USING A PAIRING PROCEDURE TO DEVELOP REINFORCERS FOR CHILDREN ON THE AUTISM SPECTRUM WITH A RESTRICTED RANGE OF PREFERRED ITEMS

A DISSERTATION

SUBMITTED TO THE FACULTY

OF

THE GRADUATE SCHOOL OF APPLIED AND PROFESSIONAL PSYCHOLOGY

OF

RUTGERS,

THE STATE UNIVERSITY OF NEW JERSEY

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

OF

DOCTOR OF PSYCHOLOGY

New Brunswick, New Jersey October, 2011

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Abstract

Children with ASD often have significant educational challenges such as skill deficits and behavioral problems. Reinforcement procedures represent one of the fundamental Applied Behavior Analysis concepts for addressing these concerns, making it important that there are powerful motivators to use for reinforcement. Unfortunately, individuals with autism have restricted interests, which may limit available reinforcers and complicate the development of treatments using reinforcement based procedures. The present study tested a procedure to develop novel reinforcers for three individuals with autism. Two neutral items were paired with known reinforcers during work sessions at school. Preference increased for five of the six items and reinforcement value increased for four of the six items.
Acknowledgements

I would like to thank Robert LaRue for his generous support and guidance throughout the course of this study. The idea and execution would not have been possible without his support. I would also like to thank my committee member and advisor Sandra Harris for all of the help that she offered throughout my years at GSAPP and during this study. A special thanks also goes out to Amy Hansford for going above and beyond in spearheading the coordination of the final elements of this study as well as aiding in the collection of reliability data along with Yair Kramer. To the teachers and staff at the Douglass Developmental Disabilities Center for allowing me into your classrooms and offering your resources in the completion of this study. To the Greenwich Autism Alliance for their generous grant which helped fund this study. Finally, I want to thank my wonderful fiancé Rachel Merson, and my amazing parents George, Peggy, Randy, and Melissa for their support throughout this long journey.
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Introduction

Background Information

Autism spectrum disorders (ASD) are a class of developmental disabilities associated with significant impairments in daily functioning. These disorders are characterized by qualitative deficits in social interaction; communication; and restrictive, repetitive, and stereotyped interests, behaviors, and activities. Earlier reports estimate that approximately six out of every thousand people have ASD (Newschaffer, Croen, Daniels, Giarelli, Grether, Levy, Mandell, Miller, Pinto-Martin, Reaven, Reynolds, Rice, Schendel, & Windham, 2007). However, recent research estimates that approximately 1 in 91 has an autism spectrum disorder (Kagan, Blumberg, Shieve, Boyle, Perrin, Ghandour, Singh, Strickland, Travathen, & Van Dyck, 2009).

Children with ASD often present with associated concerns, such as skill deficits and maladaptive behavior, which can interfere with learning. These deficits and behavioral excesses tend to be frequently targeted for treatment. The intervention approach with the most empirical support in the treatment of autism is Applied Behavior Analysis (ABA). The concepts underlying ABA were first postulated by B.F. Skinner and have been thoroughly researched over the last 60 years. ABA is a science in which the principles of the analysis of behavior are applied systematically to improve
socially significant behavior. The approach employs the scientific method to precisely identify the variables responsible for change in behavior (Cooper, Heron, & Heward, 2007).

Reinforcement

Reinforcement is an integral component in the application of Applied Behavior Analysis. Reinforcement is defined as any event following a response that increases the likelihood of that response happening in the future (Skinner, 1953). It is typically divided into two categories: positive and negative reinforcement. Positive reinforcement refers to the contingent addition of a stimulus to the environment that increases future responding. For example, a child completes a math problem and is given a piece of candy. In the future, if the child does more math problems than before the candy was given, positive reinforcement has taken place.

Negative reinforcement refers to the removal of a stimulus from the environment directly following the response that produces an increase in responding. For example, a child completes a math problem and is given a five minute break. In the future, if the child does more math problems than before the break was given, than negative reinforcement has taken place.

Reinforcement and punishment are commonly used consequence-based behavior changes procedures utilized in ABA. In recent years, reliance on punishment-based procedures has decreased in favor of procedures based on reinforcement
(Donnellan & LaVigna, 1990; Iwata, Pace, Dorsey, Zarcone, Vollmer, & Smith, 1994). In fact, best practices dictate that all ABA programming, from skill acquisition programs to behavior reduction programs, begin with a focus on reinforcement-based procedures (Cooper, Heward, & Herron, 2007). Only if multiple reinforcement-based techniques have been ineffective, are punishment based procedures considered.

There is often confusion between the colloquial definition of reinforcement, and the technical one given above. A common misconception is that reinforcement refers to the qualitative assessment of an item as “good.” In other words, people often view reinforcement as giving somebody something they like. In doing so, they are defining reinforcement by the topography of the stimulus presented (e.g., a treat or a toy) rather than its effect on the future probability of the response (i.e., increased likelihood of the response). The colloquial view of reinforcement is more similar to the definition of reward than the technical definition of reinforcement. For example, a stimulus assumed to be pleasant (e.g., a Skittle) can be provided contingent upon a response (e.g., pushing a button). However, positive reinforcement would only have occurred in the event that button pushing increased. If the button pushing behavior did not increase, then the child may have been rewarded but not reinforced. Similarly, if the addition of a stimulus assumed to be aversive increases the likelihood of a response, then positive reinforcement has taken place. For instance, a boy breaks a lamp and his parents spank him. If lamp breaking subsequently increases, then positive reinforcement has taken place.
Given the importance of reinforcement in ABA, it is critical to have powerful reinforcers. The identification of effective reinforcers is an integral part of any successful intervention for persons with autism (Amari, Grace, & Fisher, 1995; Vollmer, Marcus, & LeBlanc, 1994). However, beyond the presence of reinforcers, other issues need to be considered in the application of reinforcement in applied settings.

**Factors that Alter the Effectiveness of Reinforcement**

While developing reinforcement-based interventions for individuals, certain factors affecting the effectiveness of these procedures need to be considered. Immediacy, motivating operations (MOs), quality, and magnitude are the primary factors contributing to the efficacy of reinforcement. Failure to consider these factors may limit the effectiveness of reinforcement-based procedures.

**Immediacy of reinforcement.**

The speed with which reinforcement is delivered is an important component to the effectiveness of reinforcement. In the initial stages of intervention, reinforcement needs to be delivered quickly and consistently to be effective. During this initial period, if reinforcement is not readily available, opportunities to maintain appropriate behavior or correct responding can be lost. Following acquisition, the immediacy of reinforcement can be faded. Research suggests that delays as short as 20 seconds, may be enough to disrupt acquisition (Horner & Day, 1991). The lack of impact, even with this short delay, is particularly relevant for children with ASD. The cognitive deficits
correlated with autism, lead to greater difficulty identifying a particular reinforcing contingency. As such immediacy is of particular importance to establish this contingency.

Secondary reinforcers are one way to increase the latency between the behavior that is being reinforced and the reinforcer. These are items that have acquired their function as a reinforcer through pairing with a primary reinforcer. Examples of secondary reinforcers include tokens or coupons. There are still problems inherent with the use of these items. First, they can be less effective during the initial stages of treatment when reinforcement must be delivered immediately and before there is an opportunity to establish their efficacy through pairing. Second, if significant time lapses between the delivery of these stimuli and the opportunity to access the primary reinforcer than the same problems of lack of immediacy arises.

**Magnitude of reinforcement.**

Magnitude is another factor known to moderate the effectiveness of reinforcement. Magnitude can take the form of intensity (i.e., having a teacher offer praise versus having the entire classroom shout praise), number (i.e., getting two pieces of candy instead of one), or duration of reinforcement (i.e., getting fifteen minutes of recess instead of ten). Manipulations of reinforcement magnitude have been shown to produce shifts in responding to the option which results in the greater magnitude of reinforcement (Catania, 1963, Lerman, Kelley, Vorndran, Kuhn, & LaRue, 2002). If all
other factors affecting reinforcement are being controlled for, an individual will allocate responding toward an option offering the greatest magnitude (i.e., intensity, number, or duration) of reinforcement.

**Quality of reinforcement.**

The quality of the reinforcement delivered has also been identified as an effective way to manipulate responding. Individuals will typically allocate their responding to the response alternative that produces the higher quality of reinforcement (Hollard & Davison, 1971). This is a more difficult construct measure since it lacks objectivity. As such, preference assessments are typically used, and high preference items are identified as those that higher in quality. Quality of reinforcement has received significant research backing and is robust predictor of responding (Dixon & Cummings, 2001; Mace, Need, Shade, & Mauro, 1996; Neef & Lutz, 2001; Neef, Mace, & Shade, 1993; Neef, Mace, Shade, & Shea, 1992).

**Effects of motivating operations**

Another factor limiting the effective use of reinforcement, is the concept of motivating operations (MOs). Motivating operations have two defining effects. They alter the effectiveness of reinforcers or punishers, as well as the frequency of operant response classes related to those consequences (Laraway, Snycerski, Micheal, & Poling, 2003). Vollmer and Iwata (1991) reported that MOs may have important implications for reinforcer assessment and delivery. They noted that response rates during
reinforcement conditions varied as a function of deprivation and satiation. When an organism is deprived of a reinforcer, the reinforcer may increase in value and increase responding to access the reinforcer. If the organism is satiated with a reinforcer, it may decrease the value of the items and decrease responding to access it. In fact, in the Vollmer and Iwata (1991) study, very commonplace levels of these phenomena drastically influenced the effectiveness of reinforcement. Their findings suggest that the constant presentation of a single stimulus may cause an individual to become satiated from a stimulus; even if that individual is highly motivated to contact that stimulus under other circumstances. If satiation occurs than the MO is abolished, temporarily reducing the reinforcing properties of the stimulus. These effects of MOs have subsequently been replicated across numerous contexts (DeLeon, Anders, Rodriguez-Catter, & Neidert, 2000; DeLeon, Iwata, Goh, & Worsdell, 1997; Gottschalk, Libby, & Graff, 2000; McAdam et. al, 2005).

**Restricted Interests in Children with Autism**

These factors affecting reinforcement have pertinent implications for the treatment of children with autism. By definition, individuals with autism have restricted interests, which may complicate the development of treatments using reinforcement-based procedures (DeLeon, Neidert, Anders, & Rodriguez-Catter, 2001). These restricted interests leave a limited range of options available for reinforcement. This limited range, in conjunction with the satiation of MOs, may result in the temporary loss
of reinforcing properties of those stimuli and leave no alternative options for reinforcement.

Having very few preferred items can result in great difficulty identifying potential reinforcers. Several methods exist for discerning potential reinforcers (DeLeon & Iwata 1996; Fisher, Piazza, Bowman, Hagopian, Owens, & Selvin, 1992; Northup, George, Jones, Broussard, & Vollmer, 1996; Pace, Ivancic, Edwards, Iwata, & Page, 1985). However, if few items or activities are preferred, than the results of these procedures may be either indiscriminate or specious. In other words, since multiple preference assessments require the individual to make a choice, they may chose an item whether it is preferred or not, rendering the assessment ineffective for identifying preferences.

Additional problems associated with a restricted range of reinforcing activities were identified by Hanley, Iwata, Roscoe, Thompson, and Lindberg (2003). They postulated that, although client preference should be one of the determining factors in the selection of leisure activities and vocational opportunities, certain pattern of preference can be problematic. For example, an individual who only prefers one of a few activities (as is often reported for individuals diagnosed with autism spectrum disorders) may not contact alternative sources of stimulation available from other activities. Alternatively, an individual who participates only in passive leisure activities (e.g., lying in bed and watching television) may derive little benefit from vocational
training or even from constructive leisure activities required for community involvement. Furthermore, is it possible that engagement in a particular activity is strongly influenced by the quantity and quality of the activities available, as well as other events taking place where the activity of interest occurs. This suggests that the activities that the individual prefers may be a reflection of a limited environmental history that has not allowed the individual to contact potential reinforcement associated with more varied or productive behaviors.

This phenomenon may affect preference for tangible items in the same way that it affects preference for activities. Just as the lack of environmental history disallows an individual’s contact with reinforcement, so does the lack of appropriate usage and exposure to an item not allow them to contact reinforcement. Furthermore, for individuals with restricted and perseverative interests, it may be necessary to systematically design scenarios in which items and/or activities are reinforced in order to allow a given stimuli to contact reinforcement.

**Procedures for Identifying Preferred Stimuli**

Procedures have been developed to test the preferences of an individual in order to ascertain potential reinforcers. The first commonly employed method of assessment is preference surveys (Fox & DeShaw, 1993; Rotatori, Fox, & Switski. 1979). These are typically indirect measures completed by caregivers attempting to identify items that the participant prefers.
The information garnered from indirect methods is typically used to inform
direct preference assessments. Direct preference assessments are environmental
manipulations conducted to systematically identify an individuals preferences. The
three most commonly used preference assessments are the single operant preference
assessment, the paired choice preference assessment and the multiple stimulus without
replacement preference assessment.

*Single Operant Preference Assessment:* The single operant preference
assessment measures an individual’s approach behavior towards numerous, individually
presented items (Pace, Ivancic, Edwards, Iwata, & Page, 1985). In this procedure, the
items are presented and the observer codes whether or not the participant approaches
the item. Another variation of this assessment measures the duration the learner’s
engagement with the item (DeLeon, Iwata, Conners, & Wallace, 1999). The single
operant assessment quickly identifies preferences and is a relatively simple procedure
to conduct. One problem with the assessment is that individuals may approach all items
making the results difficult to interpret. This procedure cannot distinguish the
differences in preference when multiple items are approached, in which case it may
result in the overidentification of reinforcers.

*Paired Choice Preference Assessment:* In paired choice preference assessments,
potential reinforcers are presented in pairs (Fisher, Piazza, Bowman, Hagopian, Owens,
& Selvin, 1992). The pairs are presented to the participant who is told to “pick one”.
The observer documents which item the participant approaches. In a paired choice
preference assessment all possible item combinations are presented. If the participant does not make a selection, or selects both items, the items and the instruction are represented. The paired stimulus assessment is the most reliable at measuring durable preferences, and unlike the single operant assessment, measures relative preference. Unfortunately, the paired stimulus assessment can be a time consuming assessment and the least adept at measuring moment-to-moment preference fluctuations.

Multiple Stimulus Without Replacement Preference Assessment: The multiple stimulus without replacement (MSWO) preference assessment involves the concurrent presentation of many items at one time (DeLeon & Iwata, 1996). In MSWO assessments, individuals have all of their options placed in an array in front of them and are instructed to choose from the stimuli. After they make their choice, that item is removed and the individual is then allowed to choose from the remaining stimuli until all choices are exhausted. The MSWO provides a rank order of the preference of the items (i.e., which item was chosen first, second, etc.) The MSWO is fast and is effective for measuring momentary preferences.

Each of these preference assessments can be used to identify items that may function as reinforcers. However, difficulties still limit the ability of clinicians to identify stimuli that reliably function as reinforcers for children with ASD. First, the utility of the procedure is restricted by the items included. A limited number of items can be tested in any given preference assessment. As a result, it is possible that practitioners may measure the preference of several stimuli, none of which necessarily function as
reinforcers for the individual. Secondly, communication decrements prominent in autism interfere with a participant’s ability to identify potential reinforcers. Indirect preference surveys ideally result in the identification of potential reinforcers; however this is not always the case. Finally, restricted interests commonly seen in autism may limit the accuracy and usefulness of the findings. In conjunction with the limited number of items included, communication decrements prominent in ASD, and selection bias, it is possible that these methods result in the overidentification of items which do not function as reinforcers.

The History of Pairing and the Use of Pairing Procedures

One established procedure that could possibly be used to broaden reinforcer repertoires is pairing. Pairing is a procedure in which one stimulus is delivered simultaneously, or temporally adjacent to a reinforcing stimulus (Esch, Carr, & Grow, 2009). Research has indicated that pairing a high preference stimulus with a lower preference stimulus may increase the value of the lower preference stimulus over time.

A common applied use of pairing is seen during the beginning of a work session, in many ABA programs. Pairing is often used in educational settings. Practitioners deliver reinforcement, which often involves interacting with learners in the presence of their favorite toys, foods, and activities. By presenting themselves with high preference items, the reinforcing properties of the items become associated with the teacher.
Pairing is currently part of best practices in ABA (Cooper, Heron, & Heward, 2007) and has reached this point after years of research.

Pairing has been frequently used in the treatment of feeding disorders. Capaldi (1996) suggested that the initial development of food preferences may be the result of flavor pairing. Research has shown that pairing less preferred flavors with more preferred flavors, increase the preference for the less preferred flavor (Bayens, Eelen, Van den Bergh, & Crombez, 1990). Pairing, as implemented in the feeding research, has involved both simultaneous and sequential item presentation. Simultaneous pairing is the concurrent presentation of less preferred foods, mixed with highly preferred foods. Sequential pairing involves offering a less preferred food directly before or after highly preferred foods. Several studies suggest that simultaneous pairing results in greater increases in the consumption of nonpreferred foods than does sequential presentation (Piazza, Patel, Santana, Goh, Delia, & Lancaster, 2002; Kern & Marder, 1996), especially when combined with stimulus fading (Patel, Piazza, Kelly, Ochsner, & Santana, 2001). If the highly preferred food is incrementally removed from the mixture than the nonpreferred food is more likely to become preferred after the pairing procedure is stopped. The Premack principle is one explanation for this phenomenon.

The Premack principle states that behaviors having a higher probability of occurrence may be used to strengthen behaviors having a lower probability of occurrence (Premack, 1959; Premack, 1962). When applied to feeding research, this
suggests that pairing less preferred foods with highly preferred foods leads to an increase in consumption of the less preferred foods. Amari, Grace, and Fisher (1995) studied increasing consumption of low preference ketogenic foods using the Premack Principle. These researchers offered higher preference ketogenic foods contingent on the consumption of lower preference ketogenic foods. This design was a replication of previous sequential pairing feeding designs. Amari, Grace, and Fisher were successful in increasing the intake of lesser preferred foods using the Premack principle. One limitation of this study was that the long term effects of this procedure were not noted. Therefore, it was not possible to determine if the procedures produced lasting effects after treatment. The Premack principle may be sufficient to increase the consumption of less preferred foods, but not to develop preferences for more preferred foods. This means that generalization would not take place after the treatment was stopped.

Several studies have evaluated the use of pairing for feeding disorders; however, the literature regarding the use of pairing to develop preferences is more sparse. The goals of these studies were to increase consumption. Pairing to increase the consumption of an item involves the pairing of a high preference item with a low preference item leading to the increased consumption of the low preference item. Pairing to develop preference involves the same pairing of a high preference item and a low preference item, resulting in a sustained increase in selection during preference assessments. Two studies have taken pairing a step farther to develop novel preferences.
Solberg, Hanley, Layer, and Ingvarsson (2007) attempted to develop preferences for snack items. Their goal was to attempt the pairing of lesser preferred food with reinforcement and subsequently, not only increase eating behavior; but also preference for the lesser preferred food. An initial MSWO was conducted on snacks with a large array of items, in order to identify high, medium, and low preference items to target for a paired stimulus preference assessment. A paired choice preference assessment was then conducted with five items from these different categories as an initial assessment. The same procedures were conducted with condiments and activities; the preferred items targeted for pairing with the lesser preferred food items. These assessments were used to identify the low-P foods and high-P condiments and activities (for all children the preferred activity was a movie). Following these initial assessments, the lowest preference snack was paired with a high preference condiment, high preference activity, and social praise during the administration of a daily preference assessment. This daily preference assessment functioned as a pairing procedure, while also ascertaining if changes in preference occurred. If the child chose the target item, they got the item and all of the paired reinforcement. If they chose any other item in the array, they received access to the item and no paired reinforcement. After the target item moved up the preference assessment hierarchy, stimulus fading procedures were implemented. Fading was conducted by reducing quantity of the condiment, volume of the movie, and quantity of attention. Solberg et al. found that target items reliably moved up the hierarchy, yet when stimulus fading procedures where implemented,
items returned to pre-pairing levels. Effects were often maintained during the fading procedure, but in all cases when fading stopped, and the item was presented alone, it returned to the last (or very near it) item chosen in the hierarchy.

The Solberg et al. study demonstrated the effectiveness of using a simultaneous pairing procedure to develop preferences. However, the researchers did not conduct a preference assessment with the target item alone, making interpretation of the study difficult. For instance, while the low preference item moved up the preference assessment hierarchy, it is plausible that the items selection simply represented the preference of the items it was paired with rather than a change in preference for the item itself. Therefore, there is no way to know whether a transient preference for that item was established. This study also tested preferences in typically developing children. Given the restricted interests common in autism spectrum disorders, the obtained results may have been different in this population.

Hanley, Iwata, Roscoe, Thompson, and Lindberg (2003) conducted the only study to date attempting to develop preferences for tangible items and activities using pairing procedures. This study was especially relevant because it was the first to attempt to create preferences for items. The authors utilized a “preference conditioning” condition, which included 2 adults with developmental disabilities. They gave an initial structured questionnaire which was used to inform a “response restriction” preference assessment. The methods of this assessment were similar to those described by Roane,
Vollmer, Ringdahl, and Marcus (1998) in which participants had free access to an array of stimuli and could interact with any of the stimuli. Subsequently, each most preferred item is removed and the revised responding pattern is measured using the same methods. The two activities for which the participants demonstrated the highest and lowest levels of interaction were identified. “Preference conditioning” sessions were conducted which made the low preference item available concurrently with reinforcement (which took the form of high preference snack items). Post-test response restriction preference assessments showed that both participants developed preferences for the new activities which superseded their original preferences. These results were maintained at follow up. Hanley et al. also attempted to test a response restriction condition in isolation in the same study. In this condition they demonstrated that simply restricting access to highly preferred activities may be sufficient to increase engagement with low preference activities in some situations; however, a preference for these low preference activities was not established.

This study has important implications for pairing. It may be possible to broaden a repertoire of preferred items using a pairing procedure. The noncontingent delivery of reinforcement during an activity may alter preference for that activity. The literature is varied, but there is also some evidence to suggest that these preferences may also prove somewhat stable. While the aforementioned studies demonstrated that it may be possible to alter preference, they did not examine the ability of these new items/activities to function as reinforcers. If preferences can be created, it stands to
reason that these preferences may function as reinforcers. This will add to the utility of this procedure in applied settings for the treatment of children with autism.

**Purpose of the Current Investigation**

Reinforcement is an integral part of ABA programs. When viable reinforcers are lacking, difficulties arise in executing the aims of programming. The current study attempted to build on the existing body of research by developing a procedure to expand the preferences of children with autism spectrum disorders and significantly restricted ranges of preferred items.

It can be difficult to intervene with children on the autism spectrum. Problem behavior and skill deficits are common in this population. Deficits in communication and restricted and stereotyped interests add to the challenges inherent in finding successful treatments to target these problems. Communication deficits often leave the teacher struggling to find reinforcers to motivate the student. This can result in the teacher having limited options available to motivate the learner, with the exception of a small sample of perseverative interests. For individuals presenting with restricted interests, satiation may interfere with the effectiveness of reinforcers. That is to say that while a learner may eagerly work to earn access to a single item initially, the learner may eventually lose interest in the item over time. A lack of viable reinforcement options can eliminate the prime motivational tool teachers have for keeping learners active during skill acquisition and behavior reduction programs. Reliable motivational
strategies are necessary to keep learners active during teaching. The absence of
effective motivation may also compromise subsequent maintenance and generalization.
Furthermore, motivation is necessary in behavior reduction programs. Antecedents,
replacement skills, and consequences are central strategies in behavior intervention
plans. Reinforcement is the primary strategy for employing consequences and central
to the development of replacement skills. If viable options for reinforcement are not
identified than it is more difficult to reduce problem behavior.

The present study targeted the expansion of preferences in children with
restricted interests. The previous research demonstrated that it may be possible to
develop preferences; however, there is no research indicating that these procedures can
alter the effectiveness of those items as reinforcers. This leads to questions as to
whether these new preferences can be utilized in applied settings. The current
investigation built on the literature by replicating previous findings regarding
preferences, and extended the literature by measuring the reinforcing value of these
preferences. By incorporating reinforcer assessments, reliable preference assessment
methodologies, and a multielement design; it was anticipated that this study would
result in a sound methodology to broaden the reinforcement repertoires for this
population. Broadening these repertories may lead to significant gains in skill
acquisition and behavior reduction. In addition, if preferred items are in fact the result
of a history of reinforcement, then systematically creating this history will result in
sustainable results and gains in overall quality of life. Preferences are known to change
over time (Hanley, Iwata, & Roscoe, 2006), and only one study has demonstrated sustained results with pairing procedures; therefore, results may be transitory. Even so, it was expected that this study could create important means for aiding in the delivery of reinforcement to learners with autism spectrum disorders.
METHODS

Participants and Setting

Three participants aged 5 to 15 were included in the current investigation. All students had a diagnosis of Autistic Disorder and Intellectual Disability. Sam was 6 upon entry into the study. Staff reported that Sam only worked for a single item during teaching trials (i.e., Skittles). He had a history of perseverative engagement with toy cars and trains (i.e., he lined them up and looked at them out of the corner of his eye); however at the time of this study, Sam had ceased interaction with these items. Johnny was 15 upon entry. He only had one item with which he interacted (i.e., a Barney video) and also had preservative interests with regard to edibles (i.e., potato chips). Tim was 5 upon entry and engaged in perseverative interests with regards to edibles (i.e., green vegetable chips). Tim did not engage with any inedible tangible items upon entry to this study.

Students aged 3-21 with autism were considered for inclusion in the study. The study targeted children reported to have a restricted range of reinforcers. Preference was also given to children with a history of problem behavior, and/or difficulties with skill acquisition, attributed to a lack of viable options for reinforcement. The materials used for the preference assessment were chosen based upon the Reinforcer
Assessment for Individuals with Severe Disabilities (RAISD) and interviews with the child’s teacher and/or primary caregiver. The included items varied for each child based on his initial likes and their ages. Both preferred and neutral/novel items were included in the assessment.

Participants were recruited from the sample of students at the Douglass Developmental Disabilities Center (DDDC). The DDDC is a center-based treatment facility, associated with Rutgers University, for children and adolescents diagnosed with pervasive developmental disorders. The center utilizes Applied Behavior Analysis teaching methods in all components of its programming. Students with restricted interests were evaluated and treated as part of the DDDC’s standard operating procedures. DDDC teachers, consultants, and supervisory personal identified potential candidates for this study. All baseline, treatment, and follow up assessments were conducted in the students designated classroom in the Douglass Developmental Disabilities Center. Treatment sessions took place during their typical work routines.

Consistent with IRB requirements, a letter introducing parents to the study and its goals was sent to the families of children deemed applicable for the study and written parental consent was attained for all children included in the study. Assessment procedures were conducted either by the present author or by trained staff under the supervision of the present author.
Procedure

Indirect measures were used with teachers and caregivers to identify the items included in this study. Items agreed upon as highly preferred and neutral by the two respondents were included in the study. Each child was given a pre-test preference assessment including both their most preferred items, as well as items that were considered neutral. An initial reinforcer assessment consisting of the same items was also conducted. The data from these assessments were used to find the least preferred items to use in a pairing procedure. After the pairing procedure, a post-treatment preference assessment and reinforcer assessment were conducted to ascertain whether the pairing procedure was successful in altering preference.

Pre Test

Indirect measure.

Parents and teachers filled out the RAISD and participated in an interview. The interview was face-to-face with teachers and over the phone with parents. The items were chosen based on a comparison of interviews with the participant’s teachers and/or caregivers and the results of RAISD (see Table 1). Two highly preferred items were targeted for each participant; however, one participant had only one reported highly preferred item and one participant had three items included because RAISD and interview results were ambiguous. Rating and agreement among respondents were both relevant criteria for item inclusion in this study. The top two items were typically
used as reinforcers during the participant’s regular instructional programming. The other five items used in the array were either known to be neutral or novel through interviews and the RAISD.

Table 1

<table>
<thead>
<tr>
<th>Student</th>
<th>High Preference Items</th>
<th>Low Preference Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sam</td>
<td>Skittles, Trains</td>
<td>iPod, GameBoy, Slinkee, Book</td>
</tr>
<tr>
<td>Tim</td>
<td>Green Chips</td>
<td>iPod, DVD, Puzzle, Book, GameBoy</td>
</tr>
<tr>
<td>Johnny</td>
<td>Video, Chips, Blue Pillow</td>
<td>Magazine, DVD, Baseball Cards, GameBoy</td>
</tr>
</tbody>
</table>

**Paired choice preference assessment.**

Following the completion of the indirect measure, a paired choice preference assessment (Fisher et al. 1992) was conducted. This initial preference assessment consisted of the seven items described above. The items were placed in front of the participant in sets of two. The participant was then told to “pick one”. If the participant did not make a selection, or tried to take both items, the items were removed and re-presented and the experimenter again delivered the instruction. Every combination of items was presented. The least chosen item in the preference assessment was labeled \textit{low-P1}. The most preferred item was labeled \textit{high-P}. Only these three items were used
during the initial treatment conditions. The dependent measure used for the paired choice preference assessment was percent of total choices. Data were collected during the assessment.

**Reinforcer Assessment.**

A reinforcer assessment was then conducted using all items included in the array. This procedure was modified from the concurrent-operants reinforcer assessments described by Northup, George, Jones, and Broussard (1996). This assessment was necessary to measure the extent to which the items the participant had chosen in the preference assessment functioned as reinforcers. During the reinforcer assessment, the participants had to place the criterion number of blocks in the bucket to earn a coupon for the targeted item. The coupons were laminated cards (10 cm by 10 cm) with a picture of the target item. The children had the opportunity to earn as few or as many coupons as they would like within a 5-min period. Each coupon could be exchanged for 1 minute of access to the target item. Immediately following each session, children could redeem their coupons by handing the cards to the experimenter. This procedure was conducted with all items in the array, in a multielement design. Dependent measures during the reinforcer assessment included the number of coupons earned and total blocks placed in a bucket. Data were collected in the session.

**Treatment**

The data from the preference and reinforcer assessments were analyzed to select the least and most preferred and reinforcing items. If the results of the
preference and reinforcer assessments did not concur, all current data (preference assessment, reinforcer assessment, and RAISD) were reviewed to ascertain which item best fit these criteria. These items were used for the initial treatment condition. During the course of treatment, participants were not granted access to items low-P1 and low-P2 outside of the treatment condition. Because high-P was typically the item that the participants worked for during their daily programming, it was not reserved exclusively for the purposes of this assessment. However, its access was characteristically limited to short intervals of reinforcement (one or two minutes) during work sessions. Free access to the high-P items was not granted.

The treatment condition was conducted within the confines of each child’s typical daily routine. This routine consisted of morning and afternoon work sessions (either one-to-one or dyadic and about 90 minutes in length); with lunch, snack, group, and free play times activities included throughout the schedule. Treatment conditions were only conducted during work sessions. Two participants were on a fixed ratio of 1 (FR1) schedule for correct responding. The participants were told at the beginning of each work interval that they were working to earn the low-P1 for two minutes and “then you get _____(high-P). For each correct response the participant was told “you earned _____(low-P1 or 2),” after which they were given high-P. Whether the participant accepted or rejected the item, they were required to keep it for 2 minutes; however they were not required to engage with the item or manipulate it properly. One participant used a token system and the procedure was manipulated to fit his
reinforcement system. At the beginning of each work interval, the instructor told the participant that he needed to earn a predetermined number of tokens in order to earn low-P1 and one more token to earn high-P. Specifically, the instructor said “You have to earn 9 tokens to earn the ____ (low-P1 or 2) and 10 tokens to earn the video (high-P).”

After the participant spent two minutes with the low preference item he was allowed one to two minutes with the preferred reinforcer. This procedure was typically conducted for sixty to ninety minutes. The number of pairings varied from five to ten per session based on the reinforcement schedule incorporated in each participant’s typical skill acquisition programming. After each daily treatment session, a MSWO assessment was conducted. Once the low-P1 either began to reliably move up the assessment hierarchy, or remained stable for a period of time, the pairing procedure was implemented using low-P2. Dependent measures included percent of opportunities selected during the daily MSWO preference assessments and time spent engaging with the item properly. These data were analyzed through visual analysis.

Post Test

Post-intervention paired choice preference assessment.

Following the treatment conditions for each individual low preference item, two post tests were conducted. First, a final paired choice preference assessment was administered, consisting of the same seven items (six for one participant) used in the initial preference assessment. This assessment was conducted in the same setting and
under identical conditions as the initial preference assessment. The results of the post
low-P1 preference assessment were used to identify item low-P2.

Post-intervention reinforcer assessment.

After the preference assessment, another reinforcer assessment was conducted
with the items in the array. These conditions were also identical to the initial reinforcer
assessments. These sessions were scored for reliability, in person by a graduate student
observer blind to the condition.

The post low-P1 preference and reinforcer assessments functioned as the pre-
tests of Item low-P2. Subsequently, the same treatment and post-intervention methods
listed above where employed with item low-P2.

Design

A multielement design was used to assess whether the target items increased in
both relative preference and their ability to function as reinforcers, with replication
across two items within-subject, and across three different participants

Interobserver Agreement

Reliability data were collected by trained graduate students in psychology during
reinforcer assessments, preference assessments, and treatment conditions. IOA data
were collected in 37.4% of all sessions conducted. During reinforcer assessments and
paired choice preference assessments, a second observer independently collected data
during 39.5% of sessions with a range of 32.8% to 45% across participants. Exact agreement coefficients for the three participants ranged from 99.2% to 100% for blocks placed in bucket during reinforcer assessments and 93.2% to 100% for total selection during paired choice preference assessments. In the MSWO preference assessments and treatment conditions a second observer independently collected data during 34.4% of sessions with a range of 31.1% to 41.8% across participants. Exact agreement coefficients for the three participants ranged from 94.5% to 100% for total selection during MSWO preference assessments, and 88.4% to 95.2% for time engaging with items during treatment conditions. Reliability was calculated using trial-by-trial methods.
Results

Reinforcer Assessment for Individuals with Severe Disabilities

Sam

Based on the school RAISD and interview data, Skittles and toy trains were identified as potential reinforcers for Sam at school. At the time of the assessment, Skittles were used for reinforcement by classroom staff. While toy trains had been reported as potential reinforcers for Sam, staff reported that the motivation to earn them in recent weeks had not been strong. The other items included in the assessment were GameBoy (identified as preferred at home but not at school), Slinkee (not preferred), iPod (no history with item), books (not preferred), and DVD (not preferred).

Tim

Based on RAISD and interview data, green chips (green vegetable chips) were identified as the only salient reinforcer for Tim at school. The other items included in the assessment were GameBoy (no history with item), iPod (no history with item), toy whale (no history with item), puzzle (not preferred), book (not preferred), and DVD (not preferred).
Johnny

Based on RAISD and interview data, video and edibles (chips and gummies) were identified as reinforcers for Johnny at school. Chips were chosen for use in this assessment. The other items included in the assessment were GameBoy (no history with item), baseball cards (no history with item), DVD (while this item was similar in topography to the video, the targeted item was age appropriate and there was no history with the item), magazine (not preferred), and blue pillow (preferred).

Pre Test

Sam

The initial preference assessment and reinforcer assessment resulted in differing information regarding the relative preference and reinforcing potency of various items.

PCPA.

Skittles were the most preferred item, as judged by the paired choice assessment (selected 100% of the time), followed by GameBoy (83%); Slinkee (66%); iPod (50%); and trains, book, and DVD (all 16%). (See Figure 1)
Reinforcer Assessment.

Skittles resulted in the least blocks placed in the bucket (32) followed by, trains (35), book (40), GameBoy (42), Slinkee (43), IPod (46), and DVD (47). (See Figure 2)
Based on these results (i.e., low to moderate preference across assessments), the book was identified as target item low-P1 for the initial pairing procedure. The trains were not used despite being chosen at equal rates in the preference assessment and resulting in less responding during the reinforcer assessment. Skittles were identified as item high-P with which to pair the low preference items based on interview data and the initial paired choice preference assessment.

The post-test paired choice preference assessment for the book resulted in the choice of the iPod as item low-P2. The iPod was chosen 0% of the time during the post-book paired choice assessment and thus was selected despite being chosen 50% of the time during the pre-treatment preference assessment.
Tim

PCPA.

The initial preference assessment resulted in green chips being chosen the most (100%) followed by, iPod (66%), DVD (50%), puzzle (50%), GameBoy (50%), and book (30%). The toy whale was removed from the array because it evoked an avoidance response from Tim. (See Figure 3)

![Tim - Initial Preference Assessment](image)

**Figure 3.** Percentage of selections by Tim during initial paired choice preference assessment.

Reinforcer Assessment.

The puzzle resulted in the least blocks placed in the bucket (17) followed by DVD (19), GameBoy (20), iPod (28), green chips (30), and book (31). (See Figure 4)
Figure 4. Blocks placed in bucket to earn access to items in Tim’s initial reinforcer assessment.

Based on these results, the puzzle was identified as low-P1 for the initial pairing procedure. The book was not used despite having the lowest rates in the preference assessment because it had the highest rate of responding allocated in the reinforcer assessment. Green chips were identified as the high-P item to pair with the targets, based on interview data and the initial paired choice preference assessment.

The post-test paired choice preference assessment for the puzzle resulted in the choice of the book as item low-P2. It was identified as a relatively low choice item on the PCPA and reinforcer assessments, as well as maintaining a low choice ranking on the MSWOs.
Johnny

PCPA.

Results from the PCPA were consistent with the interview results. Video and chips were the most chosen items (66%) as judged by the paired choice preference assessment, followed by a blue pillow (50%), magazine (50%), DVD (50%), baseball cards (50%), and GameBoy (16%). (see Figure 5)

![Figure 5. Percentage of selections by Johnny during initial paired choice preference assessment.](image)

**Reinforcer Assessment.**

During the reinforcer assessment, Johnny put the most blocks in the bucket to earn access to the video (45) followed by the chips (39), blue pillow (34), magazine (34), DVD (32), baseball cards (28), and GameBoy (3). (See Figure 6)
Figure 6. Blocks placed in bucket to earn access to items in Johnny’s initial reinforcer assessment.

Based on these results, the GameBoy was identified as low-P1 for the initial pairing procedure as it had the lowest response rate both in the preference and reinforcer assessment. Video was identified as the high-P item to pair with the targets based on agreement between interview data, the initial paired choice preference assessment, and the reinforcer assessment.

The pre-test preference assessment and reinforcer assessment results led to baseball cards as the selection for item low-P2. This item was chosen despite being the most preferred item in the post-GameBoy preference assessment.
Treatment

Sam

The book (*low-P1*) was initially paired with Skittles (*high-P*) during Sam’s treatment sessions. Sam engaged with the book 72% of the time over these sessions. Book preference began as the 7th ranked item in the paired choice assessment, and after five treatment sessions increased to an average rank of 5.4. (see Figure 7)

The iPod (*low-P2*), was paired with Skittles (*high-P*) during the second round of treatment sessions. Sam engaged with the iPod 65% of the time over these sessions. Sam’s MSWO selection of the iPod began as the 7th ranked item and increased to an average ranking of 6.4. The last two assessments resulted in the iPod ranked 7th, so the treatment phase was terminated after 5 sessions.
Figure 7. Sam’s post treatment session MSWO assessment results.

Tim

The puzzle (low-P1) was initially paired with the green chips (high-P) during Tim’s treatment sessions. Tim engaged with the puzzle 45% of the time over these sessions. After four sessions, his MSWO results for puzzle preference remained stable with an average ranking of 5.5. (see Figure 8)

The book (low-P2) was paired with green chips (high-P) during the second round of Tim’s treatment sessions. Tim engaged with the book 57% of the time during these sessions. Tim’s selection of the book increased from the 5th chosen item in the previous
paired choice preference assessment and the 7th chosen item after the second treatment session to the 4th ranked item after five treatment sessions.

![Graph showing preference changes over sessions]

Figure 8. Tim’s post treatment session MSWO assessment results.

**Johnny**

The GameBoy was initially chosen as item *low-P1* and paired with video (*high-P*) during Johnny’s treatment sessions. Johnny engaged with the GameBoy 91% of the time during these sessions. Johnny’s GameBoy preference began as 7th in the initial paired choice preference assessment and after five sessions increased to an average ranking of 2.8. (see Figure 9)

The baseball cards (*low-P2*) were paired with video (*high-P*) during the second round of Johnny’s treatment sessions. Johnny engaged with the baseball cards 87% of
the time during these sessions. Johnny’s baseball card preference began as 4th in the initial paired choice preference assessment and after five sessions increased to an average ranking of 3.0.

Figure 9. Johnny’s post treatment session MSWO assessment results.
Post Test

Sam

Table 2

Results of paired choice preference assessments and reinforcer assessments for Sam.

<table>
<thead>
<tr>
<th></th>
<th>PrePreference Assessment</th>
<th>PreReinforcer Assessment</th>
<th>Post Low-P1 Preference</th>
<th>Post Low-P1 Reinforcer</th>
<th>Post Low-P2 Preference</th>
<th>Post Low-P2 Reinforcer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Book - Low-P1</strong></td>
<td>16%</td>
<td>40</td>
<td>50%</td>
<td>34</td>
<td>33%</td>
<td>34</td>
</tr>
<tr>
<td><strong>iPod – Low-P2</strong></td>
<td>50%</td>
<td>46</td>
<td>0%</td>
<td>31</td>
<td>33%</td>
<td><strong>41</strong></td>
</tr>
<tr>
<td><strong>Skittles – High-P</strong></td>
<td>100%</td>
<td>32</td>
<td>83%</td>
<td>38</td>
<td>100%</td>
<td>47</td>
</tr>
</tbody>
</table>

Sam’s first post treatment paired choice preference assessment indicated that the book increased in preference, moving from being selected in 16% of opportunities and was ranked 5th of 7 items, to being selected 50% of the time and being ranked the 4th most preferred item (see Figure 10). Daily post treatment session MSWO assessments indicated that after an initial decrease in preference, the book made a stable increase to the fourth most preferred in the array. The reinforcer assessment results indicated a shift in relative response rate from the fifth most response effort allocated to access the item (40 blocks) to the third most response effort allocated to access the item (34 blocks) (see Figure 11).
Figure 10. Percentage of selections by Sam during first post treatment (Book) paired choice preference assessment.

Figure 11. Blocks placed in bucket by Sam during first post treatment (Book) reinforcer assessment.
The post treatment preference assessment for *low-P1* was used to identify item *low-P2* for pairing. Based on this assessment the iPod was chosen. Skittles remained the high preference item. Sam’s second post treatment paired choice preference assessment indicated that the iPod increased from being selected 0% of the time and the 7th ranked item (least chosen), to being selected 33% of the time and ranked 3rd most chosen. Although the rank order was higher (3rd compared to 4th), the iPod was still chosen less often than during the initial paired choice preference assessment (50% compared to 30% of opportunities). Daily post treatment MSWO preference assessments indicated that after an initial increase in preference from the 7th to the 5th most preferred item, the iPod remained stable as the 7th most preferred item in the array (least chosen). The post treatment reinforcer assessment for *low-P2*, indicated that the iPod ranked 5th for the amount of response effort allocated to access it. However, the specific amount of response effort given increased (31 to 41 blocks). This response effort was still lower than the initial reinforcer assessment when the third most response effort was allocated to access the item (46 blocks). Furthermore, a general increase was seen in responding during the third reinforcer assessments when Sam placed more blocks in the bucket for six out of the seven items in the array.

The post *low-P2* preference assessment also indicated a subsequent drop in responding to access the book from the fourth most selected (50%) to among the five items that were selected the third most (33%) (see Figure 12). This decrease was also witnessed on the daily MSWO preference assessments as the book moved from the 3rd
to the 6th most selected item. The book also decreased to the item with the least amount of response effort allocated to access the item on the post low-P2 reinforcer assessment (34 blocks) (see Figure 12). However, this was the same amount of responding allocated in the previous reinforcer assessment.

Figure 12. Percentage of selections by Sam during second post treatment (iPod) paired choice preference assessment.
Figure 13. Blocks placed in bucket by Sam during second post treatment (iPod) reinforcer assessment.

Table 3 – continued

Results of Tim’s paired choice preference assessments and reinforcer assessments.

<table>
<thead>
<tr>
<th></th>
<th>PrePreference Assessment</th>
<th>PreReinforcer Assessment</th>
<th>Post Low-P1 Preference</th>
<th>Post Low-P1 Reinforcer</th>
<th>Post Low-P2 Preference</th>
<th>Post Low-P2 Reinforcer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puzzle - Low-P1</td>
<td>50%</td>
<td>17</td>
<td>40%</td>
<td>6</td>
<td>33%</td>
<td>22</td>
</tr>
<tr>
<td>Book - Low-P2</td>
<td>33%</td>
<td>31</td>
<td>20%</td>
<td>2</td>
<td>60%</td>
<td>33</td>
</tr>
<tr>
<td>Green Chips – High-P</td>
<td>100%</td>
<td>30</td>
<td>80%</td>
<td>4</td>
<td>100%</td>
<td>34</td>
</tr>
</tbody>
</table>
Tim’s low-P1 post treatment paired choice preference assessment indicated that the puzzle decreased in preference, moving from being selected on 50% of opportunities and the 3rd of 7 items, to being selected on 40% of opportunities and being the 4th most preferred item (see Figure 12). Daily post treatment session MSWO assessments indicated no change in preference as the 4th most chosen item. The reinforcer assessment results indicated a shift in relative response rate from the least most response effort allocated to access the item (17 blocks) to one of the two items with the most (6 blocks) (see Figure 14).

![Tim - Post Treatment Preference Assessment for Low-P1 (Puzzle)](image)

Figure 14. Percentage of selections by Tim during first post treatment (Puzzle) paired choice preference assessment.
The low-P1 treatment preference assessment was used to identify item low-P2. Based on this assessment the book was chosen. Green chips were still used as item high-P. Tim’s low-P2 post-treatment paired choice preference assessment indicated that the book increased from being selected 20% of the time and chosen the 5th most among 7 items, to 60% of the time and chosen the 2nd most. This gain was significant after being chosen the least in the initial preference assessment. Daily post treatment MSWO preference assessments also supported a stable increase, moving from being selected 7th after the second day to 3rd by the end of treatment. The low-P2 post treatment reinforcer assessment indicated that the book increased in response effort allocated, from the 7th most (2 blocks) to the 3rd most to access the book (33 blocks).
This response effort was similar to the initial reinforcer assessment when the most response effort was allocated to access the item (31 blocks).

The low-P2 preference assessment also indicated a decrease in puzzle selection from the 3rd most (40%) to the 4th most (33%) selected item (see Figure 16). This decrease was also witnessed on the daily MSWO preference assessments as the puzzle moved from the 3rd item to the 6th item selected. The puzzle also decreased from the most response effort allocated in the low-P1 reinforcer assessment (6 blocks) to the fourth most in the low-P2 reinforcer assessment (22 blocks) (see Figure 17). However, Tim’s variable levels of responding across the reinforcer assessments left these relative differences difficult to interpret.

![Tim - Post Treatment Preference Assessment for Low-P2 (Book)](image)

Figure 16. Percentage of selections by Tim during the second post treatment (book) paired choice preference assessment.
Figure 17. Blocks placed in bucket by Tim during second post treatment (book) reinforcer assessment.

Table 4

Results of paired choice preference assessments and reinforcer assessments for Johnny.

Johnny

<table>
<thead>
<tr>
<th></th>
<th>PrePreference Assessment</th>
<th>PreReinforcer Assessment</th>
<th>Post Low-P1 Preference</th>
<th>Post Low-P1 Reinforcer</th>
<th>Post Low-P2 Preference</th>
<th>Post Low-P2 Reinforcer</th>
</tr>
</thead>
<tbody>
<tr>
<td>GameBoy - Low-P1</td>
<td>16%</td>
<td>3</td>
<td>66%</td>
<td>41</td>
<td>16%</td>
<td>19</td>
</tr>
<tr>
<td>BaseballCard – Low-P2</td>
<td>50%</td>
<td>28</td>
<td>66%</td>
<td>0</td>
<td>100%</td>
<td>22</td>
</tr>
<tr>
<td>Videos – High-P</td>
<td>66%</td>
<td>45</td>
<td>33%</td>
<td>43</td>
<td>50%</td>
<td>23</td>
</tr>
</tbody>
</table>
Johnny

Johnny’s low-P1 post-treatment paired choice preference assessment indicated that the GameBoy increased in preference, moving from being selected on 16% of opportunities and being the 7th out of 7 items, to being selected 66% of the time and being among the two items selected the 2nd most (see Figure 18). Daily post-treatment session MSWO assessments, indicated that GameBoy made a stable increase in preference, from the 5th item chosen to the 2nd item chosen. The low-P1 reinforcer assessment results indicated an increase in relative response rate from the 7th most response effort allocated to access the item (3 blocks) to the 2nd most response effort (41 blocks) (see Figure 19).

Figure 18. Percentage of selections by Johnny during first post treatment (GameBoy) paired choice preference assessment.
The low-\textit{P1} preference assessment was not used as the primary selection criteria for the target item low-\textit{P2}. The three least chosen items on the preference assessment were the items with which Johnny had a history of reinforcement (video, chips, and blue pillow). As a result, baseball cards were selected. This item was among two items selected the 4\textsuperscript{th} least amount of opportunities on the low-\textit{P1} preference assessment, and had less responding than the DVD (the second item selected equally) on the low-\textit{P1} reinforcer assessment. Video was still used as item high-\textit{P}.

Johnny’s low-\textit{P2} post-treatment paired choice preference assessment indicated that the baseball cards increased from being selected on 66\% of opportunities and chosen the 2\textsuperscript{nd} most (along with 2 other items), to 100\% of the time and selected the
most (see Figure 20). This gain was also significant after being among three items selected the 2nd most (50% of the time) in the initial preference assessment. Daily post treatment MSWO preference assessments indicated a stable increase, from the 4th item selected to the 2nd item selected. The low-P2 post treatment reinforcer assessment indicated that the baseball cards increased in response effort allocated, from among those items with the least response effort to access (0 blocks) to the 4th most effort to access (22 blocks) (see Figure 21). This response effort was similar in relative responding to the initial reinforcer assessment when 28 blocks were placed in the bucket; however, the responding was greater in relation to the other items in the array across assessments (6th most initially, 7th at low-P1, 4th at low-P2).

The low-P2 post-treatment preference assessment also exposed a decrease in GameBoy selection from among those selected the 2nd most (66%), to a return to pretreatment selection rates (among those selected the 7th most, 16%). This decrease was also witnessed on the daily MSWO preference assessments as the GameBoy moved from the 2nd item chosen in the final treatment session, to the 7th item chosen post treatment, and maintaining at similar levels. The GameBoy also shifted in response rate, from the 7th most response effort allocated to access the item in the pre-treatment reinforcer assessment (3 blocks), to the 2nd most response effort to access in the low-P1 reinforcer assessment (41 blocks). At the low-P2 reinforcer assessment it returned to among those with the 7th most responding (13 blocks).
Figure 20. Percentage of selections by Johnny during the second post treatment (baseball card) paired choice preference assessment.

Figure 21. Blocks placed in bucket by Johnny during second post treatment (baseball cards) reinforcer assessment.
Discussion

Reinforcement is a vital component of effective programming. The effectiveness of intervention is dependent on reinforcement procedures used to strengthen adaptive behavior and to address challenging behavior. Without sound reinforcement strategies, the ability to effectively motivate individuals with autism is compromised.

While reinforcement is a vital component in the implementation of ABA programming, many factors contribute to difficulties in using the strategy effectively. Children with autism often have a restricted range of effective reinforcers. In addition, communication deficits may leave them unable to disclose potential reinforcers. Furthermore, repeated use of the same reinforcer may result in satiation, which can interfere with skill acquisition. These difficulties can reduce the effectiveness of skill acquisition and behavior reduction programs.

The current study attempted to broaden the repertoire of reinforcers for children with Autistic Disorder. This has important implications for the implementation of Applied Behavior Analysis. Considering the importance of powerful reinforcers, having more of them at their disposal provides teachers more options during the intervention process. In other words, diversity of reinforcement can maximize the
effectiveness of treatment. As a result, it becomes exceedingly important to ensure that multiple types of powerful reinforcers are present.

The current study utilized a pairing procedure to alter the preferences of three children. The process started by conducting structured (i.e., the RAISD) and unstructured interviews to ascertain appropriate items to incorporate into an assessment. The identified items were used in pre-tests, including paired choice preference assessments and reinforcer assessments, to both obtain baseline data and identify appropriate items for the treatment condition. The treatment condition consisted of pairing a low preference item with access to a high preference item; each judged by the results of the preference and reinforcer assessments. Daily MSWO preference assessments were used to monitor changes in preference. The pairing procedure was subsequently replicated with a second low preference item. Treatment effects were evaluated with post-test paired choice preference assessments and reinforcer assessments.

Results revealed that overall, preference increased for five of the six items as judged by pre-post rankings in paired choice preference assessments. Preference also increased for four of the six items as judged by the daily post-treatment MSWO assessments. Reinforcement value increased for four of the six items as defined by a procedure in which participants received greater amounts of a reinforcer contingent on a task placing blocks in a bucket (i.e., the participants put more blocks in a bucket to
access four of the six items). While the items increased in relative preference and reinforcement quality in general, it is unclear whether all of these changes were clinically significant. For some participants, the rank order of low preference items increased in preference by one or two positions. For others, rank order increased, but percent of opportunities selected (for preference assessments) or blocks placed in the bucket (for reinforcer assessments) did not. Idiosyncratic patterns were identified for each targeted item.

Sam had gains in preference for each of the low preference items targeted in the pairing procedures (i.e., book and iPod). His response rate in the reinforcer assessment increased for one of the two items. While response rate in the reinforcement assessment and percentage of selection in preference assessment both increased for the second low preference item in Sam’s assessments, neither rate exceeded the original baseline reinforcer and preference assessments. Also of note, after the pairing was discontinued, the initial low preference item decreased to pretreatment levels.

For Tim, one of the two low preference items targeted increased in selection in preference assessments (i.e., puzzle and book). One of the two items also increased in response rates during the reinforcement assessments. Overall, Tim had the least clinically significant results among the participants. The pairing procedure was less effective with Tim, relative to the other participants. He also had the lowest rate of
engagement, during pairing sessions, with the low preference items (i.e., 45% of the time for the initial low preference and 57% for the second low preference item).

Johnny had gains in preference for each of the two low preference items used in the pairing procedure (i.e., GameBoy and baseball cards). Both of these items also increased in response rate in reinforcement assessments. Johnny had the most robust gains across these measures. He also had the highest rate of engagement with the low preference items (i.e., 91 and 87%). After the pairing was discontinued, Johnny’s initial low preference item decreased to pretreatment levels. Also of note, while response rate in the reinforcement assessment and percentage of selection in preference assessment both increased for the second low preference item, reinforcement rate did not exceed that rate from the reinforcement assessment after pairing for the initial low preference item.

During an analysis of the overall results, it became apparent that many of the increases in preference and reinforcement value were transient. For Johnny and Sam, the initial low preference item increased significantly in preference. For Johnny alone it also increased in reinforcement value. However, these changes in preference decreased to pre-treatment levels after the pairing procedure was stopped. Thus, the pairing procedure was initially successful in shifting the preferences and/or reinforcing ability of two of the three initial low preference items (the only items with follow-up
assessments). However, these gains did not maintain once the pairing procedure was withdrawn.

This study did not employ strategies to ensure maintenance. ABA programming focuses not on only the acquisition of skills, but the maintenance and generalization of those skills. The current study programmed for acquisition, but did not focus on the strategies that may have resulted in the maintenance of these increases in preference and reinforcing value. This may be best explained in the context of the concept of conditioned motivating operations (CMOs).

The effects of the pairing procedure used in the current investigation may have been related to a specific type of CMO, specifically, a surrogate CMO (CMO-S). Surrogate CMOs involve the pairing of a previously neutral stimulus with an unconditioned motivating operation (UMO) or another CMO (Michael, 1982). The neutral stimulus subsequently takes on the properties of the unconditioned reinforcer; however, the CMO-S or UMO need not be a tangible item. For example, assume that grilled cheese is a high preference item and tomato soup is a neutral stimulus (not preferred). If tomato soup is consistently paired with eating grilled cheese sandwiches, tomato soup may increase in preference in its own right. When the tomato soup is no longer paired with the grilled cheese, it may become less preferred over time. This CMO-S pairing effect may explain the initial increases in preference in for low
preference items and the subsequent loss of this effect when the pairing procedure ceased.

Items low-P 1 and 2 may have acquired their reinforcing effects (a CMO-S) while being paired with item high-P (the original UMO or CMO). Repeatedly pairing a low preference item with a high preference item may have increased the preference for the low preference item. Thus it can be reasoned that the changes in relative preference in item that were initially low preference, may have been the result of a surrogate conditioned motivating operation.

The concept of a CMO-S may also explain the subsequent return of the item to its previous level of preference. The literature indicates that the cessation of pairing (e.g., no longer pairing the tomato soup with the grilled cheese) is likely to result in the original, neutral stimulus returning to the level it was at before the pairing process. Once access to the high preference item is not granted following the presentation of the low preference item, the low preference item loses its CMO-S properties and regains its previous stimulus properties.

Despite a conceptual history dating back to 1957, there has been little research supporting the existence of surrogate CMOs (McGill, 1993). A recent study attempting to validate the experimental utility of CMO-S had ambiguous results (Michael, 1993). The current study builds on the literature by offering support for this phenomenon. It also builds on the literature in other ways.
The results of the current study are similar to those seen in Solberg et al. (2007). That study increased the preference for snack items of three children using a pairing procedure. For each of the three children, preferences faded after pairing. The present investigation also successfully shifted the preferences of items and similarly, the preferences did not maintain post-treatment. Solberg et al. (2007) obtained these results through the use of edibles and a simultaneous pairing procedure. Similar results were obtained in this study, using a sequential pairing procedure. In addition, we found that similar effects could be obtained using tangible items. This replication with differing items and methodology adds support to the stability of this phenomenon.

The results from the current investigation do differ somewhat from those seen in Hanley et al. (2003). In that study, level of preference was changed for a tangible item for two participants. The Hanley et al. study is the only study to date that not only shifted changes in preference, but maintained these changes at follow-up. This pattern was not observed in the Solberg et al. (2007) study, nor was it replicated in the current investigation. To date, two of the three investigations attempting to shift preference have only resulted in transient increases.

Given the importance of identifying novel reinforcers and the initial positive outcomes obtained in the current study, further research is warranted. Future research is necessary to ascertain whether increases in preference and reinforcement value can be maintained post-treatment. One possibility for achieving maintenance is the use of
an intermittent pairing procedure. To this point, no studies have implemented an intermittent pairing schedule following the initial pairing procedure to sustain changes in preference. This procedure could be implemented through systematic fading procedures after the pairing has increased reinforcement value. In other words, the presentation of the low-P item could be followed with the presentation of the high-P item intermittently over time. The development of new items to use as reinforcers for children with autism is important, but it provides no utility if the items immediately revert to neutral stimuli.

Future studies should also identify the best method to implement pairing. Past studies have focused on simultaneous pairing to increase preference. Feeding literature has identified this method as superior to sequential pairing in order to increase food intake. The current study utilized sequential pairing in hopes of maintaining gains in reinforcement value. Simultaneous pairing divides attention between multiple stimuli. For example, if a preferred video (a high preference item) is simultaneously paired with a book (a low preference item), the book may become preferred through association; however, the individual’s attention will likely be directed towards the video not the book. By not attending to the stimulus properties of the book, an individual may be less likely to develop a preference for the book in isolation, leaving increases in reinforcement value less likely to maintain post-treatment. In the current study, sequential pairing was not successful in maintaining increases in reinforcement value; therefore, simultaneous methods may be more appropriate.
The current study has important implications for the treatment of children with autism. Reinforcement is a vital component of ABA treatment programs, however these children typically have a restricted range of reinforcers. This study successfully developed novel reinforcers for three children with autism. With these new options for treatment, skill acquisition will be facilitated, behaviors can be more easily managed, and programming will be better able to reach its goals.
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### Table 1

*Items used in study for each participant and reported preference rating.*

<table>
<thead>
<tr>
<th>Student</th>
<th>High Preference Items</th>
<th>Low Preference Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sam</td>
<td>Skittles, Trains</td>
<td>iPod, GameBoy, Slinkee, Book</td>
</tr>
<tr>
<td>Tim</td>
<td>Green Chips</td>
<td>iPod, DVD, Puzzle, Book, GameBoy</td>
</tr>
<tr>
<td>Johnny</td>
<td>Video, Chips, Blue Pillow</td>
<td>Magazine, DVD, Baseball Cards, GameBoy</td>
</tr>
</tbody>
</table>

### Table 2

*Results of paired choice preference assessments and reinforcer assessments for Sam.*

<table>
<thead>
<tr>
<th>Item</th>
<th>PrePreference Assessment</th>
<th>PreReinforcer Assessment</th>
<th>Post Low-P1 Preference</th>
<th>Post Low-P1 Reinforcer</th>
<th>Post Low-P2 Preference</th>
<th>Post Low-P2 Reinforcer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Book - Low-P1</td>
<td>16%</td>
<td>40</td>
<td>50%</td>
<td>34</td>
<td>33%</td>
<td>34</td>
</tr>
<tr>
<td>iPod - Low-P2</td>
<td>50%</td>
<td>46</td>
<td>0%</td>
<td>31</td>
<td>33%</td>
<td>41</td>
</tr>
<tr>
<td>Skittles – High-P</td>
<td>100%</td>
<td>32</td>
<td>83%</td>
<td>38</td>
<td>100%</td>
<td>47</td>
</tr>
</tbody>
</table>
Table 3 - continued

Results of Tim’s paired choice preference assessments and reinforcer assessments.

<table>
<thead>
<tr>
<th></th>
<th>PrePreference Assessment</th>
<th>PreReinforcer Assessment</th>
<th>Post Low-P1 Preference</th>
<th>Post Low-P1 Reinforcer</th>
<th>Post Low-P2 Preference</th>
<th>Post Low-P2 Reinforcer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Puzzle - Low-P1</strong></td>
<td>50%</td>
<td>17</td>
<td>40%</td>
<td>6</td>
<td>33%</td>
<td>22</td>
</tr>
<tr>
<td><strong>Book – Low-P2</strong></td>
<td>33%</td>
<td>31</td>
<td>20%</td>
<td>2</td>
<td>60%</td>
<td>33</td>
</tr>
<tr>
<td><strong>Green Chips – High-P</strong></td>
<td>100%</td>
<td>30</td>
<td>80%</td>
<td>4</td>
<td>100%</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 4

Results of paired choice preference assessments and reinforcer assessments for Johnny.

<table>
<thead>
<tr>
<th></th>
<th>PrePreference Assessment</th>
<th>PreReinforcer Assessment</th>
<th>Post Low-P1 Preference</th>
<th>Post Low-P1 Reinforcer</th>
<th>Post Low-P2 Preference</th>
<th>Post Low-P2 Reinforcer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GameBoy - Low-P1</strong></td>
<td>16%</td>
<td>3</td>
<td>66%</td>
<td>41</td>
<td>16%</td>
<td>19</td>
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<tr>
<td><strong>BaseballCard – Low-P2</strong></td>
<td>50%</td>
<td>28</td>
<td>66%</td>
<td>0</td>
<td>100%</td>
<td>22</td>
</tr>
<tr>
<td><strong>Videos – High-P</strong></td>
<td>66%</td>
<td>45</td>
<td>33%</td>
<td>43</td>
<td>50%</td>
<td>23</td>
</tr>
</tbody>
</table>
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References


