PROGRESSIVE RESPONSE EFFORT PREFERENCE ASSESSMENTS

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ABSTRACT
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The identification of preferred and reinforcing stimuli has long been a focus of behavior analysts in applied settings. Research has primarily focused on different methodologies for assessing whether stimuli are preferred and there has been additional research on identifying under what conditions those stimuli will function as reinforcers. Recently, research has begun to examine responses and reinforcers from a behavioral economic perspective. The present study compared responding in a situation where the price of one item was increased, but the price of alternative items remained the same, to a situation where the price of all available items increased. Multiple stimulus with replacement (MS) preference assessment methodology was used and price was altered by increasing the distance of the stimuli from the participant. During the first assessment, the item chosen most frequently in the first session was systematically moved 6 – 24 inches beyond the other items during subsequent sessions. During the second assessment, all items were systematically moved 6 – 24 inches beyond the starting point in front of the participant during subsequent sessions. Results for the first assessment indicated that for four of the five participants, consumption of the target item decreased as a function of increased price for that item. Results for the second assessment indicated that at high costs, clear preference for one item was observed for three of the five participants. Taken collectively, these results suggest that response effort is a variable

that should be taken into consideration when evaluating effective treatments for individuals with disabilities. Preference and reinforcer effectiveness may shift as individuals are presented with tasks that require increased response effort in terms of reaching or moving about their environment.

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CHAPTER 1

INTRODUCTION

Preference refers to the relative rate of responding to one of two or more alternative stimuli (Catania, 1998, p. 402). Both indirect and direct methods of assessing preference have been examined in an attempt to identify stimuli that may potentially serve as reinforcers. Reinforcer identification is essential in applied behavior analysis for both skill acquisition programs and decreasing problem behavior. More recently, researchers have examined the efficacy of a behavioral economic approach to preference and reinforcers.

A review of indirect and systematic methods of identifying preferences and a summary of the literature on additional variables affecting the assessment of preference will be discussed. A brief overview of behavioral economics will be presented. Finally, a review of the literature on evaluating preference from a behavioral economic point of view will be discussed.

The present study being reported in this dissertation is part of a series of studies that have been conducted on behavioral economics and preference by the author and colleagues. The methodologies presented here are an extension of previous response effort preference assessment methodology. Portions of the previous research were

presented at the 32nd meeting of the Association for Behavior Analysis in Atlanta and are included as supplemental material to this dissertation.

Indirect Assessment of Preference

Perhaps the easiest method to identify potential preferred items is to ask the individual or their caregiver. Asking can be done by having an individual make a list, by giving him or her options and asking which of two items is more preferred, by having them rank a list, or by completing a preference survey. A example of a preference survey is the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD), developed by Fisher, Piazza, Bowman, and Amari (1996). This survey asks caregivers to identify preferred stimuli in sensory areas (e.g., visual, auditory, olfactory) and requires the administrator to probe the caregiver for additional information. At the end of the survey, the caregiver is asked to rank the top 16 items identified. The results of Fisher et al. indicated that caregiver report of standard items was not very good at identifying reinforcers. However, when combined with the survey and a systematic choice assessment, results were more predictive of identifying reinforcers. The unreliability of caregiver report was also demonstrated by Green, Reid, Canipe, and Gardner (1991). They noted that systematic preference assessments were better at predicting the effectiveness of reinforcers.

In addition, it may not be possible to accurately differentiate between highly preferred stimuli and less-preferred stimuli when using surveys alone (Northup, George, Jones, Broussard, & Vollmer, 1996). When comparing the use of surveys to verbal paired stimulus and pictorial paired stimulus preference assessments, Northup et al. found

the accuracy of the survey was only about 55%. These results were also replicated with a larger number of participants (Northup, 2000). Northup also noted that surveys may be susceptible to a larger percentage of false positives than more systematic preference assessments. Cote, Thompson, Hanley, and McKerchar (2007) compared teacher reports of preferences to direct assessment of preference for preschoolers. Their results indicated low correspondence between the teacher report and the direct assessment. Interestingly, items identified by both methods were still effective as reinforcers. However, Cote et al. stated that items identified by the direct assessment were found to be comparatively more reinforcing than those identified by teacher report alone. Given the inconsistencies of verbal reports and surveys, behavior analysts need more reliable methods of identifying stimuli that may function as reinforcers.

Systematic Preference Assessments

While the validity of indirect assessments such as caregiver reports is questionable, the use of systematic preference assessments has proven to be more predictive of reinforcer effectiveness. Systematic preference assessments require direct measures of preference. Pace, Ivancic, Edwards, Iwata, and Page (1985) developed a trial based method of preference assessments that is commonly referred to as the single stimulus presentation method. Participants in Pace et al. were presented with a variety of stimuli, one at a time. Approach was recorded over a series of trials. Items were then tested as reinforcers by being presented contingent on an arbitrary behavior. The authors concluded that items with high approach during the preference assessment were more likely to function as reinforcers.

Although the single stimulus preference assessment methodology is an improvement over surveys and other means of asking individuals what is preferred, a weakness of this assessment is the possibility of false positives. False positives may occur if the individual approaches all items that are presented in front of them. Although this was not the case for Pace et al. (1985), Paclawaskyj and Vollmer (1995) used a single stimulus assessment for individuals with visual impairments and found that because of the participants' specific disability, this methodology was not effective as the participants tended to approach all items to identify them through manipulation.

Fisher et al. (1992) compared the single stimulus methodology to a paired stimulus methodology. In the paired stimulus method, two stimuli are presented at the same time. Each of the stimuli is presented against the rest of the stimuli in a forced or paired choice format. The participant is required to make a choice between two stimuli on each trial. This methodology allows for a better comparison between stimuli. Stimuli can be ranked in terms of preference from those chosen on a high percentage of the trials to those chosen on a low percentage of trials, thus differentiating between high and low preferred stimuli. This is an advantage over the single stimulus method, which does not allow for this discrete ranking. The authors proceeded to identify whether the high preferred and low preferred items functioned as reinforcers. Fisher et al. concluded that high preferred items from the paired stimulus preference assessment were more likely to function as reinforcers when compared to the low preferred stimuli.

One disadvantage of the paired stimulus preference assessment is the duration of the assessment. Depending on the number of stimuli being assessed, it can take up to an hour to administer. When assessing edible items, satiation may occur for some

individuals requiring the assessment to be completed over more than one day. Due to the duration concerns of the paired stimulus methodology, Windsor, Piché, and Locke (1994) developed a multiple stimulus (MS) preference assessment methodology. In the MS preference assessment method, a number of preferred stimuli are placed on the table in front of the participant. At the beginning of the first trial, the participant is told "choose one". If edible items are being used, following consumption of one item, that item is replaced and the next trial begins. If tangible items such as toys are being assessed, the participant is allowed a short period of time (e.g., 15 s) to manipulate the item and then it is placed back in the array and the next trial begins. A set number of trials are completed and then data are calculated in terms of percentage of trials in which each item was approached or selected. Windsor et al. found that not only is the duration of this assessment much shorter than that of the paired stimulus methodology, but items selected on a high percentage of trials also functioned as reinforcers in reinforcer assessments.

The multiple stimulus methodology has the advantage of being able to present a number of stimuli at one time and can be conducted much more quickly than the paired stimulus assessment. However, a weakness of the multiple stimulus assessment is that similar to the single stimulus methodology, it does not result in a discrete ranking of preference. This type of assessment may result in false negatives (DeLeon & Iwata, 1996). That is, there is the possibility that some items may never be selected from the array. Those items, if assessed further, may prove to function as reinforcers.

DeLeon and Iwata (1996) evaluated a variation of the multiple stimulus preference assessment. They compared the paired stimulus and the multiple stimulus with replacement methods to a multiple stimulus without replacement (MSWO) method.

For the MSWO they combined elements of both the paired stimulus and multiple stimulus methodologies. In this method, the participant is presented with an array of stimuli on the table in front of them, as in the multiple stimulus with replacement. At the beginning of the first trial they are told 'choose one'. The trial ends after the edible item has been consumed or the tangible item has been manipulated for a short period of access. At the end of the trial, the tangible item is removed from the participant. Neither the edible nor the tangible item is replaced in the array. The second trial begins and the participant may now select from the remaining stimuli. The assessment continues until all items have been selected or a specified amount of time has passed since the trial began. DeLeon and Iwata found that compared to the other two assessment methods, the MSWO took about half the time that the paired stimulus took to administer and resulted in an orderly ranking of preference. It also accounts for all items unlike the multiple stimlus method where some items may not be selected from the array. DeLeon and Iwata also noted that higher ranking items were more likely to function as reinforcers than lower ranking items.

One other example of a preference assessment methodology is the free operant assessment (Ringdahl, Vollmer, Marcus, & Roane, 1997). Free operant assessments can either be completely naturalistic, where a clinician spends time observing an individual in his or her natural environment to identify what items he or she interacts with or specific items can be arranged in the environment to determine whether they will be interacted with. One example of a more formally arranged free operant assessment was reported by Roane, Vollmer, Ringdahl and Marcus (1998). Roane et al., attempted to identify an effective method of identifying reinforcers in a brief assessment. They used a 5-min free

operant assessment. Items were placed in a circle on a table. Prior to the beginning of the assessment, the participant was brought into the room and moved around the table and prompted to interact with each of the stimuli. Once this was complete, the participant was moved away from the table and the session began. No prompts to interact were provided. Data were collected on approach to the items. Overall results of the assessment indicated that items that were manipulated during the free operant assessment showed greater reinforcing effects. The authors also concluded that the advantages of this methodology included the brief duration and the absence of problem behavior compared to a paired stimulus assessment. Roane et al., found that trial-based methods of assessing preferences were more likely to result in problem behavior because they may be viewed as work and/or because items were removed at the end of a trial. Similar to the MS method, a free operant assessment did not produce a rank ordering of preference.

While the dependent variable in systematic preference assessments has typically consisted of approach response to the items, both duration of manipulation and latency to problem behavior have been examined for their utility as dependent variables. DeLeon, Iwata, Connors, and Wallace (1999) used duration-based measures to assess stimulus preferences with individuals whose MSWO results were ambiguous. That is, undifferentiated approach percentages were obtained for many of the stimuli. DeLeon et al. suggested that ambiguous results may occur when many of the stimuli in the array are either highly preferred or only a few are highly preferred. Stimuli were presented in a single stimulus format and the duration of interaction was measured. The results indicated that duration-based measures were a valid method of identifying reinforcing stimuli. Hagopian, Rush, Lewin, and Long (2001) obtained similar results when they

used a single stimulus engagement method to predict reinforcer effectiveness. Derby et al. (1995) compared the use of approach responses and latency to the first aberrant response as dependent variables in paired choice assessments and found that both dependent variables effectively identified reinforcing stimuli.

Overall, the procedural variations associated with systematic preference assessments have both strengths and weaknesses including relative duration, ability to produce a ranking of preference and the ability to predict reinforcer effectiveness. However, some are clearly better than others.

Further Examination of Preference Assessments

Providing access to an item in a preference assessment can affect the outcome of the preference assessment. Higbee, Carr, and Harrison (1999) compared the results of pictorial and tangible MSWO preference assessments. During pictorial preference assessments, two dimensional laminated photographs of the actual stimuli were presented. During tangible preference assessments, the actual stimuli were presented. Higbee et al. found that the items predicted by the tangible assessment were more likely to function as reinforcers than those predicted by the pictorial assessment. However, the results may have been affected by procedural differences. No access to the item was provided in the pictorial assessment, whereas 20 s of access was provided in the tangible assessment. Also, no assessment of the participants' ability to mand using the picture cards was conducted prior to the study. Higbee et al. concluded that this may have affected the results if the participant was not familiar with using pictures to request items.

Additional examinations of presentation methods have been reported by Conyers et al. (2002) who compared three paired-stimulus presentation methods for assessing preference: Presenting the item, presenting pictures, and presenting the spoken name of the item. Participants' discrimination skills were tested prior to the preference assessments. The results suggested that it may be important to use a presentation method that is consistent with the participant's level of discrimination. For example, using a vocal presentation preference assessment with an individual who has poor discrimination skills may not be effective at predicting which items will serve as reinforcers. Tessing, Napolitano, McAdam, DiCesare, and Axelrod (2006) noted that when access was not provided in a vocal preference assessment, results were much different from when access was provided.

The duration of availability of a reinforcer may also shift preference from high to low. Steinhilber and Johnson (2007) demonstrated that preference results were different depending on whether the item was provided for 15 second or 15 minutes after it was selected. They concluded that some preferred items such as access to video games may not be reinforcing if only provided for 15 seconds.

Transitory Nature of Preference

For many individuals preference is unstable over time, as revealed by the fact that repeated measures can result in differences in stimulus hierarchy ranking (Carr, Nicolson, & Higbee, 2000). As mentioned previously, some preference assessment methods can be time consuming. Thus, it may be challenging to identify effective and persistent reinforcers for some individuals. Hence, clinicians have examined variations of common

preference assessment methodologies in an attempt to identify a shorter but still effective assessment (Carr et al. 2000; Ortiz & Carr 2000). For example, Carr et al. evaluated a brief multiple-stimulus preference assessment. Using the methodology reported by DeLeon and Iwata (1996), they presented only three stimulus arrays rather than the five presented by DeLeon and Iwata. The results of the reinforcer assessment that followed demonstrated that it was possible to identify effective reinforcers with a reduced number of presentations. They also noted that correlations between the first presentation and all three presentations suggested that using only one presentation may be just as effective at predicting reinforcers. Higbee, Carr, and Harrison (2000), came to the same conclusion indicating that an MSWO preference assessment could be conducted in about 15 min allowing preference assessments to be conducted on a more frequent basis.

Change in preferences may be due to establishing operations, effort, or other environmental variables. Hanley, Iwata, and Roscoe (2006) examined the stability of preferences over 3 to 6 month periods of time and found that it is possible to systematically produce changes in preference. Their results indicated that some determinants of changes in preference over time included establishing operations and history of interaction with the reinforcer.

The effects of establishing operations on preference assessment outcomes were evaluated by Gottschalk, Libby, and Graff (2000). They found that both deprivation and satiation impacted which items were more preferred during each assessment. Similar results were also demonstrated by McAdam et al. (2005) when they systematically restricted items or provided access to items prior to preference assessments. When

designing treatments that will maintain changes in behavior over long periods of time, it may be important to have information on how preference may shift.

If preferences do shift, it may be that even a low ranking item may sometimes function as a reinforcer. For example, Roscoe, Iwata, and Kahng (1999) demonstrated that stimuli that are ranked as low preferred can indeed function as reinforcers. They compared the relative and absolute reinforcement effects of 10 food items. Relative reinforcement effects occur when assessing reinforcers in a concurrent operants paradigm. They found that highly preferred stimuli functioned as reinforcers but relatively non-preferred stimuli did not. Absolute reinforcement effects were evaluated in a single stimulus assessment where the non-preferred item was presented contingent on a behavior and the highly preferred stimulus was not available. Results here indicated that weakly preferred items may function as reinforcing stimuli when their effects are not being masked by the presence of strongly preferred stimuli. In this situation, the less preferred item substituted as a reinforcer for the more highly preferred item when the latter was not available. Francisco, Borrero, and Sy (2008), systematically replicated Roscoe, et al. (1999) and obtained similar results for 2 of their 3 participants. Thus stimuli identified as low preferred in the initial preference assessment maintained responding in the absence of high preferred reinforcers.

The identification of substitutable reinforcers was further addressed by Green and Freed (1993). The relationship between reinforcers can be viewed as being on a continuum with substitutes on one end and complements at the other. Substitutable reinforcers are functionally interchangeable. This concept was also examined by Shore, Iwata, DeLeon, Kahng, and Smith (1997) who evaluated the effectiveness of access to

preferred items as generating behavior that could compete with self-injury. They found that free access to preferred items successfully competed with self-injury. However, when the item was presented as the reinforcer in a differential reinforcement of other behavior (DRO) intervention, it was not effective. The same item was also not effective in situations where the participant was required to work to obtain the item. Shore et al. suggested that the delay to reinforcement in the DRO and work interventions may have resulted in their ineffectiveness at reducing self-injury. Perhaps in this situation, self-injury was more preferred as a reinforcer than the tangible items, but the lower preferred items were more effective as reinforcers when no effort was required to obtain them.

Substitutability is often examined by economists studying human behavior in terms of price of commodities. Economists study the choice of one commodity over another in the natural environment rather than in isolated laboratory environments. Behavior analysts have begun to turn to the field of economics to help explain preference assessment outcomes and the effects of reinforcement.

Behavioral Economics

Behavioral economics is based on the principles of microeconomics "the discipline that documents the decision processes in the human economy" (Hursh & Silberberg, 2008, p. 188). One such principle is that human consumption should be studied in the natural environment. Another principle is that of measuring relative consumption as a function of price. Economic theory typically studies the cost-benefit ratio of consumption and price. Income can be viewed in terms of responses while commodities available for purchase can be viewed in terms of reinforcers. In behavioral

economics, consumption is the amount of the reinforcer obtained, whereas price is the amount of responding or effort required to obtain the reinforcer.

Substitutability is an economic concept that refers to the functional similarity of reinforcers (Green & Freed, 1993). If the price of a reinforcer being increased results in increased consumption of an alternative reinforcer, the alternative reinforcer is a substitute. Other stimuli in the environment may function as either complements or independents. If the price of a reinforcer being increased results in decreased consumption of alternative stimuli, then those stimuli would be complements. Alternative stimuli that are not affected by increases in price of another reinforcer are considered independents.

Another economic concept is unit price, which refers to the ratio of costs over benefits. For example, if a 32 ounce box of cereal costs $4.99 and the 16 ounce box costs $3.99, the larger box has a smaller price per ounce ($0.16 per ounce versus $0.25 per ounce). In behavioral economics, unit price is conceptualized as the ratio of response effort over magnitude of the reinforcer (Borrero, Francisco, Haberlin, Ross, & Sran, 2007). That is, how many responses are required per reinforcer.

These concepts of consumption and price have been studied in a laboratory setting, where the economy can either be defined as open or closed. Open economies are ones in which there are reinforcers available throughout the day both within and outside of any session that is conducted. Closed economies are ones in which the total allotment of reinforcers for the day is available within the session. No additional reinforcers are provided post-session (Green & Freed, 1993). Hursh (1980) viewed the closed economy

as an ideal state for demand analysis because “daily consumption is the result of the equilibrium of supply and demand”.

Demand elasticity is the extent to which consumption of a reinforcer is affected by changes in price for that reinforcer (Green & Freed, 1993). Demand can either be elastic or inelastic. When demand is elastic, the more consumption will change as price increases, demonstrating the commodity is less valuable. Elastic demand is sensitive to price increases. When demand is inelastic, consumption will persist as price increases, which is to say, inelastic demand is fairly insensitive to price increases (e.g., gasoline). Demand is inelastic when there are no equivalently priced substitutes available. The transition point at which demand changes from being inelastic to being elastic is called P_{max}. Reinforcers with a large P_{max} value will be more likely to maintain responding when the price of a reinforcer is increased (Hursh & Silberberg, 2008). Demand curves show where demand is inelastic and the point, P_{max}, where demand changes to elastic. Demand curve is defined by Hursh (1980) as how much of a commodity will be consumed by the subject at a given price.

To better extend research on human behavior from the experimental environment to the natural environment, researchers may wish to consider the benefits of interpreting behavioral phenomena within a behavioral economic framework (Hursh, 1980).

Behavioral Economics and Preference

Behavioral economics has recently become a more popular topic in the field of behavior analysis. In a theoretical and conceptual work, Hursh and Silberberg (2008) argued that economic demand equations should be used to identify the value of a

reinforcer and to predict reinforcers' effectiveness at maintaining changes in behavior. A number of recent studies in the applied literature have investigated several different behavioral economic principles. For example, in a laboratory setting, Bullock and Hackenberg (2006) found only partial support for the concept of unit price. They noted that unit price best explained situations where fixed ratio (FR) schedules produced equal response rates. As FR schedules increased, deviations in responding from unit price predictions occurred. In an applied setting, Borrero, Francisco, Haberlin, Ross, and Sran (2007) extended the concept of unit price to severe problem behavior. They noted decreased consumption of reinforcers as unit price increased, thus finding that demand was elastic.

Tustin (1994) found that items that were preferred at low schedule constraints were no longer preferred at high schedule constraints, as revealed by a clear shift in measures of preference. DeLeon, Neidert, Anders and Rodriguez-Catter (2001) found that when given a choice between an edible and a break from task, individuals who engaged in escape-maintained problem behavior chose the edible over the break when the response requirement was at an FR 1. However, as the response requirement increased, a shift took place. At an FR 10, the break was now more preferred than the edible.

Whereas Tustin (1994) reported a clear shift in preference as schedule constraints changed, preference emergence was noted by DeLeon, Iwata, Goh, and Worsdell (1997) at higher schedule requirements. In a concurrent operants situation, when comparing two similar items (edible / edible) and two dissimilar items (edible / toy), preference for each alternative was about equal at low effort requirements. As the response effort increased, preference for one of the food items over the other emerged. This was not seen for the

dissimilar items. These results suggested that preference for one item over another may not be identified at low costs. Thus, it may be important to evaluate preference at higher costs. In addition, the two edible items may have been substitutes of one another, but the dissimilar items were not, which is why choice continued to be allocated to both dissimilar alternatives even at higher costs.

The utility of progressive ratio schedules in determining the effectiveness of reinforcers was also examined by Roane, Lerman, and Vorndran (2001). Their results largely replicated those of Tustin (1994) and DeLeon et al. (1997). Roane et al. examined the effectiveness of reinforcers at reducing destructive behavior. The results indicated that the stimuli that maintained responding at higher ratio requirements were more effective at reducing destructive behavior than those stimuli that maintained less responding. Roane et al. suggested that progressive ratio schedules may be able to more rapidly identify the effectiveness of reinforcers because each schedule value occurs only once per session. Practitioners can quickly determine if a stimulus will maintain responding for high-effort tasks. Progressive ratio schedules are more analogous to the types of reinforcement schedules found in the natural environment; therefore, they are probably better suited to identifying reinforcers in the applied setting (Francisco, Borrero, & Sy, 2008).

Purpose of Present Study

As discussed above, systematic preference assessments have been effective in identifying preferred stimuli for individuals diagnosed with developmental disabilities. However, preference has been shown to be a relative concept. It seems that in many

cases preference and reinforcer effectiveness is largely determined by the context in which they are assessed and used. Further investigation of behavioral economic methodologies to identify preferences is warranted.

There are several variables for behavior analysts to consider when attempting to identify reinforcers. Stimuli that are weakly preferred may be weakly preferred only within the array of items that they are being assessed with. For example, M&Ms may be non-preferred when assessed along with chips, popcorn, cookies, and ice-cream. However, they may be highly preferred in comparison with celery, carrots, cheese, and apples. In contrast, carrots presented contingent upon completion of folding towels may not increase the number of towels folded if the child at the next table has access to chips. If a child is working alone, has not eaten recently, and only carrots are available, an increase in the number of towels folded may occur. A second variable involves the role of response effort associated with a task (e.g., DeLeon et al., 1997, Roane at al, 2001, Tustin, 1994). An individual may complete one math problem for a pretzel, perhaps even two, but if the response requirement is to load all of the dinner dishes into the dishwasher, one pretzel may not serve as a potent enough reinforcer and may therefore not maintain responding.

The present study examined methodology for preference assessment from a behavioral economic perspective. The purpose of the study was to determine whether conceptualizing response effort as distance from the participant, rather than number of responses, was effective at identifying potential reinforcers (i.e., would they reach further to obtain a preferred stimulus). In addition, response effort in two situations was compared. In the first assessment alternative stimuli were available at lower cost as the

price of a preferred stimulus was increased. In the second assessment the price of all available stimuli was increased.

CHAPTER 2

METHOD

Participants and Setting

Five individuals diagnosed with developmental disabilities, and served within a residential behavioral stabilization unit, were selected for participation in this study. Participants were admitted to the program for the assessment and treatment of severe problem behavior. Participants chosen for the study were in the treatment phase of their admission. Diagnoses and a functional analyses of the problem behavior were conducted for all participants at the beginning of their admission. All participants were in good health. The participants provided assent and their parents or guardians provided informed consent to participation. The study received approval of the Temple University Institutional Review Board.

Connor was a 15-year-old male diagnosed with autism, impulse control disorder, and mental retardation, not otherwise specified. Connor's communication was limited to gestures and some use of picture cards. At the time of this study, Connor was prescribed Risperdal™ and Clonidine™. The dosage of Risperdal™ was increased, decreased, and subsequently increased again during the course of the study. Timothy was an 18-year-old male diagnosed with autism, intermittent explosive disorder, bipolar disorder, and mental retardation, not otherwise specified. Timothy's communication consisted primarily of

gestures and a few signs. At the time of this study, Timothy was prescribed Depakote™, Risperdal™, and Abilify™. The dosage of Risperdal™ was decreased during the course of this study. Abbey was a 15-year-old female diagnosed with autism, disruptive behavior disorder, and mental retardation, not otherwise specified. Abbey's vocal speech was her primary mode of communication, but prompting was often required. During the course of this study, Abbey was prescribed Depakote™ and Trazadone™. No medication changes occurred during the course of this study. Lynne was an 18-year-old female diagnosed with a seizure disorder, autism, and severe mental retardation. Lynne's primary mode of communication was sign language. During the course of this study Lynne was prescribed Topomax™, Depakote™, Klonipin™, Celexa™, and Risperdal™. No medication changes occurred during the course of this study. Jonathon was a 16-year-old male diagnosed with autism and mental retardation, not otherwise specified. Vocal speech was his primary mode of communication. Jonathon was not prescribed any medication during the course of this study. For all participants, sessions were conducted in the dining room of their living unit, which contained tables, chairs, and the materials needed to conduct sessions. For some sessions, other individuals living on the unit were present in the dining room.

Procedure

Five snack foods were chosen as the commodities available during the preference assessments. Food items were identified via participant, parent, and staff interview. The items identified for Connor included chocolate pudding, pretzels, chips, Cheez-its, and sugar cookies. The items identified for Timothy included Slim Jims, M&Ms, cheese

curls, Skittles, and chocolate chip cookies. Abbey's items were peanut butter crackers, fruit snacks, carrots, chips, and pretzels. Lynne's identified items were cheese curls, pretzels, chips, Skittles, and M&Ms. Jonathon identified Swedish Fish, chips, Twizzlers, Fritos, and cheese curls.

Multiple stimulus with replacement preference assessments (Windsor, Piché, & Locke, 1994) were conducted for each participant. A mat board (appendix) was placed on the table for each session. The mat board had lines drawn at 12, 18, 21, 24, 27, 30, 33, and 36 inches from the participant who was seated at one side of the table. Sessions were conducted between 1 and 5 days per week. A maximum of 2 sessions were conducted per day. All sessions were 5 min in length.

At the beginning of the initial session, the therapist stood at the table opposite the participant with bowls containing each of the stimuli aligned on the edge of the table immediately in front of the therapist. One piece of each item was placed at equal distances on the line located 12 inches in front of the participant. After each choice, the selected item was replaced immediately. This process continued for the duration of the session.

For the second session and all subsequent sessions, the items were rotated one spot to the participant's right prior to the next session to control for placement effects. For example, if chips were on the participant's left in Session 1, chips were placed second to left in Session 2, and the item that was placed furthest to the right in Session 1 was placed furthest to the left in Session 2.

At the beginning of the second session, the stimulus chosen most frequently in the initial session was placed 6 inches further away from the rest of the stimuli. The distance

was increased between sessions in an ascending (i.e., 18, 21, 24, 27, 30, 33, and 36 inches) sequence with the exception of Timothy whose order was 21, 24, 27, 30, 33, 36, and 18 inches. (Initially, proposed procedures were to examine the effects of varying the sequence of distances the target stimuli was placed.) The alternative items were always placed 12 inches in front of the participant. Thus, the items that were moved further from the participant ranged from 18 to 36 inches from the edge of the table facing the participant.

The procedure was then replicated for each participant. However, during the replication, the distance of all five items was progressively increased each session. During the first session one piece of each item was placed at equal distances on the line located 12 inches in front of the participant. After each choice throughout the 5 min session, the selected item was replaced immediately. For the second session and all subsequent sessions, the items were again rotated one spot to the participant's right each session to control for placement effects. At the beginning of the second session, all stimuli were placed at equal distances along the line located 18 inches in front of the participant. For each subsequent session, the distance was increased in ascending (i.e., 18, 21, 24, 27, 30, 33,and 36 inches) order for all stimuli.

Response Measurement and Interobserver Agreement

The dependent variable for measuring choice in the study was approach. Approach was defined as picking up a food item from the line. The frequency of responses across 10-s intervals was recorded. A second observer simultaneously but independently recorded approach responses during at least 30% (range, 38% to 63%) of

the sessions with each participant. To calculate agreement, sessions were divided into 10s intervals and the smaller number of responses recorded by one observer was divided by the larger number of responses recorded by the second observer. These fractions were then averaged across a session. Mean occurrence agreement was 90.6% (range, 74% to 100%) for Connor, 87.6% (range 71% to 100%) for Timothy, 90.2% (range, 76.5% to 100%) for Abbey, 90.7 (range, 85.7% to 96.4%) for Lynne, and 94.8% (range 84.6% to 100%) for Jonathon.

CHAPTER 3

RESULTS

Figure 1 shows the results for Connor. The top panel depicts choices for all items, as a function of distance, as the target item was moved away from Connor. In the initial session, chocolate pudding was chosen exclusively. This item was identified as the target item that was then parametrically manipulated in terms of distance from the other items in the first assessment. The distance of the chocolate pudding from other items was then parametrically manipulated in subsequent sessions. When chocolate pudding was moved to 18 inches (6 inches beyond the other items) and the alternative items remained at 12 inches, chips were chosen exclusively. When the chocolate pudding was moved even further away from the other items (e.g., 21, 24, and 27 inches), sugar cookies were chosen exclusively. When the target item was placed 30 and 33 inches away from the other items, choice switched to Cheez-its and at 36 inches, returned to sugar cookies. The bottom panel depicts choices for all items, as a function of distance, as all items were moved away from Connor. In this second assessment, when all items were moved, choices were allocated to sugar cookies at 12 inches and then Cheez-its at 18 inches. Once all items were moved to a distance of 21 inches, chocolate pudding was exclusively selected. For the remainder of the assessment, chocolate pudding was selected exclusively. Thus, when only the most preferred item was moved further away from

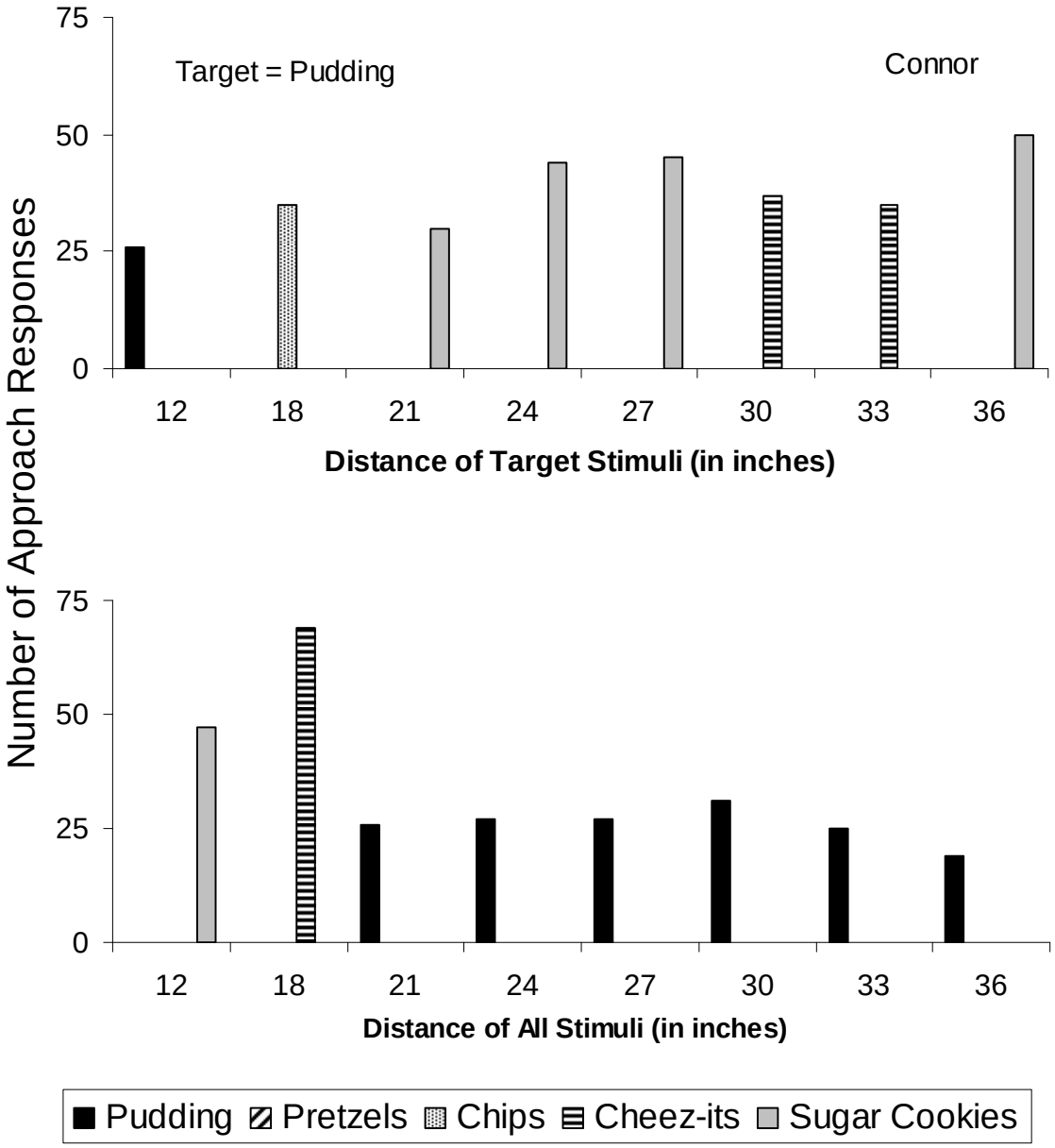

Figure 1. Response preference assessment outcomes for Connor as a function of increasing the distance of the preferred item from the other items (top panel) and a function of increasing the distance of all the items (bottom panel).

Connor, preferences shifted to other items exclusively, even with very modest increases in distance. In contrast, when all items were moved further away from Connor, preference initially shifted to other items but then developed exclusively for chocolate pudding as distances increased.

Figure 2 represents the results for Timothy. The top panel depicts choices for all items, as a function of distance, as the target item was moved away from Timothy. In the initial session when all items were at a distance of 12 inches, Slim Jim was chosen exclusively. When Slim Jim was moved to 21, 24, and 27 inches and the alternative items remained at 12 inches, all choices continued to be allocated to Slim Jim. Once Slim Jim was moved to a distance of 30 inches, preference switched to Skittles, one of the alternatives remaining at 12 inches. Only Skittles were chosen for the remainder of the assessment, even when Slim Jim was moved closer to 18 inches. The bottom panel depicts choices for all items, as a function of distance, as all items were moved away from Timothy. In the second assessment, Slim Jim was chosen exclusively at 12, 18, 21, 24, 27, and 30 inches. However, choice switched to Skittles at 33 and 36 inches. None of the additional three alternative items were sampled throughout this assessment. Interestingly, the absolute rate of approach responses declined substantially when only Skittles were selected at 33 and 36 inches. Rate of approach response for Skittles during these two sessions was similar to that in the first assessment suggesting that in general consumption of Skittles is relatively less than that of Slim Jim.

Figure 3 shows the results for Abbey. The top panel depicts choices for all items, as a function of distance, as the target item was moved away from Abbey. In the initial session, all items were sampled a similar number of times with the exception of peanut

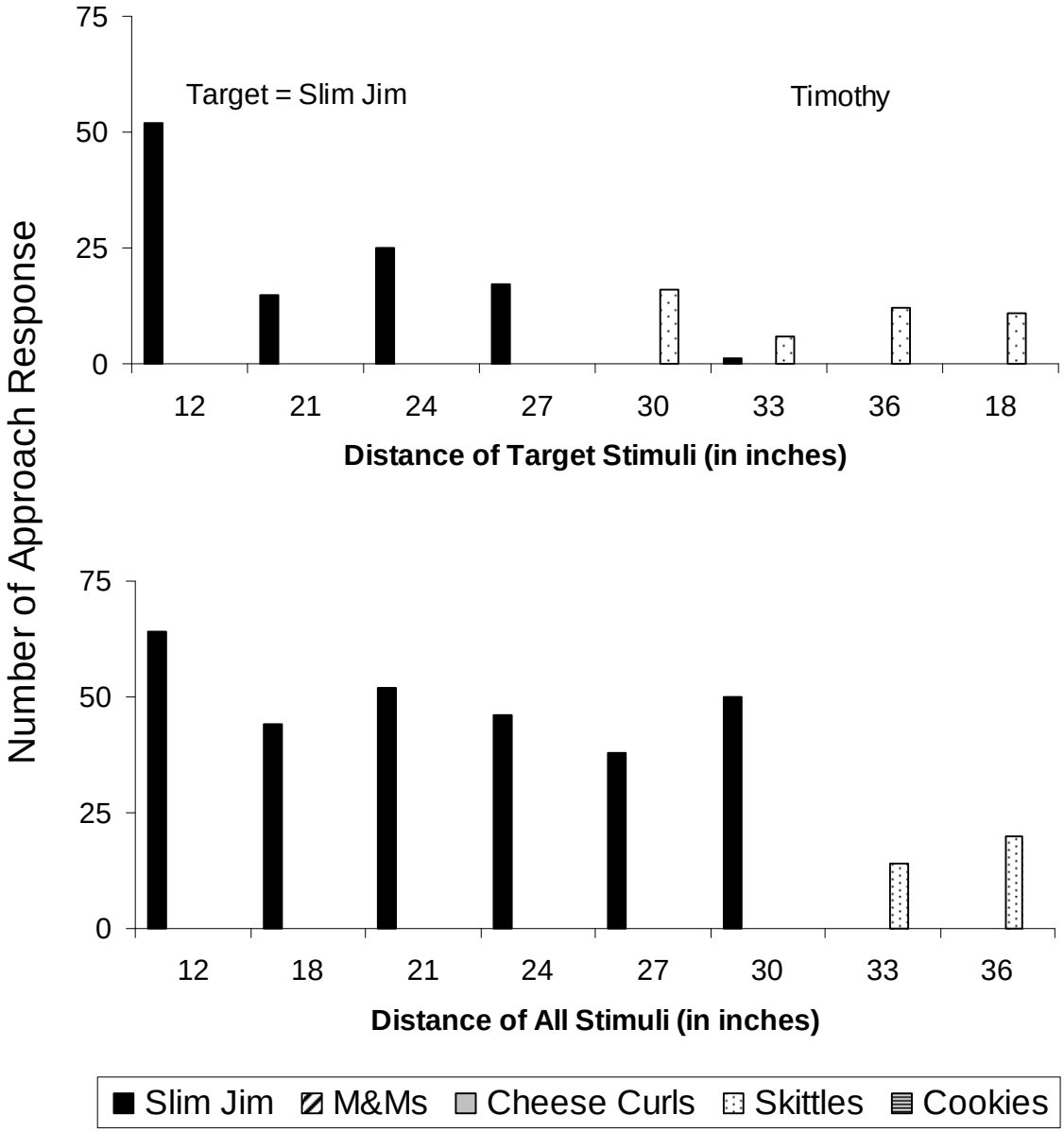

Figure 2. Response preference assessment outcomes for Timothy as a function of increasing the distance of the preferred item from the other items (top panel) and a function of increasing the distance of all the items (bottom panel).

butter crackers, which were selected one more time than the alternatives. Peanut butter crackers were then moved to 18 inches in the second session while the alternative items remained at 12 inches. The target item continued to be sampled until it reached a distance of 33 inches and then was not selected at all at 33 and 36 inches. The number of approach responses for peanut butter crackers generally decreased as distance increased. When peanut butter crackers were moved to 33 and 36 inches, choice was allocated to each of the alternative items available but not to the target item. The bottom panel depicts choices for all items, as a function of distance, as all items were moved away from Abbey. In the second assessment, peanut butter crackers were again chosen most frequently when all items were at 12 inches. As the items were moved further away in each consecutive session, all items available continued to be sampled at each distance. In contrast to the first assessment, peanut butter crackers in this assessment were chosen, along with the alternatives, approximately equally at distances of 33 and 36 inches.

Figure 4 shows the results for Lynne. The top panel depicts choices for all items, as a function of distance, as the target item was moved away from Lynne. In the initial session, cheese curls were chosen most frequently thus becoming the target item for the first assessment. Even slight increases in distance decreased selections of cheese curls to zero (except for one selection at 24 inches) throughout the remainder of the assessment. Preferences switched among three items as distances were increased, with pretzels most preferred at 18, 21, 24, and 27 inches, Skittles most preferred at 30 inches, and then for the final two sessions of the assessment, chips were chosen most frequently. During most of the sessions in the first assessment, alternative items were also sampled fairly often. The bottom panel depicts choices for all items, as a function of distance, as all items were

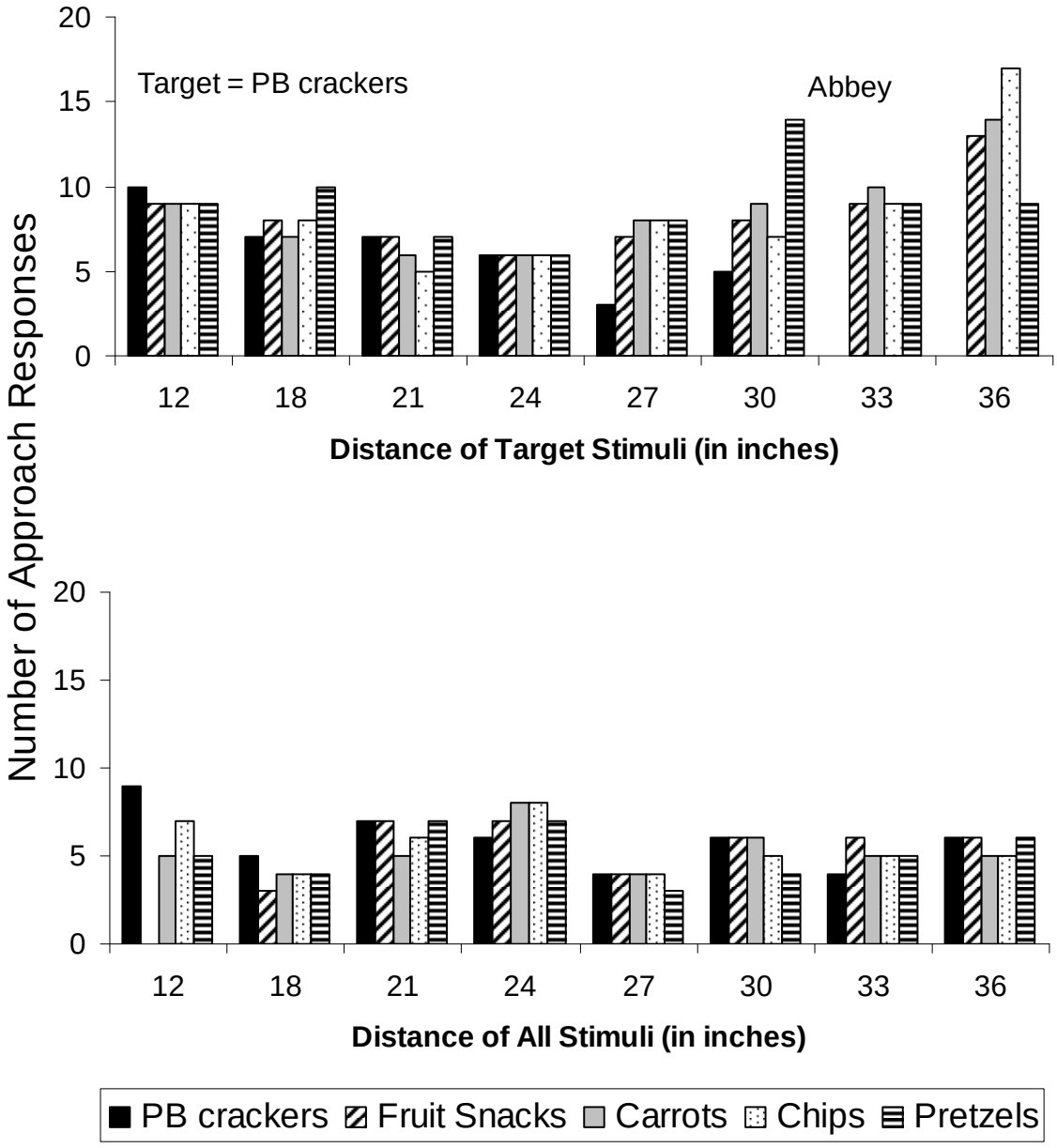

Figure 3. Response preference assessment outcomes for Abbey as a function of increasing the distance of the preferred item from the other items (top panel) and a function of increasing the distance of all the items (bottom panel)

moved away from Lynne. In the second assessment, chips were chosen most frequently at 12, 18, and 21 inches although pretzels were sampled in each of these sessions. Preferences then switched to pretzels again at 24 and 27 inches. At 30 inches, chips were chosen most frequently and at 33 and 36 inches, pretzels were chosen exclusively. Cheese curls, the most preferred item from the first assessment, were only selected a few times at 30 inches and were never selected at any other distance.

Figure 5 shows the results for Jonathon. The top panel depicts choices for all items, as a function of distance, as the target item was moved away from Jonathon. Prior to the beginning of the session, when asked which item was his favorite, Jonathon responded, "fish". However, in the initial session, each available item was chosen a similar number of times. Swedish Fish were identified as the target item for the assessment based on the verbal response prior to the session. The target item continued to be sampled as it was moved further away. Consumption of other items was generally greater as the distance of Swedish Fish was increased, although at the furthest distance, consumption of all items was almost equal. The bottom panel depicts choices for all items, as a function of distance, as all items were moved away from Jonathon. During the second assessment, each of the alternatives was chosen a similar number of times each session. This pattern continued even as all of the items were moved to further distances resulting in no clear preference for any one item over the others.

In the first assessment, where only one item was moved away from the participant, for three out of the five participants (Connor, Timothy, and Lynne), preferences shifted away from the target item. Connor never chose the target item again once it had been moved just 6 inches further from the alternative items while Lynne

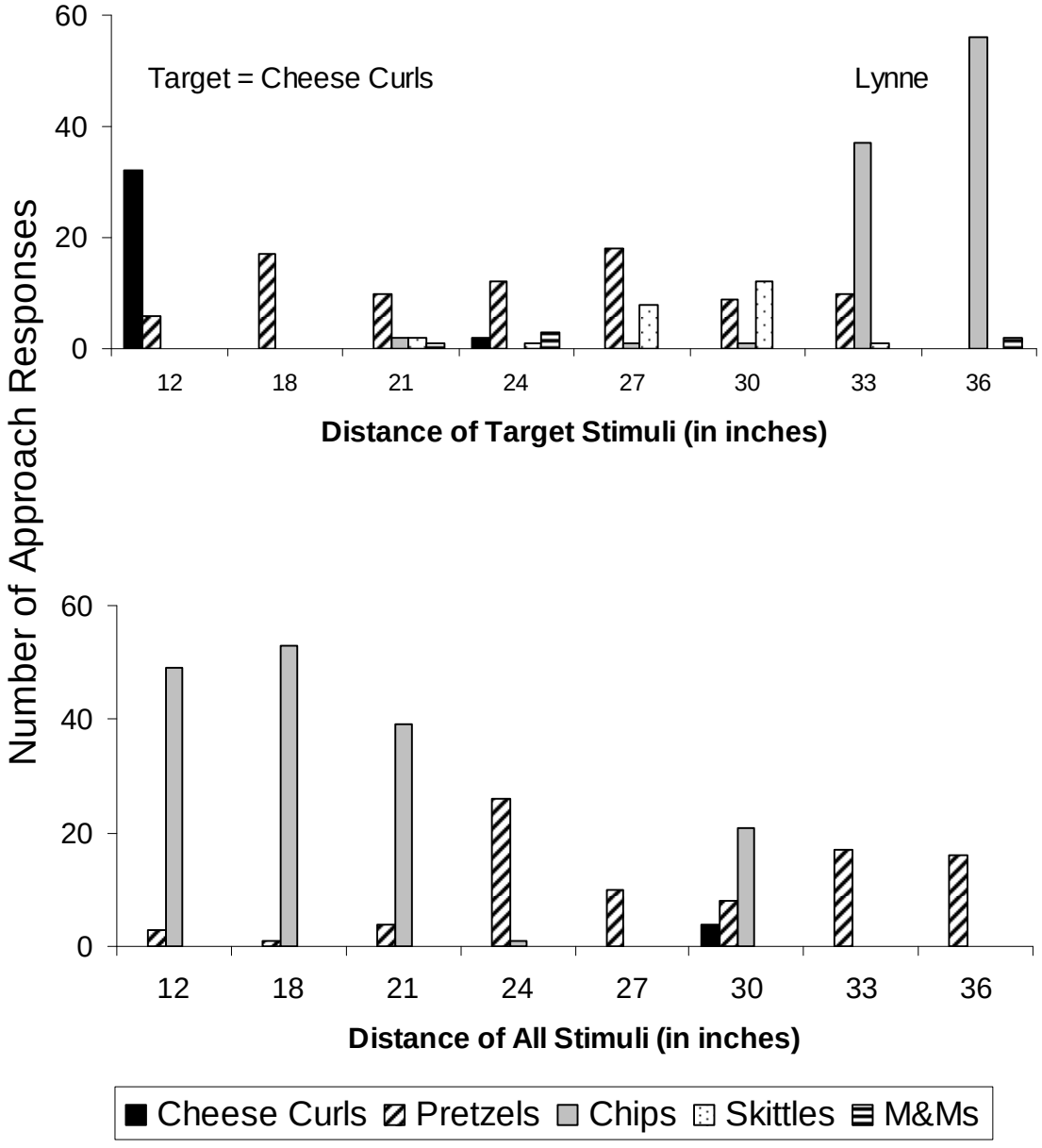

Figure 4. Response preference assessment outcomes for Lynne as a function of increasing the distance of the preferred item from the other items (top panel) and a function of increasing the distance of all the items (bottom panel).

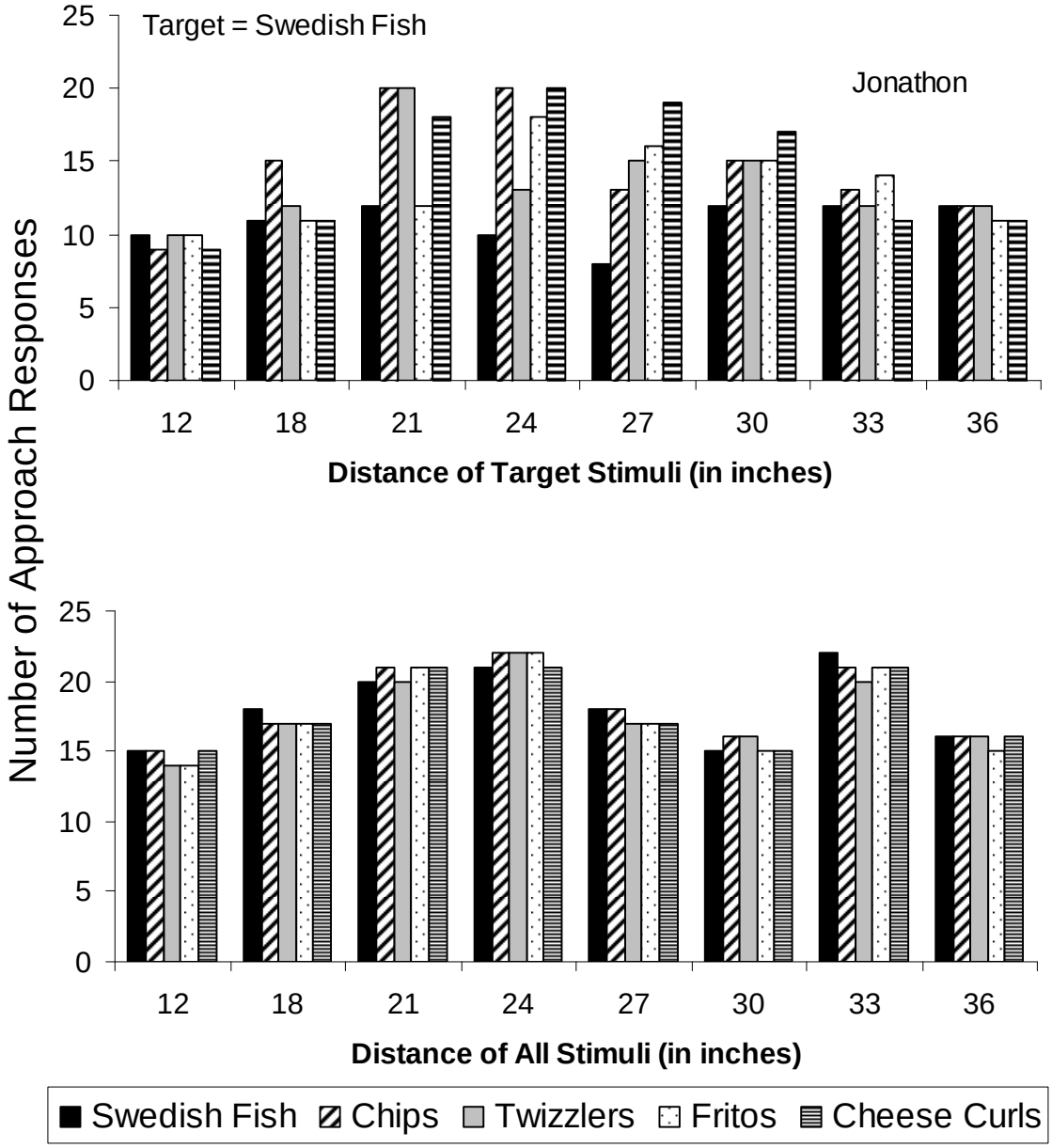

Figure 5. Response preference assessment outcomes for Jonathon as a function of increasing the distance of the preferred item from the other items (top panel) and a function of increasing the distance of all the items (bottom panel).

sampled the target item one time when it was placed at 24 inches. Timothy's preference for the target item persisted for several sessions once the target item was moved farther away from the alternative items. Overall, Skittles appeared to be a substitute for Slim Jims because consumption of Skittles increased as the price of Slim Jim increased.

For the other two participants, (Abbey and Jonathon) all items were sampled in the initial session. Abbey's preference for the target item ceased once it was moved to a distance of 33 inches. No preference amongst the alternatives could be identified. For Jonathon, preference for the target item persisted throughout the assessment. Even when the target item was moved to a distance of 36 inches, it was chosen as frequently as alternative items.

In the second assessment, where all five items were moved away from the participant, Connor's preference reversed to chocolate pudding, which had been the target item in the first assessment, but never chosen again once the distance was increased from the alternative items. The preference for chocolate pudding in this assessment persisted even when all items were placed at 36 inches. Although chocolate pudding was not selected when all items were at 12 and 18 inches, in general, these findings suggest that, for Connor, chocolate pudding is likely to serve as a potent reinforcer, as preference for this item emerged as the cost of all alternatives increased.

For Timothy, a similar pattern was seen in the second assessment as in the first, as initially preference for Slim Jims occurred. This preference persisted for more sessions in the second assessment, but switched to Skittles when all items were at a distance of 33 inches. One way to interpret these findings may be that satiation for Slim Jim occurred.

A second interpretation may be that Skittles are more likely to function as a reinforcer when the cost is high for all alternatives.

In the second assessment, Lynne continued to sample many of the available items. However, preference for pretzels emerged as cost increased and when the items were placed at a distance of 33 and 36 inches, exclusive preference for pretzels occurred. Abbey and Jonathon sampled all items in each session of the second assessment with little differentiation of preference. Overall, for Abbey and Jonathon it was not possible to determine preference for one item over another when cost was equal, even at high costs.

CHAPTER 4

DISCUSSION

The use of systematic preference assessments to identify highly-preferred items has been studied extensively in the applied literature. The present study took a behavioral economic approach and used systematic preference assessments in which response effort or price was conceptualized as the distance of the item from the participant. As noted by Borrerro, Francisco, Haberlin, Ross, and Sran (2007), price does not have to be conceptualized as number of responses per reinforcer, but could potentially be conceptualized as effort to obtain the reinforcer or delay associated with obtaining the reinforcer. The impact on changes in preference was assessed by systematically increasing the distance of a preferred edible item from other edible items and then increasing the distance of all available items. Just as progressive ratio schedules have been used in reinforcer assessments, this assessment aimed to identify whether the participant would reach further for a preferred edible. An item that is placed further away requires increased response effort from the participant. If an individual continues to choose that item, despite an increased response effort, it follows that he or she may be more likely to engage in tasks where that item is the available reinforcer. These results suggest that clinicians should take response effort into account when designing interventions for individuals with disabilities. Although for many table top tasks

response effort may not be an issue, vocational tasks, which often require movement around an area, are more likely to require an increased response effort to complete.

The present study adds to previous findings in the behavioral economic literature (DeLeon et al., 1997; Roane et al., 2001; Tustin, 1994) which have demonstrated shifts in preference as cost of the reinforcer was increased. Using a traditional preference assessment alone may have limited ability to predict reinforcer effectiveness as overall cost to obtain the reinforcer increases. These assessments showed, for the majority of participants, that items available at lower cost were often preferred to those available at higher costs. Having items available in the immediate environment that are potential substitutes for higher preferred items may decrease the effectiveness of interventions if those items are available at lower costs.

In contrast to the results of the first assessment, increasing the price of all available items may have provided clearer information as to the effectiveness of the items as reinforcers. These findings support the conclusions of DeLeon et al. (1997) who stated that it may be important to evaluate preference at higher costs. At the highest cost in the second assessment, clear preference for one item was observed for Connor, Timothy, and Lynne. For Timothy and Lynne, this item was not their target item from the first assessment. If only the initial preference assessment had been conducted, the item identified in that assessment for Timothy and Lynne quite possibly would not have been effective as part of an intervention.

There were a number of limitations to this study. First, multiple stimulus with replacement preference assessment methodology was used throughout both assessments. This methodology, although frequently used, may not result in a hierarchy of preference

if not all items are selected. Only two of the participants in the study sampled all available items in the initial sessions. However, even then a hierarchy was not obtained because each item was selected a similar number of times. Connor and Timothy typically chose only one item during each session and there were some items that Lynne did not select. It is possible that false negatives were obtained for these three participants as items not selected may prove to be reinforcers if assessed differently. In the absence of the high preferred items or presentation in a paired choice format the participants may have sampled the other items. Nevertheless, the number of sessions conducted across the two assessments allowed repeated exposure to the items and multiple opportunities to select alternative items.

A second limitation of this study was the time it took to complete the assessments. Due to high consumption rates, sessions were limited to two per day. Therefore, it took a minimum of eight days to complete both assessments for each participant. For most applied settings, this assessment would be too time consuming. Future research should examine the possibility of parametrically increasing the distance of the items within a single session to determine if similar results are obtained.

Thirdly, the participants selected to participate in this study were all behaviorally stable and did not present with any feeding (e.g., poor swallow reflex), visual, or motor difficulties. It is not clear how easy the assessment would be to conduct with individuals as part of an initial assessment and treatment development for problem behavior. Future research should also focus on conducting behavioral economic preference assessments with leisure items rather than edible items. This would be important for identifying

preferred items to be used as reinforcers during times when it is not possible or practical to provide access to edible reinforcers.

Finally, the assumption for all of the participants was that the items selected for the assessments were fairly highly preferred. Results may have been different if the items presented were less preferred. As Roscoe, Iwata, and Kahng (1999) demonstrated, low preferred items may function as reinforcers when highly preferred items are not present in the environment. Future research should examine results in a lean environment where preferred items are limited, because choice of the target item may be more resistant to change even as price increases.

Additionally, there were several potential limitations of this study from a behavioral economic perspective. First, the sessions were set at 5 minutes in duration. Hursh and Silberberg (2008) argued that in behavioral economics, the session should not be terminated after a set number of reinforcers have been obtained, but when the participant has "had enough" at the "price we have charged". So it follows that setting a limit on the time that the participant has to consume the reinforcer at the offered price, may not result in a good representation of the essential value of the reinforcer. A second limitation may have been the cost to obtain the reinforcer. A distance of 36 inches from the participant may not have been a high enough cost to produce changes in consumption. Increasing the cost in increments of 3 inches may also not have been a large enough change. As Hursh and Silberberg (2008) stated, "an imperceptibly small increase in price should, by virtue of its imperceptibility, leave consumption levels unchanged" (p. 190).

Overall, the results provide preliminary evidence that a behavior economic approach to preference may be useful in identifying reinforcers. It is possible that by

simply increasing the distance of the items across each session resulted in the second assessment being a reinforcer assessment rather than just one of preference. Future studies should examine how items identified under this type of progressive response effort assessment are effective as reinforcers for everyday tasks for the individual.

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APPENDIX

PHOTOGRAPH OF THE MAT BOARD
WITH LINES DRAWN AT 12, 18, 21, 27, 30, 33, AND 36 INCHES