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Evaluating and Increasing the Range of Reinforcers for Individuals with Autism Spectrum Disorder

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EVALUATING AND INCREASING THE RANGE OF REINFORCERS FOR INDIVIDUALS WITH AUTISM
SPECTRUM DISORDER

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Psychology

by

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To Trip and Elle whose smiles melt my heart and to Jimmy who holds it.

For Lauren Savoy Olinde, in memoriam, who will always inspire.

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Abstract

Prior research has demonstrated the utility of several preference-assessment methodologies to identify stimuli more likely to function as reinforcers for individuals with limited verbal repertoires. However, differing results have been obtained from studies evaluating the reinforcement effects of stimuli identified as high preference by one assessment method but low preference by another assessment method. The first focus of the project was to evaluate the reinforcing efficacy of edible and leisure items based on predictions from preference assessments. Results indicated that edible and leisure items approached frequently during a single-stimulus preference assessment but infrequently during a paired-stimulus preference assessment produced less reinforcing efficacy in comparison to edible and leisure items approached frequently during both assessments. However, items identified as moderately or low preferred based on the results of paired-stimulus assessments still maintained responding during reinforcer assessments for 4 out of 5 items assessed. Implications of these results for the utility and interpretation of two separate preference-assessment methodologies are discussed. The second focus of the project was to evaluate if preference and/or reinforcing efficacy could be increased through conditioning procedures for individuals with limited interest in activities (a core symptom of Autism Spectrum Disorder). Responding during preference and reinforcer assessments did not increase following differential reinforcement of appropriate toy play with low preference leisure items. Potential factors in producing this lack of increase in preference or reinforcer efficacy are discussed.

Chapter 1

Introduction

Review of the Literature

Prevalence of Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is a neurodevelopment disorder characterized by the core symptoms of social-communication deficits and restricted, repetitive patterns of behavior, interests, or activities (American Psychiatric Association, 2013). The most recent estimates from the Center for Disease Control and Prevention (CDC)'s Autism and Developmental Disabilities Monitoring (ADDM) Network place the prevalence of ASD at 1.13% or one in 88 children (Center for Disease Control and Prevention, 2012). The prevalence of ASD has been on the rise over the last decade, and the most recent estimate represents a considerable increase from the CDC's estimate of ASD prevalence from 2000 (0.67% or one in 150 children; CDC, 2012). Autism Spectrum Disorder diagnoses have been reported in all racial and ethnic groups as well as across all socioeconomic statuses. Additionally, males are diagnosed with ASD almost five times more than females (CDC, 2012).

Effectiveness of Reinforcement-Based Programs to Address ASD Symptoms

The rise of ASD prevalence has been accompanied by a call for effective treatments to address ASD symptoms (Ringdahl, Kopelman, & Falcomata, 2009). The National Institutes of Health (NIH) recognizes a number of therapies and interventions are available; however, the organization cautions parents in the use of treatments without support from scientific studies (National Institutes of Health, National Institute of Neurological Disorders and Stroke, 2009). Instead, the NIH advocates for early intervention, multi-disciplinary interventions that meet the

needs of the individual child, and evidence-based practice (NIH, NINDS, 2009). One treatment approach for individuals with ASD that not only has received support from the NIH but also has produced abundant empirical support is the use of strategies based on the science of applied behavior analysis (ABA; Matson & Neal, 2009; NIH, NINDS, 2009).

Applied behavior analysis refers to a methodology with the defining treatment characteristics of applied, behavioral, analytic, technological, systematic, effective, and having generality (Baer, Wolf, & Risley, 1968). That is, ABA is a science on which a host of treatments are based rather than a specific treatment package, and a number of treatment strategies utilizing ABA principles have been identified to address the core symptoms of ASD (Matson & Neal, 2009). One such group of treatments described in the ABA literature involves the addition or removal of a stimulus following a target behavior which results in an increased probability that the target behavior will occur in the future (Ringdahl et al., 2009). These treatments are referred to as reinforcement-based procedures and have become "the foundation for programs that address the behavioral deficits and excesses exhibited by individuals with autism" (p. 18).

Examples of commonly used reinforcement-based procedures included token economies, differential reinforcement, and non-contingent reinforcement (NCR). Token economy systems of reinforcement involve the exchange of tokens, points, stickers, etc. for access to preferred items/activities or removal of non-preferred items/activities. Differential reinforcement refers to providing access to preferred items/activities or removal of non-preferred items/activities for one behavior or set of behaviors while withholding these contingencies for another behavior or set of behaviors. Non-contingent reinforcement, which

is also referred to as environmental enrichment in the literature, involves providing free access to highly-preferred stimuli to potentially compete with (and thus reduce) maladaptive behavior. The inclusion of these and similar reinforcement-based procedures has resulted in increased adaptive behaviors (e.g., communication, accurate task responding, eye-contact, on-task behavior) and decreased problem behaviors (e.g., aggressive, destructive, self-injurious, and stereotypic behaviors) for children with ASD (Tiger, Toussaint, & Kliebert, 2009; Ringdahl et al., 2009).

Significance of Reinforcer Selection

Reinforcers incorporated into reinforcement-based programs are often selected based on the function of problem behavior as identified by functional assessment (e.g., an analogue functional analysis; Iwata, Dorsey, Silfer, Bauman, & Richman, 1982/1984). However, reinforcers that are not based on the function of problem behavior are also selected for inclusion in some instances, especially when a) problem behavior is maintained by automatic reinforcement (i.e., maintained by the direct sensory consequences of the behavior rather than the delivery of preferred items/activities or removal of non-preferred items/activities; Skinner, 1957; Vaughn & Michael, 1982), b) the function-based reinforcer is not available or feasible to deliver, and/or c) the reinforcement-based program was developed to increase adaptive behavior for an individual who exhibits behavioral deficits (e.g., communication delays, deficits in independent functioning or other skill areas, etc.) but exhibits little to no maladaptive behaviors of excess (e.g., aggressive, disruptive, self-injurious behavior, etc.). In these instances, reinforcers are typically selected based on the child's preference for items/activities, and the success of reinforcement-based programs that rely on such reinforcers may be linked to

ensuring highly-preferred items/activities with which the child readily engages are provided (Tiger et al., 2009; Vollmer, Marcus, & LeBlanc, 1994). For example, Volmer et al., 1994 compared two reinforcement-based treatments to reduce automatically-maintained self-injurious behavior (SIB) that incorporated either high-preference or low-preference items and found reductions in SIB when and only when high-preference items were used.

Because the ability to reliably identify reinforcers is instrumental to the success of reinforcement-based programs, to date, a considerable amount of research has been dedicated to identifying and evaluating reinforcers for individuals with and without disabilities (Matson & Neal, 2009). Experimental research has focused on 1) methods of assessing preference for individuals with limited verbal repertoires, 2) evaluating the absolute and relative reinforcer efficacy of preferred stimuli, and 3) the effects of conditioning neutral stimuli to enhance preference or reinforcing properties. All of these areas could benefit from expansion and represent valuable work to identify effective positive reinforcers which may be essential to the reduction of problem behavior, increase of appropriate behavior, and/or acquisition of new skills for children with autism.

Methods of Assessing Preference

A number of methods to identify preference for stimuli have been developed and validated as successful in identifying effective reinforcers for individuals with limited verbal repertoires (DeLeon & Iwata, 1996; Fisher et al., 1992; Pace et al., 1985; Roane, Vollmer, Ringdahl, & Marcus, 1998; Windsor, Piche ´, & Locke, 1994). These methods tend to be similar in how preference for stimuli is defined but tend to differ in how stimuli are presented. That is, preference is generally determined by recording approach responses to or interactions with a

variety of stimuli and comparing responding across stimuli; however, the format in which stimuli are presented has varied across studies. Variations range from single-stimulus presentations (Pace et al., 1985), paired-stimulus presentations (Fisher et al., 1992), and grouped-array presentations including multiple-stimulus presentations, multiple-stimulus-without-replacement presentations, and free-operant presentations (DeLeon & Iwata, 1996; Roane et al., 1998; Windsor et al., 1994).

A formal method for identifying potential reinforcers was first evaluated by Pace et al. (1985) by repeatedly exposing six individuals to 16 stimuli and measuring approach behaviors. At the start of each trial, a single stimulus was presented to the participant. The stimulus was provided briefly if approached, and trials continued in a counterbalanced order until each stimulus was presented for a total of 10 times. Differential approach responses were observed across stimuli for all participants, and stimuli approached on at least 80% of trials were labeled preferred while stimuli approached on 50% or less of trials were considered non-preferred. The reinforcing efficacy of preferred and non-preferred stimuli was subsequently evaluated through a reinforcer assessment for all participants. During the reinforcer assessment, baseline conditions with no programmed consequences for completing a target response were alternated with conditions of access to either a preferred or non-preferred item contingent upon the occurrence of a target response in a reversal design. Overall, increases in percentage of correct target responses were observed during preferred conditions relative to baseline and non-preferred conditions suggesting the assessment procedure was effective at identifying stimuli that will likely serve as reinforcers.

Although the development of a formal method to identify potential reinforcers represents a significant advancement for behavior analysts working with individuals with disabilities, one potential limitation of a single-stimulus presentation is the inability to differentiate preference in the event that most or all stimuli are frequently approached. This differentiation may be important in determining reinforcer efficacy (i.e., all preferred items may not serve as equal reinforcers). To address this potential limitation, Fisher et al. (1992) evaluated an extension of the method formulated by Pace et al. (1985) using a concurrent-operant paradigm. To do this, these authors first replicated the Pace et al. (1985) procedures with four participants. Next, the same stimuli were presented in pairs rather than singly. At the start of each trial, two stimuli were present, but only the first stimulus approached was provided while the non-approached stimulus was removed. Each stimulus was paired with every other stimulus once in a randomized order for a total of 15 presentations for each stimulus. Differential approach responses were observed across stimuli for two participants during the single-stimulus assessments; however, all or most stimuli were approached on at least 80% of trials for the remaining two participants. In contrast, differential approach responses were observed across stimuli for all participants during the paired-stimulus assessments. The reinforcing efficacy of stimuli approached on at least 80% of trials during both assessments (i.e., high-high stimuli) and stimuli approached on at least 75% of trials during the paired-stimulus assessment but 60% or fewer trials during the single-stimulus assessments (i.e., SP-high stimuli) was subsequently evaluated through a reinforcer assessment for all participants. During the reinforcer assessment, stimuli were assessed during baseline conditions with no programmed consequences and a concurrent-operant condition where

participants gained access to a high-high stimulus or a SP-high stimulus by engaging in a target response associated with the stimulus in a reversal design. Higher levels of responding to the target response associated with access to the high-high stimulus were observed for all participants suggesting the paired-stimulus assessment better predicted which stimuli would produce greater relative reinforcing efficacy.

The single-stimulus and paired-stimulus preference-assessment methods developed by Pace et al. (1985) and Fisher et al. (1992) laid the groundwork for direct assessment of preference and are still widely used by clinicians to identify effective positive reinforcers; however, additional variations of these methods have been evaluated utilizing grouped-array presentations (DeLeon & Iwata, 1996; Roane et al., 1998; Windsor et al., 1994). For example, Windsor et al. (1994) evaluated a multiple-stimulus method in which all items being assessed were available in the array on each trial. At the start of each trial, all stimuli were present, but only the first stimulus approached was provided while the non-approached stimuli were removed. They compared their method to the paired-stimulus method and overall found similar results with an assessment that took less time to administer. However, this method shares a similar potential limitation with the single-stimulus preference assessment of lack of differentiation across stimuli. Although lack of differentiation is a potential shared shortcoming of both the single-stimulus method and the multiple-stimulus method, this limitation presents itself differently in a significant way. Differentiation may not result following a single-stimulus preference assessment due to all or most items approached and concluding all or most stimuli would be effective as reinforcers (potentially producing false-positive results); whereas, differentiation may not result following a multiple-stimulus preference assessment due to the

same stimuli approached across all or most trials concluding stimuli never approached would not be effective as reinforcers (potentially producing false-negative results).

To address the potential limitation of lack of differentiation while preserving the advantage of the brief nature of the multiple-stimulus preference assessment, DeLeon and Iwata (1996) extended the method developed by Windsor et al. (1994) by utilizing the same presentation format (i.e., an array with all items being assessed available) but modifying subsequent trials to exclude stimuli previously selected. By including this feature, the procedure, named a multiple-stimulus-without-replacement preference assessment, inherently produced a discrete ranking similar to the inherent nature of the paired-stimulus procedure. This method was also confirmed to effectively identify reinforcers for target responses through subsequent reinforcer assessments.

Roane et al. (1998) also developed a method to extend the multiple-stimulus format and potentially address the discrete-ranking problem by evaluating a 5-min free-operant assessment. During the assessment, all stimuli being assessed were placed in a circle on a table, the participant had free access to the stimuli, and observers recorded the percentage of 10-s intervals with any item manipulation. Results were compared to results of a paired-stimulus assessment conducted with the identical items, and the free-operant assessment identified the same most-preferred item as the paired-stimulus assessment for approximately half of participants while results differed across the two assessments for the remaining participants. Despite these differences, results of subsequent reinforcer assessments indicated the free-operant assessment successfully identified stimuli that functioned as reinforcers. In addition, the free-operant assessments were conducted in less time and associated with fewer problem

behaviors than the paired-stimulus assessments. Although this method does not inherently result in a discrete ranking as the paired-stimulus and multiple-stimulus-without-replacement methods produce, the authors cite their 5-min free-operant methodology may circumvent this need by allowing for frequent updates of preference.

The aforementioned studies have yielded several successful methodologies to identify potential reinforcers for individuals with limited verbal repertoires, each with associated strengths and weaknesses. Single-stimulus preference assessments are advantageous in that by presenting each stimulus singly rather than in a concurrent-operant paradigm, one can glean information about each stimulus without the potential reinforcing efficacy masked by the presence of another more-preferred stimulus. That is, single-stimulus assessments may be best suited to identify all stimuli that might serve as reinforcers. However, results of preference assessments utilizing a single-stimulus presentation may be prone to false positives (i.e., all items approached may not serve as reinforcers) and do not provide information regarding relative preference of stimuli (i.e., stimuli equally approached may not necessarily serve as equal reinforcers). While the paired-stimulus and multiple-stimulus-without-replacement procedures have addressed these issues by utilizing methods that inherently develop a discrete rank-order of stimuli, collectively, methods that utilize paired or group arrays may be prone to false negatives (i.e., items never or infrequently approached may serve as reinforcers in the absence of alternative stimuli).

Evaluating Reinforcer Efficacy

Information regarding both the absolute and relative reinforcing efficacy of preferred stimuli may be extremely valuable to clinicians designing interventions to decrease maladaptive

behavior and/or increase adaptive behavior in that by knowing the range of stimuli that function as reinforcers and to what degree, one may be better equipped to develop strategies with lasting positive outcomes. Several studies have evaluated the relative and absolute reinforcement effects of stimuli identified as potential reinforcers during preference assessments by conducting reinforcer assessments for stimuli selected based on the results of paired-stimulus preference assessments alone or the combined results of single-stimulus preference assessments and paired-stimulus preference assessments of identical stimuli (Francisco, Borrero, & Sy, 2008; Glover, Roane, Kadey, & Grow, 2008; Roscoe, Iwata, & Kahng, 1999; Penrod, Wallace, & Dyer, 2008). As part of their investigations, each study examined to what degree (if any) relatively less-preferred stimuli would maintain responding in the absence of relatively more-preferred stimuli.

The degree to which relatively less-preferred stimuli function as reinforcers was first evaluated by Roscoe et al. (1999). These authors conducted separate single-stimulus and paired-stimulus preference assessments of identical edible items, replicating the Pace et al. (1985) and Fisher et al. (1992) procedures, and then evaluated the reinforcing effects of stimuli for which the results of both assessments were similar and stimuli for which the different preference-assessment methodologies yielded differing results. During the single-stimulus preference assessments, six out of eight participants approached all stimuli during 100% of trials, and the remaining two participants approached nine out of ten and seven out of ten stimuli during 100% of trials, respectively. In contrast, all participants demonstrated both high and low levels of approach across items during the paired-stimulus preference assessments. Stimuli identified as high preference (i.e., approached during at least 75% of trials) by both

assessments (HP stimuli) and stimuli identified as high preference by the single-stimulus assessment but low preference (i.e., approached during fewer than 25% of trials) by the paired-stimuli assessment (LP stimuli) were selected for subsequent assessment of reinforcer efficacy. The relative reinforcer efficacy of selected stimuli was evaluated under concurrent-schedule arrangements where participants were provided access to either HP or LP stimuli contingent on responding to an associated press panel or writing pad (i.e., panel pressing was targeted for all participant except one participant whose target response was letter writing) on a fixed-ratio (FR) 1 schedule of reinforcement. Higher rates of responding to the panel or pad associated with the HP stimuli were observed compared to baseline (where there were no programmed consequences for responses) for seven out of eight participants. In addition, almost exclusive responding to the panel or pad associated with the HP stimuli was observed for these participants resulting in little change in responding to the panel or pad associated with the LP stimuli from baseline. Following this evaluation of relative reinforcer efficacy utilizing a concurrent-operant arrangement, the absolute reinforcer efficacy of LP stimuli was evaluated for these seven participants under single-schedule arrangements where only access to LP stimuli was provided contingent upon target responding on an FR 1 schedule. Under single-schedule arrangements, LP stimuli maintained responding at similar rates to those obtained with contingent HP stimuli for six out of seven participants.

Results of the Roscoe et al. (1999) study suggested a single-stimulus method of preference and reinforcer assessment may be especially beneficial for individuals for whom highly-preferred stimuli are difficult to identify in that these methods may identify a reinforcement effect even if a relative reinforcement effect is not observed in a concurrent

arrangement. In addition, the authors suggested LP stimuli and HP stimuli may be similar in their ability to maintain responding based on the response rates observed (i.e., similar response rates with LP stimuli under the single-schedule arrangement were observed compared to response rates with HP stimuli under the concurrent-schedule arrangement). However, responses were reinforced under low-schedule requirements (i.e., FR 1) which may have influenced the reinforcer-efficacy outcomes of the assessment. That is, an equivalent efficacy observed under dense schedules of reinforcement may differentiate as response requirement increase (DeLeon, Iwata, Goh, & Worsdell, 1997; Tustin, 1994).

In a later study, Glover et al. (2008) also evaluated the reinforcing efficacy of HP and LP stimuli under single- and concurrent- schedule arrangements; however, a slightly different method was utilized. Rather than assessing reinforcer efficacy under FR 1 schedules of reinforcement, reinforcer efficacy was assessed under FR schedules yoked to breakpoints obtained under progressive-ratio (PR) schedules of reinforcement. These authors first conducted a progressive-ratio analysis which involved increasing response requirements across the course of an observation until responding ceased, similar to the procedures described by Roane, Lerman, and Vorndran (2001). This analysis was conducted to establish breakpoints (i.e., the highest schedule requirement completed during a single observation) to which subsequent schedule requirements were yoked. Higher breakpoints were obtained for HP stimuli than for LP stimuli across all participants. Following the progressive-ratio analysis, responding was evaluated under single- (LP stimuli only) and concurrent- (both LP and HP stimuli) FR schedule arrangements ranging from FR 1 to FR 3 for LP stimuli and FR 16 to FR 23 for HP stimuli (i.e., schedules varied across participants depending on the breakpoints previously obtained).

Almost exclusive responding to HP stimuli was observed even when HP stimuli were presented under lean schedules of reinforcement and LP stimuli were presented under dense schedules of reinforcement during concurrent arrangements. In addition, when presented in a single-schedule arrangement, LP items only maintained responding for one out of three participants.

These latter results differ from the results of Roscoe et al. (1999) in that regardless of presentation (single or concurrent), LP stimuli did not function as effective reinforcers consistently for two out of three participants. For one of these participants, the LP stimulus was somewhat effective as a reinforcer under a single-schedule arrangement; however, this effect was not replicated when the same arrangement was presented in a reversal design. One possible explanation for differing results is the schedules of reinforcement utilized. Roscoe et al. (1999) utilized FR 1 schedules for all participants; whereas, the schedules utilized by Glover et al. (2008) ranged from FR 1 to FR 3. However, noteworthy is that the participant with the most discrepant schedule (i.e., FR 3) showed the most similar results to Roscoe et al. (1999) while the results of the two participants with denser schedules (i.e., FR 1 and FR 2) were inconsistent with Roscoe et al. (1999).

A second possibility for differing results across the Roscoe et al. (1999) and Glover et al. (2008) studies relates to the stimuli included for assessment. Only edible items were assessed by Roscoe et al. (1999); whereas, Glover et al. (2008) assessed only non-edible leisure items. Findings from a study by DeLeon, Iwata, and Roscoe (1997) suggest edible items may generally have a higher reinforcing efficacy than non-edible leisure items. These authors conducted separate preference assessments of edible and non-edible items, and then conducted a third preference assessment that included the highest-preferred edible and highest-preferred non-

edible items from the initial assessments. For 12 out of 14 participants, a stronger preference for edible items was observed when both edible and non-edible items were assessed simultaneously.

Two additional studies published in the same year, Fransisco et al. (2008) and Penrod et al. (2008) also evaluated the absolute and relative reinforcer value of LP stimuli using progressive-ratio schedules; however, these studies produced differing results from Glover et al.'s (2008) evaluation regarding the absolute reinforcing efficacy of LP stimuli. These differences are especially evident when examining the various breakpoints obtained across studies. Fransisco et al.'s (2008) results showed LP stimuli functioned as effective reinforcers under single-arrangement progressive-ratio schedules for two participants for whom a progressive-ratio analysis was conducted. For a third participant in this study, a reinforcement effect was not demonstrated for LP items under an FR 1 schedule of reinforcement in a prior analysis; therefore, this participant was excluded from the progressive-ratio analysis. Unlike Glover et al. (2008) who observed mean breakpoints between 1 and 3 for their participants when responding was associated with LP stimuli, considerably higher mean breakpoints were observed for Fransisco et al.'s (2008) participants (i.e., 6.5 and 16, respectively). Penrod et al.'s (2008) results also showed LP stimuli functioned as effective reinforcers under single-arrangement progressive-ratio schedules for their four participants. One participant demonstrated a similar mean breakpoint to Glover et al.'s (2008) participants (i.e., a mean breakpoint of 3); whereas, three of Penrod et al.'s (2008) participants demonstrated higher mean breakpoints (i.e., 4, 6, and 7, respectively), indicating higher reinforcer efficacies for LP stimuli than observed in Glover et al.'s (2008) study. One notable difference in method

between the Penrod et al. (2008) and Francisco et al. (2008) studies and the Glover et al. (2008) study which may have contributed to the differing results, as noted as different between Glover et al.'s (2008) and Roscoe et al.'s (1999) methods, surrounds the stimuli included for assessment. As with Roscoe et al.'s (1999) participants, only edible stimuli were assessed for Francisco et al.'s (2008) and Penrod et al.'s (2008) participants; whereas, Glover et al. (2008) evaluated non-edible leisure stimuli. Lastly, although results differed regarding the absolute reinforcer efficacy of LP stimuli, the results of Francisco et al. (2008) and Penrod et al. (2008) studies were similar to both Glover et al. (2008) and Roscoe et al. (1999) regarding the relative reinforcing efficacy of LP stimuli in that HP stimuli generally produced greater reinforcing efficacy than LP in concurrent-operant arrangements (Francisco et al., 2008) or when comparing breakpoints from single-operant progressive-ratio arrangements (Penrod et al., 2008).

Collectively, the Roscoe et al. (1999), Glover et al. (2008), Penrod et al. (2008), and Francisco et al. (2008) studies produced similar results regarding the relative reinforcing efficacy of HP and LP stimuli but mixed results regarding the absolute reinforcing efficacy of LP stimuli. That is, all studies demonstrated that under concurrent-operant arrangements or single-operant progressive-ratio arrangements, HP stimuli served as more effective reinforcers than LP stimuli; however, only two of the four studies concluded LP stimuli served as effective reinforcers in the absence of HP stimuli under increased schedule requirements (Francisco et al., 2008; Penrod et al., 2008) with the remaining two studies either producing opposing results (Glover et al., 2008) or only evaluating reinforcement effects under continuous schedules of reinforcement (Roscoe et al., 1999). In addition, non-edible leisure stimuli were only assessed in

one of the four studies (Glover et al., 2008), and this study produced discrepant results from those that only evaluated edible stimuli. The limited number of studies evaluating the reinforcing efficacy of LP and HP stimuli under increased scheduled requirements as well as the further limited number of these studies evaluating the reinforcer efficacy of non-edible leisure stimuli represent opportunities for expansion of this line of research. Examining these facets will be one focus of the current investigation.

Importance of Enhancing Preference and Reinforcer Efficacy

Identifying effective reinforcers for individuals with disabilities may be instrumental in teaching and in developing behavioral interventions to maintain appropriate behavior and decrease inappropriate behavior (Ringdahl et al., 2009). Although the advancement of assessment technologies to reliably identify preference and reinforcer efficacy has aided in the selection of stimuli to include in teaching and intervention, finding a variety of effective reinforcers may still prove difficult for individuals with limited interest in activities (a core symptom of ASD). Exclusive preference for one or few stimuli or activities may be problematic in that this pattern of preference may limit educational, social, and other potentially enjoyable activities (Hanley, Iwata, Roscoe, Thompson, & Lindberg, 2003; Leaf et al., 2012). Specifically, the availability of a variety of reinforcers may be important to achieve behavior change in the event that the highest-preferred item or activity cannot be feasibly delivered in certain settings or over long periods of time (Francisco et al., 2007; Roscoe et al., 1999). Additionally, exclusive preference for a certain item/activity may compete with the opportunity to access alternative sources of stimulation from other items or activities (Hanley et al., 2003). Thus, the need exists

for methods not only designed to identify preference and reinforcer efficacy but also to enhance preference and reinforcer efficacy of neutral stimuli.

Several studies have examined the effects of respondent conditioning (i.e., pairing a neutral stimuli with an established reinforcer) and operant conditioning (i.e., providing an established reinforcer contingent on engaging in a targeted response) on previously neutral stimuli, such as toys and activities, to establish these stimuli as conditioned reinforcers (Hanley, Iwata, & Lindberg, 1999; Miguel, Carr, & Michael, 2002; Smith, Michael, & Sundberg, 1996; Sundberg, Michael, Partington, & Sundberg, 1996; Yoon & Bennett, 2000). Furthermore, the effects of such conditioned reinforcers on adaptive and maladaptive behaviors have been examined in several additional studies (Eason, White, & Newsome, 1982; Delgado, Greer, Speckman, & Goswami, 2009; Greer, Becker, Saxe, & Mirabella, 1985; Nuzzolo-Gomez, Leonard, Ortiz, Rivera, & Greer, 2002; Tsai & Greer, 2006). Specifically, these studies have centered on the effects of conditioning sounds as reinforcers on increasing vocal behavior (Smith et al., 1996; Sundberg et al., 1996; Miguel et al., 2002; Yoon & Bennett, 2000), the effects of conditioned reinforcers on decreasing stereotypic behavior (Eason et al., 1982; Greer et al., 1985; Nuzzolo-Gomez et al., 2002) and increasing the rate of skill acquisition (Delgado et al., 2009; Tsai & Greer, 2006), and the effects of conditioning procedures on altering preference for socially-desirable activities (Hanley et al., 1999; Hanley et al., 2003; Tsai & Greer, 2006).

Conditioning Sounds as Reinforcers to Increase Vocal Behavior

Most children acquire the language of their caregivers without direct instruction or reinforcement-based programs (Sundberg et al., 1996); however, for children diagnosed with ASD, interventions to increase vocal behavior may be pertinent (Miguel et. al., 2002). In 1996,

Sundberg et al. experimentally demonstrated the effects of a stimulus-stimulus pairing procedure to increase the vocal behavior of four children with language delays and one child with typical development. These authors evaluated the pairing procedure by recording vocalizations emitted by participants during pre-pairing (baseline), pairing, and post-pairing observations. During pre- and post-pairing, the participant's vocalizations were recorded under conditions of no reinforcement (i.e., the observer(s) did not provide any programmed social reinforcement following vocal behavior). During pairing, a target vocalization (i.e., a specific sound, word, or phrase) was paired with an established reinforcer (e.g., tickles, clapping, praise, a leisure activity, etc.). This was accomplished by a familiar adult approaching the participant, emitting the target vocalization, and immediately providing the preferred form of attention or activity. Approximately 15 pairings per minute were conducted during 1 to 2 min periods for all participants with the number of target vocalizations ranging from one sound paired during one session to 30 words and phrases paired during approximately 40 sessions across a six-month period. The pairing process was successful at increasing the overall frequency of vocal behavior for all participants and resulted in an increase of almost all target vocalizations. That is, 26 out of 30 targeted vocalizations increased after pairing for one participant, eight out of ten targeted vocalizations increased after pairing for a second participant, and all targeted vocalizations increased after pairing for the remaining three participants.

The results showed that pairing neutral sounds, words, and phrases with established reinforcers resulted in an increase of those sounds, words, and phrases. The authors attributed the increase in the frequency of vocal behavior to conditioned reinforcement in that the

auditory product of the vocalizations automatically strengthened vocal behavior following pairing with an established reinforcer.

The hypothesis that the effects demonstrated by Sundberg et al. (1996) were a result of conditioned reinforcement was supported by a follow-up study conducted by Smith et al. (1996) whose manipulations ruled out the possibility of an increase in vocal behavior following pairing as a function of imitation. These authors evaluated the pairing procedures utilized by Sundberg et al. (1996) for two infant participants with typical development and extended this work by including additional conditions of neutral and negative pairing for one of the infant participants. During neutral pairing, the familiar adult approached the child and emitted the target vocalization; however, no programmed reinforcement was provided. During negative pairing, the familiar adult approached the child, emitted the target vocalization, and immediately delivered a reprimand. Target vocalizations increased following positive pairing (i.e., the pairing procedures described by Sundberg et al., 1996) and decreased following negative pairing. In addition, the participant did not emit the target vocalization following neutral pairing. These results highlight the contribution of the delivery of an established reinforcer following the target vocalization emitted by the adult to the effect of increased vocal behavior as opposed to the increase in vocal behavior resulting from mere increased exposure to the target vocalization from a model.

Sundberg et al. (1996) and Smith et al. (1996) showed that young individuals with a broad range of abilities (i.e., children with and without language delays and infants with typical development) can increase their vocal repertoires through a procedure involving pairing a neutral stimulus (e.g., sound, word, phrase) with preferred activities. Miguel et al. (2002)

extended this area of research by replicating these effects with children diagnosed with ASD.

The pairing procedure was effective at increasing targeted one-syllable utterances of two out of three male participants with ASD in this study evaluating the effectiveness of conditioning sounds as reinforcers to increase vocal behavior with a relevant population.

Conditioning Leisure Items as Reinforcers for Play to Replace Stereotypic Behavior

In addition to increasing vocal behavior, the effects of conditioning neutral stimuli as reinforcers on decreasing problem behavior have been evaluated by several researchers. For example, Eason et al. (1982) examined the effects of teaching play with toys on reducing the stereotypic behaviors of children with autism and intellectual disabilities by providing praise and edibles immediately following appropriate play. Rates of stereotypy and appropriate toy play were assessed during baseline and posttest conditions without extrinsic reinforcement, and a decrease in stereotypy and an increase in independent, appropriate toy play were observed following teaching sessions (i.e., posttest) for all participants. In addition, these results maintained during follow-up observations conducted two and three months after training. These researchers showed that pairing established reinforcers (i.e., praise, edibles) with previously non-preferred items (i.e., toys) resulted in an increase in appropriate play behavior which effectively replaced the previously-preferred stereotypic behavior.

In a similar evaluation, Greer et al. (1985) conditioned non-preferred leisure items of young adults who demonstrated low rates of appropriate play and high rates of stereotypy during free operant (baseline) conditions prior to training. Following training sessions consisting of pairing appropriate toy play with established reinforcers, rates of toy play increased and rates of stereotypy decreased for all participants. Results maintained six months later without

additional training. These researchers, like Eason et al. (1982), also showed that conditioning reinforcers, such as leisure items, may result in an effective treatment for stereotypic behavior.

In a more recent evaluation, Nuzzolo-Gomez et al. (2002) demonstrated these same effects with preschool children with autism. In this study, a specific leisure item (i.e., books) was conditioned for one participant while several leisure items (e.g., blocks, balls, puzzles, dolls, stuffed animals, etc.) were conditioned for three participants. As with the aforementioned studies, all participants demonstrated an increase in toy play post-conditioning; however, a decrease in stereotypy was only observed for three out of the four participants. It is worth noting that the participant whose stereotypy did not differ pre- and post-conditioning demonstrated low rates of toy play prior to conditioning but did not demonstrate high rates of stereotypy prior to conditioning.

Conditioning Leisure Items as Reinforcers to Accelerate Learning

In addition to examining the effects of conditioned reinforcers on problem behavior, several authors have evaluated the effects of conditioned reinforcers on learning. In 2006, Tsai and Greer investigated the effects of conditioning books on the number of trials four preschoolers required to acquire a reading task (i.e., textual responding). In this experiment, the authors first measured each preschoolers' engagement with toys and books during a free-operant arrangement. Prior to conditioning, all preschoolers exclusively engaged with toys and did not allocate any engagement to books. In addition to assessing engagement with books and toys, the authors assessed how many trials each preschooler required to achieve mastery of vocal responses to a set of five sight words to establish a pre-conditioning baseline. Next, books were paired with praise and edibles until a shift in preference from toys to books was observed

during free-operant probes. Following conditioning, a second set of five sight words were taught using identical teaching procedures as utilized prior to conditioning, and a decrease in the number of trials to mastery was observed for all participants.

In a similar evaluation, Delgado et al. (2009) studied the effects of conditioning print stimuli (e.g., flashcards with letters, shapes, or pictures) on the acquisition of match-to-sample skills for three preschoolers with disabilities. The three participants were selected for inclusion in this study following observation of slower acquisition rates for 2D match-to-sample tasks than for other academic tasks. These slower rates were observed during instructional programs utilizing a host of research-based tactics including time-delay fading, positional prompts, and simultaneously presenting a foil stimulus (e.g., blank flashcard, 3D object) with the target stimuli (Cooper, Heron, & Heward, 2007). The authors also report these preschoolers did not visually attend to the print stimuli used in their respective 2D match-to-sample programs. Following conditioning (i.e., pairing looking at print stimuli with praise and edibles), results were not unlike the result of Tsai and Greer (2006) in that all participants showed both an increase in looking at print stimuli and a more rapid acquisition of 2D match-to-sample skills.

Conditioning Low-Preference Activities to Shift Preference

Conditioning procedures have also been utilized to modify established preferences by making initially less preferred but more socially appropriate activities more reinforcing. Hanley et al. (1999) examined the activity preferences of four individuals with developmental disabilities and then shifted the preferences of three individuals utilizing a conditioning procedure (the fourth individual was not a participant in this part of the study). For example, after evaluating one participant's preferences, it was determined that lying in bed listening to

music was a highly-preferred activity; whereas, socializing with others in a recreation room was a less preferred activity for this participant. However, this preference was reversed following pairing socializing in the recreation room with the delivery of Reese's peanut butter cups. Similarly, the preferences of the additional participants were shifted from listening to music to completing bedroom chores and from lounging to washing dishes, respectively, by delivering highly-preferred edibles and music contingent upon engagement in the initially less preferred activity. Noteworthy, is that the participants' preferences were only evaluated under conditions of reinforcement for engagement in the initially less preferred activity and not under conditions without additional reinforcement; therefore, it is unclear whether the initially less preferred activity had acquired reinforcing properties.

A separate study by Hanley et al. (2003) sought to demonstrate if a preference shift following pairing would maintain once reinforcement was withdrawn. In this study, low preference activities were paired with the noncontingent delivery of highly-preferred edibles for two participants with developmental disabilities during 5-min pairing sessions. Pairing sessions continued until a preference shift was observed during test sessions where both the initially high preference and the initially low preference activities were concurrently available. That is, once the initially low preference activity was selected more frequently than the initially high preference activity, pairing sessions were terminated. Following the termination of pairing sessions, a preference shift of activities maintained under conditions without additional reinforcement for both participants. These results replicate those of Hanley et al. (1999), and extend this line of research by demonstrating durable preference shifts following pairing. The

authors cite the acquisition of reinforcing properties for engagement in low preference activities as a plausible explanation for their results.

Conditioning neutral stimuli has shown to be advantageous in increasing vocal behavior and play behavior, decreasing problem behavior, and increasing preference for socially-appropriate activities; however, conditioning procedures may also serve as a method to increase the number of items or activities that will serve as effective reinforcers for individuals in need of reinforcement-based programs. The degree to which previously neutral or low preference leisure items/activities will serve as reinforcers for the completion of other tasks following prompting and embedded reinforcement for engagement with those initially low preference items/activities represents an opportunity to expand of this line of research and will also be a focus of the current investigation. Additionally, preference shifts have been evaluated in previous studies, but these evaluations have typically involved comparisons in a concurrent or free operant paradigm. Examinations by Eason et al. (1982), Greer et al. (1985), and Nuzzolo-Gomez et al. (2002) of participants' preferences for engagement with leisure items opposed to stereotypy and examinations by Hanley et al. (1999) and Hanley et al. (2003) of participants' preferences for an initially less preferred but more socially appropriate activity opposed to an initially highly preferred but less socially appropriate activity are examples of these types of comparisons. In contrast to concurrent or free operant paradigms, the current investigation seeks to determine the degree to which preference may be altered following differential reinforcement of appropriate engagement with initially low preference items/activities by evaluating rank-order shifts of repeated paired-stimulus preference assessments.

Purpose and Rationale

An important educational goal for any student is to expand preferences for socially - appropriate activities (Greer et al., 1985). This goal may be especially challenging for individuals with ASD given a restricted pattern of behavior, interests, or activities is a defining characteristic of the disorder. One step in achieving this goal is to first reliably identify stimuli that are preferred and serve as effective reinforcers for children with limited interests. If few stimuli are identified as reinforcers, developing a larger variety of stimuli that serve as reinforcers may enhance education opportunities in that a) a larger pool of reinforcers would be available for inclusion in reinforcement-based programs and b) the individual may contact more naturally occurring reinforcers for engaging in social and educational activities. Previous work has demonstrated the utility of several preference assessment methodologies to identify stimuli more likely to function as reinforcers for individuals with limited verbal repertoires by utilizing distinct stimuli presentation (i.e., single, paired, or grouped) and examining approach responses (DeLeon & Iwata, 1996; Fisher et al., 1992; Pace, et al., 1985; Roane et al., 1998; Windsor et al., 1994). However, differing results have been obtained from studies evaluating the reinforcement effects of stimuli identified as high preference by one assessment method but low preference by another assessment method. That is, stimuli that meet this description were found to serve as effective reinforcers under increased schedule requirements in the absence of high preference items in two evaluations (Francisco et al., 2008; Penrod et al., 2008) but did not demonstrate reinforcing properties in a third evaluation (Glover et al., 2008). A fourth study, and the earliest evaluation of this type, also concluded stimuli identified as high preference by one assessment method but low preference by another assessment method

could serve as effective reinforcers; however, this study utilized continuous schedules of reinforcement which is often impractical or unachievable in the natural environment.

One potential explanation for these inconsistencies is variation in the type of stimuli assessed. While Roscoe et al. (1999), Fransisco et al. (2008), and Penrod et al. (2008) all assessed only edible items and produced similar results (i.e., low preference edibles were found to serve as reinforcers in the absence of high preference edibles), Glover et al. (2008) assessed only leisure items, and their results were not consistent with the results of evaluations of edible items (i.e., low preference leisure items did not maintained responding in the absence of high preference leisure items). The limited number of studies evaluating the absolute and relative reinforcer efficacy of non-edible leisure items/activities represents an opportunity for expansion of this line of research.

The purpose of Experiment 1 was to expand the literature on identifying effective reinforcers for children with ASD by studying the relationship between the results of separate preference assessment methodologies and reinforcer efficacy for edible and leisure stimuli. Specifically, the absolute and relative reinforcer efficacy of edible and leisure items was evaluated following single-stimulus and paired-stimulus preference assessments through reinforcer assessments utilizing progressive-ratio schedules of reinforcement to determine if and to what extent items identified as low preference in a paired-stimulus preference assessment but high preference in a single-stimulus preference assessment will serve as reinforcers in the absence of alternatives.

It was hypothesized that the results of the single-stimulus preference assessments would be predictive of absolute reinforcer efficacy while the results of the paired-stimulus

preference assessments would be predictive of relative reinforcer efficacy. That is, items identified as high preference in a single-stimulus preference assessment but low preference in a paired-stimulus preference assessment would serve as reinforcers but not to the same extent as items identified as high preference in both assessments. It was also predicted that larger discrepancies in relative reinforcer efficacy will be observed with leisure items than with edible items, and that low preference leisure item may show little to no reinforcing efficacy. Results have implications for the utility and interpretation of two separate preference-assessment methodologies and may help guide clinical decision making regarding which methodology will best target the objective for assessment (i.e., to identify several items that may serve as reinforcers or to identify the most potent reinforcer).

The identification of items that may serve as reinforcers may be essential to the success of any reinforcement-based intervention program (Tiger et al., 2009). Thus, not only is it important to ensure accurate assessment of preferred items/activities, but it also may be of equal importance to expand limited preferences to provide effective services. That is, while client preferences should always be taken into consideration when designing educational or habilitative programs, some patterns of preference, such as preference for a very limited number of items/activities or preference for socially undesirable activities, may be challenging (Hanley et al., 2003). In these instances, implementing strategies to expand preference and enhance the reinforcing efficacy of low preference items may lead to better treatment outcomes for individuals with limited interests.

Several studies have shown respondent and operant conditioning procedures can be used to establish previously neutral or low preference stimuli as conditioned reinforcers (Eason

et al., 1982; Delgado et al., 2009; Greer et al., 1985; Hanley et al., 1999; Hanley et al., 2003; Miguel et al., 2002; Nuzzolo-Gomez et al., 2002; Smith et al., 1996; Sundberg et al., 1996; Tsai & Greer, 2006; Yoon & Bennett, 2000). These studies have mainly focused on the effects of conditioned reinforcement on decreasing specific maladaptive behaviors and/or increasing specific adaptive behaviors, such as replacing stereotypy with play (Eason et al., 1982; Greer et al., 1985; Nuzzolo-Gomez et al., 2002) or increasing vocal behavior (Smith et al., 1996; Sundberg et al., 1996; Miguel et al., 2002; Yoon & Bennett, 2000), and less attention has been dedicated to evaluating the degree to which conditioned low preference leisure items/activities will serve as reinforcers for the completion of other tasks and the degree to which preference may be altered following conditioning procedures.

The purpose of Experiment 2 was to determine if preference and/or reinforcer efficacy would be altered following differential reinforcement of appropriate toy play with initially low preference leisure items. Specifically, low preference leisure items/activities that demonstrate little to no reinforcer efficacy during a progressive-ratio reinforcer assessment will be selected for conditioning. During conditioning sessions, appropriate toy play was prompted and reinforced by providing praise and high preference edible and/or leisure items for play. These sessions continued until high levels of appropriate play with the initially low preference items were observed. Preference shifts were evaluated by conducting paired-stimulus preference assessments pre- and post-conditioning, and reinforcer efficacy was evaluated by conducting progressive-ratio reinforcer assessments pre- and post-conditioning. It was hypothesized that both preference and reinforcer efficacy would increase following intervention. Results have implications for enhancing the preference and reinforcing efficacy of stimuli previously

identified as low preference and associated with little to no reinforcing efficacy and their use in reinforcement-based interventions.

Chapter 2 Method

General Method

Participants

Participants were recruited from a behavior treatment clinic, Marcus Autism Center, which provides behavioral assessment and treatment services for children who exhibit challenging behaviors and/or skill deficits. Inclusion criteria for Experiment 1 consisted of children, adolescents, or young adults (ages three years, zero months to 21 years, 11 months) with a professional diagnosis of Autism Spectrum Disorder (ASD) who might benefit from preference assessments, reinforcer assessments, or intervention to increase toy-play skills. Inclusion criteria for Experiment 2 consisted of individuals who meet Experiment 1 inclusion criteria and either a) whose caregiver(s) reported a restricted interest in leisure items and deficits in toy-play skills (e.g., shows little interest in most leisure items, does not show interest in a variety of leisure items/activities, interest is restricted to a specific type of play, etc.) or b) a restricted interest in leisure items and deficits in toy play skills are identified during Experiment 1. Exclusion criteria for both experiments consisted of challenging behaviors that required greater than a 1:1 staffing ratio or challenging behaviors that required a behavioral treatment plan that could not be implemented by one person while simultaneously engaging in other activities. These exclusion criteria were included to decrease the probability of problem behavior that interfered with procedural fidelity or participant performance during any experimental condition.

Kara, Peter, and Barry participated in Experiment 1; and Barbara, Peter, and Barry participated in Experiment 2. Kara (Experiment 1 only) was a 9-year-old female admitted to the Marcus Autism Center's Brief Behavioral Intervention Program (BBI) with the primary goal of assessing and treating hair-pulling. She also engaged in grabbing, hitting, screaming, crying, and dropping. Kara used some speech in single words and also used gestures and leading by the hand to communicate. She was recruited for participation towards the end of her admission in the program. Although some decreases in problem behaviors were observed during the program, the primary researcher and the BBI Program Manager agreed that she could benefit from reinforcer assessments in hopes that additional treatment gains might be made if potent leisure or edible reinforcers could be identified.

Peter (Experiments 1 and 2) was a 5-year-old male admitted to the Marcus Autism Center's Day Treatment Program for the assessment and treatment of aggressive behaviors in the form of hitting, kicking, scratching, pinching, biting, and pulling/pushing others; disruptive behaviors in the form of throwing, swiping, or ripping items and surface kicking; and eloping behaviors. Peter's primary form of communication was speech in full sentences. He was recruited for participation towards the end of his admission following interview with his mother regarding toy-play skills deficits, and he continued to participate after a successful discharge from the Day Treatment Program.

Barry (Experiment 1 and 2) was a 7-year-old male admitted to the Marcus Autism Center's Bowel Movement (BM) Training Program for the treatment of encopresis. Barry emitted some words and sounds, but his primary form of communication was gestures or leading by the hand. He was recruited following observation of restricted interest in leisure

items and deficits in toy-play skills during initial assessments conducted during the BM Training Program. He participated during his admission and following a successful discharge. In addition to ASD, Barry presented with a Feeding Disorder and was also receiving services through the Marcus Autism Center Outpatient Feeding Program to address his feeding difficulties. Due to this diagnosis, Barry was excluded from all assessments that included edible items.

Barbara (Experiment 2 only) was an 8-year-old female admitted to the Marcus Autism Center's Toilet Training Programs (BM and Urine) to address encopresis and enuresis. Barbara communicated through gestures or leading by the hand. She was recruited following observation of restricted interest in leisure items and deficits in toy-play skills during initial assessments conducted during the Toilet Training Programs. She participated throughout her admissions.

Two additional participants, Kacie and Kevin, began Experiment 1 procedures but were excluded due to problem behavior and a visual impairment. Kacie was a 19-year-old-female who engaged in spit play with materials during assessments, was difficult to transition back to the work area following any instance of elopement from the area due to aggressive behavior, and who had an undisclosed visual impairment. Kevin was a 14-year-old-male who engaged in dropping and could not be lifted safely by one person to transition to the work area upon arrival or following breaks. Alternative options for services were discussed with both families.

Written informed parental consent was obtained for all participants. Written or verbal informed assent was not obtained for any participant due to cognitive impairments. In addition, all participating therapists were notified of the study's purpose and procedural responsibilities

prior to participation. Therapists were required to have at least a high-school diploma and one year of undergraduate study in psychology.

Setting and Materials

Both experiments were conducted in unused rooms or areas at the Center or the participant's home (Barbara only). Rooms with limited distractions were selected for each participant and included a table and chairs, as appropriate. A plastic container was used for each child to store edible and leisure items, research protocols, and data collection forms. Session frequency varied based on participants' availability from brief (i.e., 5 – 20 min), daily visits with the primary researchers during natural breaks from the participant's day program to weekly or bi-weekly longer appointments (i.e., typically 1-2 hours but sometimes 6-8 hours). To control for potential variability in key establishing operations, targeted edible and leisure items were restricted for at least 1 hour prior to appointments.

Experiment 1

Experiment 1 evaluated the reinforcing efficacy of edible and leisure items based on predictions from preference assessments for children with ASD. The following research questions for Experiment 1 were considered: (1) will edible items approached frequently during a single-stimulus preference assessment but infrequently during a paired-stimulus preference assessment have similar reinforcing efficacy as edible items approached frequently during both assessments? (2) will leisure items approached frequently during single-stimulus preference assessment but infrequently during a paired-stimulus preference assessment have similar reinforcing efficacy as leisure items approached frequently during both assessments?

Method

Dependent measures

The primary dependent measures for the current study were approach response during preference assessments and the number of target responses and reinforcer administrations during reinforcer assessments. During preference assessments, approach responses were defined as any contact of any part of the participant's hand with the item. During reinforcer assessments, target responses were selected based on material availability and the individual skill sets of participants. A card exchange was selected for Kara and button-pressing was selected for Peter and Barry, initially. Following high rates of button-pressing responding during baseline for Peter (see Reinforcer Assessments for a detailed description of procedures), Peter's target response was modified to a card touch because it was hypothesized that the audible sound produced by the button maintained responding in the absence of programmed consequences.

A card exchange (Kara) was defined as any instance in which Kara moved the card resulting in the card contacting the palm side of the therapist's hand or any instant in which Kara inserted the card between two of the therapist's fingers or between the therapist's thumb and palm.

A card touch (Peter) was defined as any instance in which Peter's finger(s), thumb, hand, or wrist – palm side down made contact with the colored portion of the card from a distance of 1" or greater. Contact with a fist or with the back of the hand was excluded, and at least 50% of the palm was required to make contact with the colored portion if the palm was used. If the

colored portion of the card was hit simultaneously with both hands, this response was scored as one instance.

A button press (Barry) was defined as any instance in which Barry's finger(s), thumb, hand or wrist – palm side down made contact with the button resulting in an audible clicking sound. Contact with a fist or the back of the hand was excluded, and if the button was hit simultaneously with both hands, this response was scored as one instance.

Because the response requirement to gain access to preferred items was systematically increased using a progressive-ratio (PR) schedule of reinforcement during reinforcer assessments, break points (i.e., the highest schedule value completed) were used to evaluate the relative reinforcing efficacy of target stimuli. Target responses were collected during baseline, high/high, and high/low conditions, and number of reinforcer administrations were collected during high/high and high/low conditions (see Reinforcer Assessments for detailed descriptions of conditions).

Experimental design

The reinforcing effects of contingent preferred items on target responding were examined utilizing demand curve analysis (Bickel, Marsh, & Carroll, 2000). At least 3 baseline sessions were conducted, and baseline sessions continued until 1 or fewer responses per session are observed across 3 consecutive sessions with no increasing trend (as determined by visual inspection of the data). Following baseline, test sessions (i.e., high/high and high/low conditions) were conducted in a random order until either a) three consecutive sessions with the identical breakpoint were observed or b) five consecutive sessions with breakpoints of 2 or fewer variations and no increasing or decreasing trend were observed. Sessions continued until

both items met criteria simultaneously. Different colored buttons/cards and matching colored containers during edible conditions were associated with each condition for Peter and Barry to promote discrimination between conditions. For Kara, a picture of each item was printed on the card used for target responding, and clear, plastic bags for edibles were used to promote discrimination across conditions.

Indirect Assessments of Preference

Parents of the participants were administered the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD), a structured parent interview identifying potentially reinforcing items for children with limited verbal repertoires (Fisher, Piazza, Bowman, & Amari, 1996). Questions on the RAISD are categorized to identify a wide variety of items that produce different types of sensory stimulation (e.g., visual, auditory, tactile), and as part of the RAISD, caregivers were asked to create a rank-ordered list of preferred items. In addition, Peter and Barry's caregivers were asked to nominate 5 leisure items with which they reported a play-skill deficit and would like to see an increase in skills. A variety of edible and leisure items were selected for inclusion in subsequent direct assessments of preference based on the results of the RAISD and additional informal reports from caregivers regarding child preferences. That is, high, medium, and low ranked items were included to ensure a continuum of preference is included (i.e., low preferred as well as high-preferred items). At least one caregiver nominated item, as described above, was included for Peter and Barry.

Direct Assessments of Preference

Preference for the same 10 edible and 10 leisure items identified through the indirect assessments described above were assessed across two distinct preference-assessment

methodologies (i.e., single stimulus and paired stimulus) for each participant (leisure only for Barry). That is, Kara and Peter experienced four separate preference assessments: a single-stimulus preference assessment of leisure items, a single-stimulus preference assessment of edible items, a paired-stimulus preference assessment of leisure items, and a paired-stimulus preference assessment. Preference for edible items was assessed separately from preference for leisure items to control for displacement (DeLeon, Iwata, & Roscoe, 1997). Barry experienced two separate preference assessments: a single-stimulus and paired-stimulus preference assessment of leisure items. The order of assessments was randomly selected.

Item sampling. Prior to the first edible and first leisure preference assessment, the therapist allowed the child to sample each item by labeling each item, placing each item in the child's hand, and providing 5-s free access to the item. Because participants were already exposed to the items during the first edible and leisure preference assessments, sampling of each item was not conducted prior to subsequent preference assessments.

Single-stimulus preference assessments. Single-stimulus preference assessments using procedures similar to those described by Pace et al. (1985) were conducted to assess preference for edible and leisure items. Five sessions were conducted during each assessment. Each session consisted of 20 trials during which 4 items was presented 5 times each. Sequence of item presentation was random but counterbalanced within and across sessions to control for order effects and to ensure all items are presented a total of 10 times each. At the start of each trial, one item was placed approximately 0.6 m in front of the participant. Edible items were placed on a plate or napkin and only a small portion of each edible was provided per trial. The therapist stated the name of the item as it was placed in front of the child but otherwise

restricted his/her attention. If the participant approaches the item within 5 s, he or she was allowed to consume the item if edible or allowed 20-s access to the item if leisure. If consumption of an edible item did not occur within 1 min, the item was removed. Following consumption of (or 1 minute access to) edible items or 20-s access to leisure items, the next trial begin. If the participant did not approach the item within 5 s, the therapist placed the item in the child's hand or up to the child's lips and vocally prompted consumption (e.g., "You can eat the ____/play with the ____"). After 5 s, leisure items were removed and edible items were removed if not consumed. The item was immediately presented again. If the participant did not approach the item during the second presentation, the item was removed; and a new trial began. Following the assessments, approach percentages were calculated for each item by dividing the number of trials during which an approach response was observed by the number of trials during which the item was presented and multiplying by 100%.

Paired-stimulus preference assessments. Paired-stimulus preference assessments using procedures similar to those described by Fisher et al. (1992) were also conducted to assess preference for the edible and leisure. At the start of each trial, two items were placed approximately 0.6 m in front of the participant and approximately 0.3 m away from each other. Edible items were placed on separate but identical plates or napkins, and only a small portion of each edible was provided per trial. The therapist labeled each item as it was placed in front of the child, delivered the prompt to "pick one," and then restricted his/her attention. If the participant approached an item within 5 s, the therapist immediately removed the non-approached item and allowed the participant to consume the approached item if edible and allowed the participant 20-s access to the approached item if leisure. If an edible item was not

consumed within 1 min, it was removed. Following consumption of (or 1 minute access to) edible items or 20-s access to leisure items, the next trial began. If the participant attempted to approach both stimuli simultaneously, the therapist blocked the participant from touching the items and presented the trial again. If the participant approached both items simultaneously during the second presentation, both items were removed; and a new trial began. If the participant did not approach either item within 5 s, the therapist placed each item in the child's hand for 5 s and vocally prompted consumption (e.g., "You can eat the _____/play with the _____"). After 5-s access to each item, the pair was immediately presented again. If the participant did not approach either item during the second presentation, the items were removed; and a new trial began. Pairs of items were presented in a random order, and trials continued until every item was paired with every other item once. Following the assessments, approach percentages were calculated for each item by dividing the number of trials during which an approach response was observed by the number of trials during which the item was presented and multiplying by 100%.

Reinforcer Assessments

Following indirect and direct assessments of preference, assessments to determine if selected items included in the preference assessments might function as reinforcers were conducted as the primary analysis of Experiment 1. Kara and Peter experienced separate reinforcer assessments for edible and leisure items, and Barry experienced a reinforcer assessments for leisure items. The order of assessments was randomly selected.

Target stimuli. Based on the results of the preference assessments four target items were identified according to the high- and low-preference item-selection procedures described

by Roscoe et al., 1999 for Kara and Peter. One edible and one leisure item for each of these participants was selected that was identified by both the single-stimulus and paired-stimulus preference assessments to be high-preferred/high-preferred (i.e., high percentages of approach responses were observed during both assessments). These items were referred to as high/high items. One edible and one leisure item for Kara and Peter were also selected that produced discrepant results across the single-stimulus and paired-stimulus preference assessments (i.e., high percentages of approach responses were observed during the single-stimulus preference assessment and low percentages of approach responses were observed the paired-stimulus preference assessment). These items were referred to as high/low items. Modifications to the aforementioned target stimuli selection procedures were made for Barry based on his direct preference assessment results, and these modifications and rationale for modifications are described in Chapter IV.

Baseline. Baseline sessions were conducted to rule out the possibility that the target response was maintained by automatic reinforcement. The therapist placed the card or button in front of the participant and physically-guided the target response by telling the participant, “If you push the button/exchange the card like this, you don’t get anything.” The therapist then replaced the card (Kara only), restricted his/her attention, and ignored all target responses. The session was terminated after 1 min without a target response. Peter and Barry were provided with a 5-min break outside of the session room or area prior to the start of the next session. Due to dropping that occurred during transitions, Kara was provided with a 5-min break inside the session room prior to the start of the next session. These breaks were conducted with a therapist other than the therapist who conducted sessions of the current study with Kara, and

with moderately preferred items/activities brought into the room. Baseline sessions were conducted until 3 consecutive sessions during which 1 or fewer target response occurred and no increasing trend in responding was observed. This criterion was met within 10 sessions by all participants (following the aforementioned change in target response for Peter). These data are not presented in Chapter IV but are available upon request.

Pre-session exposure. Immediately prior to test sessions, one forced-exposure trial was conducted similar to baseline procedures. That is, the therapist physically guided a target response and then delivered the target stimulus while saying “If you push the button/exchange the card like this, you get a (target stimulus).” Following consumption of (or 1 minute access to) edible items or 20-s access to leisure items, the session and data collection began.

Test Conditions. During test conditions, the therapist placed the card or button in front of the participant, placed the stimulus behind the button, and restricted his or her attention. The therapist also restricted access to the target stimulus while keeping it within sight of the participant. If the participant emitted the target response, the therapist provided him/her with the target stimulus according to a multiplicative PR schedule (i.e., 1 to 2, 4, 8, 16 responses, and so on). In other words, the participant was required to emit the target response once to contact reinforcement, initially. Following consumption of a small piece (or 1 minute access to a small piece) of an edible item or 20-s access to a leisure item, the participant was required to press the button twice to contact reinforcement (then four times, then eight, and so on) such that the response requirement progressively increases multiplicatively across trials within the session. The session was terminated after 1 min without the target response. Peter and Barry were provided with a 5-min break outside of the session room, and Kara was provided with a 5-

min break inside the session room, as described during baseline, prior to the start of the next session.

Data Collection, Inter-Observer Agreement, and Procedural Fidelity

Data were collected using pen and paper data collection forms during preference assessments and using real-time data-collection software, Behavioral Data Analysis and Collections System (BDACS), programmed on desktop or laptop computers during reinforcer assessments. Due to a system crash, data were collected using pen and paper data collection forms during some sessions of Barry's reinforcer assessment. Data were collected during sessions by the therapist (preference assessments only), from an observation area by a second researcher, or via video scoring in the event a second researcher was unavailable. Two sessions were excluded from analyses due to loss of video. Data collected via pen and paper data collection forms by the therapist during these excluded sessions (breakpoints only) are available upon request.

To assess interobserver agreement (IOA), a second observer collected data during 52% of trials during preference assessments. Agreement was defined as both observers recording an approach response for the item presented during single-stimulus trials and both observers recording an approach response for the same item and no approach response for the item's pair during paired-stimulus trials. IOA was calculated by dividing agreements by agreements plus disagreement and multiplying by 100%. Observers were considered trained following discussion of operational definitions and data collection procedures with the primary researcher. Agreement was observed during 97.6% of trials.

During reinforcer assessments, a second observer collected data during 39% of Kara's sessions, 27% of Peter's sessions, and 33% of Barry's sessions. Agreement was defined as the number of 10-s bins in which two observers scored the same frequency of a target behavior divided by the number of 10-s bins with agreement plus the number of 10-s bins with disagreement, multiplied by 100%. Data collectors were trained through discussion of procedures and operational definitions and through in-vivo data collection and/or data collection while viewing video-recorded sessions. Observers were considered trained once levels of agreement with the primary researcher or a trained observer were 80% or greater for three consecutive sessions. Each observer met this criterion prior to his/her data being included in the study. Exact agreement scores consistently fell below 80% for Barry; therefore, additional training of staff was conducted, and sessions with low IOA were re-scored following this training.

The average exact IOA for card exchanges for Kara was 87.8% with a range of 71.8% to 100% per session across observers, and the average exact IOA for reinforcer delivery for Kara was 96.7% with a range of 87.5% to 100% per session across observers. The average exact IOA for card touches for Peter was 86.6% with a range of 69.1% to 100% per session across observers, and the average exact IOA for reinforcer delivery for Peter was 99.72% with a range of 92.9% to 100% per session across observers. The average exact IOA for button presses for Barry was 75.3% with a range of 64.9% to 83.3% per session across observers, and the average exact IOA for reinforcer delivery for Barry was 96.4% with a range of 84.2% to 100% per session across observers.

Although exact agreement calculations are the most accurate measure of agreement, partial agreement scores were also calculated for button presses for Barry. To calculate partial agreement scores, the smaller frequency scored was divided by the larger frequency scored for all 10-s bins in disagreement, and this proportion was added to the number of 10-s bins in agreement before dividing by the number of 10-s bins with agreement plus the number of 10-s bins with disagreement, multiplied by 100%. The average partial IOA for button presses for Barry was 88.7% with a range of 74.2% to 95.85% per session across observers.

Procedural fidelity data were evaluated for reinforcer assessments to ensure sessions were implemented as intended. This data was collected during 33% of sessions by the primary researcher using a timer and a procedural integrity checklist. The primary researcher assessed whether the item corresponding to the condition was placed behind the card or button, the item was restricted prior to meeting the schedule, attention was restricted, the correct item was delivered, the item was delivered within 5 s of meeting the schedule requirement, and access was provided for no less than 10 s and no more than 30 s. These data were collected once per schedule requirement, and percent accuracy was calculated by dividing the number of correct number by the number of correct plus incorrect responses and multiplying by 100%. All sessions were conducted with 90% or greater procedural fidelity (mean = 97.5%, range, 90.4% to 100%).

Experiment 2

Experiment 2 evaluated if preference and/or reinforcer efficacy was altered following differential reinforcement of appropriate play with low preference leisure items for children with Autism. The following research questions for Experiment 2 were considered: (1) will

preference for leisure items increase following differential reinforcement of appropriate toy play? and (2) will reinforcer efficacy of leisure items increase following differential reinforcement of appropriate toy play?

Method

Dependent Measures

The primary dependent measures for the current study were the percentage of trials with approach responses during pre- and post-conditioning preference assessments; and the number of targeted responses and reinforcer administrations during pre- and post-conditioning progressive ratio reinforcer assessments. In addition, data on appropriate toy play were collected during baseline and differential reinforcement sessions of conditioning (described below) to demonstrate an increase in appropriate play. Operational definitions for approach responses during preference assessments and target responses during reinforcer assessments were identical to those described for Experiment 1. A button press was selected as the target response during reinforcer assessments for Barbara, and the operational definition for this response was identical to the response defined for Barry.

Target toy-play responses were also selected and defined for each participant based on the target stimulus selected and each participant's individual skill set during evaluations of differential reinforcement of appropriate toy play. For Barbara, a puzzle set containing four puzzles was selected as the target stimulus, and target appropriate toy-play responses were defined as placing a picture of any puzzle on the table, opening the puzzle box, and placing any puzzle piece on the table. For Peter, a puzzle set containing four puzzles was also selected as the target stimulus, and target appropriate toy-play responses were defined as placing a picture

of any puzzle on the table, opening the puzzle box, and placing any puzzle piece on the matching puzzle picture. For Barry, a Lego set was selected as the target stimulus, and target appropriate toy-play responses were defined as placing the top of the Lego box and two Lego cars on the table, which served as bases for the set, and connecting any Lego to any of the bases or another Lego. For all participants, only novel responses were scored to ensure the participant did not meet termination criterion (see Differential Reinforcement Condition for details) by repeating responses (e.g., opening and closing the box).

Experimental Design

Preference change was examined utilizing a multiple-probe-across-participants design (Horner & Baer, 1978), and reinforcer efficacy was examined utilizing demand curve analysis (Bickel, Marsh, & Carroll, 2000). Although evaluating the effects of differential reinforcement on appropriate toy play was not a primary aim of this study, these effects were evaluated using a multiple-baseline-across participants design.

Initial Indirect and Direct Assessments of Preference

Indirect assessments of preference and a paired-stimulus preference assessments of leisure items were conducted as described for Experiment 1 for Barbara. Because these assessments were conducted for Peter and Barry during Experiment 1, these assessments were not repeated.

Target stimulus

Based on the results of the initial paired-stimulus leisure preference assessment, a low preference target stimulus was identified. The item with the lowest percentage of trials with

approach responses for which the participant's caregiver also reported a skill deficit was selected as the target stimulus.

Initial Reinforcer Assessment

Following indirect and direct assessments of preference, a reinforcer assessment was conducted with the target stimulus as described for Experiment 1. Because this assessment was conducted as a part of Experiment 1 for Barry, this assessment was not repeated.

Differential Reinforcement of Appropriate Toy Play (Conditioning)

Following indirect and direct assessments of preference, the effects of a conditioning procedure was evaluated.

Baseline. Appropriate toy play was measured with no programmed consequences during 10-min sessions to establish a baseline of appropriate toy play to compare with toy play during differential reinforcement conditions. During baseline, the participant and a therapist was present in a session room or partitioned/designated area with a table and chairs. The target stimulus was placed on the table at the start of each session; however, no programmed consequences were provided for playing with the item. Although additional items were not available, the participant was allowed to move around in the room/area and was not required to sit at the table. A therapist was present in the room with the participant at all times to control for therapist presence during differential reinforcement conditions; however, the therapist did not interact with the participant unless necessary for safety (e.g., remove from a high surface) or to prevent elopement. Baseline sessions continued until stable responding was determined by visual inspection of the data.

Training Trials. Following baseline, training trials were conducted. Training sessions consisted of 10 trials during which one type of target response was taught (i.e., placing the puzzle pictures on the table). Sessions continued until the participant demonstrated 100% independent responding during 1 session. Once one type of target response was mastered, the remaining target responses (e.g., opening the box, placing the pieces on the table) were taught sequentially. All mastered responses were prompted (if needed) and reinforced prior to the start of each session.

The therapist began training by delivering a vocal prompt for the participant to complete the target response. If the participant engaged in the target response following the vocal prompt, the therapist provided a small piece of a preferred edible item and/or 20-s access to a preferred leisure item to the participant. Prior to the start of each session, Peter and Barry selected an item from any array of three preferred items as identified by previous assessments and observations at the Center (edible items for Peter and leisure items for Barry). Barbara was provided a small portion of sunflower seeds and 20-s access to an i-pad during each session, which were identified by her mother and program therapists as highly preferred. At the start of the next trial, the therapist waited 3 seconds to provide the participant the opportunity to independently engage in the target response and continued to provide this opportunity as long as the participant continued to respond independently. All correct responding was reinforced throughout training regardless of prompt level required. If the participant did not respond correctly within 3 s during any trial, a more intrusive prompt was provided (i.e., vocal, model, or physical), as needed. If the participant required additional prompting during any trial, the therapist initiated subsequent trials with the most intrusive prompt level required. Prompts

were faded to a less intrusive prompt level as the participant is successful (i.e., demonstrates 100% correct responding at the current prompt level for 1 session) and accelerated to a more intrusive prompt level if the participant did not respond correctly within 3 s to the current prompt level during any trial. If the participant did not respond to the vocal prompt during the initial training trial, more intrusive prompts (i.e., model or physical) were provided until the participant emitted the target response and subsequent trials were conducted as described above. Training trial data will not be presented but can be made available upon request.

Differential Reinforcement Condition. Following training trials, appropriate toy play was measured during 10-min sessions where a therapist delivered praise and reinforcers, as described for each participant in the section above, contingent on appropriate toy play. The therapist did not prompt toy play during these sessions. All other procedures were identical to baseline procedures. Differential reinforcement sessions continued until three consecutive sessions with 1.2 responses per minute or greater of appropriate toy play were observed. This value was selected because it represents at least 80% of the number of responses taught completed for all participants. For Barry, additional training trials were conducted following 6 differential reinforcement sessions due to low, stable responding. Barry was continuing to emit correct responses during these sessions; however, he was disconnecting the Legos and restarting following reinforcement intervals, which did not allow for enough novel responses to be completed within a 10 min session to meet mastery criterion. Following additional training trials and a modification to procedures which involved blocking these behaviors and removing the Legos during reinforcement intervals, mastery criterion was quickly met.

Subsequent Direct Assessments of Preference

In keeping with a multiple-probe-across-participants design, each participant experienced identical paired-stimulus leisure item preference assessments following the initial assessment with at least one assessment conducted prior to differential reinforcement of appropriate toy play and at least one assessment conducted subsequent to differential reinforcement of appropriate toy play to evaluate changes in preference following conditioning.

Post-Conditioning Reinforcer Assessment

Following differential reinforcement of appropriate toy play, a reinforcer assessment was conducted with the target stimulus as described for Experiment 1 to evaluate for changes in reinforcer efficacy following conditioning.

Data Collection, Inter-Observer Agreement, and Procedural Fidelity

Data were collected using pen and paper data collection forms during all sessions. Data were collected during sessions by the therapist (training trials and preference assessments only), from an observation area by a second researcher, or via video scoring in the event a second researcher was unavailable.

To assess interobserver agreement (IOA), a second observer collected data during 52% of trials during preference assessments. Agreement was defined as both observers recording an approach response for the same item and no approach response for the item's pair during paired-stimulus trials. IOA was calculated by dividing agreements by agreements plus disagreement and multiplying by 100%. Observers were considered trained following discussion of operational definitions and data collection procedures with the primary researcher. Agreement was observed during 96.6% of trials.

During reinforcer assessments, a second observer collected data during 35% of Barbara's sessions, 33% of Peter's sessions, and 28% of Barry's sessions. Agreement was defined as the number of 10-s bins in which two observers scored the same frequency of a target behavior divided by the number of 10-s bins with agreement plus the number of 10-s bins with disagreement, multiplied by 100%. Data collectors were trained through discussion of procedures and operational definitions and through in-vivo data collection and/or data collection while viewing video-recorded sessions. Observers were considered trained once levels of agreement with the primary researcher or a trained observer were 80% or greater for three consecutive sessions.

The average exact IOA for button pressing for Barbara was 90.1% with a range of 70.6% to 100% per session across observers, and the average exact IOA for reinforcer delivery for Barbara was 93.3% with a range of 76.7% to 100% per session across observers. The average exact IOA for card touches for Peter was 95.6% with a range of 86.7% to 100% per session across observers, and the average exact IOA for reinforcer delivery for Peter was 100%. The average exact IOA for button presses for Barry was 82.45% with a range of 64.3% to 100% per session across observers, and the average exact IOA for reinforcer delivery for Barry was 95.7% with a range of 87.1% to 100% per session across observers.

Procedural fidelity data were evaluated for reinforcer assessments and treatment evaluations to ensure sessions were implemented as intended. This data was collected during 26% of reinforcer-assessment sessions and 29% of treatment-evaluation sessions by the primary researcher using a timer and a procedural integrity checklist. Procedural fidelity assessment was identical to Experiment 1 during reinforcer assessments. During baseline

sessions of treatment evaluations, the primary researcher assessed whether the item was freely available to the participant and if attention was restricted throughout the session. During differential reinforcement sessions, the primary researcher assessed whether the item was freely available to the participant and whether differential reinforcement of appropriate toy play was correctly implemented (i.e., praise/preferred items were provided following appropriate play and praise/preferred items were otherwise restricted). These data were collected within 10-s bins of each session.

Percent accuracy for reinforcer assessments were calculated as described for Experiment 1, and percent accuracy for treatment evaluations was calculated by dividing the number of 10-s bins scored as correct by the number 10-s bins scored as correct plus the number of 10-s bins scored as incorrect and multiplying by 100%. Average procedural fidelity was 98.5% with a range of 88.2% to 100% per sessions across observers during reinforcer assessments, and average procedural fidelity was 98.9% with a range of 96.7% to 100% during treatment evaluations.

Chapter 3 Results

Experiment 1

Figures 1 and 2 depict the results of edible and leisure single-stimulus and paired-stimulus preference assessments for Kara. The x-axis represents the stimuli assessed, and the y-axis represents the percentage of approach responses. The purple vertical bars represent data obtained from a paired-stimulus preference assessment, and the blue vertical bars represent data obtained from a single-stimulus preference assessment. Kara approached a device playing a Dora video and Cheetos frequently during both assessments and approached books and popcorn frequently during the single-stimulus assessment but infrequently during the paired-stimulus assessment. These four items represent the target stimuli for subsequent reinforcer assessments.

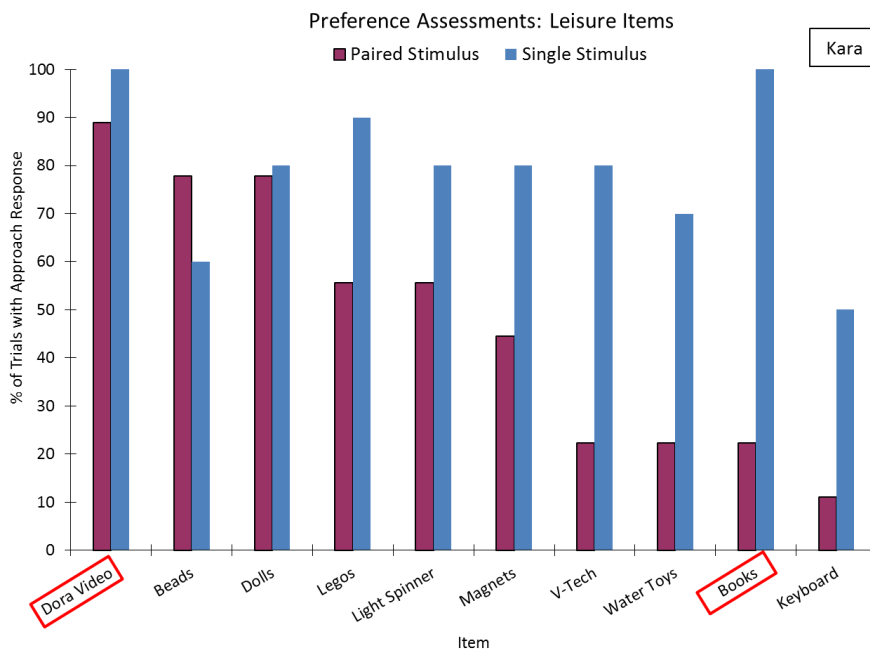


Figure 1: Kara's percentages of trials with an approach response during paired-stimulus and single-stimulus preference assessments of leisure items.

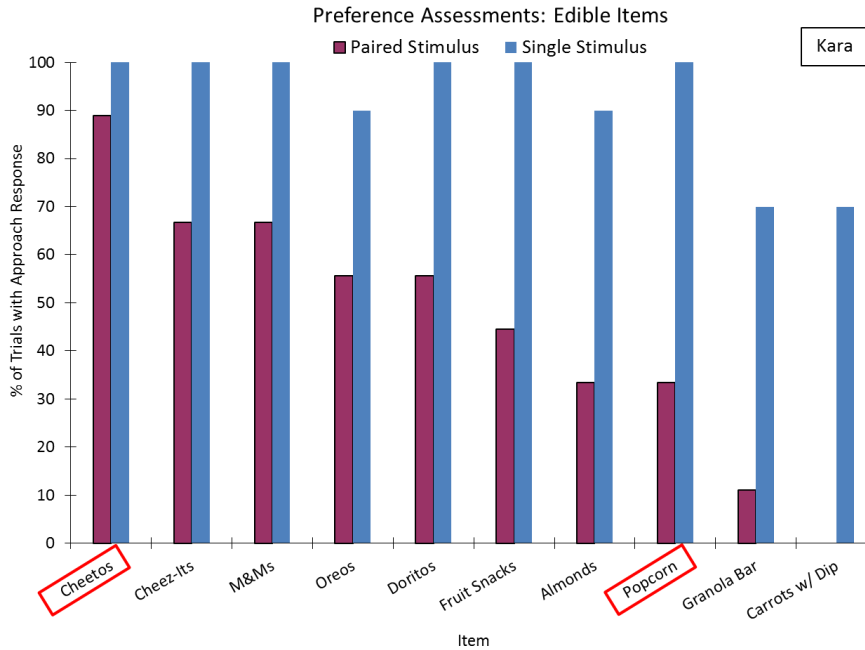


Figure 2: Kara’s percentages of trials with an approach response during paired-stimulus and single-stimulus preference assessments of edible items.

Figures 3 and 4 depict the results of edible and leisure single-stimulus and paired-stimulus preference assessments for Peter utilizing the same format described for Figures 1 and 2. Peter approached a bracelet maker, a create-and-color puppy, super hero toys, and an Octonauts video frequently during both assessments of leisure items. To determine the high/high leisure target stimulus, a therapist presented these four items in an array with each item equidistant from Peter and equidistant from each other. The therapist labeled each item and provided a prompt to Peter to “pick one.” Peter selected the bracelet maker from the array; therefore; this item represents the high/high leisure target stimulus for subsequent reinforcer assessments. Peter approached the bubbles and a device playing drum music frequently during the leisure single-stimulus assessment but infrequently during the leisure paired-stimulus assessment. To determine the high/low leisure target stimulus, a therapist

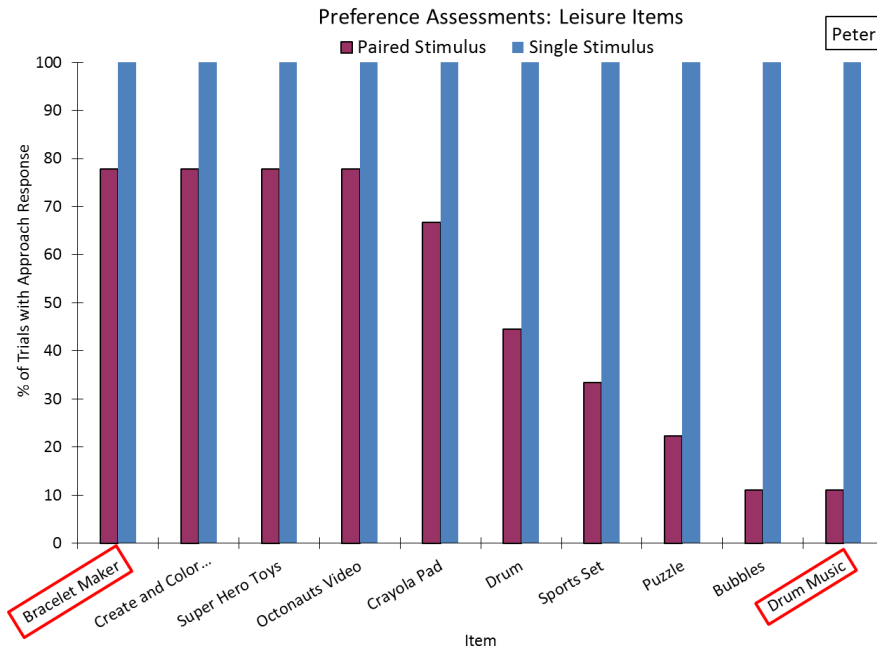


Figure 3: Peter's percentages of trials with an approach response during paired-stimulus and single-stimulus preference assessments of leisure items.

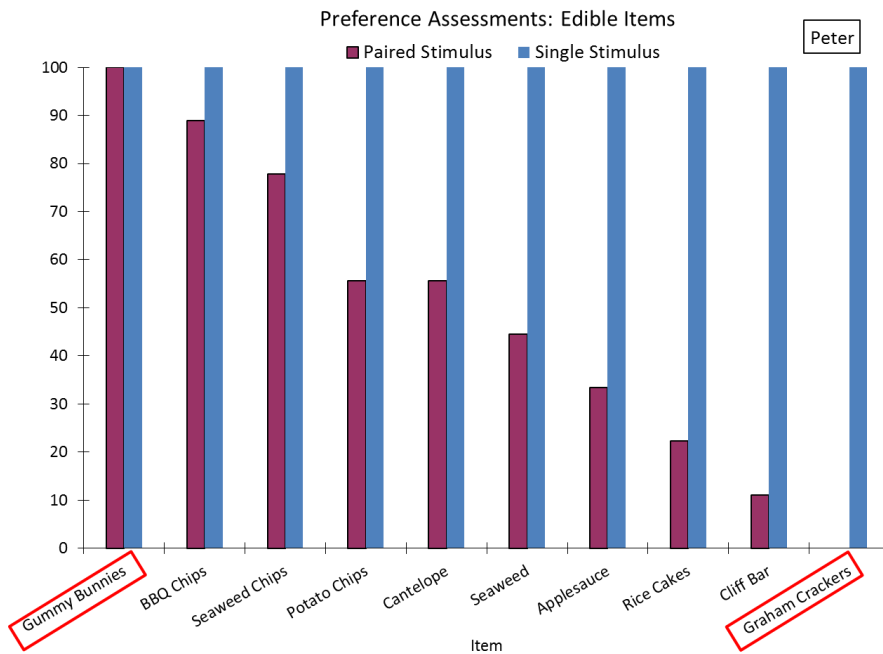


Figure 4: Peter's percentages of trials with an approach response during paired-stimulus and single-stimulus preference assessments of edible items.

presented these two items in an additional trial conducted identically to previously described paired-stimulus preference assessment procedures. Peter selected the bubbles in this trial. The non-select item, a device playing drum music, represents the high/low leisure target stimulus for subsequent reinforcer assessments. During assessments of edible items, Peter selected Gummy Bunnies frequently during both assessments and selected graham crackers frequently during the single-stimulus assessment but infrequently during the paired-stimulus assessment. These items represent the edible target stimuli for subsequent reinforcer assessments.

Figure 5 depicts the results of leisure single-stimulus and paired-stimulus preference assessments for Barry utilizing the same format described for Figures 1 and 2. Barry selected cars frequently during both assessments, and this item represents the high/high target stimulus. Although discrepancies were observed between the single-stimulus and paired-stimulus results, a high/low stimulus as defined by Roscoe et al. (1999; i.e., approached during 85% or greater of trials during a paired-stimulus assessment and 25% or fewer trials during a single-stimulus assessment) was not identified. However, two additional target stimuli were selected for subsequent reinforcer assessments based on the discrepancies that occurred. Peter approached the guitar during 100.00% of trials during the single-stimulus preference assessments and during 55.56% of trials during the paired-stimulus preference assessment, and this item was selected for subsequent reinforcer assessments as a high/moderate target stimulus. Peter approached the Legos during 60.00% of trials during the single-stimulus preference assessments and during 11.11% of trials during the paired-stimulus preference assessment, and this item was selected for subsequent reinforcer assessments as a moderate/low target stimulus.

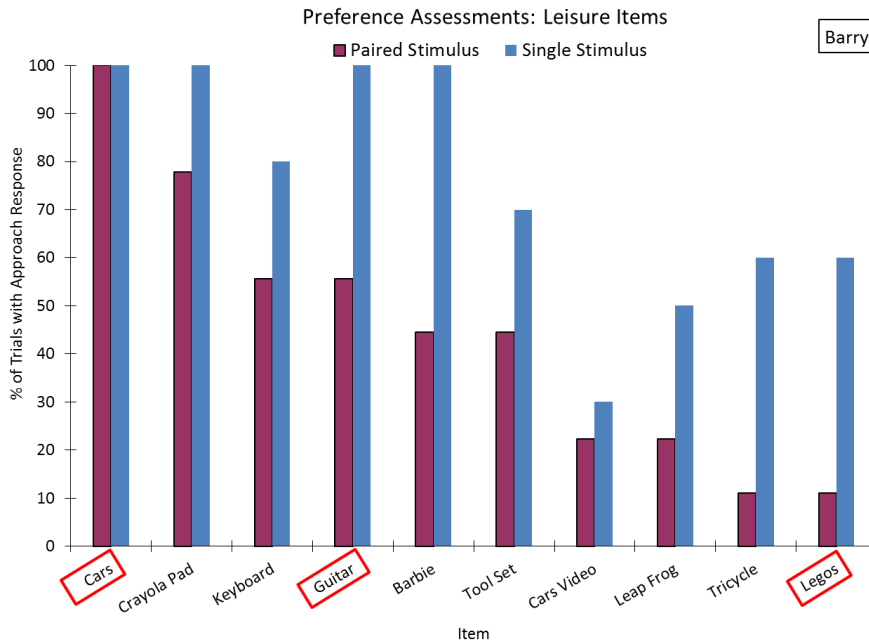


Figure 5: Barry’s percentages of trials with an approach response during paired-stimulus and single-stimulus preference assessments of edible items.

Figures 6 and 7 depict the results of progressive-ratio reinforcer assessments of leisure items for Kara through demand curves and work functions, respectively. For Figure 6, the x-axis represents the progressive-ratio schedule requirement, and the y-axis represents the mean number of reinforcers earned across sessions. Higher breakpoints were observed when a card exchange was associated with access to the high/high leisure stimulus than when associated with access to the high/low leisure stimulus. When a card exchange was associated with the high/high leisure stimuli, Kara met an FR4 schedule requirement during all sessions, met an FR 8, FR 16, and FR 32 schedule requirement during some sessions, and did not meet an FR 64 schedule requirement during any session. When a card exchange was associated with access to the high/low leisure item Kara did not meet an FR 1 schedule requirement during any session. For Figure 7, the x-axis represents the progressive-ratio schedule requirement, and the y-axis represents the cumulative number of responses emitted across sessions. A greater number of

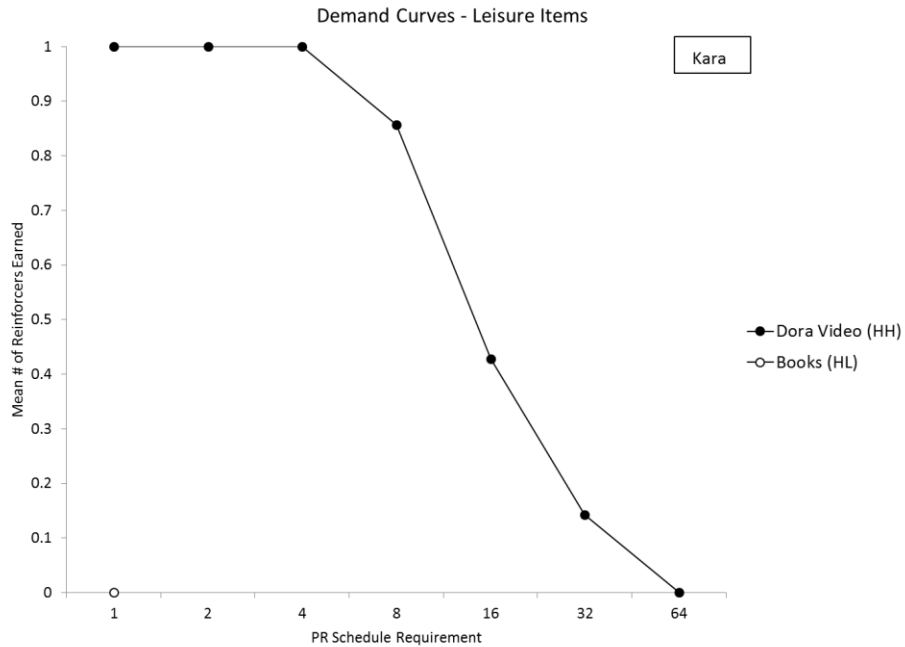


Figure 6: Kara’s mean number of reinforcers earned during progressive-ratio reinforcer assessments of high/high and high/low leisure items.

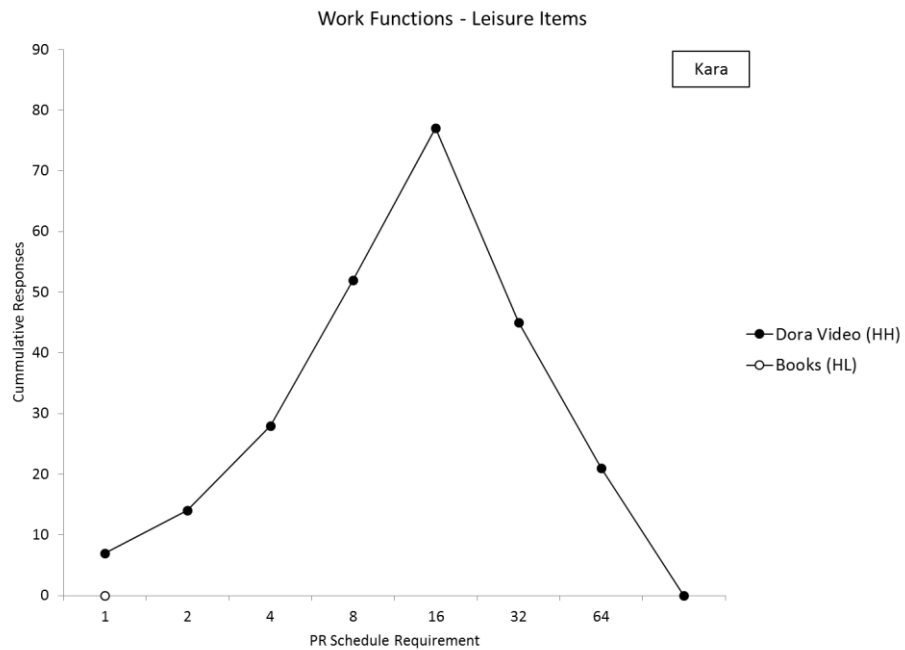


Figure 7: Kara’s cumulative responses during progressive-ratio reinforcer assessments of high/high and high/low leisure items.

cumulative responses was observed for access to the high/high leisure stimulus in comparison to the high/low leisure stimulus across all schedule requirements utilized.

Figures 8 and 9 depict the results of progressive-ratio reinforcer assessments of edible items for Kara through demand curves and work functions, respectively, utilizing the same format described for Figures 6 and 7. Higher breakpoints were observed when a card exchange was associated with access to the high/high edible stimulus than when associated with access to the high/low edible stimulus. When a card exchange was associated with the high/high edible stimuli, Kara met an FR2 schedule requirement during all sessions, met an FR 4, FR8, and FR 16 schedule requirement during some sessions, and did not meet an FR 32 schedule requirement during any session. When a card exchange was associated with access to the

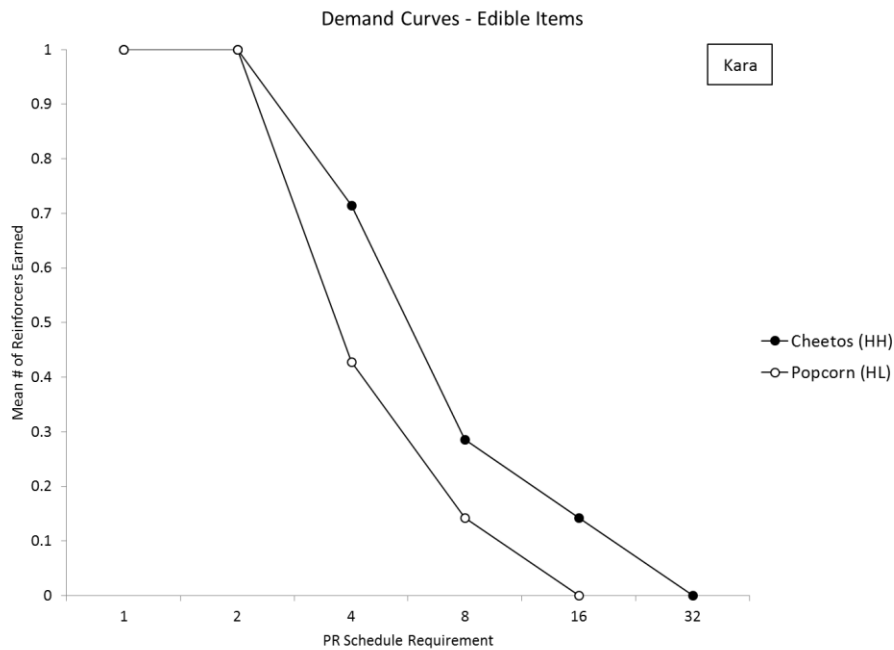


Figure 8: Kara’s mean number of reinforcers earned during progressive-ratio reinforcer assessments of high/high and high/low edible items.

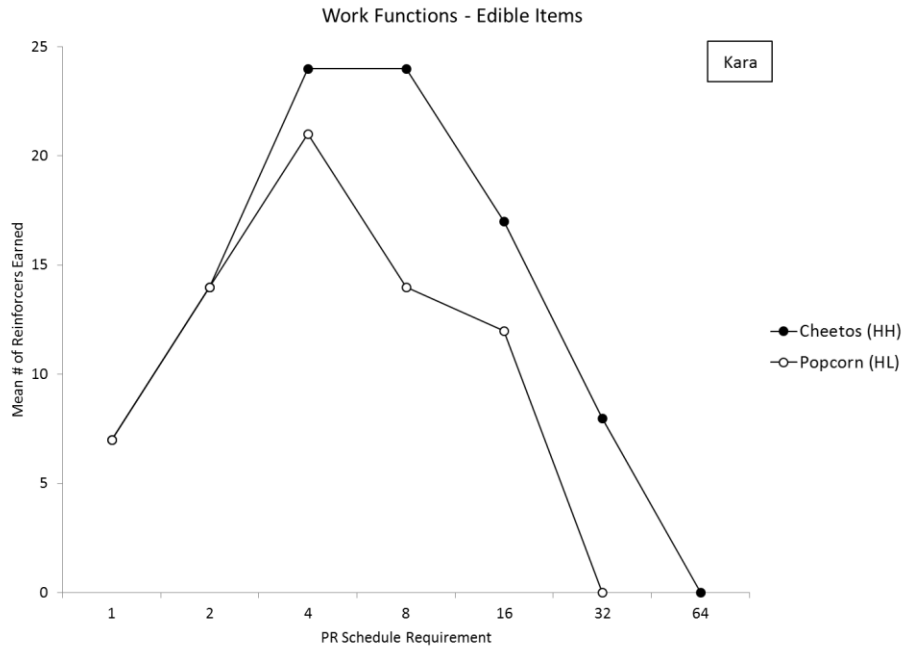


Figure 9: Kara’s cumulative responses during progressive-ratio reinforcer assessments of high/high and high/low edible items.

high/low edible item, Kara met an FR 2 schedule requirement during all sessions, met an FR 4 and FR 8 schedule requirement during some sessions, and did not meet an FR 16 schedule requirement during any session. In addition, a greater number of cumulative responses was observed for access to the high/high leisure stimulus in comparison to the high/low leisure stimulus across FR 4, FR 8, FR 16, and FR 32 schedule requirements.

Figures 10 and 11 depict the results of progressive-ratio reinforcer assessments of leisure items for Peter through demand curves and work functions, respectively, utilizing the same format described for Figures 6 and 7. Higher breakpoints were observed when a card touch was associated with access to the high/high leisure stimulus than when associated with

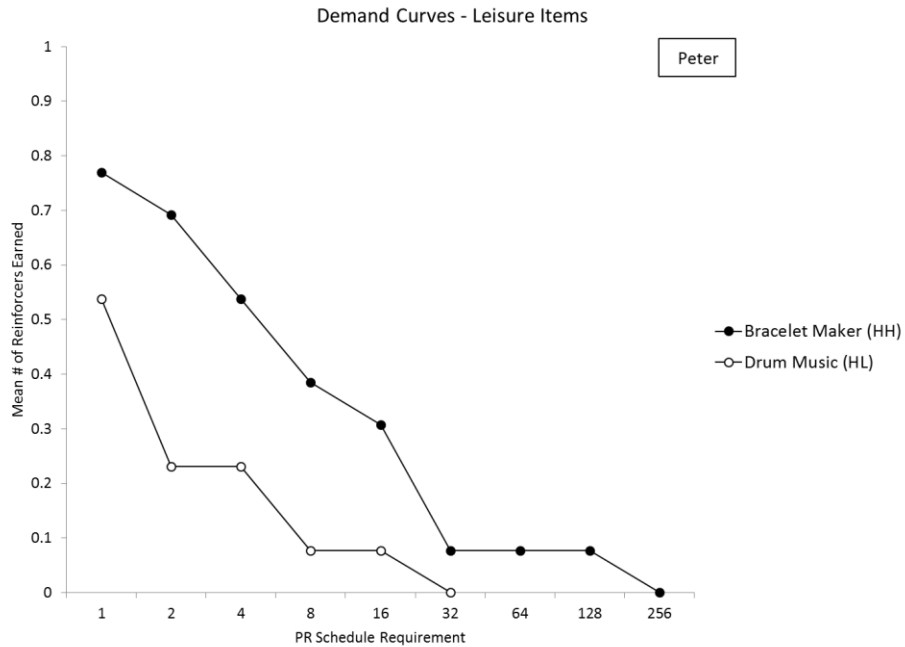


Figure 10: Peter's mean number of reinforcers earned during progressive-ratio reinforcer assessments of high/high and high/low leisure items.

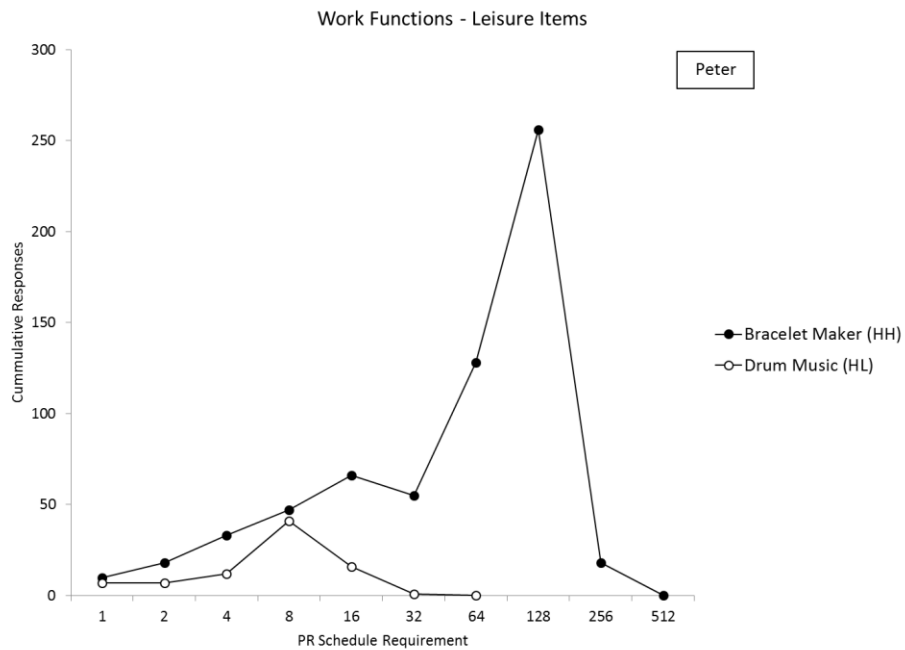


Figure 11: Peter's cumulative responses during progressive-ratio reinforcer assessments of high/high and high/low leisure items.

access to the high/low leisure stimulus. When a card touch was associated with the high/high requirement during some sessions and did not meet an FR 256 schedule requirement during any session. When a card touch was associated with access to the high/low leisure item, Peter met an FR 1, FR 2, FR 4, FR 8, and FR 16 schedule requirement during some sessions and did not meet an FR 32 schedule requirement during any session. In addition, a greater number of cumulative responses was observed for access to the high/high leisure stimulus in comparison to the high/low leisure stimulus across FR 4, FR 8, FR 16, and FR 32 schedule requirements.

Figures 12 and 13 the depict results of progressive-ratio reinforcer assessments of edible items for Peter through demand curves and work functions, respectively, utilizing the same format described for Figures 6 and 7. Higher breakpoints were observed when a card touch was associated with access to the high/high edible stimulus than when associated with access to the high/low edible stimulus. When a card touch was associated with the high/high edible stimuli, Peter met an FR 8 schedule requirement during all sessions, met an FR 16, FR 32, FR 64, and FR 128 schedule requirement during some sessions, and did not meet an FR 256 schedule requirement during any session. When a card touch was associated with access to the high/low edible item, Peter met an FR 1, FR 2, FR 4, FR 8, FR 16, FR 32, FR64, and FR 128 schedule requirement during some sessions and did not meet an FR 32 schedule requirement during any session. In addition, a greater number of cumulative responses was observed for access to the high/high edible stimulus in comparison to the high/low edible stimulus across all schedule requirements utilized.

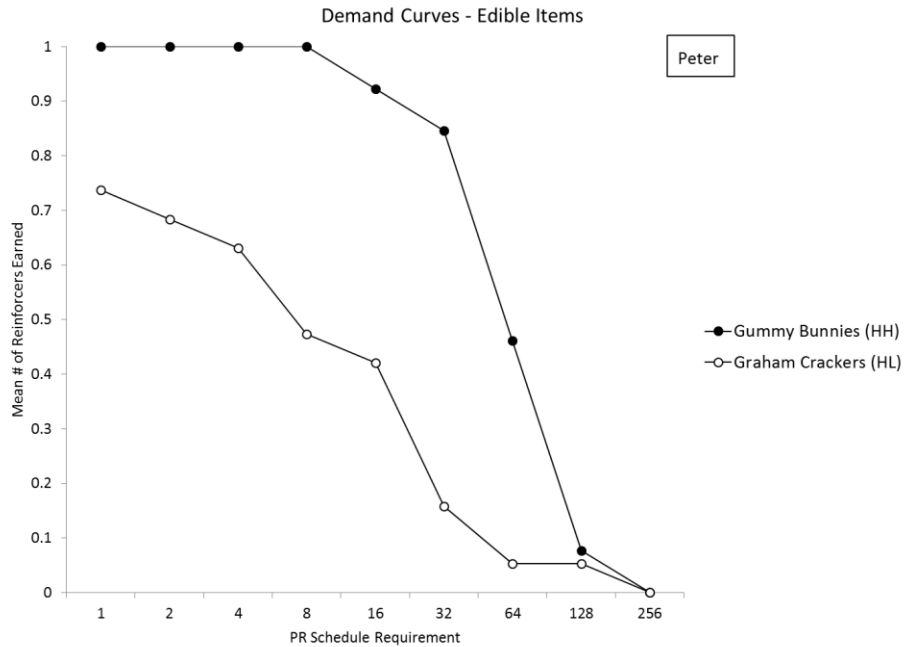


Figure 12: Peter’s mean number of reinforcers earned during progressive-ratio reinforcer assessments of high/high and high/low edible items.

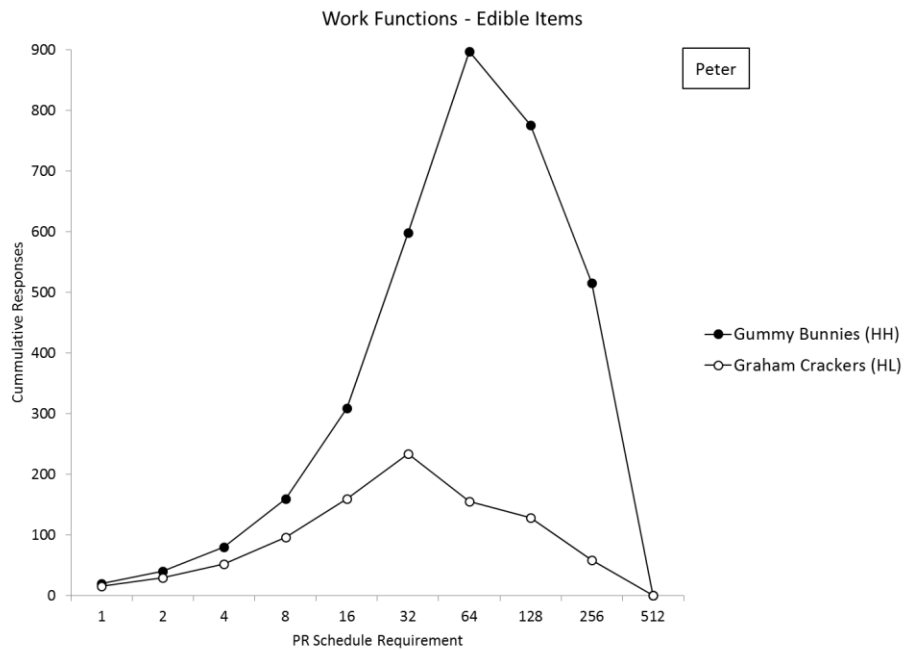


Figure 13: Peter’s cumulative responses during progressive-ratio reinforcer assessments of high/high and high/low edible items.

Figures 14 and 15 depict the results of progressive-ratio reinforcer assessments of leisure items for Peter through demand curves and work functions, respectively, utilizing the same format described for Figures 6 and 7. Higher breakpoints were observed when a button press was associated with access to the high/moderate leisure stimulus than when associated with access to the high/high leisure stimulus or moderate/low stimulus, and higher breakpoints were observed when a button press was associated with access to the high/high leisure stimulus than when associated with access to the moderate/low stimulus. When a button press was associated with the high/moderate leisure stimuli, Peter met an FR 16 schedule requirement during all sessions, met an FR 32, FR 64, and FR 128 schedule requirement during some sessions, and did not meet an FR 256 schedule requirement during any session. When a button press was associated with the high/high leisure stimuli, Peter met an FR 4 schedule requirement during all sessions, met an FR 8, FR 16, FR 32, FR 64, and FR 128 schedule requirement during some sessions, and did not meet an FR 256 schedule requirement during any session. When a button press was associated with access to the moderate/low leisure item, Peter met an FR 4 schedule requirement during all sessions, met an FR 8, FR 16, and FR 32 schedule requirement during some sessions, and did not meet an FR 64 schedule requirement during any session. In addition, a greater number of cumulative responses was observed for access to the high/moderate leisure stimulus in comparison to the high/low leisure stimulus across FR 8, FR 16, FR 32, and FR 64 schedule requirements; however, a greater number of cumulative responses was observed for access to the high/high leisure items across FR 128 and FR 256 schedule requirements. A work function is not presented for the moderate/low item

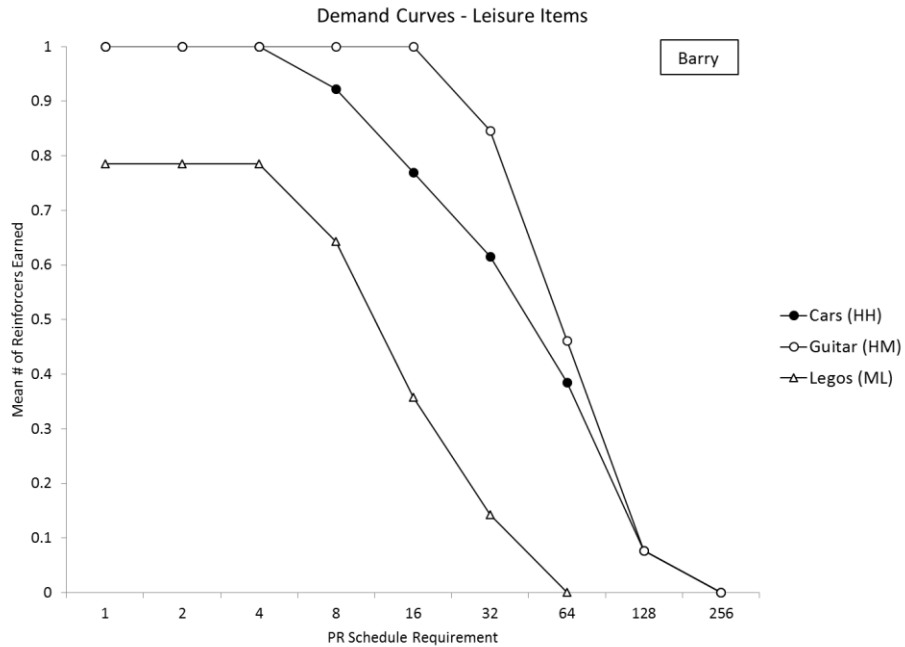


Figure 14: Barry's mean number of reinforcers earned during progressive-ratio reinforcer assessments of high/high, high/moderate, and moderate/low leisure items.

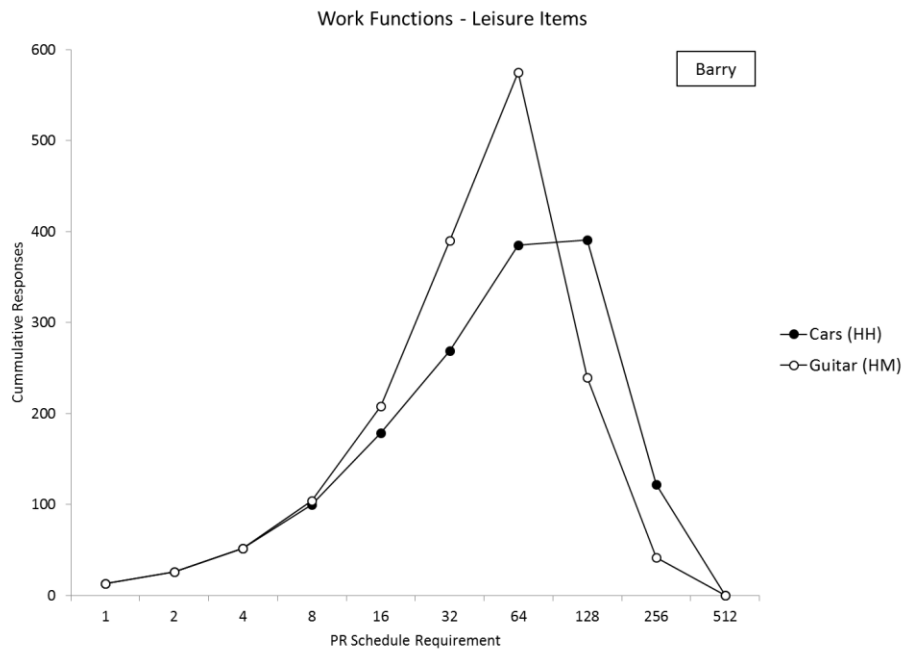


Figure 15: Barry's cumulative responses during progressive-ratio reinforcer assessments of high/high and high/moderate leisure items.

due to an equal number of sessions conducted with this item in comparison to the other two items.

In addition to demand curves and work functions, Barry's breakpoints are displayed to aid in interpretation of his results. Figure 16 depicts sessions on the x-axis and breakpoints on the y-axis utilizing a logarithmic scale. Because a logarithmic scale does not allow for depiction of breakpoints less than 1 (i.e., no responding), sessions during which no responses were emitted are outlined in red. Although stability criteria were met with all items assessed, the

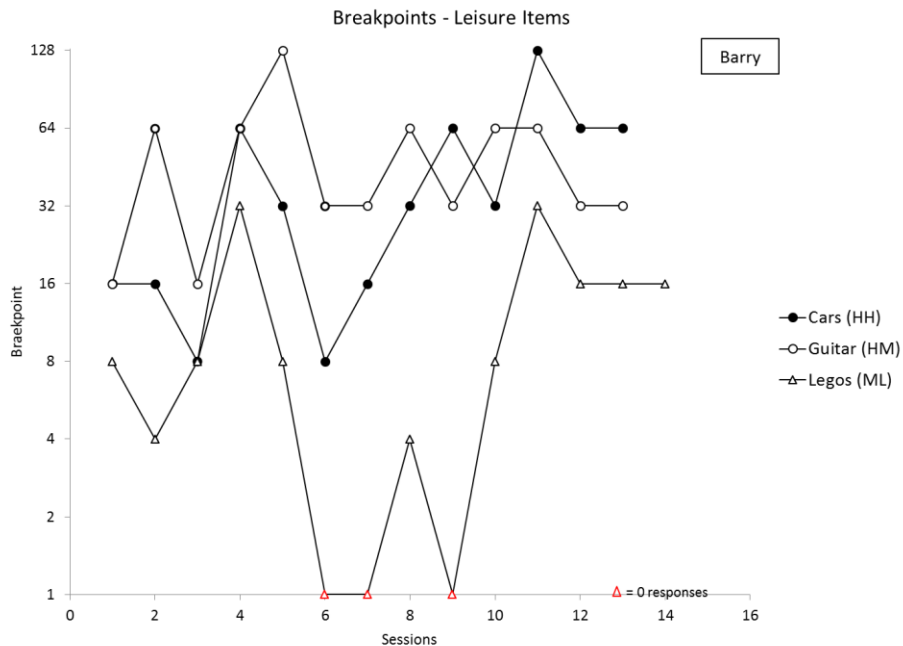


Figure 16: Barry's breakpoints during progressive-ratio reinforcer assessments of high/high, high/moderate, and moderate/low leisure items.

overall trend of the data represents an increase in responding for all items, and a particularly noteworthy increase in responding when button pressing was associated with the high/high stimulus. That is, although higher breakpoints were observed for the high/moderate stimulus in comparison to the high/high stimulus when evaluating the mean number of reinforcers earned across the entire assessment (as represented by the demand curves in Figure 14), higher

breakpoints were observed for the high/high stimulus across the last 3 sessions of the assessment when compared to the high/moderate and moderate/low stimuli.

Experiment 2

Figure 17 depicts the results of the initial, pre-conditioning paired-stimulus preference assessments of leisure items for Barbara. The x-axis represents the stimuli assessed, and the y-axis represents the percentage of approach responses. Barbara did not approach the puzzle during any trial. This item represents the target stimuli for subsequent differential reinforcement of appropriate toy play and subsequent reinforcer and preference assessments.

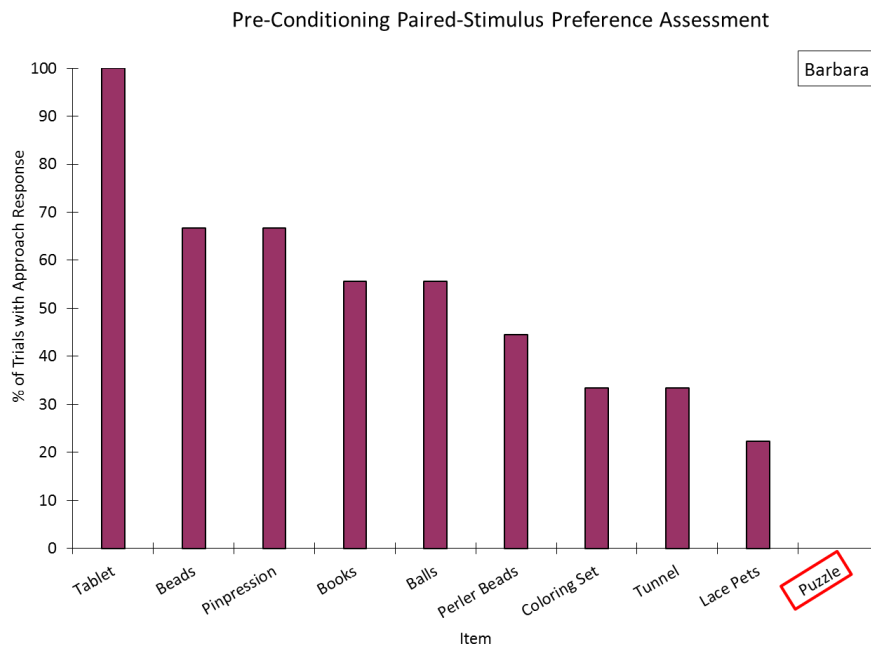


Figure 17: Barbara’s percentages of trials with an approach response during her initial pre-conditioning paired-stimulus preference assessment of edible items used for item selection.

Figure 18 depicts the results of the initial, pre-conditioning paired-stimulus preference assessments of leisure items for Peter. Results from Experiment 1 were utilized to select the target stimuli and are represented in Figure 18 in the absence of the single-stimulus preference assessment results. The x-axis represents the stimuli assessed, and the y-axis represents the

percentage of approach responses. Peter approached the puzzle, bubbles, and drum music during less than 25% of trials. The puzzle was selected as the target stimuli for subsequent differential reinforcement of appropriate toy play and subsequent reinforcer and preference assessments based on Peter’s mother’s report prior to the assessment that puzzles were an item with which she would like to see an increase in skills.

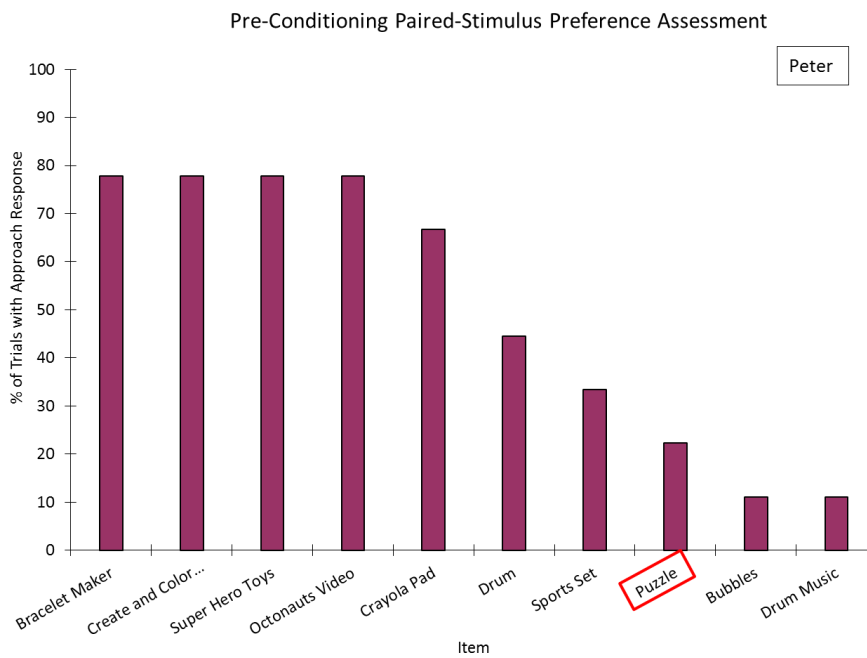


Figure 18: Peter’s percentages of trials with an approach response during his initial pre-conditioning paired-stimulus preference assessment of edible items used for item selection.

Figure 19 depicts the results of the initial, pre-conditioning paired-stimulus preference assessments of leisure items for Barry. Results from Experiment 1 were utilized to select the target stimuli and are represented in Figure 19 in the absence of the single-stimulus preference assessment results. The x-axis represents the stimuli assessed, and the y-axis represents the percentage of approach responses. Barry exhibited the lowest approach responses for Legos and a tricycle. Legos were selected as the target stimuli for subsequent differential reinforcement of appropriate toy play and subsequent reinforcer and preference assessments

based on Barry's mother's report prior to the assessment that Legos were an item with which Barry exhibited a play-skill deficit and with which his mother would like to see an increase in skills.

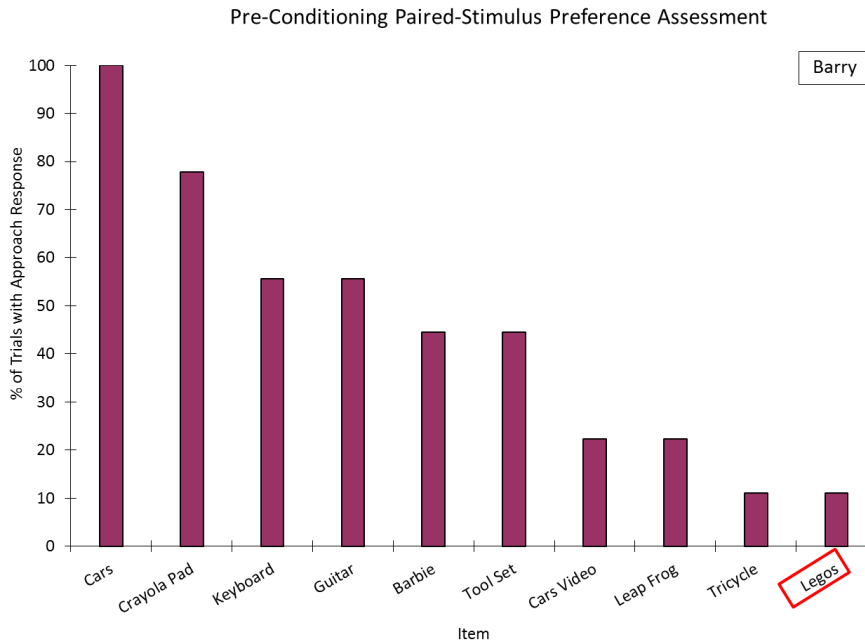


Figure 19: Barry's percentages of trials with an approach response during his initial pre-conditioning paired-stimulus preference assessment of edible items used for item selection.

Figure 20 depicts the results of differential reinforcement of appropriate toy play (conditioning) across the three participants. The x-axis represents the number of sessions, and the y-axis represents the responses per minute of targeted appropriate toy-play responses. All participants demonstrated low levels of appropriate toy play during baseline and high levels of appropriate toy play during conditioning. All participants met mastery criterion of three consecutive sessions with 1.2 responses per minute or greater of appropriate toy play.

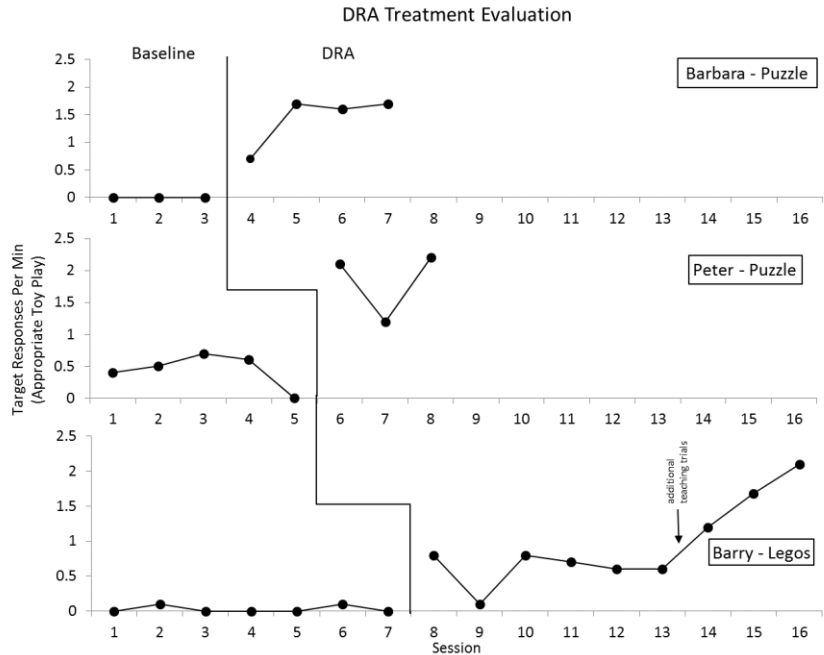


Figure 20: Targeted appropriate toy-play responses during baseline and differential reinforcement conditions across participants.

Figures 21 and 22 depict the results of pre- and post-conditioning progressive ratio reinforcer assessments of the targeted leisure stimulus for Barbara utilizing demand curves and lines graphs of breakpoints. For Figure 21, the x-axis represents the progressive-ratio schedule requirement, and the y-axis represents the mean number of reinforcers earned across sessions. When button-pressing was associated with access to the puzzle prior to conditioning, Barbara earned the reinforcer under FR 1, FR 2, and FR 4 schedule requirement during some sessions, and never earned the reinforcer under an FR 8 schedule requirement. When button-pressing was associated with access to the puzzle after conditioning, Barbara earned the reinforcer under an FR 4 schedule requirement during all sessions and never earned the reinforcer under an FR 8 schedule requirement. For Figure 22, the x-axis represents sessions, and the y-axis represents breakpoints. Similar to Barry’s demand curve results from Experiment 1, Barbara’s

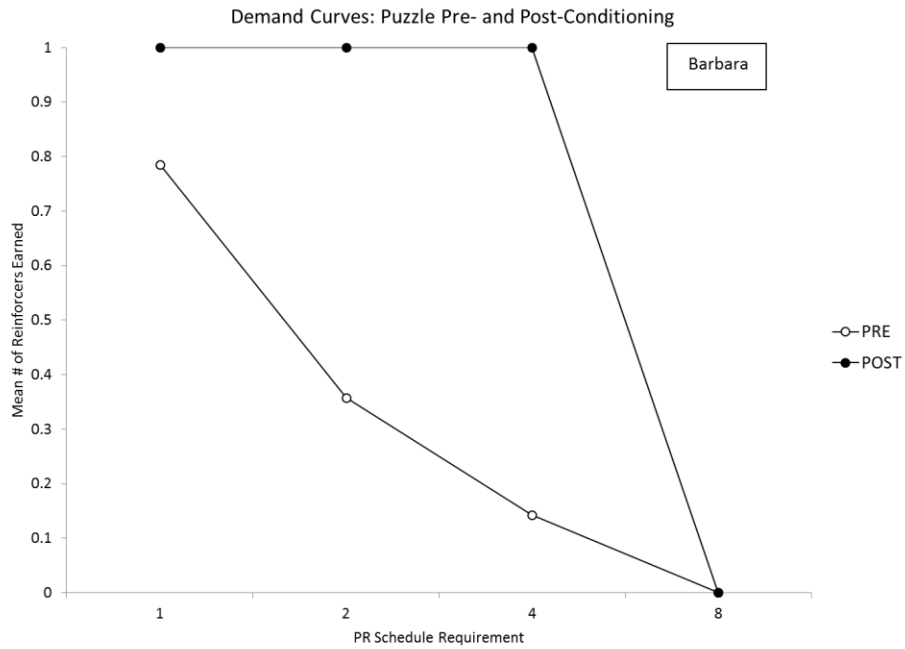


Figure 21: Barbara’s mean number of reinforcers earned during progressive-ratio reinforcer assessments pre- and post-conditioning.

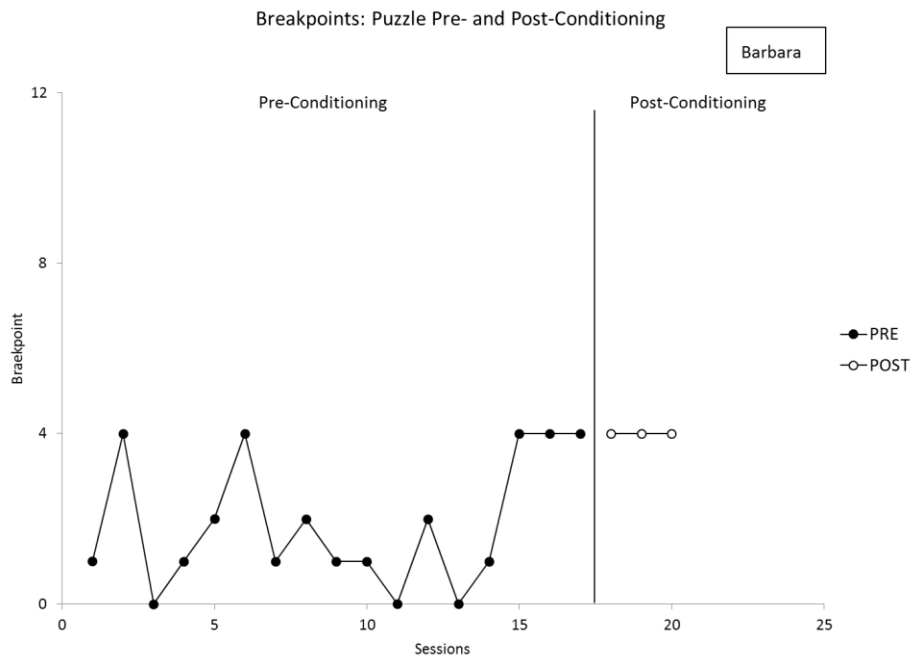


Figure 22: Barbara’s breakpoints during progressive-ratio reinforcer assessments pre- and post-conditioning.

demand curves results should also be interpreted with caution and in combination with the breakpoints trends depicted in Figure 22. That is, although higher breakpoints were observed for the puzzle post-conditioning in comparison to pre-conditioning when evaluating the mean number of reinforcers earned across the entire assessment (as represented by the demand curves in Figure 21), identical breakpoints were observed across the last 3 sessions of each assessment.

Figures 23 and 24 depict the results of pre- and post-conditioning progressive ratio reinforcer assessments of the targeted leisure stimulus for Peter utilizing demand curves and lines graphs of breakpoints in the identical format described for Figures 21 and 22. When a card

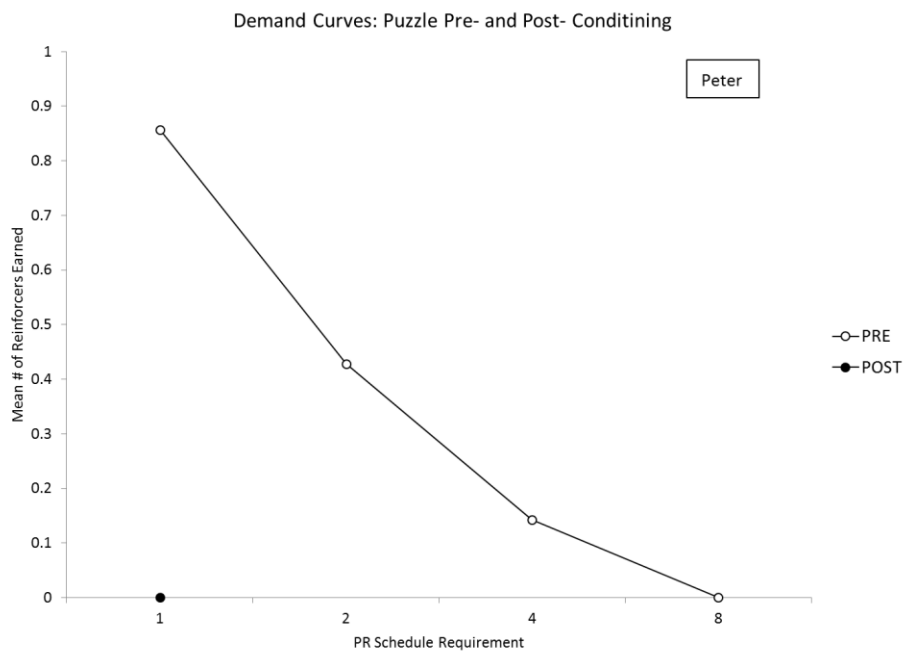


Figure 23: Peter’s mean number of reinforcers earned during progressive-ratio reinforcer assessments pre- and post-conditioning.

touch was associated with access to the puzzle prior to conditioning, Peter earned the reinforcer under FR 1, FR 2, and FR 4 schedule requirement during some sessions, and never earned the reinforcer under an FR 8 schedule requirement. When a card touch was associated

with access to the puzzle after conditioning, Peter did not earn the reinforcer under an FR1 schedule requirement during any session. In addition, lower breakpoints were observed post-conditioning in comparison to pre-conditioning without notable trends across the assessment (as represented by Figure 24).

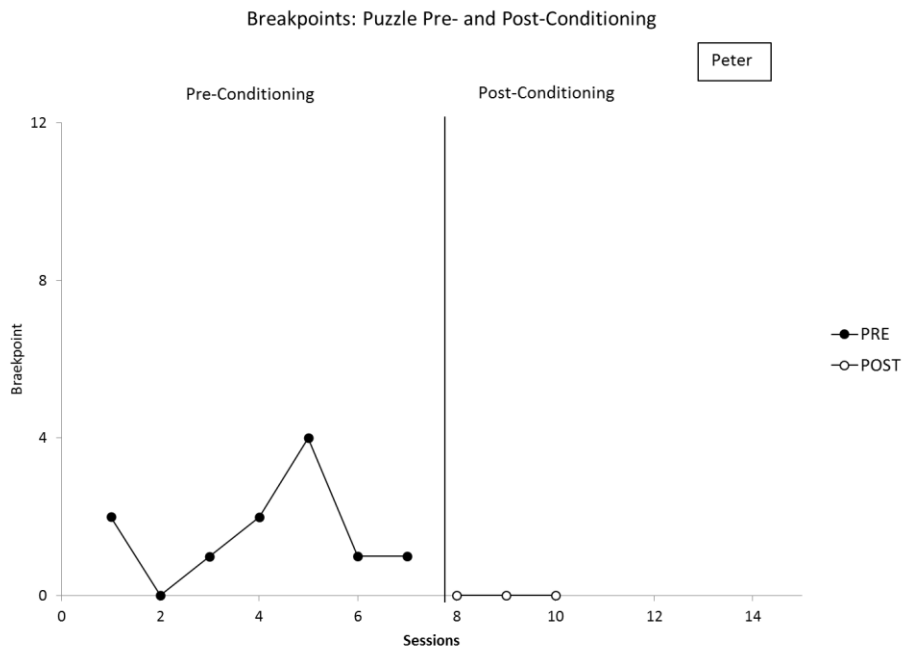


Figure 24: Peter’s breakpoints earned during progressive-ratio reinforcer assessments pre- and post-conditioning.

Figures 25 and 26 depict the results of pre- and post-conditioning progressive ratio reinforcer assessments of the targeted leisure stimulus for Barry utilizing demand curves and lines graphs of breakpoints in the identical format described for Figures 21 and 22. Results from Experiment 1 represent the pre-conditioning conditions. When button-pressing was associated with access to Legos prior to conditioning, Barry earned the reinforcer under FR 1, FR 2, FR 4, FR 8, FR 16, and FR 32 schedule requirement during some sessions, and never earned the reinforcer under an FR 64 schedule requirement. When button-pressing was associated with access to Legos after conditioning, Barry earned the reinforcer under an FR 1 schedule during

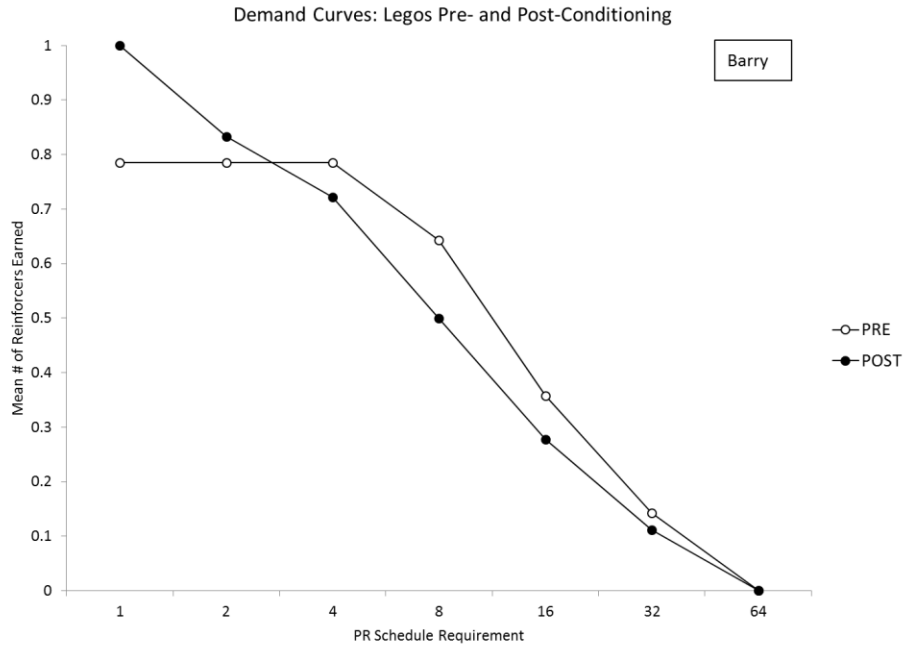


Figure 25: Barry's mean number of reinforcers earned during progressive-ratio reinforcer assessments pre- and post-conditioning.

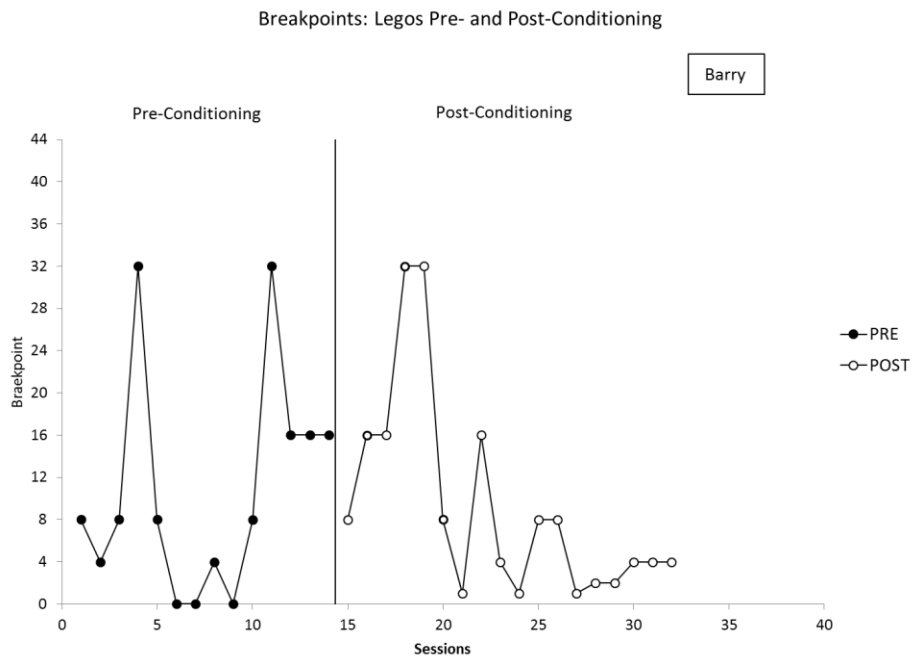


Figure 26: Barry's mean number of reinforcers earned during progressive-ratio reinforcer assessments pre- and post-conditioning.

all sessions, earned the reinforcer under FR 2, FR 4, FR 16, and FR 32 schedule requirements during some sessions, and did not earn the reinforcer under an FR 64 schedule requirement during any session. In addition, an overall increasing trend in breakpoints was observed prior to meeting the stability criterion pre-conditioning while an overall decreasing trend in breakpoints was observed post-conditioning (as represented by Figure 26). Possible explanations for these trends are discussed in Chapter V.

Figure 27 depicts the results of pre- and post-conditioning leisure paired-stimulus preference assessments across the three participants. The x-axis represents the number of assessments, and the y-axis represents the percentage of approach responses for the target stimulus for each participant. All participants demonstrated low percentages of approach responses to the target stimulus during pre- and post-conditioning leisure paired-stimulus preference assessments.

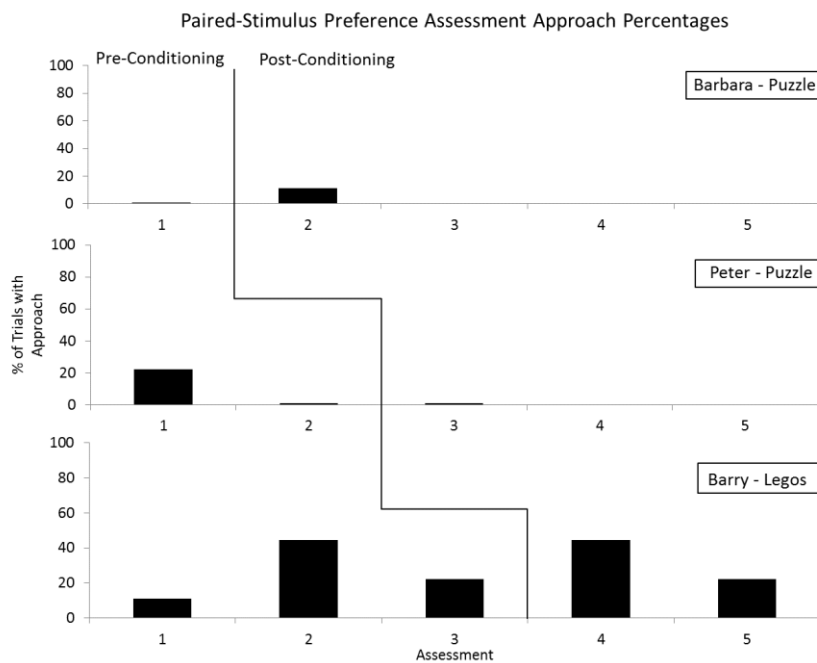


Figure 27: Percentages of trials with an approach response during pre- and post- conditioning paired-stimulus preference assessments of leisure items across participants.

Chapter 4

Discussion

The current study examined the relationship between the results of separate preference-assessment methodologies and reinforcer efficacy of edible and leisure stimuli. In addition, the reinforcer efficacy of low-preference leisure items was evaluated following teaching appropriate toy-play skills. The results of this study expand previous findings on the relative and absolute reinforcer effects of items selected from preference assessments (Francisco et al., 2008; Glover et al., 2008; Penrod et al., 2008; and Roscoe et al., 1999) by evaluating reinforcer efficacy under increased schedule requirements and evaluating both edible and leisure items. In addition, the results of this study expand previous findings on conditioning neutral stimuli (Eason et al., 1982; Greer et al., 1985; Hanley et al., 1999; Hanley et al., 2003; and Nuzzolo-Gomez et al., 2002) by evaluating the degree to which neutral stimuli serve as reinforcers for the completion of tasks following conditioning and by evaluating preferences for neutral stimuli following condition through repeated paired-stimulus assessments.

Experiment 1

Reinforcer Efficacy as Predicted by Preference Assessments

Results of Experiment 1 revealed that for two out of three participants (Kara and Peter) leisure items approached frequently during single-stimulus preference assessments but infrequently during paired-stimulus preference assessments did not have similar reinforcing efficacy as leisure items approached frequently during both assessments. For the third participant (Barry), a leisure item approached during 100% of single-stimulus preference-

assessment trials but during only approximately 50% of paired-stimulus preference-assessment trials demonstrated similar reinforcing efficacy as a leisure item approached during 100% of trials of both assessments. In addition for Barry, a leisure item approached during 60% of single-stimulus preference-assessment trials but during only approximately 10% of paired-stimulus preference-assessment trials demonstrated less reinforcing efficacy than the aforementioned items but still demonstrated some reinforcing properties. These results are similar to the results found by Glover et al., 2008, who also assessed the relative and absolute reinforcer efficacy of leisure items, in that results of a paired-stimulus preference assessment better predicted reinforcer efficacy than results of a single-stimulus preference assessment.

Kara's results are also similar to Glover's results in that a leisure item identified as low preference by a paired-stimulus assessment did not maintain responding. Barry's results are dissimilar to these latter findings of Glover because a leisure item identified as low preference by a paired-stimulus assessment maintained responding at an FR 16 schedule of reinforcement. Peter's results are also dissimilar to this finding of Glover's; however, the results of Peter's reinforcer assessment of leisure items should be interpreted with caution. During this assessment, both the high/high and high/low leisure items demonstrated reinforcing properties with the high/high item demonstrating greater reinforcer efficacy; however, a decreasing trend was observed in breakpoints across both items (data not shown but available upon request). A greater reinforcing efficacy was still observed for the high/high item across the last five sessions; but this difference was slight, and several sessions with no responding were observed for both items. These results call into question the sustainability of reinforcing properties for leisure items for Peter.

Results of Experiment 1 also revealed, for participants who experienced assessments of edible items, that edible items approached frequently during single-stimulus preference assessments but infrequently during paired-stimulus preference assessments did not have similar reinforcing efficacy as leisure items approached frequently during both assessments. These results are similar to the results of Francisco et al., 2008 and Penrod et al., 2008, who also evaluated the reinforcement effects of edible items under increased schedule requirements, in that results of a paired-stimulus preference assessment better predicted reinforcer efficacy than results of a single-stimulus preference assessment.

The results of the current study are also similar to these two studies in that edible items identified as low preference by a paired-stimulus assessment served as effective reinforcers in the absence of high-preference alternatives. As described for leisure items, results of Peter's reinforcer assessment of the high/low edible item should be interpreted with caution due to the trend in breakpoints (data not presented but available upon request). The high/low edible item demonstrated reinforcing properties towards the beginning of the assessment, but several sessions with no responding were observed across the last 5 sessions of the assessment questioning the sustainability of the reinforcing properties of this item. This trend was not observed for the high/high edible item, which maintained responding at an FR 32 or greater schedule requirement across the last 5 sessions.

Results of the current study differ from the results of Roscoe et al., 1999, who found low- preference edible items to have similar reinforcing properties as high-preference edible items; however, edible items were only evaluated under continuous schedules of

reinforcement during the Roscoe evaluation as opposed to increased schedules as in the current study.

Differences between Leisure and Edible Reinforcers

It was predicted that larger discrepancies in relative reinforcer efficacy would be observed with leisure items than with edible items, and that low-preference leisure items may show little to no reinforcing efficacy. Both of these predictions were represented in Kara's results; however, larger discrepancies were observed with edible items than with leisure items for Peter, and low-preference leisure items showed reinforcing efficacy for both Peter and Barry. It is important to note, that as aforementioned, the results regarding the absolute reinforcing efficacy of leisure items for Peter were somewhat inconclusive.

Implications, Limitations, and Future Directions

These results have implications for the utility and interpretation of two separate preference-assessment methodologies. Results indicated paired-stimulus assessments better predicted reinforcer efficacy, but also indicated that items approached during 50% or greater of trials during single-stimulus assessments were likely to serve as reinforcers (Kara's results for books were the exception). This means, utilizing a paired-stimulus methodology may be advantageous in determining which item will likely serve as the most potent reinforcer but may not provide clear results as to all item(s) that are likely to function as reinforcers. Utilizing a single-stimulus methodology may be advantageous to identify a greater number of items likely to serve as reinforcers; however, this assessment could also produce false positives as represented by Kara's results for books. In other words, because the books were approached during 100% of single-stimulus trials, the results of Kara's single-stimulus preference

assessment of leisure items indicate that books would likely serve as reinforcers. However, during Kara's reinforcer assessment of leisure items, she did not emit a target response to gain access to the books during any session indicating that, despite high approach responses, books lack reinforcing properties.

One limitation of Experiment 1 is the small number of items assessment for each participant. Future research may help further clarify how best to identify the most potent reinforcer and the greatest number of reinforcers in the most efficient manner by conducting reinforcer assessment on a greater number of stimuli following preference assessments. For example, assessing items with low approach responses during single-stimulus assessments to determine if any items approached (regardless of ranking) are likely to function as reinforcers or assessing additional items with low approach responses during paired-stimulus reinforcers, especially in the event of results similar to Kara's where low-preference items do not function as reinforcers. Assessing additional items is also important because it should not be assumed that all items with identical or even higher approach responses during preference assessments will serve equally well as reinforcers.

The results of the current study are also an important demonstration of the utility of progressive-ratio reinforcer assessments. Valuable information was obtained, especially from Kara's results, to guide treatment decisions. However, additional research is warranted to determine methodological manipulations to decrease the length of the assessment procedures utilized in the current study. Sessions conducted with each participant to establish stability with all items assessed totaled 28 for Kara, 66 for Peter, and 40 for Barry (3 items only). Even if only interested in assessing the highest-preferred edible item and highest-preferred leisure item to

potentially determine the most potent reinforcer following paired-stimulus assessments, assessment using the current methodology would likely be lengthy. Limitations to the current study that may have contributed to the length of assessments and specific areas of opportunity for future research to evaluate methods to decrease the length of progressive-ratio reinforcer assessments are discussed in the following two paragraphs.

The variability of session frequency and state of deprivation within and across participants as well as the variability of response effort across participants represent additional limitations to Experiment 1. Regarding sessions number variability, it is possible that even though breaks between sessions were programmed such that no item could be assessed within 11 min of the previous session conducted with that item (e.g., 5 min break – 1 min of no responding with alternating item – 5 min break), states of satiation/deprivation for the item and fatigue related to responding in previous sessions may have contributed to fluctuations in breakpoints within appointments. In addition, across appointments, caregivers were asked to restrict the target items; however, it is unknown if these items were able to be successfully restricted or if similar items were provided prior to appointments. Barry, specifically, often arrived to his appointments with a toy car from home which differed from the cars assessed in the study because it did not have sound functions but still may have contributed to both fluctuations in breakpoints across appointments for toy cars (if access prior to appointments was variable) and to the overall results of the reinforcer assessment for leisure items. Regarding response effort, it is noteworthy that the participant with the target response requiring the greatest effort (Kara – card exchange) also had the shorter assessment length; however, the effects of this specific variable on that outcome can only be speculated. Systematically

evaluations of response effort and conditions of satiation/deprivation are needed to determine the effects of these variables on assessment length.

In addition to these variables, including visual cues and/or utilizing a method that does not require stability to be established should be considered. The current study utilized a method of assessment reliant on a learning history with the contingencies to establish stability. That is, during reinforcer assessments, the increase in schedule requirement is unknown to the learner until the schedule has been met. Including additional visual cues representing schedule requirements (e.g., responses of putting coins in bank or clothespins on line with the number of coins/clothespins presented matching the schedule requirement) may help facilitate learning and increase stability in responding. Additionally, a comparison of continuing sessions until a stability criterion versus conducting a specific number of sessions determined a-priori could be conducted to determine the necessity of stability to accumulate data needed to evaluate reinforcer efficacy.

Another area of opportunity for future research is to validate the results of the current study or future evaluations of methodology under naturalistic treatment conditions. That is, evaluate the effectiveness of items to reduce problem behavior or increase deficit skills following reinforcer assessments (during which either the same methods were utilized for all items or different methods yielded conflicting results), during treatment implementation or during conditions analogous in response effort and schedules of reinforcement to natural conditions.

Experiment 2

Reinforcer Efficacy and Preference Changes

Results of Experiment 2 revealed that for all three participants neither reinforcer efficacy nor preference increased (by more than 1 approach response) following differential reinforcement of appropriate toy play, and for two out of three participants (Peter and Barry) reinforcer efficacy decreased following differential reinforcement. These decreases were slight and for Peter, it is plausible that this result was an effect of order. That is, Peter's pre-conditioning reinforcer assessment was conducted prior to experiencing additional reinforcer assessments as a part of Experiment 1. During these reinforcer assessments, added experience with the contingencies of the assessment procedures was gained, which were not part of his learning history during the pre-conditioning assessment. It is also plausible this decrease was a valid effect of conditioning.

For Barry, there were noteworthy procedural differences from pre- to post-conditioning assessments that may have accounted for the decrease in reinforcer efficacy during his assessments. Specifically, Barry's pre-conditioning assessment was conducted in alternation with two other items as a part of Experiment 1, and this assessment was conducted across several appointments. In contrast, Barry's post-conditioning assessment was conducted with less time between sessions (due to lack of alternating items) and was completed during one, lengthy appointment. It is possible that satiation occurred during the post-conditioning assessment and accounted for the decrease in comparison to pre-conditioning. Although Barry's post-conditioning trend in breakpoints (see Figure 26) supports this explanation, it is also possible this decrease is a valid effect of conditioning.

When evaluating results of pre- and post-conditioning preference assessments, Barbara's results and observations during the assessment are most noteworthy. Although Barbara's approach responses to the puzzle increased from 0 to 1 (pre- to post-conditioning), the puzzle remained the lowest-preferred item post-conditioning. In addition, Barbara's behaviors during the post-conditioning assessment support a loss of any potential conditioning effects once reinforcement was removed. That is, Barbara selected the puzzle on the second trial it was presented and began to engage in targeted appropriate toy-play responses while looking at the therapist during the post-conditioning assessment. The therapist restricted her attention and did not provide any programmed consequence for appropriate play. Following removal of the puzzle, Barbara did not select the puzzle during any additional trial.

These results are in contrast to previous work in the area that has shown conditioning procedures can be used to establish previously neutral or low preference stimuli as conditioned reinforcers (Eason et al., 1982; Delgado et al., 2009; Greer et al., 1985; Hanley et al., 1999; Hanley et al., 2003; Miguel et al., 2002; Nuzzolo-Gomez et al., 2002; Smith et al., 1996; Sundberg et al., 1996; Tsai & Greer, 2006; Yoon & Bennett, 2000); however, procedures and target stimuli selection utilized in the current study were novel to this line of research. That is, previous work in the area has mostly focused on the effects of conditioning on vocal behavior, stereotypy, and skill acquisition; whereas, the current evaluation focused on the degree to which preference and reinforcer efficacy for low preference items may be altered following conditioning of those items.

The results are also in contrast to the two previous studies most similar to the current evaluation due to their inclusions of examinations of preference shifts (Hanley et al., 1999;

Hanley et al.); however, one of these studies did not evaluate preference shift in the absence of reinforcement, and the second study continued conditioning procedures until a preference shift was observed prior to the removal of reinforcement. It is likely these procedural differences contributed to the contradicting results.

Implications, Limitations, and Future Directions

The current study has implication for conditioning reinforcers in that low-preference items may be difficult to condition as potent reinforcers, and more intensive intervention than provided by the procedures of this study may be necessary for successful conditioning once reinforcement is removed. The aim of this study was to evaluate a brief intervention to increase toy-play skills, and although all participants' skills increased, a dense schedule of reinforcement (i.e., FR 1) was utilized. This dense schedule of reinforcement was not thinned prior to the removal of reinforcement during post-conditioning reinforcer and preference assessments, which may have contributed to the lack of increase in reinforcer efficacy or preference post-conditioning, and represents a limitation of the current study. The effects of conditioning following reinforcement-schedule thinning on reinforcer efficacy and preference represent an area of future evaluation.

As described for Experiment 1, the variability of progressive-ratio session frequency and state of deprivation within and across participants and within and across appointments represent additional limitations of Experiment 2. Because only low preference items were assessed in Experiment 2, it is less likely that access was provided prior to appointments; however, pre-appointment access to similar items is still unknown. In addition, as aforementioned for Barry, sessions were conducted more frequently during his post-

conditioning reinforcer assessment due to lack of alternating items than during his pre-conditioning reinforcer assessment, which may have confounded results due to differing states of deprivation/satiation.

Lastly, stability in responding was established in fewer sessions post-conditioning in comparison to pre-conditioning for 2 out of 3 participants' reinforcer assessments. It is plausible that this result was an effect of order rather than conditioning in that the participants' learning histories with the progressive-ratio reinforcer-assessment contingencies utilized in this study gained pre-conditioning contributed to increased stability during post-conditioning assessments. When utilizing mean number of reinforcers earned across assessments to examine demand curves, order effects could confound results, as described for Barbara's data. Future researchers utilizing progressive-ratio reinforcer assessments for pre/post analyses might consider conducting a progressive-ratio reinforcer assessment for at least one non-targeted item prior to a pre-assessment of a target item to assist in controlling for this variable.

General Discussion

In summary, results of the current study indicated that items approached frequently during a single-stimulus preference assessment but infrequently during a paired-stimulus preference assessment produced less reinforcing efficacy in comparison to items approached frequently during both assessments. However, items identified as moderately or low preference based on the results of paired-stimulus assessments still maintained target responses during reinforcer assessments for 4 out of 5 items assessed. It was also found that for items identified as low preference and for which a skill deficit was observed, responding

during preference and reinforcer assessments did not increase following differential reinforcement of appropriate toy play.

The current study highlights the importance of careful interpretation of preference-assessment results and intervention results as they may relate to preference and reinforcer efficacy. For example, items identified as low preference by a paired-stimulus assessment may serve as reinforcers, and items identified as high-preference by a single-stimulus assessment may not exhibit reinforcing properties. Therefore, the importance of reinforcer assessments and a focus on ways to increase the efficiency of progressive-ratio reinforcer assessments, in particular, is emphasized. In addition, altering preference and reinforcer efficacy for individuals with ASD may be challenging and require additional strategies than the intervention provided by this study but represents an area of opportunity for future research.

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Appendix 1

Institutional Review Board (IRB) Approval



Date: 06/24/2014

NOTIFICATION OF APPROVAL Children's Healthcare of Atlanta Institutional Review Board

Study Title: Evaluating and Increasing the Range of Reinforcers for Individuals with Autism Spectrum Disorder
Principal Investigator: Megan Kliebert Wiggins, MA

CHOA IRB#: 14-098

Date IRB Approval Issued: 06/24/2014

Date IRB Approval Expires: 06/23/2015

IRB Review Type: Full Committee

Sites Associated with this IRB Approval:

- Expedited
- Children's at Eggleston
- Children's at Scottish Rite
- Children's at Hughes Spaulding
- Marcus Autism Center

Risk Category:

- 46.404 OHRP (50.51 FDA)
- 46.405 OHRP (50.52 FDA)
- 46.406 OHRP (50.53 FDA)
- 46.407 OHRP (50.54 FDA)

Children's Healthcare of Atlanta Institutional Review Board approved the above referenced study.

- The stamped approved informed consent document for use in this study is attached. Only this original shall be used to make copies for study enrollment. You may not use any informed consent document that does not have this Institutional Review Board's current stamp of approval. The board has determined one parent signature is required.
- The requirement for written informed consent is waived for this study.
- The requirement for authorization for the release of protected health information for research purposes is waived for this study.
- The requirement for authorization of release of protected health information is partially waived for this study.
- This study is open for data analysis only.

While conducting this research, please ensure that the following occur:

- As applicable, informed consent is sought and appropriately documented from each prospective subject or the subject's legally authorized representative before the subject participates in the research.
- IRB approval for continuation of the study is obtained prior to the above referenced expiration date. Failure to obtain approval for continuation prior to the expiration date results in immediate termination of the research at the above referenced study sites.
- Any modification to the study procedures or documents approved by the IRB are submitted to and approved by the IRB prior to implementing the change.
- Serious adverse events reports are reported to the IRB within five (5) days of knowledge of them.
- Appropriate study records are maintained as mandated by this institution, the sponsoring agency, and the U.S. Food and Drug Administration.
- Hospital staff involved with this study are fully informed and trained regarding their involvement with this research or its subjects.

The IRB office may provide a request for continuing renewal at 60 and 30 days prior to the expiration date indicated above. However, it is the Principal Investigator's responsibility to ensure that the continuing renewal materials are submitted in adequate time to allow IRB review and approval prior to the expiration date. Failure to obtain IRB approval for continuation results in immediate termination of the research. In this case, the study may not be re-opened under this CHOA IRB# unless the continuing renewal materials are received within 90 days of the expiration date and approved by the IRB. Otherwise, the study must be submitted as a new protocol and a new CHOA IRB# will be assigned.

As a reminder, in addition to IRB approval, the PI is responsible for obtaining all applicable organizational approvals for the study (Legal, Clinical Engineering, Sourcing, Departmental, etc.).

Sincerely,

Serrana Slaton

Serrana Slaton,
IRB Administrator

Documents Approved:

Protocol - Version date: 06/09/2014

Informed Consent - Version date: 06/24/2014

Assent - Version date: 06/24/2014

HIPAA - Version date: 05/24/2014

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Appendix 2 IRB Authorization Agreement

Version Date: 03/31/2011

Sample text for an Institution with a Federalwide Assurance (FWA) to rely on the IRB/IEC of another Institution (Institutions may use this sample as a guide to develop their own agreement).

Institutional Review Board (IRB) Authorization Agreement

Name of Institution or Organization Providing IRB Review (Institution/Organization A):

Children's Healthcare of Atlanta

IRB Registration #: 00001436 Federalwide Assurance (FWA) #, if any: 00000644

Name of Institution Relying on the Designated IRB (Institution B):

Louisiana State University and Agricultural & Mechanical College

FWA #: 00003992

The Officials signing below agree that _____ may rely on the designated IRB for review and continuing oversight of its human subjects research described below: (check one)

This agreement applies to all human subjects research covered by Institution B's FWA.

This agreement is limited to the following specific protocol(s):

Evaluating and Increasing the Range of Reinforcers for Individuals with

Name of Research Project: Autism Spectrum Disorder

Name of Principal Investigator: Megan Kiebert Wiggins

Sponsor or Funding Agency: _____ Award Number, if any: _____

Other (describe): _____

The review performed by the designated IRB will meet the human subject protection requirements of Institution B's OHRP-approved FWA. The IRB at Institution/Organization A will follow written procedures for reporting its findings and actions to appropriate officials at Institution B. Relevant minutes of IRB meetings will be made available to Institution B upon request. Institution B remains responsible for ensuring compliance with the IRB's determinations and with the Terms of its OHRP-approved FWA. This document must be kept on file by both parties and provided to OHRP upon request.

Signature of Signatory Official (Institution/Organization A):

Paul Spearman Date: 7/14/2014 Chief Research Officer
Print Full Name: Paul Spearman, MD Institutional Title: _____

NOTE: The IRB of Institution A may need to be designated on the OHRP-approved FWA for Institution B.

Signature of Signatory Official (Institution B):

Dennis Landin Date: 7/10/14
Print Full Name: Dennis Landin Institutional Title: Chair, LSU IRB

Vita

Megan K. Wiggins is a candidate for the Doctor in Philosophy degree in the school psychology program at Louisiana State University. She graduated with her Bachelor of Science degree in psychology in 2006 from Louisiana State University and received her Masters of Arts degree in psychology in 2010 from Louisiana State University. Megan completed her pre-doctoral internship at The Marcus Autism Center in Atlanta, Georgia, and she currently works as a Behavioral Clinical Practitioner at the Center. Megan completed her graduate work under the supervision of Dr. Jeffrey H. Tiger and Dr. George H. Noell.