TESTING THE PAIRED STIMULUS PREFERENCE ASSESSMENT AS A PREDICTOR OF REINFORCER EFFICACY IN DOGS

Sara Mackenzie Vicars
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TESTING THE PAIRED STIMULUS PREFERENCE ASSESSMENT AS A PREDICTOR OF REINFORCER EFFICACY IN DOGS

A Thesis

by

Sara Mackenzie Vicars

Approved by:

__________________________________, Committee Chair
Caio F. Miguel, Ph.D

__________________________________, Second Reader
Becky Penrod, Ph.D

__________________________________, Third Reader
Jennifer L. Sobie, Ph.D

______________________________________
Date
Student:  Sara Mackenzie Vicars

I certify that this student has met the requirements for format contained in the University format manual, and that this thesis is suitable for shelving in the Library and credit is to be awarded for the thesis.

__________________________, Graduate Coordinator___________________
Jianjian Qin, Ph.D               Date

Department of Psychology
Abstract

Preference and reinforcer assessment research with animals has been limited in providing a full analysis of all available methodology. The paired-stimulus (PS) preference assessment has been shown to be effective in yielding a hierarchy of preference with animal participants; however, reinforcer assessments have not been conducted in any of these studies. The purpose of the current study was to evaluate use of the single-stimulus (SS) and PS preference assessments as predictors of reinforcer effectiveness with dogs (*canis lupus familiaris*). The preference assessments were followed by single, concurrent, and basis 2 progressive-ratio (PR 1) reinforcement assessments to assess absolute and relative reinforcer efficacy with 12 participants. Results indicate that the PS preference
assessment was able to predict preference and reinforcer efficacy. Various features of each assessment are discussed.

_______________________, Committee Chair
Caio F. Miguel, Ph.D

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Date
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Operant behavior refers to behavior that can be modified by its consequences (Catania, 1998). The modification of these behaviors is achieved via operant conditioning, which involves two processes, reinforcement and punishment. When an increase in the future frequency of behavior is observed, reinforcement has taken place (Skinner, 1938). It follows then that the first step in implementing operant conditioning as a positive behavior change strategy would be to identify potential reinforcers (Pace, Ivancic, Edwards, Iwata, and Page, 1985). This process can be accomplished quite easily: simply ask the individual what they prefer. However, this may not be possible when working with individuals with severe developmental disabilities or animals who cannot readily communicate their preferences. The field of Applied Behavior Analysis (ABA) has produced extensive research in the area of systematic preference and reinforcer assessments. However, behavior analytic methods to identify preferred items that may function as reinforcers has not been extended to (or evaluated with) animals (Cox, Gaglione, Prowten, and Noonan, 1996; Araujo and Milgram, 2004).

Behavior analysts began to systematically examine preference and reinforcer identification in the mid-1980’s. Since then, three major methods for assessing preference have been validated (Cooper et al., 2007; e.g., Pace, et al., 1985; Fisher et al., 1992; DeLeon and Iwata, 1996). The three main methods are single-stimulus (SS), paired-stimulus (PS), and multiple-stimulus (MS) assessments. All three methods have the same
purpose, to identify preferred items that may function as effective reinforcers. Each preference assessment is followed by a reinforcer assessment. In a reinforcer assessment, items are delivered following a target behavior. If the future frequency of the target behavior increases, this item is said to function as a reinforcer. Preference and reinforcer assessments provide crucial information for the applied field to affect positive behavior change.

ABA Preference and Reinforcer Assessment Research

Prior to conducting a preference assessment, the items to be included in the assessment must be selected. There are two general methods to identify these items: Caregiver report and free operant observation (Cooper et al., 2007). Caregiver report is generally obtained by using an interview protocol such as the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD; Fisher, Piazza, Bowman, and Amari, 1996). This protocol asks caregivers to list and rank preferred items across six sensory domains. Research has shown that relying solely on caregiver report is not a sufficient method to identify preference or potential reinforcers (Mason, McGee, Farmer-Dougan, and Risley, 1989).

During a free operant observation, the individual is allowed unrestricted access to several items/activities (Quilitch, Christophersen, and Risley, 1977). The researcher then records the items/activities that the individual engages with, as well as the duration of engagement. An item is never removed from the array. A free operant observation can either be contrived or naturalistic (Cooper et al., 2007). In a contrived observation, the
researcher places items in the array that may be of interest to the individual. Conversely, the naturalistic observation is conducted in the individual’s everyday environment.

**Single Stimulus Assessment (SS)**

In the SS procedure, stimuli are presented one at a time in a random order and data are taken on approach/engagement behavior. Approach behavior is defined as occurrence with the stimulus (i.e., yes or no; Pace at al., 1985), whereas engagement is defined as the duration engaged with the stimulus (DeLeon, Iwata, Conners, and Wallace, 1999). A limitation of the SS procedure is that some individuals may approach or consume most or all of the stimuli presented. This makes it difficult to create a hierarchy of preference because all stimuli are seen as either preferred or not preferred (Hagopian, Rush, Lewin, & Long, 2001).

Pace et al. (1985) used the SS assessment to identify potential reinforcers for individuals who could not directly communicate their preferences. During the assessment, preference was measured by recording whether participants approached each stimulus. Two stimuli were selected for inclusion in a reinforcer assessment: a preferred stimulus, defined as one approached on 80% or more trials, and a non-preferred stimulus, defined as one approached on 50% or fewer trials. During the reinforcer assessment, complying with a simple vocal request was either followed by the preferred stimulus (preferred condition), the non-preferred stimulus (non-preferred condition), or no programmed consequence (baseline condition). These conditions were arranged in a reversal design. Results of this study indicated that the SS preference assessment was successful in identifying preferred stimuli that functioned as reinforcers for individuals
with developmental disabilities. Modifications of this assessment for practical use were found to decrease maladaptive behaviors and increase correct responding (Mason et al., 1989).

**Paired Stimulus Assessment (PS)**

During the PS or forced-choice assessment, stimuli are presented in pairs and data are taken on which stimulus is approached. The pairs are determined by matching each stimulus with every other stimulus. These pairs are then presented in a random order. This is the standard assessment with human participants since it is the most predictive of reinforcer effectiveness (Piazza, Fisher, Hagopian, Bowman, and Toole, 1996). One limitation of the PS assessment is the lengthy amount of time is takes to administer it when analyzing many stimuli (Hagopian et al., 2001). For example, a minimum of 90 trials would be required when determining a hierarchy of preference for ten items.

Additional research on the SS assessment indicated that the method was superior to caregiver report in identifying reinforcers (Green et al., 1988; 1991); however, the method was also found to identify stimuli as preferred that did not function as effective reinforcers (Green et al., 1988; 1991). That is, the SS method produced false positives as individuals often approached most or all items presented. Therefore, Fisher and colleagues (1992) developed the PS procedure aimed to better differentiate among preferred stimuli.

Fisher et al. (1992) directly compared the standard SS procedure and the new PS procedure with individuals with severe developmental disabilities. The SS assessment was conducted in the manner described by Pace at al. (1985). During the PS assessment,
two stimuli were presented simultaneously on every trial. Every stimulus was paired with every other stimulus once in a randomized order for a total of 120 trials. Following preference assessments, a concurrent-schedule reinforcer assessment was conducted to highlight the relative strength of two potential reinforcers in direct competition. One stimulus, the “high-high stimulus,” was identified as high preferred by both the SS and PS assessment (i.e., chosen on over 80% of trials in both assessments). The other stimulus, the “SP-high stimulus,” was identified as high preferred by the SS assessment, and low preferred by the PS assessment (i.e., chosen on over 80% of SS trials, and less that 60% of PS trials). Results indicated that participants allocated the vast majority of responding to the “high-high stimulus” option. This study provided further evidence that the SS assessment is prone to identifying false positives, preferred stimuli that do not function as reinforcers in a concurrent-schedule.

A concurrent-schedule reinforcer assessment was used because it was considered a more sensitive measure of preference than absolute response rate (Fisher and Mazur, 1997). However, Fisher et al. acknowledged that a single-schedule reinforcer assessment is beneficial when a behavior change agent is interested in whether a single stimulus will function as a reinforcer (i.e., absolute reinforcement effect). Roscoe, Iwata, and Kahng (1999) agreed with Fisher et al., and stated that a concurrent-schedule method might mask the absolute reinforcement effects associated with each stimulus. Roscoe et al. (1999) hypothesized that a low-preferred stimulus may in fact function as a reinforcer when presented alone, in the absence of a high-preferred stimulus. Therefore, Roscoe and colleagues (1999) extended the Pace et al. (1985) and Fisher et al. (1992) studies to
evaluate the relative and absolute reinforcement effects of stimuli under both concurrent and single-schedules of reinforcement, respectively.

Based on results of the SS and PS preference assessments, Roscoe et al. (1999) selected a “high-preferred” and “low-preferred” item for inclusion in the reinforcer assessments. The “high-preferred” stimulus was defined as the food item approached most frequently on both the SS and PS assessments. The “low-preferred” stimulus was defined as the food item for which results of the SS and PS assessments differed the most (i.e., chosen on 100% of SS trials, and 0% of PS trials). The reinforcer assessment began with a concurrent-schedule, in which participants were free to allocate responses to either option. During the single-schedule condition, the low-preferred food item was the only stimulus available contingent on responding.

Several important results were obtained in this study. First, results of the SS assessment showed that participants generally approached most or all food items presented. This lends further support to the notion that the SS assessment may produce false positive results. Second, in the PS assessment, preference was more distributed across stimuli. Third, during the concurrent-schedule of reinforcement, seven out of eight participants allocated the majority of responses to the high-preferred stimulus option. However, in the single-schedule of reinforcement with the low-preferred item, six of these seven participants displayed response rates similar to those allocated to the high-preferred stimulus option. Results demonstrate the importance of choosing a reinforcer assessment based on the goal of the assessment. If the goal is to gain information on relative reinforcer effects, use a concurrent-schedule procedure. On the other hand, if the
goal is to determine reinforcer potency for a single stimulus, a single-schedule procedure is more appropriate. Roscoe and colleagues claimed that the SS assessment and single-schedule of reinforcement may be useful in identifying reinforcers for individuals with few high-preferred stimuli, or when attempting to expand the pool of potential reinforcers. More recent research has evaluated use of another reinforcer assessment, the progressive-ratio (PR) schedule, in which response requirements increase in a single session. The PR-schedule provides rapid evaluation of reinforcer efficacy (Roane, Lerman, and Vorndran, 2001; Penrod, Wallace, and Dyer, 2008).

Research continued to validate the utility of the PS assessment in modified versions and/or across different variables (Paclawskyj and Vollmer, 1995: visual impairments; Roane, Vollmer, Ringdahl, and Marcus, 1998: mini-PS; Erbas, Ozen, Acar, 2004: down syndrome; Clevenger and Graff, 2005: pictorial-PS; Tessing, Napolitano, McAdam, DiCesare, Axelrod, 2006: vocal-PS). In addition to providing a hierarchy of preference, the PS assessment was also found to provide a hierarchy of reinforcer effectiveness (Piazza, et al., 1996).

**Multiple Stimulus Assessment (MS)**

Finally in the MS assessment, several stimuli are presented and data are collected on which stimulus the participant approaches or consumes. All stimuli are available on every trial. A variation of the MS method is the multiple stimulus without replacement (MSWO) procedure. With the MSWO method, a stimulus is removed from the array once it is selected (DeLeon & Iwata, 1996). This could continue until all stimuli have been
selected or a criterion is reached. One limitation of MS procedures is that the participant must scan the stimuli prior to making a selection (Hagopian et al., 2001).

Windsor, Piche, and Locke (1994) compared the PS and MS preference assessments for learners with severe disabilities. The results of these assessments were also compared to staff rankings of preferences for these individuals. The PS method was conducted as described by Fisher et al. (1992). During the MS method, six edible items were available in random order on all trials. Participants were instructed to choose one out of the six items on each trial. Results of the study indicated that staff rankings, PS, and MS assessments generally identified the same most-preferred item. The MS assessment took significantly less time to administer, 50 trials versus 150 trials in the PS assessment. However, the PS assessment produced more consistent results across sessions than the MS assessment. In addition, the PS assessment also resulted in a more clear hierarchy of preference. The authors concluded that more research is necessary to contrast the different preference assessment methods.

A limitation of the MS assessment (Windsor et al., 1994) is that it often produced false negative results. That is, because all items are available on every trial, stimuli that may function as reinforcers may never be chosen because they are masked by more preferred items. For example, an individual could choose their most-preferred item on every trial. To address this limitation, DeLeon and Iwata (1996) introduced a variation of the MS procedure known as the multiple-stimulus without replacement assessment (MSWO). In the MSWO procedure, when an item is selected, it is not presented in
subsequent trials. This forces individuals to choose between less preferred items to create a hierarchy of preference.

DeLeon and Iwata (1996) compared the MS (Windsor et al., 1994) and MSWO assessments using the PS assessment (Fisher et al., 1992) as the standard comparison. During the MSWO assessment, the selected item was removed from the array and not replaced in subsequent trials. During the MS method, selected items were represented in all trials. Lastly, PS assessment sessions followed the methodology described by Fisher et al. (1992). In a single-schedule reinforcer assessment, responding resulted in access to a preferred stimulus. The preferred stimulus was defined as one selected in the PS and MSWO assessments, but not selected in the MS assessment. Results indicated that the preferred stimulus did function as a reinforcer, indicating that in at least some cases, stimuli not selected in MS assessments will function as reinforcers. The MSWO method was also found to provide a clearer stimulus ranking than the MS method as compared to the PS standard.

The literature on preference assessments allows for systematic evaluation of preference and reinforcers. These methods are especially beneficial when working with populations such as individuals with developmental disabilities and animals.

**Applied Animal Behavior Preference Assessment Research**

Researchers in the field of Applied Animal Behavior (AAB) have used various methods to assess preferences in a variety of animal species such as location preferences with dolphins (Shyan, Merritt, Kohlmeier, Barton, and Tenge, 2002), diet preferences with calves (Atwood, Provenza, Wiedmeier, and Banner, 2001), food preferences with
orangutans (Clay, Bloomsmith, Marr, and Maple, 2009), food preferences with dogs (Araujo and Milgram, 2004), etc. This type of research has increased with new emphasis being placed on enrichment for animals in captivity and use of operant conditioning methods to train animals (Fernandez, Dorey, and Rosales-Ruiz, 2004). However, the common variable lacking in AAB preference assessment research is the inclusion of reinforcer assessments. As a result, limited information is available on how to effectively identify potential reinforcers for animal training. Nonetheless, several methods to evaluate preference alone have been investigated: free operant methods, SS-like methods, PS-like methods, and MS-like methods.

**Free Operant Methods**

Shyan et al., (2002) utilized free operant methods to evaluate different dimensions (i.e., depth, area, surface area) of dolphins’ pool preference. Participants included two male and five female captive Atlantic Bottlenose dolphins (*Tursiops Truncatus*). Researchers made unobtrusive observations of the dolphins after zoo hours. Using momentary time sampling methods, researchers recorded each dolphins whereabouts (i.e., specific pool) every 10 minutes for two hours across several weeks. Following a statistical analysis, results indicated that dolphins spent the most time in pools of moderate depth, volume, and surface area. This was followed by shallow, and the least amount of time was spent in deep areas. These results are similar to findings of some wild populations of dolphins. Authors concluded that the results of this preference assessment provide useful information for dolphin enrichment, specifically, when building dolphin enclosures: “bigger is not necessarily better” (Shyan et al., p.224).
MacLean, Prior, Platt, and Brannon (2009) also used free operant methodology to determine environmental preferences for 10 rhesus (*Macaca mulatta*) and four long-tailed (*Macaca fascicularis*) macaques. Specifically, researchers were interested in preference between upper and lower rows of a double tier cage and level of illumination. During both conditions, monkeys had access to both the upper and lower rows via a tunnel. Time spent in each row was recorded. In condition A, the upper row was better illuminated. In condition B, the lower row was better illuminated; the order of conditions was counterbalanced across participants. As dictated by a statistical analysis, participants displayed a strong preference for the upper row regardless of level of illumination, indicating that elevation is more important than light. This study provides evidence for the importance of providing these animals with cages that have access to high-resting places. With the information from this preference assessment, animal behavior researchers can increase the quality of life for these animals (MacLean et al., 2009). However, there is no information provided about the effects of these variables as reinforcers.

**Single Stimulus Assessment**

Atwood and colleagues (2001) utilized SS-like methodology to test whether animals offered a choice in diet versus a mixed diet would consume more and gain weight more efficiently. Participants included 31 calves (*Bos Taurus*), divided into two groups. One group (*n* = 16) was fed a mixed diet including rolled barley, rolled corn, corn silage, and alfalfa hay. The other group (*n* = 15) was fed the same four foods presented in individual bins. All participants were fed the mixed diet for three weeks to familiarize
calves with the ingredients. During the study, researchers recorded the intake of the foods in kg, and the weight of the calves. Following a statistical analysis, results indicated that calves being fed the mixed diet ate more in total. The rate of weight gain did not differ between the groups. Authors concluded that offering a variety of foods encourages high levels of intake in calves.

**Paired Stimulus Assessment**

AAB researchers have also used PS-like methods to assess preference in various animals. For example, Clay, Bloomsmith, Marr, and Maple (2009) developed a study to investigate the usefulness of PS-like preference assessments in evaluating food preferences with captive orangutans. Participants included nine orangutans (four male, five female) at the Zoo Atlanta. Specifically seven participants were Sumatran orangutans (*Pongo pygmaeus abelii*), one Bornean orangutan (*Pongo pygmaeus pygmaeus*), and one hybrid. Experimental sessions took place in an indoor holding area over six months. Five familiar food items were cut into equal-sized pieces, and 20 food pairings were presented on matching dishes. Position bias was controlled for by presenting each item with every other item on both the right and left sides. Orangutans were required to emit a selection response of pointing during the PS-like assessment. Results of the assessment indicated three important findings. First, orangutans do show preferences for certain foods. Second, individual orangutans have specific preferences, which may differ from other orangutans. Third, orangutans’ preferences change over time. Clay and colleagues (2009) wrote that results of their study have vast implications for the management of captive primates. Authors stated that preference assessments can be used for enrichment purposes and may
identify potential reinforcers to use in operant conditioning. However, a reinforcer assessment was not conducted.

PS-like methodology was also used to assess food preference in five cotton-top tamarins (*Saguinus Oedipus*; Fernandez et al., 2004). The purpose of this study was to find an accurate way to identify potential reinforcers in a zoo setting. Participants included three male and two female tamarins between the ages of 3 and 14. Research was conducted in the tamarins’ housing enclosure at the Frank Buck Zoo in Texas. Seven familiar foods items were presented in the PS method described by Fisher et al. (1992). The experiment began with the tamarins pre-sampling all food items to ensure familiarity. During the PS-like assessment, two food items were held up simultaneously several inches apart on tweezers. The selection response was defined as the tamarin grasping and removing the food item from the tweezers. Results of this experiment indicated that all five tamarins varied greatly in their total food preference; however, there was a general trend for overall food selection. Authors suggested that these results show that individual differences should be considered when determining enrichment items, diets, and foods to use as reinforcers for operant conditioning procedures. However, like in the previous studies, a reinforcer assessment was not conducted.

Fernandez et al. (2004) discussed that the field of AAB often relies on caregiver assumptions of what will function as a reinforcer for any given animal. This is problematic because caregiver report is not a reliable method of reinforcer identification (Mason et al., 1989). For example, in this study (Fernandez et al., 2004), results indicated that caregiver report of tamarin preference was not in line with the results of the PS
assessment. Authors concluded that the PS preference assessment may be ideal for efficiently and effectively identifying preferences on an individual basis in captive animal settings.

Cox et al. (1996) modified the PS assessment to investigate food preferences of a seven year old, female California sea lion (Zalophus Californianus). The study began with a shaping procedure of the target response, touching the nose to a plastic stimulus card. Once this response was mastered, 12 symbols were presented in pairs. Each symbol was associated with a specific food and a specific sound (e.g., makarel and a bell). All foods presented in the assessment were withheld from the sea lion outside the study. Symbol presentation and position were varied and counterbalanced across trials. On every trial the sea lion stood on a pedestal until directed to choose between two symbols. When the sea lion touched a symbol with her nose, a specific sound was presented (i.e., “bridging stimulus”), followed by the associated food. Each food was paired against another food on 30 consecutive trials. If the sea lion did not allocate at least 90% of responding to one symbol (i.e., 27 out of 30 trials), 100 consecutive trials were conducted of the same pairing. Results indicated that the sea lion allocated the majority of responses to foods with more nutritional content, higher levels of oil and protein. In addition, the sea lion displayed preference for foods that contained less moisture. Cox and colleagues (1996) concluded that this method was successful in identifying food preferences for a California sea lion.

PS-like methods have also been used with domestic dogs to assess different variables, such as quantity discrimination. Ward and Smuts (2007) used 29 pet domestic
dogs (*Canis lupus*) of varying breeds (18 female, 11 male) between the ages of one and 12 years. Experimental sessions occurred in a testing room. Only one food item, hot dog, was used to test dog’s ability to discriminate different quantities of food (1 vs. 4, 1 vs. 3, 2 vs. 5, 1 vs. 2, 2 vs. 4, 3 vs. 5, 2 vs. 3, and 3 vs. 4). During the PS-like assessment, plates holding the different hot dog ratios were covered with lids at the beginning of each trial. The lids were simultaneously removed, and participants were allowed to consume one plate of food while the experimenter removed the other plate. Results of this experiment indicated that eight of the 29 dogs showed extreme position bias, consuming food on the same side on every trial. 15 of the 18 remaining dogs chose the larger quantity more often; two dogs chose the smaller and larger quantity equally; one participant chose the smaller quantity more often. By using the PS-like assessment method, experimenters concluded that some dogs can perform similar to nonhuman primates on quantity discrimination tasks.

Prato-Previde, Marshall-Pescini, and Valsecchi (2008) also used a PS-like assessment method to assess the effects of social influence of owners on domestic dogs’ (*Canis lupus*) performance in a quantity discrimination task. 54 dog-owner dyads participated in the study, 22 male and 32 female dogs between the ages of 6 months and 10 years of varying breeds and mixes. Dry dog food in different amounts was used, and the position of the large and small quantity was counterbalanced. Both foods were covered with lids that were simultaneously removed following the observing response. In one condition, the owner showed preference for one plate by picking it up, and saying
something about the food in an “enthusiastic tone.” Results of the PS-like assessment showed that some dogs chose the plate that the owner “preferred.”

**Multiple Stimulus Assessment**

AAB research has also employed a method similar to the MS assessment to investigate food preferences with animals. The MS-like method was developed by Araujo and Milgram (2004) and termed the cognitive palatability assessment protocol (CPAP). Two male and three female beagles between the ages of two and ten years old participated in the study. Two foods were compared, one dry food and one moist food. A reversal design with four phases was used in this study. The first phase followed the methodology of a MS assessment to determine object preferences. Three objects of differing shapes were placed over 1g portions of moist food. The object participants displaced most often across 12 trials was considered the participants’ most preferred object. The most preferred object was then associated with no food in subsequent testing. Two days following phase one, the object-food contingency was taught where a “non-preferred” object was paired with the moist food, and the other “non-preferred” object was paired with the dry food. Following the training, the three objects and corresponding foods/no food were presented. Preference was measured by the overall frequency of object selection and food consumption. Researchers also investigated if food preference would remain consistent when the object-food associations were reversed. All participants showed a strong and reliable preference for the object associated with the moist food. Four out of five participants also displayed preference for the moist food during the object-food pairing reversal phase. While results of the CPAP were robust,
authors commented that the procedure may not be practical due to the extensive training required and lengthy time to administer. This study was essentially a reinforcer assessment comparing dry and moist dog food. However, the study never truly examined preference for various food items.

**One-Pan Assessment**

A variation of the behavior analytic SS preference assessment is known as the one-pan assessment in AAB. During the one-pan test, animals are given free access to a large amount of a single food, and researchers record different variables of eating behavior (i.e., amount consumption, rate of eating, duration, etc.). In a study conducted by Rashotte et al. (1984), the one-pan assessment was implemented with four purebred male beagles. The study was conducted in the dogs’ runs housed on the open-roof of the laboratory on a 4-story building. Dogs’ eating behavior was measured by an infrared photo-beam, which could detect time and duration of eating and drinking. In addition, the food and water was weighed daily. Following a statistical analysis, results indicted that the average amount of food eaten and duration of eating was negatively correlated with the average daily temperature. Overall, authors concluded that certain environmental variables are more likely to influence the eating behavior of dogs. This test provides no information on preference or potential reinforcers.

**Two-Pan Assessment**

The two-pan test is the most common method of assessing food preferences in AAB and the animal food industry. It is often referred to as the traditional method to measure relative animal preferences (Rashotte and Smith, 1984). Similar to the PS
assessment, the two-pan test involves comparing the consumption of two foods presented simultaneously (Araujo and Milgram, 2004). However in the two-pan test, animals are given free access to large amounts of two foods, and eating behavior can be freely allocated to each food without restriction. Amount consumed and time to consume the foods are recorded to provide a measure of preference. This procedure allows for preference to be determined rapidly, but does not control for the effects of satiation or food interactions. In addition, this test is not conducive to testing several food items due to timeliness and potential gastrointestinal problems. Finally, the test has never been followed by a reinforcer assessment.

The two-pan test has been used by Goodwin Davidson, and Harris (2005) to determine relative flavor preferences for eight stabled horses (*Equus* caballus). During testing sessions two different flavors were added to the standard diet and presented in mounted mangers in the horses’ stalls. Experimenters recorded the quantity of each food consumed in kg as well as the time to consume. Through statistical analysis of the results two flavors were ranked as most-preferred by all participants. These two flavors were then presented individually, and consumption time was measured. Both flavor additions appeared to be effective in increasing consumption of important minerals for horses’ diets. The same method was employed by Kennedy, Currier, Glowaky, and Pagan (1999) to test how the addition of fruit flavors influence horses’ consumption of oats. Results of this study also indicated that adding fruit flavors to oats increased consumption. These studies demonstrate identification of preference, but provide no information on whether these flavors could be used as potential reinforcers for horses.
Ferrell (1984) employed the two-pan preference test to investigate how novelty influences the development of food preferences in puppies (*Canis lupus*). During the two-pan test, a familiar and an unfamiliar diet were simultaneously presented to puppies. Following statistical analysis, results indicated that puppies exhibited a strong *initial* preference for the novel diet. The author concluded that novelty plays a large role in food preference for dogs. Ferrell (1984) also used the two-pan test to assess beagle puppies’ preferences for five sugars and two nonnutritive compounds added to both semi-moist food and water. Results suggest that participants were sensitive to both type and amount of sugar or nonnutritive sweetener in semi-moist food. No clear preferences were observed when these sweeteners were added to water. Again, this provides no information about reinforcer efficacy.

In 1984 an apparatus was developed to improve the quality of data obtained in one and two-pan tests by Smith et al. This apparatus uses computer technology to obtain fine-grained measures of dogs’ feeding behavior. While the apparatus does provide information on how dogs distribute their behavior to the different foods, it provides no further information about preferences or potential reinforcers. In addition, a study conducted by Smith, Rashotte, Austin, and Griffin (1984) concluded that results of a two-pan test and fine-grained analysis were essentially the same.

**Applied Animal Behavior Reinforcer Assessment Research**

Finally, the only method discussed in animal behavior research that specifically examines whether preferred foods will function as reinforcers is the concurrent-schedules procedure. In AAB literature this technique has been used alone, not in conjunction with
preference assessment methods. The concurrent-schedules procedure is identical to that described in the behavior analytic literature: animals are presented with two response options which each provide access to a different stimulus (Rashotte and Smith, 1984). The underlying principle of the concurrent-schedules procedure is the matching law. The matching law states that relative rates of responding across options are distributed in proportions that match the relative rate of reinforcement on each option (Hernstein, 1961). This law is not only applied to reinforcement that differs quantitatively (i.e., amount), but also qualitatively (i.e., preference; Rashotte and Smith, 1984).

Green and Rashotte (1984) designed a bridge study to investigate how dogs perform in a concurrent-schedule procedure modeled after those used with rats and pigeons in the laboratory. Dogs were placed in an experimental room with two levers. Bowls were positioned under the levers for food delivery. To obtain the food, participants were required to press the lever upwards with their nose. Each lever was programmed on a variable interval (VI) 60s schedule of reinforcement, but each lever produced a different amount of the same food. Results showed that the matching phenomenon was not as robust at the individual-animal level as described in research with rats in the lab.

Rashotte, Foster, and Austin (1984) designed a study (Green and Rashotte, 1984) to investigate the utility of the concurrent-schedule method in practical applications. Researchers compared foods based on different levels of fat coating in both two-pan and concurrent-schedule tests. The two-pan procedure was shown to produce more extreme differences in preference than the concurrent-schedule assessment; however, neither test produced highly differentiated preferences in fat coating. When the researchers repeated
this procedure with foods that differed more (e.g., dry food, semi-moist food, and a mixture of the two), results indicated that the concurrent-schedule procedure yielded clearer differences in preference; however, both tests produced results that were directionally similar.

**Limitations of AAB Preference and Reinforcer Assessment Research**

Procedures used in the field of AAB are not aimed at identifying preferred items that may function as reinforcers. While the concurrent-schedule procedure described in AAB is an effective reinforcer assessment, it does not analyze preference and is both technically demanding and time consuming (Rashotte et al., 1984). Therefore, this procedure is not practical for application outside the lab (Chao, 1984). In addition, the two-pan test may be useful when solely determining preference between two dog foods; however, it is not a viable option to determine potential reinforcers. First, it does not control for the effects of satiation (Araujo and Milgram, 2004). Second, this test lacks external validity as trainers and owners may not be willing to feed such a large amount of food to the animal. This procedure may in fact cause gastrointestinal problems for the animals (Rashotte and Smith, 1984). Third, the two-pan test is not practical when comparing multiple food items due to the length of time to administer (Griffin, Scott, and Cante, 1984), and thus, a hierarchy of preference cannot be attained. The lengthy time is especially important when considering that research indicates that preferences change over time and should be assessed on an ongoing basis (Mason et al., 1989; Clay et al., 2009).

The process of selecting reinforcers to use in animal training is often taken for
granted. Most often, reinforcers are selected based on caregiver assumptions or availability (Fernandez et al., 2004). With more animal trainers using operant conditioning methods (Fernandez et al., 2004), an effective and efficient method of assessing preference that predicts reinforcer efficacy seems necessary in the field of AAB (Fernandez et al., 2004). The purpose of the current study was to evaluate use of the SS and PS preference assessments as predictors of reinforcer effectiveness with dogs (*canis lupus familiaris*). The stimuli identified as “most-preferred,” “moderately-preferred,” and “least-preferred” by the preference assessments were evaluated in both concurrent and single-schedules of reinforcement. The PS assessment was further evaluated with use of a Basis 2 PR1 reinforcer assessment (Jarmolowicz and Lattal, 2010). Results of the assessments were compared to owner report of dogs’ preferences. The MS assessment was not analyzed due to prerequisite skills involving scanning stimuli prior to selection.
Chapter 2

METHOD: EXPERIMENT 1

Experiment 1 was a pilot study designed to systematically replicate Fisher and colleagues’ 1992 research comparing the SS and PS preference assessments using domesticated dogs as participants. Specifically, the accuracy of each preference assessment in identifying effective reinforcers was evaluated.

Participant

The participant in this experiment was one domesticated dog (*canis lupus familiaris*), Millie, a four-year-old, female Terrier-mix. Millie was recruited from a personal contact, and had no known physical disabilities, or history of aggression. The owner signed a consent allowing Millie to participate in the study. The document described risks and benefits associated with the study (see Appendix A).

Setting and Materials

All sessions took place in Millie’s owner’s kitchen. The owner was asked not to feed Millie less than four hours prior to testing (Prato-Previde et al., 2008) to increase the value of food as reinforcer. Five different kinds of food, identified to be preferred by the owner, were used in this experiment. All food items were presented in approximately two cm by two cm pieces. Wet food was not included in the assessment for two reasons. First, it was difficult for the experimenter to deliver wet food by hand during the reinforcer assessment. Second, as DeLeon, Iwata, and Roscoe (1997) showed that food consistently displaced leisure items in a preference assessment with human subjects, it was assumed
that wet food might displace dry food with animals in the current study. Identical plates approximately four inches in diameter were used to present the food during the SS and PS preference assessments. Identical plates were selected to control for preference emerging based on shape or size of the plates used. A separate plate was used for each food item to reduce the possibility of the carryover of smells. The same plates were also used during the reinforcer assessment.

**Response Definitions and Data Collection**

During SS and PS preference assessments, the experimenter recorded consumption behavior for participants on every trial. For example, “all”, “some”, or “none” for the SS assessment (see appendix B), or stimulus “A” or “B”, or “no consumption” for the PS assessment (see appendix C). During the reinforcer assessment, a trained observer recorded the frequency of engagement in the arbitrary response allocated to each response option (see appendix D). One assessment was conducted each day at approximately the same time across three consecutive days. Testing ranged from 15 to 30 minutes a day.

**Experimental Design**

For the reinforcer assessment an ABA reversal design was used. A phases represent baseline, and the B phase represents when the concurrent-schedule of reinforcement was in effect. Three sessions were conducted in each condition, each lasting three minutes.
Interobserver Agreement (IOA) and Treatment Integrity

As experiment 1 was a pilot study, IOA and treatment integrity data were not collected.

Procedures

Prior to all assessments, five “preferred” food items were selected for inclusion based on owner report (cheese, chicken strips, lamb biscuits, and novel and familiar chicken dog food). The participant was then allowed to pre-sample each food item once in a random order to ensure familiarity prior to the SS and PS preference assessments. Finally, the concurrent-schedule reinforcer assessment was conducted to determine relative reinforcer efficacy of the food items. All sessions were conducted at least four hours after meals to control for potential abolishing-operation effects (i.e., satiation).

Pre-Sample

Millie was given the opportunity to sample each food item once prior to the preference assessments. This was included to ensure that she had been exposed to each food item prior to testing. The pre-sample occurred at least four hours after she was last fed, and immediately prior to beginning the SS preference assessment. The sample consisted of presenting each food item individually on a plate, and allowing the participant free access to consume the food item.

Single Stimulus Assessment

The five food items were individually presented a total of four times each in a randomized order during the SS assessment (Pace et al., 1985). Each trial began with an observing response in which the plate was placed approximately two inches in front of
the participant’s nose to give the opportunity to smell the food. Following the observing response, the plate was placed approximately 0.7 m in front of the participant (Fisher et al., 1992). The participant was allowed to consume as much or as little of the food item on the plate. If the participant did not approach or consume all the food within 5 s, the trial was terminated.

**Paired Stimulus Assessment**

The same five food items were presented in randomly arranged pairs during the PS assessment (Fisher et al., 1992). Each food item was paired with every other food item two times, for a total of 20 paired stimulus presentations. Each food item was presented on both the right and on the left when paired with every other stimulus. Prior to each trial, the same observing response in the SS assessment was required. Each plate was placed approximately two inches in front of the dog’s nose to give the opportunity to smell the food one at a time. Following the observing responses, the plates were placed approximately 0.7 m in front of the animal and approximately 0.7 m apart (Fisher et al., 1992). This distance is within dogs’ peripheral capabilities (Cook, Mughannam, Szymanski, and Williams, 2007). While the participant consumed one food item, the other plate was removed (Ward and Smuts, 2007). In the case that the participant did not approach either food item within 5 s, the trial was terminated.

Food items consumed on at least 80% of trials on both SS and PS assessments (i.e., the high-high stimulus; HH) were compared to food items consumed on at least 80% of SS trials and 60% or fewer PS trials (i.e., the high-low stimulus; HL; Fisher et al.,
The purpose of comparing these two food items was to investigate the utility of the SS assessment in identifying reinforcers as compared to the PS assessment.

**Reinforcer Assessment**

The experimenter was seated approximately one meter in front of the participant during all conditions of the reinforcer assessment. During the concurrent-schedule condition, either the HH or HL food item was delivered contingent on engagement in the arbitrary response allocated to one of the response options. An arbitrary response was chosen primarily to ensure that participants were not familiar with the task. Furthermore, the purpose of the study was designed to teach the contingencies in effect and not acquisition of a specific skill. The arbitrary response was operationally defined as the animal’s nose coming within 1” of either plate on the floor. One plate was paired with the HH food item; the other plate was paired with the HL food item. In between responses, the participant’s was required to move her nose at least 6” away from both plates to be considered a separate response. The distance was inserted to prevent participants from “hovering” over the plate. Food pairings (e.g., HH or HL) with respect to plate position (e.g., right or left) were counterbalanced across sessions during the concurrent-schedule condition. Both food items were simultaneously available on a continuous schedule of reinforcement.

Prior to each concurrent-schedule session, three pairings of each food item on its corresponding plate were presented. The delivery of the six total food presentations was pre-randomized according to the data sheet. The animal then had free access to the food item within five seconds. In the event that the participant allocated ten consecutive
responses to one option, that option was removed and three responses toward the other stimulus were prompted (Dixon and Cummings, 2001). During the initial baseline and the return to baseline phases, no pre-session pairings or programmed consequences were delivered. All sessions were terminated after three minutes.
Figure 1 shows the percentage of selections across food items for Millie. Dark bars indicate selection during the SS preference assessment. Light bars indicate selection during the PS preference assessment. Millie consumed all food items on 100% of trials during the SS assessment. During the PS preference assessment, Millie selected cheese on 100% of trials, chicken jerky on 75% of trials, novel chicken dog food on 50% of trials, lamb biscuits on 25% of trials, and familiar dog food on 0% of trials.
Figure 1. Preference assessment data – Millie. Percentage of selections across food items for Millie.
Figure 2 shows the frequency of responses for Millie during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the HH food item, cheese. Open circles indicate responses emitted toward the option paired with the HL food item, familiar chicken dog food. For all baseline sessions, Millie did not engage in the arbitrary response more than two times. During concurrent-schedule sessions, Millie allocated all responses to the alternative paired with the HH food item. These results indicate that the SS preference assessment may not be as effective as the PS preference assessment in identifying preferred items that will function as effective reinforcers. However, these results only indicate relative reinforcer efficacy of the food items. As Roscoe and colleagues (1999) illustrated, perhaps if the HL food item was presented in a single-schedule of reinforcement, it too would function as an effective reinforcer. The rationale for this being that the reinforcing properties of the HL food item were masked by those of the HH food item. If the HL food item was available without competition, it too may have caused an increase in the future frequency of the arbitrary response. Experiment 2 included both single and concurrent-schedule reinforcer assessments to address this limitation of Experiment 1.
Figure 2. Reinforcer assessment data – Millie. Frequency of responses for Millie during reinforcer assessment sessions.
Chapter 4

METHOD: EXPERIMENT 2

Experiment 2 was designed to evaluate not only relative reinforcer efficacy, but also absolute reinforcer efficacy. Therefore, a single-schedule reinforcer assessment was included. According to Roscoe et al. (1999), the concurrent-schedule reinforcer assessment may mask reinforcement properties of a less preferred item because it is pitted against a more preferred item. Therefore, a single-schedule reinforcer assessment would highlight absolute reinforcement properties of both the HH and HL food items.

**Participants**

Participants included four domesticated dogs (*canis lupus familiaris*) between the ages of five and ten years old of varying breeds. Pets were recruited from personal contacts, and had no known physical disabilities, or history of aggression. Maggie was a ten-year-old, female German Shepherd. Boots was a five-year-old, male German Shepherd. Koda was a seven-year-old, male Gold Retriever-mix. Arrow was a five-year-old, male Red Bone Coonhound. Per owners report, Maggie, Boots and Koda had similar levels of obedience training (e.g., sit, stay, down, etc.). Arrow was the only participant with additional complex-behavior training (e.g., bow, spin, speak, locating specific items, etc.)

**Setting and Materials**

Setting and materials used in this experiment were identical to those described in Experiment 1. However, the five foods included in the preference assessments were
determined according to responses on a questionnaire that asked owners to list and rank ten food items their dog “enjoys.” This questionnaire was adapted from the RAISD developed by Fisher and colleagues (1996; see Appendix D).

**Response Definitions and Data Collection**

Response definitions and data collections were identical to that described in Experiment 1. One assessment was conducted each day at approximately the same time across four consecutive days. Testing ranged from 15 to 40 minutes a day.

**Experimental Design**

For the reinforcer assessment an ABACAD reversal design was used. A phases represent baseline conditions, the B phase represents the concurrent-schedule condition, and C and D phases represent single-schedule conditions with either the HH or HL food item. The order of the C and D phases was counterbalanced across participants. Three sessions were conducted in each condition, each lasting three minutes.

**Interobserver Agreement (IOA) and Treatment Integrity**

As experiment 2 was a pilot study, IOA and treatment integrity data were not collected.

**Procedures**

The procedure was the same as in Experiment 1 except that a single-schedule reinforcer assessment followed the concurrent-schedule reinforcer assessment. The same arbitrary response described in Experiment 1 was also used in Experiment 2, which consisted of the participant’s nose coming within 1” of the plate.
Single-Schedule Reinforcer Assessment

During each single-schedule session, one plate was presented approximately 0.7 m in front of participants. Only one food item was available throughout each condition on a continuous schedule of reinforcement contingent on engaging in the arbitrary response. Similar to the concurrent-schedule condition, three pairings of the food item on the plate were presented prior to beginning. During single-schedule baseline sessions, no pre-session pairings or programmed consequences were delivered. The order of single-schedule conditions (e.g., HH or HL) was counterbalanced across participants.
Figure 3 shows the percentage of selections across food items for Maggie. The darkest bars indicate selection during the SS preference assessment. Medium-dark bars indicate selection during the PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items ranked “1” by owners are graphed as 100% (5/5); “2” as 80% (4/5); “3” as 60% (3/5); “4” as 40% (2/5); and “5” as 20% (1/5). Maggie consumed all food items on 100% of trials during the SS preference assessment. During the PS preference assessment, Maggie selected the woof stick on 100% of trials, deli turkey on 63% of trials, chicken jerky on 63% of trials, cheese on 25% of trials, and familiar dog food on 0% of trials. Maggie’s owner predicted that she would consume deli turkey on 100% of trials, cheese on 80% of trials, chicken jerky on 60% of trials, woof stick on 40% of trials, and dog food on 20% of trials. The only agreement between the ranking provided by the owner and results of the PS assessment was the food item selected least, familiar dog food.
Figure 3. Preference assessment data – Maggie. Percentage of selections across food items for Maggie.
Figure 4 shows the frequency of responses for Maggie during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the HH food item, woof stick. Open circles indicate responses emitted toward the option paired with the HL food item, familiar dog food. During all baseline sessions, Maggie did not engage in the arbitrary response more than two times. During the concurrent-schedule reinforcer assessment, Maggie allocated only one response to the alternative paired with the HL food item. The majority of responses were allocated to the option paired with the HH food item; however, responding was somewhat variable (6, 5, and 14 responses, respectively). Responding was also variable during the single-schedule reinforcer assessment with the HL food item, (1, 7, and 0 responses, respectively). Lastly, responding was again variable, but significantly higher during the single-schedule reinforcer assessment with the HH food item (14, 1, 17 respectively).
Figure 4. Reinforcer assessment data – Maggie. Frequency of responses for Maggie during reinforcer assessment sessions.
Figure 5 shows the percentage of selections across food items for Boots. The darkest bars indicate selection during the SS preference assessment. Medium-dark bars indicate selection during the PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items ranked “1” by owners are graphed as 100% (5/5); “2” as 80% (4/5); “3” as 60% (3/5); “4” as 40% (2/5); and “5” as 20% (1/5). Boots consumed all food items on 100% of trials during the SS preference assessment. During the PS preference assessment, Boots selected the deli turkey on 75% of trials, chicken jerky on 63% of trials, cheese on 63% of trials, woof stick on 50% of trials, and familiar dog food on 0% of trials. Boot’s owner predicted that he would consume deli turkey on 100% of trials, cheese on 80% of trials, chicken jerky on 60% of trials, woof stick on 40% of trials, and dog food on 20% of trials. The only disagreements between the ranking provided by the owner and that of the PS assessment included order of the food items ranked second and third.
Figure 5. Preference assessment data – Boots. Percentage of selections across food items for Boots.
Figure 6 shows the frequency of responses for Boots during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the HH food item, deli turkey. Open circles indicate responses emitted toward the option paired with the HL food item, familiar dog food. During baseline sessions, Boots did not engage in the arbitrary response more than two times. During the concurrent-schedule reinforcer assessment condition, the rate of responding was low overall; however, Boots allocated the majority of responses to the alternative paired with the HH food item (HH condition average = 4.3 responses; HL condition average = 1 response). Differentiation in responding toward each food item was also observed during the single-schedule reinforcer assessment. During single-schedule reinforcer assessment sessions with the HH food item, responding increased across sessions (5, 10, and 19 responses, respectively). On the other hand, during single-schedule reinforcer assessment sessions with the HL food item, Boots only emitted one response across sessions.
Figure 6. Reinforcer assessment data – Boots. Frequency of responses for Boots during reinforcer assessment sessions.
Figure 7 shows the percentage of selections across food items for Koda. The darkest bars indicate selection during the SS preference assessment. Medium-dark bars indicate selection during the PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items ranked “1” by owners are graphed as 100% (5/5); “2” as 80% (4/5); “3” as 60% (3/5); “4” as 40% (2/5); and “5” as 20% (1/5). Koda consumed all food items on every trial during the SS assessment, with the exception of familiar dog food, which he consumed on 50% of trials. During the PS preference assessment, Koda selected the deli turkey on 88% of trials, chicken jerky on 75% of trials, cheese on 50% of trials, woof stick on 38% of trials, and his familiar dog food on 0% of trials. Koda’s owner predicted that he would consume cheese on 100% of trials, deli turkey on 80% of trials, chicken jerky on 60% of trials, woof stick on 40% of trials, and dog food on 20% of trials. The only agreement between the rankings provided by his owner and that of the PS assessment, were the two food items ranked lowest (e.g., fourth and fifth).
Figure 7. Preference assessment data – Koda. Percentage of selections across food items for Koda.
Figure 8 shows the frequency of responses for Koda during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the HH food item, deli turkey. Open circles indicate responses emitted toward the option paired with the HL food item, woof stick. During all baseline sessions, Koda did not engage in the arbitrary response more than three times. During concurrent-schedule reinforcer assessment sessions, although responding was somewhat variable, Koda allocated the vast majority of responses to the alternative paired with the HH food item (7, 3, 12 responses, respectively). Rates of responding allocated to the option paired with the HL food item were extremely low (0, 1, 0 responses, respectively). Differentiation in responding toward each food item was also observed during the single-schedule reinforcer assessment. During single-schedule reinforcer assessment sessions with the HL food item, responding remained consistent at one response per session across the condition. On the other hand, similar to the results observed with Boots during single-schedule reinforcer assessment sessions with the HH food item, responding increased across sessions (1, 5, and 12 responses, respectively).
Figure 8. Reinforcer assessment data – Koda. Frequency of responses for Koda during reinforcer assessment sessions.
Figure 9 shows the percentage of selections across food items for Arrow. The darkest bars indicate selection during the SS preference assessment. Medium-dark bars indicate selection during the PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items ranked “1” by owners are graphed as 100% (5/5); “2” as 80% (4/5); “3” as 60% (3/5); “4” as 40% (2/5); and “5” as 20% (1/5). Arrow consumed all food items on 100% of trials during the SS assessment. During the PS preference assessment, Arrow selected the cheese on 75% of trials, chicken jerky on 63% of trials, unfamiliar dog food on 63% of trials, peanut butter sandwich on 50% of trials, and carrots on 0% of trials. Arrow’s owner predicted that he would consume chicken jerky on 100% of trials, cheese on 80% of trials, unfamiliar dog food on 60% of trials, peanut butter sandwich on 40% of trials, and carrot on 20% of trials. The only disagreement between the rankings provided by the owner and that of the PS assessment, was the order of the two top-ranked food items.
Figure 9. Preference assessment data – Arrow. Percentage of selections across food items for Arrow
Figure 10 shows the frequency of responses for Arrow during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the HH food item, cheese. Open circles indicate responses emitted toward the option paired with the HL food item, carrots. During baseline sessions, Arrow did not engage in the arbitrary response more than two times. During the concurrent-schedule reinforcer assessment, Arrow allocated all responding toward the option paired with the HH food item; however, responding was low with only four responses total in the concurrent-schedule condition. Differentiation in responding toward each food item during the single-schedule reinforcer assessment was also not clear for Arrow. Similar to the pattern observed with Boots and Koda, responding increased across sessions for both the HH and HL food items during the single-schedule reinforcer assessment (1, 23, and 26 responses, respectively for the HH food item; 11, 21, and 23 responses, respectively for the HL food item).
Figure 10. Reinforcer assessment data – Arrow. Frequency of responses for Arrow during reinforcer assessment sessions.
Results of Experiment 2 were somewhat inconclusive as responding was often low or variable across conditions. In addition, a learning effect was observed during single-schedule sessions for three of the four participants. For Boots, Koda, and Arrow responding increased on subsequent sessions when food items were delivered alone (see Figures 6, 8, and 10). Despite the variability, the majority of responding across participants was allocated toward the response option paired with the HH food item during both schedules of reinforcement. This suggests that the PS assessment, and not the SS assessment, is able to identify preferred food items that also function as reinforcers, but further investigation is necessary. To address the low, variable, or increasing responding observed in the single-schedule reinforcer assessment, Experiment 3 included several modifications to specifically address these limitations. The arbitrary response was operationally defined differently in Experiment 3 to decrease the response effort and use a more practical response, (i.e., hand-targeting; Pryor, 2009). Also, the single-schedule was changed to a Basis 2 PR 1 reinforcer assessment to assess the absolute reinforcer efficacy via cumulative responses and breaking points (i.e., the last schedule requirement completed).
Chapter 6

METHOD: EXPERIMENT 3

Experiment 3 was designed with several procedural modifications to better differentiate among preference and reinforcer efficacy. First, the SS preference assessment was left out. In the previous two experiments, little information was gained from the SS assessment as participants consumed nearly all food items on every trial. Second, the PS preference assessment was conducted on three consecutive days at different times (i.e., morning, afternoon, and evening) to assess any effect time of day may have on preferences. Third, baseline conditions were removed during reinforcer assessment sessions as little to no responding was observed during all baseline sessions in the previous two experiments. Furthermore, anecdotal reports suggest that baseline sessions became aversive for participants. Fourth, the arbitrary response was operationally defined differently to decrease the response effort and use a more practical response (i.e., hand-targeting; Pryor, 2009). Finally, the single-schedule reinforcer assessment was modified into a Basis 2 PR 1 reinforcer assessment to provide more information on the absolute reinforcer effectiveness of each food item.

Participant

The participant in this experiment was one domesticated dog (*canis lupus familiaris*), Arrow, a five-year-old, male Red Bone Coonhound who also participated in Experiment 2. There was no issue with his continued participation because a different arbitrary response was used in Experiment 3.
Setting and Materials

Setting and materials used in this experiment were identical to those described in Experiment 2.

Response Definitions and Data Collection

As in Experiments 1 and 2, the experimenter recorded consumption behavior for the participant on every trial during the PS preference assessments (e.g., stimulus A or B, or no consumption). During the reinforcer assessment, the food items defined as “most-preferred” and “least-preferred” by the PS preference assessment were delivered contingent on engagement in the arbitrary response. The arbitrary response was operationally defined as the dog’s nose coming into contact with the experimenter’s closed fist (i.e., hand-targeting; Pryor, 2009). During Basis 2 PR 1 reinforcer assessment sessions, a trained observer recorded cumulative responses and the breaking point, the last ratio requirement completed twice. One assessment was conducted each day at approximately the same time across four consecutive days. Testing ranged from 15 to 40 minutes a day.

Interobserver Agreement (IOA) and Treatment Integrity

As experiment 3 was a pilot study, IOA and treatment integrity data were not collected.

Procedures

The procedure was very similar to that described in Experiments 1 and 2. However, the PS preference assessment was conducted on three consecutive days at separate times (e.g., morning, afternoon, evening). A Basis 2 PR 1 reinforcer assessment
was piloted to assess absolute reinforcer efficacy of the “most-preferred” and “least-preferred” food items as identified by the PS assessment.

**Basis 2 PR 1 Reinforcer Assessment**

During Basis 2 PR 1 sessions, the “most-preferred” or “least-preferred” food item was delivered contingent on engagement in the arbitrary response in the required ratio (i.e., 1, 1, 2, 2, 3, 3, 4, 4, etc.; see appendix E). The participant was required to touch his nose to the experimenter’s closed fist, then move at least 6” away from the experimenter’s closed fist between responses. Once schedule requirements were met, the food item was dropped onto a plate directly below the experimenter’s fist. A gradual schedule progression with two trials required for each schedule requirement was used to prevent rapid ratio strain (e.g., Basis 2 PR 1; Roane, Lerman, and Vorndran, 2001; Penrod et al., 2008; Jarmolowicz and Lattal, 2010). Data was collected on the breaking point (e.g., the last schedule requirement completed two times). Schedule requirements were reset to the lowest value (i.e., FR1) on subsequent sessions (Roane et al., 2001). Sessions were terminated following one minute with no responding, or when the participant walked at least five feet away from the experimenter for five seconds or more, or when the participant lied down with head on the floor.
Figure 11 shows the percentage of selections across food items for Arrow. The dark bars indicate selection during the PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items ranked “1” by owners are graphed as 100%; “2” as 80%; “3” as 60%; “4” as 40%; and “5” as 20%. During the PS preference assessments, Arrow selected ground beef on 63% of total trials (75%, 75%, and 38% respectively), chicken jerky on 63% of total trials (50%, 63%, and 75% respectively), lamb biscuits on 50% of total trials (38%, 38%, and 75% respectively), beef jerky on 42% of total trials (63%, 25%, and 38% respectively), and pork rinds on 33% of total trials (25%, 50%, and 25% respectively). Arrow’s owner predicted that he would consume ground beef on 100% of trials, pork rinds on 80% of trials, beef jerky on 60% of trials, lamb biscuits on 40% of trials, and chicken jerky on 20% of trials. No agreements were observed between owner report and results of the PS assessment. However, percentage selections during the PS assessments were similar across food items indicating that there may not be extreme differences in preference between these items.
Figure 11. Preference assessment data – Arrow. Percentage of selections across food items for Arrow.
Figure 12 shows the breaking point, the last ratio requirement completed, for Arrow during Basis 2 PR 1 reinforcer assessment sessions. Solid circles indicate responding emitted toward the option paired with the “most-preferred” food item, ground beef. Open circles indicate responses emitted toward the option paired with the “least-preferred” food item, pork rinds. Responding increased steadily across sessions no matter the food item delivered. In the first phase with the “most-preferred” food item, the breaking point increased across sessions from two to seven. In the second phase with the “least-preferred” food item, the breaking point increased across sessions from seven to ten. In a follow-up session with the “most-preferred” food item, the breaking point remained at ten. This data not only reveal a learning effect across sessions, but also suggest that both items identified as “preferred” by the owner functioned as effective reinforcers. This may explain the somewhat undifferentiated levels of responding to each food item during the PS assessments, suggesting that all items were similarly preferred. In addition, time of day may have had a slight effect on Arrow’s preferences as indicated by the shifting selections during each assessment. However, shifts in preference were more likely the result of position bias, selecting items based on position alone (e.g., right or left). Position bias was observed to become more extreme during subsequent PS sessions. Arrow allocated 60%, 85%, and 80% of responses, respectively, to the left side. The data suggest that position bias may emerge among similarly ranked food items as a function of decreasing the response effort associated with the procedure in concurrent arrangements. Anecdotal observations support this, indicating that subsequent PS sessions appeared to be more aversive for Arrow; he attempted to leave the area on
multiple occasions during sessions two and three. Furthermore, similar levels of responding were observed across these food items in the Basis 2 PR 1 assessment.

*Figure 12. Reinforcer assessment data – Arrow. Breaking point for Arrow during Basis 2 PR 1 reinforcer assessment sessions.*
Experiment 4 was modified to address the limitations described above. First, the PS assessment was only conducted once as little information was gained from the additional assessments, and position bias emerged. Second, follow-up assessments were conducted to assess any shifts in preference that may occur. Third, the PS assessment was modified so that each food item was paired with every other food item once instead of twice to shorten the assessment, and stay in line with the method described by Fisher et al. (1992). Fourth, the observing response was modified to better control for possible position bias emerging due to the presentation order of the food items. Fifth, a training condition was included to systematically teach the arbitrary response and control for any learning effect across sessions. Sixth, black and white gloves were used in the reinforcer assessments to increase discrimination between the food items. Lastly, Experiment 4 included six food items instead of five. Three of the six items were identified to be “highly-preferred” by owners, and the other three food items were identified to be “non-preferred” by owners. Foods thought to be more highly differentiated in preference by owners were included in Experiment 4 to provide more discriminated results in both the preference and reinforcer assessments.
Chapter 8

METHOD: EXPERIMENT 4

Experiment 4 was the result and culmination of the information gathered in the three previous (pilot) studies. Three major differences exist in the final experiment. First, more highly differentiated food items were included in assessments to control for the emergence of position bias observed in Experiment 3. In addition, more easily discriminated results would provide more information for researchers and practitioners in this initial investigation. Second, the PS preference assessment was conducted only one time and was modified so that each food item was paired with every other food item once instead of twice to reduce the number of trials and follow the procedure described by Fisher and colleagues (1992). The observing response was also modified to further control for the emergence of position bias. Third, a training phase was included to systematically teach the arbitrary response and control for any learning effects across sessions. Several smaller modifications were made in the final experiment, which are described in detail below.

Participants

Participants included eight domesticated dogs (*canis lupus familiaris*) between the ages of four and ten years old of varying breeds. Pets were recruited from personal contacts, and had no known physical disabilities, or history of aggression. Shamus was a seven-year-old, male Labrador Retriever-Rottweiler mix. Bella was a five-year-old, female Standard Poodle. Beaver was a four-year-old, male Akita. Maya was a four-year-
old, female Labrador Retriever-mix. Maggie was four-year-old, female Australian Shepherd-mix. Smokey was a six-year-old male Siberian Husky. Guapo was a ten-year-old Staffordshire Terrier-mix. Arrow was a five-year-old, male Red Bone Coonhound who participated in both experiments 2 and 3. Arrow’s continued participation was again not a problem because of the training phase. Although he had previous experience with the arbitrary response, all participants were taught the response to mastery criterion prior to reinforcer assessments. Therefore, history with the arbitrary response was similar across participants.

According to the owners, all participants had similar levels of obedience training (e.g., sit, stay, down, etc.). Arrow was the only participant with additional complex-behavior training (e.g., bow, spin, speak, locating specific items, etc.). As in previous experiments, all owners signed a consent allowing their pets to participate in the study. The document described the risks and benefits associated with the study.

**Setting and Materials**

As in all experiments, sessions took place in the dogs’ owners’ homes. Owners were asked not to feed their dog less than four hours prior to testing (Prato-Previde et al., 2008) to increase the value of food as reinforcer. In this experiment, six different kinds of food were used throughout the study. These foods were determined according to responses on a questionnaire adapted from the RAISD (Fisher et al., 1996) that slightly differed from the other experiments. The questionnaire asked owners to list and rank five food items their dog “enjoys,” and five food items their dog “dislikes.” Owners were also asked to indicate how often the dog has access to these food items (see Appendix H).
As in all experiments, all food items were presented in approximately two cm by two cm pieces. Identical plates approximately four inches in diameter were used to present the food during the PS assessment. Identical bowls were used during the reinforcer assessments to deliver the food contingent on engagement in the arbitrary response. Finally, black and white gloves were used during the reinforcer assessments.

**Response Definitions and Data Collection**

During PS preference assessments, the experimenter recorded consumption behavior for participants on every trial (e.g., stimulus A or B, or no consumption; see appendix I). During the reinforcer assessment, the “most-preferred” and “least-preferred” food items identified by the PS assessment were delivered contingent on engagement in the arbitrary response. The arbitrary response was operationally defined the same as described in Experiment 3, the dog’s nose coming into contact with the experimenter’s gloved, closed fist. A trained observer recorded both the frequency of engagement in the arbitrary response, as well as the breaking point during Basis 2 PR 1 reinforcer assessment sessions. One assessment was conducted each day at approximately the same time across three to four days. Testing ranged from 15 to 40 minutes a day.

**Interobserver Agreement (IOA)**

IOA was assessed during 38.6% of all sessions. During preference assessments, an agreement was defined as both observers having recorded the same food item as consumed or not consumed for each trial. IOA was assessed on 100% of preference assessment trials, agreement for responses across participants was 100%. During reinforcer assessments, an agreement was defined as both observers scoring the same
frequency of arbitrary responses on each trial. A disagreement was defined as one observer scoring a response and the second observer not scoring a response on a single trial or vice versa. Interobserver agreement was calculated on a trial-by-trial basis by dividing the number of agreements by the number of agreements plus disagreements within each trial and multiplying by 100%. Agreement for responses across participants ranged from 98.3% to 100%. IOA across all participants was 99.5%. Individual values for each participant for the reinforcer assessments can be seen in Table 1.

Table 1

**Interobserver Agreement (IOA) – Reinforcer Assessments**

<table>
<thead>
<tr>
<th></th>
<th># Trials</th>
<th># Trials IOA</th>
<th>% Trials IOA</th>
<th>% IOA</th>
<th>IOA Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrow</td>
<td>88</td>
<td>33</td>
<td>37.5</td>
<td>100</td>
<td>N/A</td>
</tr>
<tr>
<td>Shamus</td>
<td>152</td>
<td>82</td>
<td>53.9</td>
<td>99.1</td>
<td>92.9-100</td>
</tr>
<tr>
<td>Bella</td>
<td>68</td>
<td>15</td>
<td>22.1</td>
<td>98.3</td>
<td>89.5-100</td>
</tr>
<tr>
<td>Beaver</td>
<td>64</td>
<td>27</td>
<td>42.2</td>
<td>100</td>
<td>N/A</td>
</tr>
<tr>
<td>Maya</td>
<td>86</td>
<td>34</td>
<td>39.5</td>
<td>100</td>
<td>N/A</td>
</tr>
<tr>
<td>Maggie</td>
<td>65</td>
<td>21</td>
<td>32.3</td>
<td>100</td>
<td>N/A</td>
</tr>
<tr>
<td>Smokey</td>
<td>269</td>
<td>94</td>
<td>34.9</td>
<td>100</td>
<td>N/A</td>
</tr>
<tr>
<td>Guapo</td>
<td>86</td>
<td>33</td>
<td>38.4</td>
<td>98.8</td>
<td>94.1-100</td>
</tr>
<tr>
<td>All</td>
<td>878</td>
<td>339</td>
<td>38.6</td>
<td>99.5</td>
<td>98.3-100</td>
</tr>
</tbody>
</table>
Treatment Integrity

Treatment integrity was assessed during 68.2% of sessions. An independent observer recorded antecedents and consequences delivered by the experimenter during each trial of the preference assessments. An independent observer also recorded consequences delivered by the experimenter during each trial of the reinforcer assessments. During preference assessments, a trial was scored as delivered correctly for antecedents if the experimenter presented the correct food items, presented the food items in the correct sequence during the observing response (i.e., right versus left), and required eye contact prior to providing access to the food items. A trial was scored as delivered incorrectly for antecedents, if the experimenter presented incorrect food items, presented food items in an incorrect sequence during the observing response, and/or did not require eye contact prior to the release command. A trial was scored as delivered correctly for consequences if the experimenter one, removed the unselected plate during consumption of the other food item, or two, represented the trial after five seconds of no consumption, or three, terminated the trial if participants stopped eating one food item (i.e., spit it out) for five seconds or more.

During reinforcer assessments, a trial was scored as correct for consequences delivered if the experimenter presented the stimulus contingent on engagement in the arbitrary response in the required ratio for each trial. Treatment integrity was calculated on a trial-by-trial basis for consequences by dividing the number of correct stimulus presentations by the number of correct plus incorrect stimulus presentations within each trial and multiplying by 100%. Percentages for correct antecedents and consequences
during preference assessments across participants was 100%. Percentages for correct consequences during reinforcer assessments across all participants ranged from 96.2% - 100%. Individual values for correct consequences during reinforcer assessments for each participant can be seen in Table 2.

Table 2

*Treatment Integrity (T.I.) – Reinforcer Assessments*

<table>
<thead>
<tr>
<th></th>
<th># Trials</th>
<th># Trials T.I.</th>
<th>% Trials T.I.</th>
<th>% T.I.</th>
<th>T.I. Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrow</td>
<td>88</td>
<td>48</td>
<td>54.5</td>
<td>100</td>
<td>N/A</td>
</tr>
<tr>
<td>Shamus</td>
<td>152</td>
<td>130</td>
<td>85.5</td>
<td>100</td>
<td>N/A</td>
</tr>
<tr>
<td>Bella</td>
<td>68</td>
<td>15</td>
<td>22.1</td>
<td>100</td>
<td>N/A</td>
</tr>
<tr>
<td>Beaver</td>
<td>64</td>
<td>58</td>
<td>90.1</td>
<td>100</td>
<td>N/A</td>
</tr>
<tr>
<td>Maya</td>
<td>86</td>
<td>86</td>
<td>100</td>
<td>98.2</td>
<td>91.7-100</td>
</tr>
<tr>
<td>Maggie</td>
<td>65</td>
<td>65</td>
<td>100</td>
<td>97.2</td>
<td>75-100</td>
</tr>
<tr>
<td>Smokey</td>
<td>269</td>
<td>111</td>
<td>41.3</td>
<td>97.3</td>
<td>89.5-100</td>
</tr>
<tr>
<td>Guapo</td>
<td>86</td>
<td>86</td>
<td>100</td>
<td>96.2</td>
<td>84.6-100</td>
</tr>
<tr>
<td>All</td>
<td>878</td>
<td>599</td>
<td>68.2</td>
<td>98.6</td>
<td>96.2-100</td>
</tr>
</tbody>
</table>
Procedures

Prior to testing, food items were selected for inclusion based on owners’ report. As described previously, participants were provided one sample of the food item(s) used in the subsequent assessment prior to testing each day to ensure familiarity with each stimulus. Following the PS assessment, a training phase occurred prior to the concurrent and single-schedule reinforcer assessments. Sessions throughout the study were conducted at least four hours after meals to control for potential abolishing-operation effects (i.e., satiation). In addition, only one assessment was conducted each day at approximately the same time to further control for motivating-operation effects.

For the reinforcer assessments, relative reinforcer efficacy was assessed in a concurrent-schedule of reinforcement, where two food items were pitted against each other. Absolute reinforcer efficacy of each stimulus was investigated on Basis 2 PR 1 schedule of reinforcement. The order of concurrent and Basis 2 PR 1 assessments was counterbalanced across participants. In addition, presentation order of the food items (i.e., “most-preferred” or “least-preferred”) during the Basis 2 PR 1 assessment was counterbalanced across participants. This was done to control for a potential learning effect that could be a result of presentation order as observed in Experiments 2 and 3. Finally, location of stimuli (i.e., right or left) during the concurrent-schedule was counterbalanced within participants to control for the potential emergence of position bias (e.g., responding solely to one position regardless of the food item).
Owner Questionnaire

Prior to beginning the study, each owner was asked to complete a questionnaire regarding their perception of their dog’s food preferences. This questionnaire was adapted from the RAISD (Fisher et al., 1996). The questionnaire asked owners to list and rank the preference of five foods their dog “enjoys,” and five foods their dog “dislikes.” Owners were also asked to indicate how often the dogs have access to these food items (i.e., daily, weekly, monthly, or less often). This information was later analyzed to see if familiarity is predictive of results obtained in the preference assessments.

Pre-Sample

Participants were given the opportunity to sample each food item prior to the PS preference assessment once in a random order. This was included to ensure that participants had been exposed to each food item. The pre-sample occurred at least four hours after participants were last fed, and immediately prior to beginning the PS preference assessment. As in all other experiments, the sample consisted of presenting each food item individually on a plate, and allowing participants free access to consume the food item. A sample of each food item to be used in the reinforcer assessment was also provided immediately prior to testing in the experimenter’s gloved, open hand. Therefore, one sample of the food item(s) used in the subsequent assessment was provided at the beginning of testing each day.

Paired Stimulus Assessment

The six food items ranked one through three as high-preferred and one through three as least-preferred by owners on the questionnaire were used in the PS assessment.
These six items were then presented in randomly arranged pairs. Each food item was paired with every other food item once (Fisher et al., 1992), for a total of 15 paired stimulus presentations. Each trial began with an observing response that differed slightly from the previous experiments. As in previous experiments, first the plates were placed approximately two inches in front of the dog’s nose to give the opportunity to smell the food. The presentation order of the plates (e.g., right or left) was randomized according to the data sheet. Next, the plates were placed approximately 0.7 m in front of the animal and approximately 0.7 m apart (Fisher et al., 1992). Then, the experimenter vocalized, “look at me,” and required that the dog make eye contact prior to giving the release command (e.g., “get it”). Participants were then free to consume one of the food items available. If necessary, a second experimenter held the dog’s collar during the observing response to prevent the dog from consuming either food early. While participants consumed one food item, the other plate was removed (Ward and Smuts, 2007). In the case that participants did not consume either food item within five seconds, both plates were removed and represented five seconds later. If participants did not consume either food again, the trial was terminated. If participants stopped eating one food item (i.e., spit it out) for five seconds or more, the plate was removed and the trial terminated.

The “most-preferred” and “least-preferred” food items were used in the reinforcer assessments for all participants. The “most-preferred” food item was defined as the one selected on most trials in the PS assessment. Conversely, the “least-preferred” food item was defined as the one selected on the least number of trials in the PS assessment. Each food item was paired with either a black or white glove throughout assessments to
increase discrimination. In addition, the “moderately-preferred” food item was used
during training trials and further analyzed for two participants. The “moderately-
preferred” food item was defined as the one selected on approximately 60% of trials
(range = 57%-60%) in the PS assessment.

Training

Prior to beginning each reinforcer assessment session, training trials were
conducted. The “moderately-preferred” food item, selected on approximately 60% of PS
assessment trials, was used during training. Prior to training, the experimenter presented a
sample of the “moderately-preferred” food item in her open hand. Participants were able
to freely consume the food item. Next, the experimenter placed the food item in her
gloved, closed fist and extended her arm in front of her body at the height of the
participant’s head. Upon engagement in the arbitrary response, the participant’s nose
coming into contact with the experimenter’s closed fist, the experimenter dropped the
food item into a bowl directly below her hand. If an independent response did not occur
within two seconds, the response was prompted by bringing the experimenter’s fist to the
participant’s nose, and providing free access to the food item in the bowl. Training trials
continued until the participant independently engaged in the arbitrary response on five
consecutive trials. In addition, prior to each condition, one sample of the food item to be
used in the subsequent assessment was provided, and one trial was prompted in the
manner described above.
Reinforcer Assessments

As described in previous experiments, the experimenter was seated in the same place on the floor during all sessions, approximately one meter in front of participants. Sessions were terminated following one minute with no responding, or when participants walked at least five feet away from the experimenter for five seconds or more, or when participants lied down with head on the floor. The “most-preferred” and “least-preferred” food items were consistently paired with a black or white glove throughout the assessments to increase discrimination. Pairings were counterbalanced across participants to control for any effect of color preference.

Concurrent-Schedule Reinforcer Assessment

During this condition, two stimuli were simultaneously available. The participant was able to freely allocate responding to either of the two response options. The experimenter placed one food item in one gloved hand, and the other food item in the other gloved hand and closed her fist so that the food item was not visible to participants. She then extended her gloved, closed fists at the height of the participant’s head. A black or white glove was always paired with one food item to enhance discrimination (Karn and Munn, 1932). The glove paired with each food item (e.g., black or white) remained consistent throughout the study for each participant. Presentation position of each food item with the corresponding glove (e.g., right or left) was counterbalanced within participants by randomizing the presentation for each session. Location was varied randomly to control for the potential emergence of position bias as observed in Experiment 3. Contingent on engagement in the arbitrary response the experimenter
dropped that food item into the bowl directly below. Participants then had free access to
the food item on a continuous schedule of reinforcement. Food items were delivered in a
bowl instead of the experimenter’s hands to more accurately replicate actual training
situations. In addition, presenting food in the experimenter’s hand can result in
“hovering” which would decrease responding.

As described in the pilot studies, in the event that participants allocated
approximately ten consecutive responses to one option, that response option was removed
and three trials were prompted toward the other food item (Dixon and Cummings, 2001).
Consumption of this food item was prompted no more than three times. Concurrent-
schedule sessions were terminated after two minutes, or after one minute with no
responding, or when participants walked at least five feet away for five seconds or more,
or when participants lied down with head on the floor.

**Basis 2 PR 1 Reinforcer Assessment**

As described in experiment 3, during Basis 2 PR 1 sessions, a food item was
delivered contingent on engagement in the arbitrary response in the required ratio (i.e., 1,
1, 2, 2, 3, 3, 4, 4, etc.). Participants were required to touch their nose to the
experimenter’s closed fist, then move at least 6” away from the experimenter’s closed fist
between responses. Once schedule requirements were met, the food item was dropped
into the bowl directly below. The presentation order of the food items in the Basis 2 PR 1
assessment (e.g., “most-preferred” or “least-preferred”) was counterbalanced across
participants. For four participants, “most-preferred” sessions were conducted first, while
for the other four participants “least-preferred” sessions were conducted first. The order
was varied to control for a potential learning effect that could be a result of presentation order as observed in previous experiments. The experimenter vocalized the number of the response (i.e., “one,” “two,” “eight,” etc.) as a bridging stimulus prior to meeting the ratio requirement for each trial. Vocalizations may have attained properties of a conditioned reinforcer throughout the study as the terminal vocalization on each trial was consistently paired with the food item. In addition, all participants were domesticated dogs familiar with training situations; therefore, it was assumed that human vocalizations would be more likely to function as conditioned reinforcers. Data was collected on frequency of engagement in the arbitrary response as well as the breaking point (e.g., the last schedule requirement completed two times). Schedule requirements were reset to the lowest value (i.e., FR1) for each session (Roane et al., 2001).

“Moderately-Preferred” Item Testing

The concurrent-schedule and Basis 2 PR 1 reinforcer assessments were conducted as described above with the “moderately-preferred” food item for two participants. The “moderately-preferred” food item was defined as the one selected on 60% of trials in the PS assessment. During the concurrent-schedule assessment, the “moderately-preferred” food item was pitted against the “most-preferred” item. The Basis 2 PR 1 assessment was conducted identical to the others with the “moderately-preferred” food item. No glove (i.e., bare hand) was consistently paired with the “moderately-preferred” food item.
Follow-Up

The PS assessment was repeated at a one-month interval for two participants and a two-month interval for one participant. The purpose of repeating the preference assessment was to provide information on how often food preferences shift in dogs.
Chapter 9

RESULTS AND DISCUSSION: EXPERIMENT 4

Figure 13 shows the percentage of selections across food items for Bella. Dark bars indicate selection during the PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items identified as preferred by owners and ranked “1” are graphed as 100%; “2” as 80%; and “3” as 60%. Food items identified as non-preferred by owners and ranked “1” are graphed as 40%; “2” as 20%; and “3” as 0%. During the PS preference assessment, Bella selected chicken jerky on 100% of trials, broiled chicken on 80% of trials, kong cookies on 60% of trials, and tomato and orange on 0% of trials. Bella’s owner predicted that she would consume chicken jerky on 100% of trials, kong cookies on 80% of trials, broiled chicken on 60% of trials, and carrots, tomato, and orange on 0% of trials. Owner report and results of the PS assessment were in agreement regarding the “most-preferred” food item and bottom two ranked food items.
Figure 13. PS preference assessment data – Bella. Percentage of selections across food items for Bella.
Figure 14 shows the frequency of responses (y axis) and the breaking point (z axis) for Bella during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the “most-preferred” food item, chicken jerky. Open circles indicate responses emitted toward the option paired with the “least-preferred” food item, orange. Closed triangles indicate the breaking point (BP), the last ratio requirement completed, during Basis 2 PR 1 sessions.

During the concurrent-schedule reinforcer assessment, Bella allocated most to all responding to the option paired with the “most-preferred” food item (range = 15 – 17 responses). Conversely, Bella allocated very little responding to the option paired with the “least-preferred” food item (range = 0 – 2 responses). Differentiation in responding toward each food item was also observed during the Basis 2 PR 1 reinforcer assessment. Bella emitted only one response when the “least-preferred” food item was available in the first and second sessions, and zero responses in the third session. The breaking point across sessions with the “least-preferred” food item was zero (BP = 0). Bella emitted higher responding when the “most-preferred” food item was available (range = 3 – 17 responses). The breaking point across sessions with the “most-preferred” food item ranged from one to three (average BP = 2).
Figure 14. Reinforcer assessment data – Bella. Frequency of responses (y axis) and the breaking point (z axis) for Bella during reinforcer assessment sessions.
Figure 15 shows the percentage of selections across food items for Beaver. Dark bars indicate selection during the PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items identified as preferred by owners and ranked “1” are graphed as 100%; “2” as 80%; and “3” as 60%. Food items identified as non-preferred by owners and ranked “1” are graphed as 40%; “2” as 20%; and “3” as 0%. During the PS preference assessment, Beaver selected cheese on 100% of trials, turkey on 80% of trials, chicken jerky on 60%, orange on 20% of trials, and broccoli and celery on 0% of trials. Beaver’s owner predicted that he would consume turkey on 100% of trials, chicken jerky on 80% of trials, cheese on 60% of trials, orange on 40% of trials, broccoli on 20% of trials, and celery on 0% of trials. Owner report and results of the PS assessment were in agreement regarding the two “least-preferred” food items.
Figure 15. PS preference assessment data – Beaver. Percentage of selections across food items for Beaver.
Figure 16 shows the frequency of responses (y axis) and the breaking point (z axis) for Beaver during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the “most-preferred” food item, cheese. Open circles indicate responses emitted toward the option paired with the “least-preferred” food item, celery. Closed triangles indicate the breaking point, the last ratio requirement completed, during Basis 2 PR 1 sessions.

During the Basis 2 PR 1 reinforcer assessment Beaver emitted zero responses when the “least-preferred” food item was available across sessions. Therefore, the breaking point across sessions with the “least-preferred” food item was also zero (BP = 0). Beaver emitted higher responding when the “most-preferred” food item was available (range = 5 – 19 responses). The breaking point across sessions with the “most-preferred” food item ranged from one to three (average BP = 2). During the concurrent-schedule reinforcer assessment, Beaver allocated the majority of responding to the option paired with the “most-preferred” food item (range = 10 – 16 responses). Conversely, Beaver allocated variable responding to the option paired with the “least-preferred” food item (1, 10, and 0 responses, respectively). The rate of responding was equal during the second session to both response options, ten responses each.
Figure 16. Reinforcer assessment data – Beaver. Frequency of responses (y axis) and the breaking point (z axis) for Beaver during reinforcer assessment sessions.
Figure 17 shows the percentage of selections across food items for Guapo. Dark bars indicate selection during the PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items identified as preferred by owners and ranked “1” are graphed as 100%; “2” as 80%; and “3” as 60%. Food items identified as non-preferred by owners and ranked “1” are graphed as 40%; “2” as 20%; and “3” as 0%. During the PS preference assessment, Guapo selected turkey on 100% of trials, peanut butter treats on 80% of trials, ham on 60% of trials, and mushroom, celery and onion on 20% of trials. Guapo’s owner predicted that he would consume ham on 100% of trials, turkey on 80% of trials, peanut butter treat on 60% of trials, and mushroom, celery, and onion on 0% of trials. Results of the PS assessment all differed from the owner’s prediction.
Figure 17. PS preference assessment data – Guapo. Percentage of selections across food items for Guapo.
Figure 18 shows the frequency of responses (y axis) and the breaking point (z axis) for Guapo during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the “most-preferred” food item, turkey. Open circles indicate responses emitted toward the option paired with the “least-preferred” food item, onion. Closed triangles indicate the breaking point, the last ratio requirement completed, during Basis 2 PR 1 sessions.

During Basis 2 PR 1 reinforcer assessment, Guapo emitted few responses when the “least-preferred” food item was available (range = 0 – 2 responses). The breaking point with the “least-preferred” food item ranged from zero to one (average BP = 0). Guapo emitted significantly higher responding when the “most-preferred” food item was available (range = 48 – 68 responses). The breaking point across sessions with the “most-preferred” food item ranged from five to six (average BP = 6). During the concurrent-schedule reinforcer assessment, Guapo allocated the majority of responding to the option paired with the “most-preferred” food item (range = 11 – 13 responses). Guapo allocated somewhat variable responding to the option paired with the “least-preferred” food item (0, 6, 1 responses, respectively).
Figure 18. Reinforcer assessment data – Guapo. Frequency of responses (y axis) and the breaking point (z axis) for Guapo during reinforcer assessment sessions.
Figure 19 shows the percentage of selections across food items for Maggie. The darkest bars indicate selection during the PS preference assessment. Medium-dark bars indicate selection during the one-month follow-up PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items identified as preferred by owners and ranked “1” are graphed as 100%; “2” as 80%; and “3” as 60%. Food items identified as non-preferred by owners and ranked “1” are graphed as 40%; “2” as 20%; and “3” as 0%. During the PS preference assessment, Maggie selected Softies on 86% of trials, Bark’n Bac’n on 71% of trials, jerky treats on 57% of trials, dog biscuits and dog food on 20% of trials, and carrots on 0% of trials. Maggie’s owner predicted that she would consume jerky treats on 100% of trials, Bark’n Bac’n on 80% of trials, Softies on 60% of trials, dog biscuits on 40% of trials, dog food on 20% of trials, and carrots on 0% of trials. Owner report and results of the PS assessment were in agreement regarding the bottom two ranked food items. At one-month follow-up, Maggie’s selections somewhat differed from results of the original PS preference assessment, selection between the top three ranked food items differed: Bark’n Bac’n on 100% of trials, jerky treats on 80% of trials, Softies on 60% of trials. However, selection between the bottom three ranked food items remained consistent: dog biscuits and dog food on 20% of trials, and carrots on 0% of trials. This assessment was in slightly closer agreement with owner report.
Figure 19. PS preference assessment data – Maggie. Percentage of selections across food items for Maggie.
Figure 20 shows the frequency of responses (y axis) and the breaking point (z axis) for Maggie during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the “most-preferred” food item, Softies. Open circles indicate responses emitted toward the option paired with the “least-preferred” food item, carrots. Closed triangles indicate the breaking point, the last ratio requirement completed, during Basis 2 PR 1 sessions.

During the concurrent-schedule reinforcer assessment, Maggie allocated most to all responding to the option paired with the “most-preferred” food item (range = 11 – 17 responses). Conversely, she allocated very little responding to the option paired with the “least-preferred” food item (range = 0 – 3 responses). Differentiation in responding toward each food item was also observed during the Basis 2 PR 1 reinforcer assessment. Maggie emitted between one and three responses when the “least-preferred” food item was available. The breaking point across sessions with the least-preferred food item ranged from zero to one (average BP = 1). When the “most-preferred” food item was available, Maggie emitted variable and decreasing rates of responding (19, 1, 2 responses, respectively). The breaking point across sessions with the “most-preferred” food item ranged from zero to three (average BP = 1).
Figure 20. Reinforcer assessment data – Maggie. Frequency of responses (y axis) and the breaking point (z axis) for Maggie during reinforcer assessment sessions.
Figure 21 shows the percentage of selections across food items for Maya. The darkest bars indicate selection during the PS preference assessment. Medium-dark bars indicate selection during the one-month follow-up PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items identified as preferred by owners and ranked “1” are graphed as 100%; “2” as 80%; and “3” as 60%. Food items identified as non-preferred by owners and ranked “1” are graphed as 40%; “2” as 20%; and “3” as 0%. During the PS preference assessment, Maya selected Softies on 83% of trials, jerky treats on 67% of trials, Bark’n Bac’n and dog biscuits on 60% of trials, dog food on 20% of trials, and carrots 0% of trials. Maya’s owner predicted that she would consume jerky treats on 100% of trials, Bark’n Bac’n on 80% of trials, Softies on 60% of trials, dog biscuits on 40% of trials, dog food on 20% of trials, and carrots on 0% of trials. Owner report and results of the PS assessment were in agreement regarding the bottom two ranked food items. At one-month follow-up, Maya’s selections remained consistent with the previous PS preference assessment, although percentages were slightly different: Softies on 86% of trials, jerky treats on 71% of trials, Bark’n Bac’n on 60% of trials, dog biscuits on 40% of trials, dog food on 20% of trials, and carrots on 0% of trials.
Figure 21. PS preference assessment data – Maya. Percentage of selections across food items for Maya.
Figure 22 shows the frequency of responses (y axis) and the breaking point (z axis) for Maya during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the “most-preferred” food item, Softies. Open circles indicate responses emitted toward the option paired with the “least-preferred” food item, carrots. Closed triangles indicate the breaking point, the last ratio requirement completed, during Basis 2 PR 1 sessions.

During the concurrent-schedule reinforcer assessment, Maya allocated most to all responding to the option paired with the “most-preferred” food item (range = 12 – 19 responses). Conversely, she allocated little responding to the option paired with the “least-preferred” food item (range = 0 – 4 responses). Differentiation in responding toward each food item was also observed during the Basis 2 PR 1 reinforcer assessment. When the “most-preferred” food item was available, Maya emitted between 18 and 42 responses. The breaking point across sessions with the “most-preferred” food item ranged from three to five (average BP = 4). Lower levels of responding were observed when the “least-preferred” food item was available (range = 1 – 5 responses). The breaking point across sessions with the least-preferred food item ranged from zero to one (average BP = 1).
Figure 22. Reinforcer assessment data – Maya. Frequency of responses (y axis) and the breaking point (z axis) for Maya during reinforcer assessment sessions.
Figure 23 shows the percentage of selections across food items for Arrow. Dark bars indicate selection during the PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items identified as preferred by owners and ranked “1” are graphed as 100%; “2” as 80%; and “3” as 60%. Food items identified as non-preferred by owners and ranked “1” are graphed as 40%; “2” as 20%; and “3” as 0%. During the PS preference assessment, Arrow selected chicken strip on 100% of trials, lamb biscuit on 80% of trials, peanut butter snacks on 60% of trials, apple on 40% of trials, and spinach and orange peel on 0% of trials. Arrow’s owner predicted that he would consume chicken strip on 100% of trials, lamb biscuit on 80% of trials, peanut butter snacks on 60% of trials, apple on 40% of trials, spinach on 20% of trials, and orange peel on 0% of trials. Owner report and results of the PS assessment were in total agreement with the exception of the fourth ranked food item.
Figure 23. PS preference assessment data – Arrow. Percentage of selections across food items for Arrow.
Figure 24 shows the frequency of responses (y axis) and the breaking point (z axis) for Arrow during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the “most-preferred” food item, chicken strips. Open circles indicate responses emitted toward the option paired with the “least-preferred” food item, orange peel. Closed triangles indicate the breaking point, the last ratio requirement completed, during Basis 2 PR 1 sessions.

During the Basis 2 PR 1 reinforcer assessment Arrow emitted zero responses when the “least-preferred” food item was available across sessions. Therefore, the breaking point across sessions with the “least-preferred” food item was also zero (BP = 0). Arrow emitted significantly higher responding when the “most-preferred” food item was available (range = 45 – 75 responses). The breaking point across sessions with the “most-preferred” food item ranged from six to eight (average BP = 7). During the concurrent-schedule reinforcer assessment, Arrow allocated most to all responding to the option paired with the “most-preferred” food item (range = 14 – 16 responses). Conversely, Arrow allocated very little responding to the option paired with the “least-preferred” food item (range = 0 – 2 responses).
Figure 24. Reinforcer assessment data – Arrow. Frequency of responses (y axis) and the breaking point (z axis) for Arrow during reinforcer assessment sessions.
Figure 25 shows the percentage of selections across food items for Shamus. The darkest bars represent selection during the PS preference assessment. Medium-dark bars indicate selection during the two-month follow-up PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items identified as preferred by owners and ranked “1” are graphed as 100%; “2” as 80%; and “3” as 60%. Food items identified as non-preferred by owners and ranked “1” are graphed as 40%; “2” as 20%; and “3” as 0%. During both the PS preference assessment and the two-month follow-up assessment, Shamus’s selections remained consistent and matched those predicted by his owner: beef jerky on 100% of trials, ground beef on 80% of trials, cheese on 60% of trials, and apple, spinach, and carrots on 0% of trials.
**Figure 25.** PS preference assessment data – Shamus. Percentage of selections across food items for Shamus.
Figure 26 shows the frequency of responses (y axis) and the breaking point (z axis) for Shamus during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the “most-preferred” food item, beef jerky. Open circles indicate responses emitted toward the option paired with the “least-preferred” food item, carrots. Open squares represent responses emitted toward the option paired with the “moderately-preferred” food item, cheese. Closed triangles indicate the breaking point, the last ratio requirement completed, during Basis 2 PR 1 sessions.

The first concurrent schedule reinforcer assessment compared responding to the “most-preferred” and “least-preferred” food items. During this assessment, Shamus allocated most to all responding to the option paired with the “most-preferred” food item (range = 14 – 20 responses). Conversely, Shamus allocated very little responding to the option paired with the “least-preferred” food item (range = 0 – 3 responses). The “moderately-preferred” food item was also assessed in reinforcer assessments for Shamus. A second concurrent-schedule reinforcer assessment compared responding between the “most-preferred” and “moderately-preferred” food items to provide some information on how responding differed when more similarly ranked food items were compared. During this assessment, responding was similar between the food items. Responses toward the option with the “most-preferred” food item ranged from two to 19. Responses toward the option with the “moderately-preferred” food item ranged from two to 22. Higher levels of responding were always allocated to the response option located on the right side.
Differentiation in responding between the “most-preferred” and “least-preferred” food items was also observed during the Basis 2 PR 1 reinforcer assessment. When the “most-preferred” food item was available, responding ranged between five and 13 responses. The breaking point across sessions with the “most-preferred” food item ranged from one to three (average BP = 2). When the “least-preferred” food item was available, Shamus emitted between zero and three responses. The breaking point across sessions with the “least-preferred” food item ranged from zero to one (average BP = 0). The “moderately-preferred” food item was also tested with the Basis 2 PR 1 assessment to gain information on absolute reinforcement properties for Shamus. Similar to the data observed in the concurrent-schedule assessment, differentiation in responding between the “most-preferred” and “moderately-preferred” food items was not observed during the Basis 2 PR 1 assessment. When the “moderately-preferred” food item was available, responding ranged between seven and 11 responses. The breaking point across sessions with the “moderately-preferred” food item was two (BP = 2), the same breaking point observed with the “most-preferred” food item.
Figure 26. Reinforcer assessment data – Shamus. Frequency of responses (y axis) and the breaking point (z axis) for Shamus during reinforcer assessment sessions.
Figure 27 shows the percentage of selections across food items for Smokey. Dark bars indicate selection during the PS preference assessment. Light bars indicate owner report of selection on the adapted RAISD questionnaire. Owner report was graphed as a percentage according to the ranking provided. Food items identified as preferred by owners and ranked “1” are graphed as 100%; “2” as 80%; and “3” as 60%. Food items identified as non-preferred by owners and ranked “1” are graphed as 40%; “2” as 20%; and “3” as 0%. During the PS preference assessment, Smokey selected chicken jerky on 100% of trials, turkey on 80% of trials, ham on 60% of trials, and onion, mushroom, and apple on 0% of trials. Smokey’s owner predicted that he would consume ham on 100% of trials, turkey on 80% of trials, chicken jerky on 60% of trials, and onion, mushrooms, and apple on 0% of trials. Owner report and results of the PS assessment were in agreement regarding the bottom three ranked food items.
Figure 27. PS preference assessment data – Smokey. Percentage of selections across food items for Smokey.
Figure 28 shows the frequency of responses (y axis) and the breaking point (z axis) for Smokey during reinforcer assessment sessions. Solid circles indicate responses emitted toward the option paired with the “most-preferred” food item, chicken jerky. Open circles indicate responses emitted toward the option paired with the “least-preferred” food item, apple. Open squares represent responses emitted toward the option paired with the “moderately-preferred” food item, ham. Closed triangles indicate the breaking point, the last ratio requirement completed, during Basis 2 PR 1 sessions.

During the Basis 2 PR 1 reinforcer assessment, differentiation in responding between the “most-preferred” and “least-preferred” food items was very clear for Smokey. When the “most-preferred” food item was available, responding ranged between 105 and 118 responses. The breaking point across sessions with the “most-preferred” food item ranged from nine to ten (average BP = 9). When the “least-preferred” food item was available Smokey emitted zero responses across sessions. Therefore, the breaking point across sessions with the least-preferred food item was zero (BP = 0). The “moderately-preferred” food item was also tested with Smokey. When the “moderately-preferred” food item was available in Basis 2 PR 1 sessions, responding increased from 50 and 136 responses across sessions. The breaking point across sessions with the “moderately-preferred” food item ranged from six to ten (average BP = 8), which was very similar to that observed with the “most-preferred” food item.

The first concurrent-schedule reinforcer assessment compared responding to the “most-preferred” and “least-preferred” food items. During this assessment, Smokey allocated the majority of responding to the option paired with the “most-preferred” food
item (range = 18 – 21 responses). Conversely, Smokey allocated very little responding to
the option paired with the “least-preferred” food item (range = 1 – 3 responses). The
second concurrent-schedule reinforcer assessment compared responding between the
“most-preferred” and “moderately-preferred” food items. Similar to what was observed
with Shamus during this assessment, responding was similar between the two food items.
Responding toward the option with the “most-preferred” food item ranged from zero to
19 responses, while responding toward the option with the “moderately-preferred” food
item ranged from one to 20 responses. Higher levels of responding were always allocated
to the response option located on the right side.
Figure 28. Reinforcer assessment data – Smokey. Frequency of responses (y axis) and the breaking point (z axis) for Smokey during reinforcer assessment sessions.
Chapter 10

GENERAL DISCUSSION

Results from this study show that the PS preference assessment is an effective method to identify preferred items that also function as reinforcers. This was true for all 12 participants used throughout this study. For all participants, the food item identified as “most-preferred” by the PS preference assessment increased the future frequency of responding during the various reinforcer assessments. In addition to being effective at identifying reinforcers, the PS assessment was also efficient. The assessment requires a small amount of food and very limited time. The aspect of efficiency is especially important when considering that preference assessments should be conducted on a frequent basis to determine shifts in preference (Mason, et al., 1989). Follow-up assessments in this study showed that one out of three participant’s preference changed after a one month interval.

Some interesting results of the PS preference assessment in Experiment 4 were discovered when analyzing location selection (e.g., right or left) among the top three ranked food items (see Table 3). These three food items were all identified by owners to be highly preferred. Six of the eight participants displayed fair to extreme position bias among these food item pairings. No matter the pairing, Arrow and Beaver selected the food item on the left exclusively. Arrow’s left position bias remained consistent in both Experiments 3 and 4. An explanation for this could be that because Arrow has extensive training, and his owner is right-handed, he may be familiar with food items being
presented on his left. However, this phenomenon did not hold true for other participants with less training. In addition, Maya and Maggie selected the food item on the left the majority of the time, 70% and 78% respectively. Left side selections for Maya and Maggie remained consistent during the one-month follow-up assessment. Shamus selected the food item on the right exclusively. Right side selections for Shamus also remained consistent during the two-month follow-up assessment. Finally, side bias among similarly ranked food items was further observed during the concurrent-schedule reinforcer assessment with the “most-preferred” and “moderately-preferred” food items for Shamus and Smokey. Regardless of the food item, both participants allocated the vast majority of responding to the option on the right. Right-side selections remained consistent throughout assessments for both dogs. This data indicates that concurrent arrangements may produce position bias when analyzing similarly ranked food items, and not when food items are more differentiated in preference. The implications of this data suggest that if the items to be used in a PS assessment are all thought to be preferred for an animal, and position bias emerges during testing, the items may all function as reinforcers. This implication was most clear when analyzing the data in Experiment 3 (see Figures 11 and 12).
### Position Selection Between the Top Three Ranked Food Items — Preference Assessments

<table>
<thead>
<tr>
<th></th>
<th># Trials</th>
<th># Trials-Left</th>
<th>#Trials-Right</th>
<th>% (Position)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrow</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>100% (Left)</td>
</tr>
<tr>
<td>*Shamus</td>
<td>6</td>
<td>0</td>
<td>6</td>
<td>100% (Right)</td>
</tr>
<tr>
<td>Bella</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>67% (Right)</td>
</tr>
<tr>
<td>Beaver</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>100% (Left)</td>
</tr>
<tr>
<td>Maya</td>
<td>10</td>
<td>7</td>
<td>3</td>
<td>70% (Left)</td>
</tr>
<tr>
<td>Maggie</td>
<td>9</td>
<td>7</td>
<td>2</td>
<td>78% (Left)</td>
</tr>
<tr>
<td>*Smokey</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>67% (Right)</td>
</tr>
<tr>
<td>Guapo</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>67% (Left)</td>
</tr>
<tr>
<td>All</td>
<td>43</td>
<td>27</td>
<td>16</td>
<td>63% (Left)</td>
</tr>
</tbody>
</table>

* = Same position bias observed during concurrent-schedule reinforcer assessment

Results of the concurrent-schedule reinforcer assessment revealed relative reinforcer efficacy between the “most-preferred” and “least-preferred” food items for all participants. This reinforcer assessment was also the most time efficient method; sessions were two minutes in duration. This time was chosen based on pilot studies, which found that clear differentiation was observed in two-minute sessions. As previously discussed, a limitation of the concurrent-schedule reinforcer assessment is that position bias emerged when assessing similarly-ranked food items. This was observed with the two participants...
in Experiment 4 that allocated the majority of responding to one response option (e.g., the right side), regardless of the consequence (e.g., the “most-preferred” or “moderately-preferred” food item). Despite clear position bias, rates of responding can still be analyzed because the locations were counterbalanced. Results indicate that rates of responding between the “most-preferred” and “moderately-preferred” food items in the concurrent-schedule assessment were equivalent. This indicates that both food items will function as effective reinforcers.

Results of the Basis 2 PR 1 reinforcer assessment revealed absolute reinforcer efficacy for all items tested. Highly differentiated breaking points as well as cumulative responses were observed between the “most-preferred” and “least-preferred” food items for most participants. In addition, contrast in session times between the “most-preferred” and “least-preferred” food items was also observed. Sessions with the “most-preferred” item were all significantly longer than sessions with the “least-preferred” food item. Furthermore, the duration of session times with the “least-preferred” food item decreased in subsequent sessions for six out of eight participants. For example, session one was one-minute in duration, session two decreased to 45 seconds, and session three further decreased to 30 seconds in duration. Conversely, cumulative responses, breaking points, and session times between the “most-preferred” and “moderately-preferred” food items for the two participants evaluated in Experiment 4, were very similar. This again indicates that both preferred items would function as reinforcers, and one does not appear to be more effective than the other. Although the Basis 2 PR 1 reinforcer assessment is a more timely procedure than the concurrent-schedule reinforcer assessment, it may
provide a more accurate account of reinforcer efficacy and control for position bias. However, it should be considered that this assessment is more likely to produce superstitious and aberrant behaviors as ratio requirements increase (i.e., extinction burst).

Results of the reinforcer assessments with the “moderately-preferred” food item, provide additional support for the implication that similarly ranked food items may one, produce position bias in any concurrent arrangement and two, function as effective reinforcers. When analyzing the reinforcer efficacy of “preferred” items, the findings suggest that a PR reinforcer assessment should be used to avoid the emergence of position bias. However, valuable information can also be gained by using a concurrent-schedule reinforcer assessment with “preferred” items. If location is counterbalanced and position bias still emerges, an individual could assume that both items will function as reinforcers.

The effect of familiarity of food items on preference was also assessed. This analysis yielded no clear information on whether more or less familiar foods are predictive of preference. For one participant, Bella, a food item presented on a daily basis was the “most-preferred” food item. For three participants, Arrow, Guapo, and Beaver, food items delivered on a weekly basis were selected on the most trials during the PS assessment. For one participant, Shamus, the “most-preferred” food item was one delivered on a monthly basis. This food item remained the “most-preferred” for Shamus at the two-month follow-up assessment. Finally, for three participants, Maya, Maggie, and Smokey, completely novel food items were considered “most-preferred.” For two of these three participants, a one-month follow-up assessment was conducted. For one of
these participants, Maya, preference remained consistent for the novel food item at the one-month follow-up assessment (see Figure 21). For the other participant, Maggie, preference shifted from the novel item to a food item presented on weekly basis at the one-month follow-up assessment (see Figure 19). Worth noting when analyzing Maggie’s performance during the progressive-schedule reinforcer assessment with the “most-preferred” food item (e.g., the novel food), is the extreme decrease in responding after the first session (see Figure 20). This could be interpreted as an initial effect of novelty deteriorating (Ferrell, 1984).

As observed in previous research, the PS preference assessment is an effective procedure for quickly and accurately identifying preferences in animals (Fernandez, et al., 2004; Clay, et al., 2009). The current study extends the literature by assessing reinforcer efficacy of the preferred food items. This study provides evidence that the PS preference assessment can in fact identify preferred food items that also function as reinforcers. This provides owners and animal trainers with a way to identify food items to effect positive behavior change, rather than selecting items to use haphazardly (Fernandez, et al., 2004). Similar to what has been discovered in the field of ABA, this assessment provides animal behavior change agents with a procedure to ensure reinforcer quality (Mason, et al., 1989). Furthermore, this procedure is a viable way to assess animal preferences on an individual basis rather than the typically used group method, which reports average preferences for entire species (Atwood, et al., 2001). Group assessments have various methodological flaws and neglect the importance of individual variation in preferences (Atwood, et al., 2001). The PS preference assessment provides an empirical
basis for selection of food items to both enrich animals’ environments and use as
effective reinforcers. As preference assessments have been shown to increase the
efficiency of training with humans (DeLeon, et al., 2001), this study shows that the same
is true for animals.

In conclusion, owners may be able to identify several food items presumed to be
highly preferred by their dogs that may be used as effective reinforcers. In this case, the
data show that the PS assessment may actually be unnecessary. However, for animals that
preferences cannot be assumed (i.e., animals in shelters, rescues, foster homes, training
facilities, zoos, etc.), the PS preference assessment is a time efficient, effective method to
identify preferred items that will function as reinforcers. These food items can then be
used to enrich the animals’ environment and/or in operant conditioning methods.

Limitations

While the current methodology is thought to provide a viable procedure to assess
preference and reinforcer efficacy with dogs, several limitations should be noted. First,
all sessions were conducted in participants’ natural environment where the experimenter
had little control over outside variables. For example, during some sessions the owner
may have been present in the room, while during other sessions, the owner may have
been in a different room. This could have influenced responding by deflecting attention
from the task to the owner during some sessions. In addition, some participants lived in
multiple dog homes, where they were separated during testing sessions. Therefore,
participants could have been attending to their owner, other dogs, or other outside
variables that the experimenter could not control. Even though, the study may have
benefited from a more controlled, laboratory setting, marked differences in data were not observed between sessions suggesting that these variables did not influence the findings. Furthermore, this study was meant for practical use in the natural environment. Therefore, a natural setting was chosen over a laboratory setting to provide more functional information for animal owners and trainers. Second, there was no standard control of experimenter voice tone during the Basis 2 PR 1 reinforcer assessment (i.e., conditioned reinforcement; Williams, Friend, Nevill, and Archer, 2004). Participants could have been cueing into differences in tone, volume, intonation, modulation, etc. of the experimenter’s voice. Differences in these variables could have provided information as to when participants were approaching the required ratio. For instance, the experimenter’s voice may have increased in pitch until the ratio requirement was met, providing information to participants. However, stable responding across Basis 2 PR 1 sessions was observed across participants, suggesting that voice variability did not have a significant influence on behavior.

Another limitation of the current study is the inclusion of only one small breed dog, Millie, in Experiment 1. Small breed dogs may have different eating habits than large breed dogs; however, no differences in responding were observed between this participant and all other participants (i.e., large breed dogs). Finally, a notable limitation of the procedure is that all assessments require several prerequisite behaviors. Participants in this study were required to sit, stay, and attend to experimenter instruction with food items placed 2” in front of their nose and on the floor in front of them. For animal behavior change agents attempting to identify effective reinforcers to teach these
prerequisite skills, this assessment would need to be modified. The aforementioned limitations highlight the difficulties inherent in designing and implementing research protocols in the applied setting with animal participants.

**Future Research**

Future research should replicate the current study to ensure that the phenomenon observed were not products of the experimental methodology. Additionally, the same or similar methods should be extended to other animal species and non-food items. Should such an extension yield similar results with other items and/or captive animals in zoo or rescue settings, animal trainers will benefit with the empirical knowledge of individual preferences and effective reinforcers. Future research should also further evaluate shifts in preference. Knowledge of how often preference changes may indicate how often preference assessments must be conducted. Also, investigating the use of a pre-training mini-assessment with animals, similar to the procedure used in ABA by Mason et al. (1989), could provide animal trainers with a timely way to assess these shifts in preference. Researchers should also evaluate whether or not a novelty effect exists using the procedures in this study. In addition, future investigations should evaluate whether owner report alone is sufficient in identifying effective reinforcers for dogs. Future researchers should investigate the current methodology for applicability with animals without the prerequisite behaviors required for this study (e.g., sit and stay in the presence of food). Preference and reinforcer assessment methods that better control for position bias emerging among similarly ranked food items should also be evaluated. However, the emergence of position bias in a concurrent paradigm may also indicate that
both food items would function as effective reinforcers. Further research should evaluate this phenomenon. Researchers should also investigate the utility of vocalizing the number of the response in the Basis 2 PR 1 schedule, and whether this functions as a conditioned reinforcer. Finally, researchers in the animal food industry may want to further evaluate these methods against those typically used to determine food preferences (e.g., the two-pan test). The PS method may be a preferred method to provide information on food preferences to animal food manufacturers.

**Summary**

Results of this study have several implications for using preference assessments as predictors of reinforcers with animals. First, the SS assessment was not an effective method to analyze food preferences with dogs because they consume most of all food items presented. Second, the PS assessment was effective in identifying preferred foods that function as reinforcers with dogs. However, this procedure is better suited for use with highly differentiated items of preference. Position bias emerged when comparing similarly ranked foods (i.e., preferred foods). Third, a concurrent-schedule reinforcer assessment was the most time efficient method to assess relative reinforcer efficacy; however similar to the PS assessment, position bias emerged among similarly ranked food items. Last, the Basis 2 PR 1 reinforcer assessment was more time consuming, but provided clear information on the absolute reinforcer potency of all items tested. The Basis 2 PR 1 assessment controls for position bias and provides both cumulative responses and breaking points.
APPENDIX A

Owner Consent Form

Participation in Clinical Behavioral Research

You have been invited by Sara Vicars and Caio Miguel to participate with your dog in a study evaluating preference and reinforcer effectiveness. Six edible items will be used at your discretion to determine a hierarchy of preference. Furthermore, items identified as high and low preferred will be delivered contingent on an arbitrary response to determine if these items function as reinforcers.

The behavior reinforcement techniques involved in this study will create no known risks other than those you may already face in handling your dog, but the study will take some of your time and may be slightly inconvenient. As in all research, there may be unforeseen risks to yourself or your dog. If an accidental injury occurs, appropriate emergency measures should be taken; however, no compensation or additional treatment will be made available. You will have access to consultation on your dog’s learning behavior throughout the study.

The study will last approximately three days per animal. You will also be asked to withhold food from your dog for a minimum of four hours prior to each testing session. You may drop out of the study at any time and for any reason, and if you choose to quit the study it will not affect your relationship with California State University, Sacramento now or in the future or cause any loss of service.

Your dog’s active participation in a study evaluating preference and reinforcer effectiveness is one of the principal means by which researchers, applied animal behavior consultants and obedience instructors can assess the benefits of both newly developed and existing behavior-change and behavior maintenance practices. The results of this study could help many pet owners and dog obedience trainers who are dedicated to providing their dogs with the highest preferred foods with the highest reinforcing effectiveness.

The clinical behavioral research which you have been invited to participate in has been carefully reviewed and approved by a federally mandated committee* of scientists and non-scientists who ensure that your dog’s well-being is a foremost
concern and that your dog’s participation will not predispose him/her to any unalleviated stress or pain or adversely affect his existing training.

Only behavioral data associated with completed consent forms sent or presented to Sara Vicars and/or Caio Miguel will be used for this research. Please fill in the requested information and return the completed forms to Sara Vicars, care of Caio Miguel, Department of Psychology, 1600 J Street, Sacramento, CA 95819, or call Sara at (916) 640-3533. **The identity of all owners participating in this study will be strictly confidential.** All personal information will be kept secret, and your name will never be used. While we might write about the study, no personal information will be used.

If you are interested in participating, please review and sign the attached consent form. It clarifies your rights as the legal owner of your dog and explains the liabilities associated with your decision to participate in our study.

Name of Owner: _____________________________________________________
Signature of Owner: __________________________________________________
Address of Owner: ______________________________________________
____________________________________________
Phone Number of Owner: ______________________________________
Name of Dog: _____________________________________________________
Breed: ___________________________________________________________
Can we show a picture/video of your dog to a select audience?__________
Date: ___________________________________________________________

California State University, Sacramento thanks you for considering this invitation.

* Institutional Animal Care and Use Committee
Patient Participation in Clinical Research - Owner Consent Form

**Study Title:** TESTING THE PAIRED STIMULUS PREFERENCE ASSESSMENT AS A PREDICTOR OF REINFORCER EFFICACY IN DOGS

I, ............................................, am the legal owner of ..........................................., a ............................................ year-old ..................................................

I do hereby give my consent to have ............................................ participate in a clinical applied animal behavior research study being conducted by Sara Vicars and Caio Miguel.

I understand that this study is evaluating preference and reinforcer effectiveness with food items.

I understand that my animal’s participation in this study is voluntary.

I understand that I can refuse to have my animal participate in this study. A refusal or withdrawal will not adversely affect any future care or my relationship at any time with California State University, Sacramento.

I understand that no funds are available to provide financial compensation for my animal’s participation in the study.

I understand that California State University, Sacramento will not be held liable for any unforeseen events arising from this study.

I have had the goals and anticipated risks and benefits of the study fully explained to me and I have had all my questions regarding my animal’s participation satisfactorily answered.

I have retained a signed copy of this statement.

...............................................   ............................................
Owner                                  Date

...............................................   ............................................
Witness                                Date
APPENDIX B

Single-Stimulus Preference Assessment

Participant: ____________________ Date: ___________ Evaluator:______________

Circle One

1. C All Half None  A:___________________________
2. A All Half None  B:___________________________
3. D All Half None  C:___________________________
4. D All Half None  D:___________________________
5. B All Half None  E:___________________________
6. A All Half None
7. E All Half None
8. E All Half None
9. A All Half None
10. C All Half None
11. A All Half None
12. B All Half None  18. D All Half None
13. B All Half None  19. C All Half None
14. D All Half None  20. E All Half None
15. C All Half None
16. B All Half None
17. E All Half None
APPENDIX C

Paired-Stimulus Preference Assessment

<table>
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<tr>
<th>Participant: __________________</th>
<th>Date: ___________</th>
<th>Evaluator:_______________</th>
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<th>Foods:</th>
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<td>1.</td>
<td>B vs. C</td>
<td>A:_______________________</td>
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<td>A vs. C</td>
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<td>D vs. E</td>
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<td>B vs. E</td>
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<td>B vs. A</td>
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<td>9.</td>
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<td>10.</td>
<td>A vs. B</td>
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<td>11.</td>
<td>C vs. B</td>
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<td>12.</td>
<td>C vs. A</td>
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<td>A vs. E</td>
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<td>15.</td>
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<td>18.</td>
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APPENDIX D

Concurrent-Operant Reinforcer Assessment

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<tr>
<th>Participant: ___________________</th>
<th>Date: ___________</th>
<th>Evaluator: ______________</th>
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H-H stimulus: ___________________
Presample: HH, HL, HH, HH, HL, HL

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<tr>
<th>TX CONDITION</th>
<th>Tally responses - HH:</th>
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<tr>
<td>TX CONDITION</td>
<td>Tally responses HL:</td>
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<tr>
<th>TX CONDITION</th>
<th>Tally responses - HH:</th>
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<td>TX CONDITION</td>
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<th>TX CONDITION</th>
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<td>TX CONDITION</td>
<td>Tally responses - HL:</td>
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The purpose of this survey is to obtain information about the foods that you believe would be useful as rewards for your dog.

If you have signed the consent form, please answer the following questions regarding your dog’s preferences:

1. Some dogs really enjoy foods like lamb biscuits, bacon strips, dog jerky, beef, salami, carrots, chips, cheese, etc. What are the specific foods/brands of food your dog likes to eat the most?

   **How often does your dog eat this?**

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<th>Brand</th>
<th>How Often</th>
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<td>Monthly</td>
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2. Please go back to the list in question number one, and place a number in each box to rank these foods from most favorite (1) to least favorite (10).

3. Are there any foods that your dog is allergic to? ___________________________

   _______________________________________________________________________

4. Are there any foods that you would prefer your dog not eat during our study?

   _______________________________________________________________________

   _______________________________________________________________________
APPENDIX F

Basis 2 PR 1 Data Sheet

Participant:______________ Date/Time:___________ Evaluator:___________

PR Schedule of Reinforcement: 1, 1, 2, 2, 3, 3, 4, 4, 5, 5, 6, 6, 7, 7, 8, 8, 9, 9, 10, 10, etc.

**Tally responses in each box. Move onto the next box when the food item was delivered (i.e., the line = “reinforcement”)

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APPENDIX G

Owner Report Questionnaire

Questionnaire to be completed by owners prior to the beginning of the study.

Preferred Items Assessment

The purpose of this survey is to obtain information about the foods that you believe would be useful as rewards for your dog.

If you have signed the consent form, please answer the following questions regarding your dog’s preferences:

1. Some dogs really enjoy foods like lamb biscuits, bacon strips, dog jerky, beef, salami, carrots, chips, cheese, etc. What are the specific foods/brands of food your dog likes to eat the most?

   How often does your dog eat this?

   - □ ______________________  Daily  Weekly  Monthly  Less
   - □ ______________________  Daily  Weekly  Monthly  Less
   - □ ______________________  Daily  Weekly  Monthly  Less
   - □ ______________________  Daily  Weekly  Monthly  Less
   - □ ______________________  Daily  Weekly  Monthly  Less
   - □ ______________________  Daily  Weekly  Monthly  Less

2. Some dogs really dislike some foods like bananas, dog food, popcorn, blueberries, etc. What are some specific foods/brands of food your dog does NOT like to eat?

   - □ ______________________  Daily  Weekly  Monthly  Less
   - □ ______________________  Daily  Weekly  Monthly  Less
   - □ ______________________  Daily  Weekly  Monthly  Less
   - □ ______________________  Daily  Weekly  Monthly  Less
   - □ ______________________  Daily  Weekly  Monthly  Less
   - □ ______________________  Daily  Weekly  Monthly  Less
3. Please go back to the list in question number one, and place a number in each box to rank these foods from most favorite (1) to least favorite (5).

4. Please go back to the list in question number two, and place a number in each box to rank the foods from most disliked (1) to least disliked (5).

5. Are there any foods that your dog is allergic to? _____________________________
________________________________________________________________________

6. Are there any foods that you would prefer your dog not eat during our study?
________________________________________________________________________
APPENDIX H

Paired-Stimulus Data Sheet

Participant: ________________ Date/Time: ___________ Evaluator:_____________

1. **R** D vs. F  
2. **R** A vs. B  
3. **L** D vs. A  
4. **R** F vs. E  
5. **R** F vs. C  
6. **L** E vs. B  
7. **L** E vs. C  
8. **L** A vs. E  
9. **L** C vs. A  
10. **L** E vs. D  
11. **L** A vs. F  
12. **R** B vs. D  
13. **R** C vs. D  
14. **R** B vs. F  
15. **R** C vs. B

Foods:

A __________________________
B: __________________________
C: __________________________
D: __________________________
E: __________________________
F: __________________________


REFERENCES


