to those of Joe and Doug. Responding under the reinforcing stimulus condition

remained high throughout both pre and post measures, while there were increases in responding under both the paired and unpaired stimuli conditions.

The data for Sam demonstrate a very clear relationship between the paired stimulus and an increase in responding. The data for this participant show that the originally reinforcing stimulus, straws, lost little value, as responding still remained high even after pairing procedures were implemented. Furthermore, under the paired stimulus condition (the puzzle), responding quadrupled after pairing procedures were implemented, which would appear then that the stimulus obtained reinforcing value after intervention. The stimulus used during the control procedure, the bird, did not appear to change at all in value, as responding remained at 36 total responses for both pre and post assessments. An increase in responding under the newly conditioned stimulus, as well as no change in the control stimulus, suggest that pairing procedures were effective, and newly conditioned stimuli may be established under these procedures.

Although the data for all but one participant demonstrate some variability responding under different conditions, it is still important to note that in all four participants, responding did increase under the paired stimulus condition after pairing procedures were implemented. Variability in responding may be a result of developing a learning history with the chosen task. Although all four participants were presented conditions in random orders, so as to control for sequencing effects, and students were permitted at least 20 minutes of "break" time in between assessments, it is still possible that responding was effected by this variable. For example, for some participants, responding increased on the task over the entire course of the study in all conditions. It is possible that the task itself developed some reinforcing value or perhaps students learned

faster responding over time and/or had an easier time emitting responses as sessions progressed.

Comparison of pre and post preference assessment results reveals very little change in stimulus preference assessment values for all participants. This finding supports an earlier argument made about the necessity for implementing reinforcer assessments after preference assessments, to ensure that preferred stimuli are actually reinforcing (DeLeon, Frank, Gregory, & Allman, 2009). Items that were not interacted with at all during preference assessments still produced some responding within the reinforcer assessments, stressing the importance of utilizing both preference and reinforcer assessments when determining reinforcing stimuli.

Implementing a free operant preference assessment, for both pre and post measures, presented some limitations. In all four participants, there were almost no increases in preference for the paired stimulus, after procedures took place, and preference for the most preferred items remained high throughout the study. It may have been more beneficial to implement a forced-choice preference assessment, in order to obtain information about stimulus preference when compared to only one other stimulus, versus selecting items from an array of six competing stimuli (Ortiz & Carr, 2000).

Other factors to take into consideration are setting events that may have had an effect on responding on certain session days. For example, many of the students are on medication for ADHD. One participant, Doug, receives his medication in the middle of the school day. During post measures, it was brought to the attention of the researcher that Doug had not received his medication on time that day, which may have had an

effect on overall responding. During Doug's post-pairing preference assessment, he did not engage with any of the items for the entire duration of the session. He did not attempt to get up and leave the area, but remained seated with his eyes closed.

It is also important to note that other students and instructors were frequently entering and leaving the classroom. This was often a distraction for the participants and sometimes breakpoint was reached when the student's attention could not be regained after an interruption. This is likely a very common confound that will be present in any study occurring in a classroom setting and it might be beneficial to use a different operational definition of "breakpoint" in settings in which this issue arises.

For future research on conditioned reinforcement, it may be beneficial to explore further into the classes of stimuli that are utilized in assessments. For example, in some of the experimental literature, researchers utilize different classes of stimuli in pairing procedures (Brown & Jenkins, 1968). Pairing auditory stimuli (tones) with edible stimuli (food pellets) may yield different results than using all tangible stimuli (toys), edible stimuli, or even social stimuli (praise). In addition to the class of stimuli, the salience of each type of stimuli may differ, having an effect on how relationships between different classes of stimuli are formed.

It is important to note that for the sake of experimentation, stimuli were chosen by the classroom teacher, were all considered "toys", and were all items with which the student might have had prior experience with. The present study is focused on the process that may contribute to changes in stimulus value. Future research would benefit from

using items that both the teachers and parents agree to be age appropriate and practical in the classroom setting.

Future research may also benefit from further study of the number of pairings and presentations of stimuli that are necessary and effective for the establishment of correlations. It is unclear in the literature as to which schedule of pairings and presentations is most effective, and these numbers often vary from study to study. When using a response-dependent procedure, the number of pairings is entirely dependent upon the number of responses emitted by the subject or participant. However, in participants that emit a lower number of responses overall, using a response-independent procedure is most practical, and a pairing schedule needs to be instated. A way combat this issue may be to employ probes throughout procedures, to periodically examine any changes in the values of stimuli.

Additionally, the temporal arrangement of the presentations could be important to consider. In the present study the reinforcer and neutral stimulus were always paired simultaneously, where the classical conditioning literature suggests a delay procedure may be more effective for conditioning (Brown & Jenkins, 1968). That is, the neutral stimulus could be presented a few moments before and then in conjunction with the presentation of the reinforcer.

All post measures were taken soon after pairing procedures occurred. Due to this schedule, it cannot be determined whether or not changes in stimulus values maintained lasting effects. An avenue to consider is the utilization of maintenance probes. A maintenance probe would allow the researcher to return to the setting a few

days/weeks/months later, collect data, and determine if any changes have occurred. If the effects of such a procedure are fleeting, it may be useful to know how frequently one needs to re-pair stimuli to maintain changes in stimuli values.

The data collected from the preference assessments and reinforcer assessments are a strong demonstration of an earlier claim regarding the restricted and repetitive patterns of interests and behaviors often demonstrated by people with ASD (DSM V, 2013). For 3 out of 4 participants, more than 80% of time during preference assessments was allocated to one single item and most of the responding on the task occurred primarily under the contingency of that same stimulus. Although the procedures implemented in the study yield variable results with respect to the establishment of a conditioned reinforcer, the data are still a strong indication of the importance of increasing the number of reinforcers that could potentially be used in the classroom to increase task completion in students with ASD.

The procedures implemented in the classroom very closely mirrored those of a typical day in the classroom, demonstrating the practicality and applicability of the procedures used in this study. Although the data demonstrate some variability, and future research would benefit from consideration of other variables and confounds, the data do imply that changes in stimulus values may be possible under these conditions for some students, and are only accessible via a reinforcer assessment. Furthermore, it remains evident that the establishment of new reinforcers to be used in the classroom setting has important implications for people with ASD, specifically those who demonstrate these restricted and repetitive patterns of interests and behaviors.

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Figure 1.

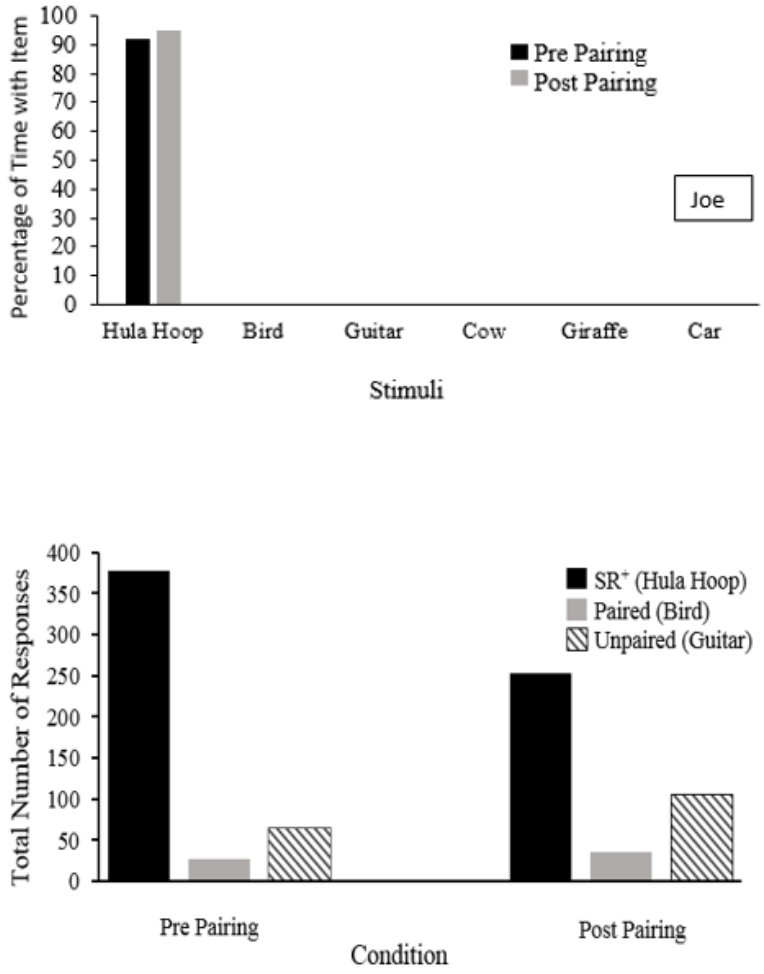

Figure 1 represents pre and post preference assessment measures as well as a comparison of pre and post progressive ratio analyses measures for Joe.

Figure 2.

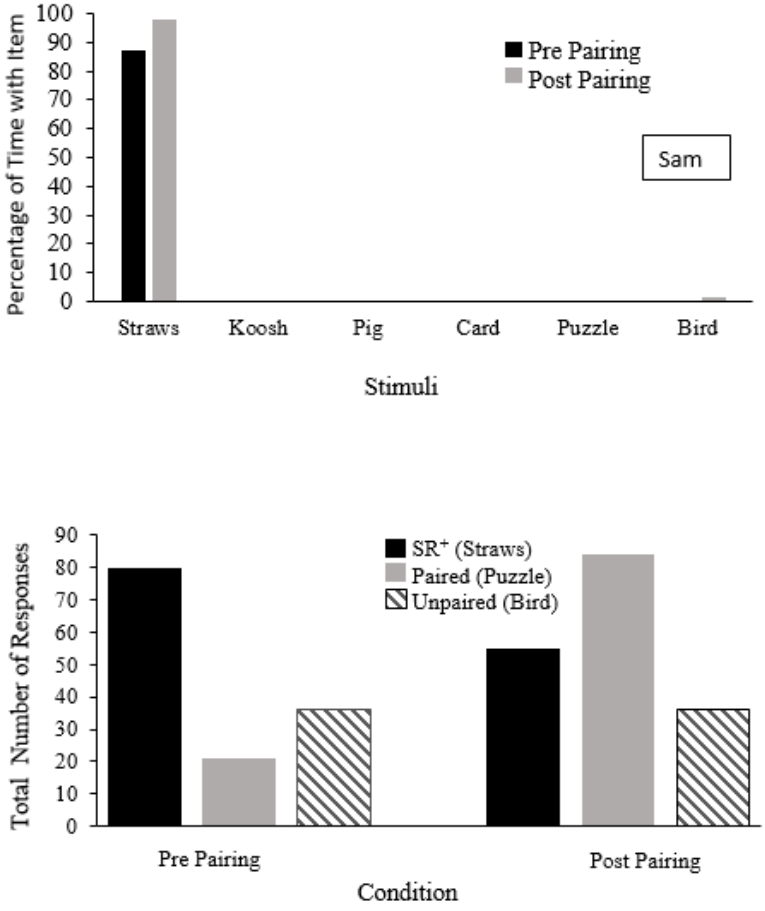

Figure 2 represents pre and post preference assessment measures as well as a comparison of pre and post progressive ratio analyses measures for Sam.

Figure 3.

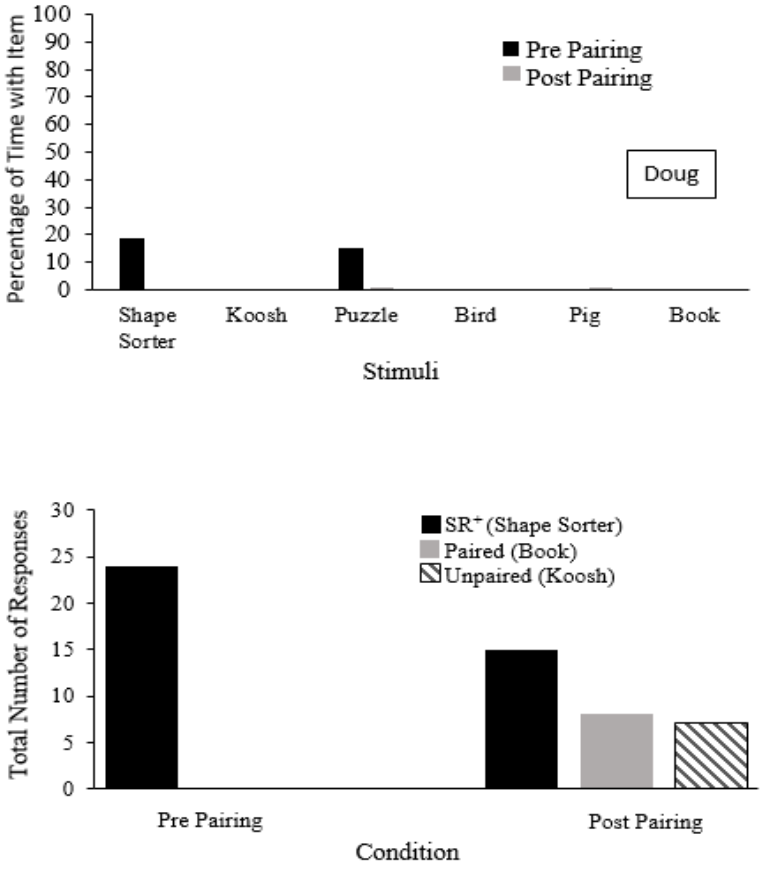

Figure 3 represents pre and post preference assessment measures as well as a comparison of pre and post progressive ratio analyses measures for Doug.

Figure 4.

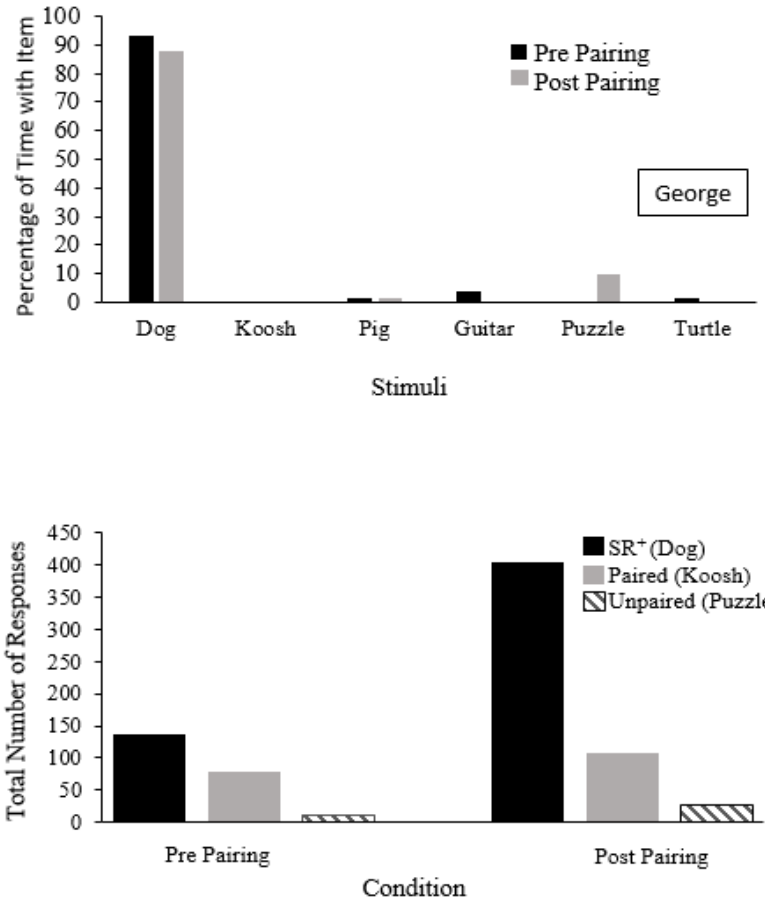

Figure 4 represents pre and post preference assessment measures as well as a comparison of pre and post progressive ratio analyses measures for George.