JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1999, **32,** 479–493 NUMBER 4 (WINTER 1999)

RELATIVE VERSUS ABSOLUTE REINFORCEMENT EFFECTS: IMPLICATIONS FOR PREFERENCE ASSESSMENTS

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We compared results obtained in two previous studies on reinforcer identification (Fisher et al., 1992; Pace, Ivancic, Edwards, Iwata, & Page, 1985) by combining methodologies from both studies. Eight individuals with mental retardation participated. During Phase 1, two preference assessments were conducted, one in which stimuli were presented singly (SS method) and one in which stimuli were presented in pairs (PS method). Based on these results, two types of stimuli were identified for each participant: High-preference (HP) stimuli were those selected on 75% or more trials during both preference assessments; low-preference (LP) stimuli were those selected on 100% of the SS trials but on 25% or fewer of the PS trials. During Phase 2, the reinforcing effects of HP and LP stimuli were evaluated in reversal designs under two test conditions: concurrent and single schedules of continuous reinforcement. Two response options were available under the concurrent-schedule condition: One response produced access to the HP stimulus; the other produced access to the LP stimulus. Only one response option was available under the single-schedule condition, and that response produced access only to the LP stimulus. Results indicated that 7 of the 8 participants consistently showed preference for the HP stimulus under the concurrent schedule. However, when only the LP stimulus was available during the single-schedule condition, response rates for 6 of the 7 participants were as high as those observed for the HP stimulus during the concurrent-schedule condition (1 participant showed no reinforcement effect). These results indicate that, although the concurrent-schedule procedure is well suited to the assessment of relative reinforcement effects (preference for one reinforcer over another), absolute reinforcement effects associated with a given stimulus may be best examined under single-schedule conditions.

DESCRIPTORS: concurrent schedules, preference, reinforcer assessment

A considerable amount of research has been conducted over the past 15 years on the identification of reinforcers for persons who have severely limited verbal repertoires. These studies have yielded methodologies for assessing preferences when stimuli are presented to individuals in a variety of different formats: singly (Pace, Ivancic, Edwards, Iwata, & Page, 1985), in pairs (Fisher et al., 1992), or in grouped arrays (DeLeon & Iwata, 1996; Roane, Vollmer, Ringdahl, & Marcus, 1998). In this study, we examined reinforcement effects observed with stimuli selected on the basis of results from single-stimulus (SS) and paired-stimulus (PS) preference assessments.

Pace et al. (1985) described a procedure in which stimuli were presented one at a time to participants (SS method), while an observer recorded whether the participant approached the stimulus. Subsequently, test conditions were conducted to determine the validity of the assessment results. Stimuli approached during a high (80% or more) and a low (50% or fewer) percentage of trials were delivered as consequences for various target responses. Results showed that those stimuli that had been approached frequently

This research was supported in part by a grant from the Florida Department of Children and Families. We thank Gregory Hanley, Jana Lindberg, and April Worsdell, who assisted in conducting the research, and Gerald Goff for his administrative support in completing portions of the research. SungWoo Kahng is now at the Kennedy Krieger Institute, Johns Hopkins University School of Medicine.

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during the assessment were more likely to function as reinforcers than were stimuli that had been approached infrequently.

Although it was not observed in the Pace et al. (1985) study, it is possible that the SS method may occasionally yield high percentages of approach responses to most or all of the stimuli. Such results might be indicative of either (a) a high degree of preference for all stimuli or (b) a tendency to approach any available stimulus, regardless of whether that stimulus functions as a reinforcer for another response. If the latter occurs, the SS method may be prone to false positive predictions about reinforcement effects.

Fisher et al. (1992) suggested that clearer differentiation between preferred and nonpreferred stimuli might be obtained when choices are made between two concurrently available stimuli. They described a method for assessing preference that involved presenting stimuli in pairs (PS method) and requiring the individual to select one of the stimuli. They conducted both SS and PS preference assessments with 4 individuals and, based on the results obtained, designated two different types of items: high-preference (HP) stimuli (those ranked high from both assessments) and low-preference (LP) stimuli (those stimuli ranked high from the SS assessment but low from the PS assessment). The reinforcing effects of the HP and LP stimuli were then evaluated in a concurrent-schedule arrangement. Two response options were concurrently available, one resulting in access to the HP stimulus and the other resulting in access to the LP stimulus. Participants allocated more time to the response option associated with the HP stimulus, thus showing preference for the HP stimulus over the LP stimulus. Based on these results, the authors concluded that the PS assessment "better predicted which stimuli would function as more potent reinforcers when a concurrent operants paradigm was used as the criterion" (p. 497).

Results of the Fisher et al. (1992) study indicated that the PS method of preference assessment, due to its tendency to produce more highly differentiated results, may be preferable to the SS method when the goal of assessment is to identify several highly preferred reinforcers. However, although the concurrent arrangement highlighted relative reinforcement effects by showing preference for HP over LP stimuli, it may have masked the absolute reinforcement effects associated with the LP stimuli. In other words, the LP stimuli may have functioned as effective reinforcers in the absence of the HP stimuli, and this information may be important when the goal of assessment is to identify *any* stimuli that might be used as reinforcers.

Brigham and Sherman (1973) illustrated the difference between relative and absolute reinforcement effects in a study on type and immediacy of reinforcement as determinants of children's choices. In the first part of the experiment, participants were exposed to several conditions under multiple schedules of reinforcement, in which two response options were presented singly in an alternating arrangement (i.e., when a red light was illuminated, key presses resulted in access to marbles; when a green light was illuminated, key presses resulted in access to candy). In the second part of the experiment, participants were exposed to the same conditions under concurrent schedules. At any time during a session, participants could switch from the red component (marbles) to the green component (candy) or vice versa. Under the multiple schedule, high rates of responding were observed for both the red and green components. However, when the same contingencies were implemented in a concurrent schedule, participants allocated responding exclusively to the red component (i.e., they did not switch to the green component).

In a more recent investigation, Graff and Libby (1999) used both single and concurrent schedules to evaluate the effects of two conditions in which participants selected a reinforcer either prior to a session (presession choice) or during a session (within-session choice). Results indicated that, when both presession and within-session response options were concurrently available, participants allocated most responses to the option that produced access to within-session choice, and the authors concluded that the within-session choice condition "enhanced performance relative to presession choice" (p. 169). However, when presession and within-session choice were presented singly (in alternating sessions), 3 of the 4 participants exhibited nearly equal rates of responding for both types of choices. Thus, an alternative interpretation is that the reinforcing effects of presession choice were masked under the concurrent-schedule arrangement.

Although the primary purpose of both the Brigham and Sherman (1973) and Graff and Libby (1999) studies was not a direct comparison of relative and absolute reinforcement effects, their results suggested that the reinforcing efficacy of one stimulus may be masked in the presence of another, more preferred stimulus. If so, the use of concurrent schedules to identify highly preferred reinforcers may not identify those stimuli that function as adequate reinforcers, resulting in some false negative predictions. We examined this possibility through a systematic replication and extension of both the Pace et al. (1985) and the Fisher et al. (1992) studies, in which the reinforcing effects of stimuli were evaluated under both concurrent and single schedules of reinforcement.

PHASE 1: STIMULUS PREFERENCE ASSESSMENT

The purpose of Phase 1 was to identify participants' preferences for edible reinforcers using two assessment methods. One procedure involved presenting stimuli singly; the other involved presenting stimuli in pairs.

Method

Participants and Setting

Eight individuals with mental retardation, all living in a state residential facility for persons with developmental disabilities, participated. They were selected for participation because they had multiple behavioral deficits, and it was determined that they might benefit from reinforcer assessments. Jim was a 34-year-old man with profound mental retardation. He was ambulatory, followed instructions, and had some functional speech. Ellen was a 25-year-old woman with moderate mental retardation and autism. She was ambulatory, followed simple instructions, and had some functional speech. Mark was a 37-year-old man with profound mental retardation and a seizure disorder. He was ambulatory, followed simple instructions, and communicated through simple gestures. Roger was a 41-year-old man with profound mental retardation. He was ambulatory, followed simple instructions, and communicated through a limited number of signs and gestures. Sean was a 28-year-old man with mild mental retardation and autism. He was ambulatory, followed a variety of instructions, and had some functional speech. Peter was a 45-year-old man with moderate mental retardation and autism. He was ambulatory, followed a variety of instructions, and had some functional speech. Matt was a 55-year-old man with profound mental retardation. He was ambulatory and followed a few simple instructions, but he had no expressive language skills. Mike was a 63-year-old man with moderate mental retardation. He was ambulatory and had well-developed receptive and expressive language skills. Seven of the 8 participants (Jim, Ellen, Roger,

Sean, Peter, Matt, and Mike) also engaged in one or more problem behaviors (aggression, self-injury, or property destruction) that were treated in contexts other than the present study. These behaviors did not seem to interfere with their performance during any of the experimental conditions.

Sessions were conducted in either a therapy room at a day-treatment program (for individuals with behavior problems) or in a quiet room at the participant's home. Each room contained a table, chairs, and other materials needed to conduct various sessions (see below for additional details). Sessions were conducted two to four times per day, 4 to 5 days per week, based on participants' availability.

Procedure

Prior to both assessments, a variety of foods and snacks were selected for inclusion based on informal reports about participants' diets and food preferences, and on item availability. Participants were allowed to consume each of the edible items to insure familiarity with all of the stimuli to be assessed. The SS assessment method was always implemented first, followed by the PS method. Throughout both phases of the study, potential establishing-operation effects (deprivation) were controlled by conducting experimental sessions at approximately the same time each day (i.e., about an hour following meals). In addition, the items used during the assessments were not delivered as reinforcers to participants in other training or treatment programs, and participants were not observed or reported to consume these items outside experimental sessions.

Single-stimulus method. Preference for 10 food items was assessed using procedures described by Pace et al. (1985). All items were presented 10 times each over the course of five sessions. During a given session, four stimuli were presented five times each in a counterbalanced order. On each trial, one stimulus was placed on a plate approximately 0.7 m in front of the participant. If the participant emitted an approach response, either touching or picking up the stimulus, he or she was permitted to consume the item. If a participant did not make a response within 5 s, the experimenter prompted the participant to pick up and consume the item, and then repeated the trial. If the participant did not approach the item when the trial was repeated, the experimenter removed the item and initiated a new trial.

Paired-stimulus method. The same 10 items presented during the SS method were also assessed using PS presentation based on procedures described by Fisher et al. (1992). Each stimulus was paired once with every other stimulus, with the order of presentation determined randomly. On each trial, two food items were placed on separate plates next to each other and approximately 0.7 m in front of the participant. An approach response to one stimulus produced access to that stimulus and the other stimulus was removed. Attempts to approach both stimuli simultaneously were blocked. If neither stimulus was approached within 5 s, the experimenter prompted the participant to pick up and consume each item, and then repeated the trial. If the participant did not approach either item when the trial was repeated, the experimenter removed both items and initiated a new trial.

Response Measurement and Reliability

Trained observers recorded whether an approach response occurred to the stimulus presented on each trial (SS method) or which of the two concurrently available items was approached on each trial (PS method). A second observer collected data independently on an average of 65% of the trials. In comparing observers' records, an agreement was defined as both observers having recorded the same selection or no selection for each trial. Interobserver agree-

ment was calculated by dividing agreements by agreements plus disagreements and multiplying by 100%. The mean percentage agreement across participants was 99.7% (range, 97.8% to 100%).

Results

Results obtained from the two assessments are shown in Figure 1 as percentages of approach responses when stimuli were presented according to the SS method and the PS method. The SS method yielded uniformly high approach percentages for 6 of the 8 participants (Sean, Peter, Mark, Matt, Roger, and Mike), who approached every stimulus on 100% of the trials. The remaining 2 participants, Jim and Ellen, approached 9 of the 10 stimuli and 7 of the 10 stimuli, respectively, on 100% of the trials. By contrast, the PS method yielded greater differentiation because an approach response could occur to only one of the two available stimuli on each trial. All participants showed high levels of approach (75% or higher) for at least one stimulus but low levels of approach (25% or lower) for another stimulus.

PHASE 2: DETERMINATION OF REINFORCEMENT EFFECTS

Predictions based on examination of data from the two assessments independently would suggest that either most (based on SS data) or only some (based on PS data) of the stimuli might function as reinforcers. Rather than test these predictions for every stimulus in Phase 2, we selected for each participant one stimulus for which results of the two assessments seemed most similar and another stimulus for which results seemed most discrepant. A high-preference (HP) stimulus was defined as the stimulus approached most frequently during both assessments. These stimuli consisted of the following items: for Jim (Reese's™ peanut butter cups, 100% approach on both assessments), Ellen (beets, 100% approach on both assessments), Mark (cheese ball, 88.9% PS approach, 100% SS approach), Roger (Snickers™, 88.9% PS approach, 100% SS approach), Sean (Skittles™, 100% approach on both assessments), Peter (Skittles™, 88.9% PS approach, 100% SS approach), Matt (M&Ms™, 77.8% PS approach, 100% SS approach), and Mike (peanut butter crackers, 88.9% PS approach, 100% SS approach). A low-preference (LP) stimulus was defined as the stimulus for which results of the two assessments showed the largest discrepancy. These stimuli consisted of, for Jim (Cheez-its™, 11.1% PS approach, 100% SS approach), Ellen (cookies, 22.2% PS approach, 100% SS approach), Mark (dried cherries, 0% PS approach, 100% SS approach), Roger (chips, 22.2% PS approach, 100% SS approach), Sean (Tootsie Rolls™, 0% PS approach, 100% SS approach), Peter (rice cakes, 0% PS approach, 100% SS approach), Matt (chips, 0% PS approach, 100% SS approach), and Mike (Tootsie Rolls™, 11.1% PS approach, 100% SS approach). Thus, all LP stimuli were approached on fewer than 25% of the PS trials but on 100% of the SS trials.

The purpose of this phase was to evaluate the reinforcing effects of these HP and LP stimuli under conditions in which (a) both stimuli were concurrently available and (b) only the LP stimulus was available.

Method

Participants and Setting

Participants, settings, and session schedules were the same as in Phase 1.

Task and Apparatus

The responses of interest consisted of pressing one or two microswitch panels or printing on one or two pads of paper. The microswitch panels were two different colors (either blue and yellow or green and red)

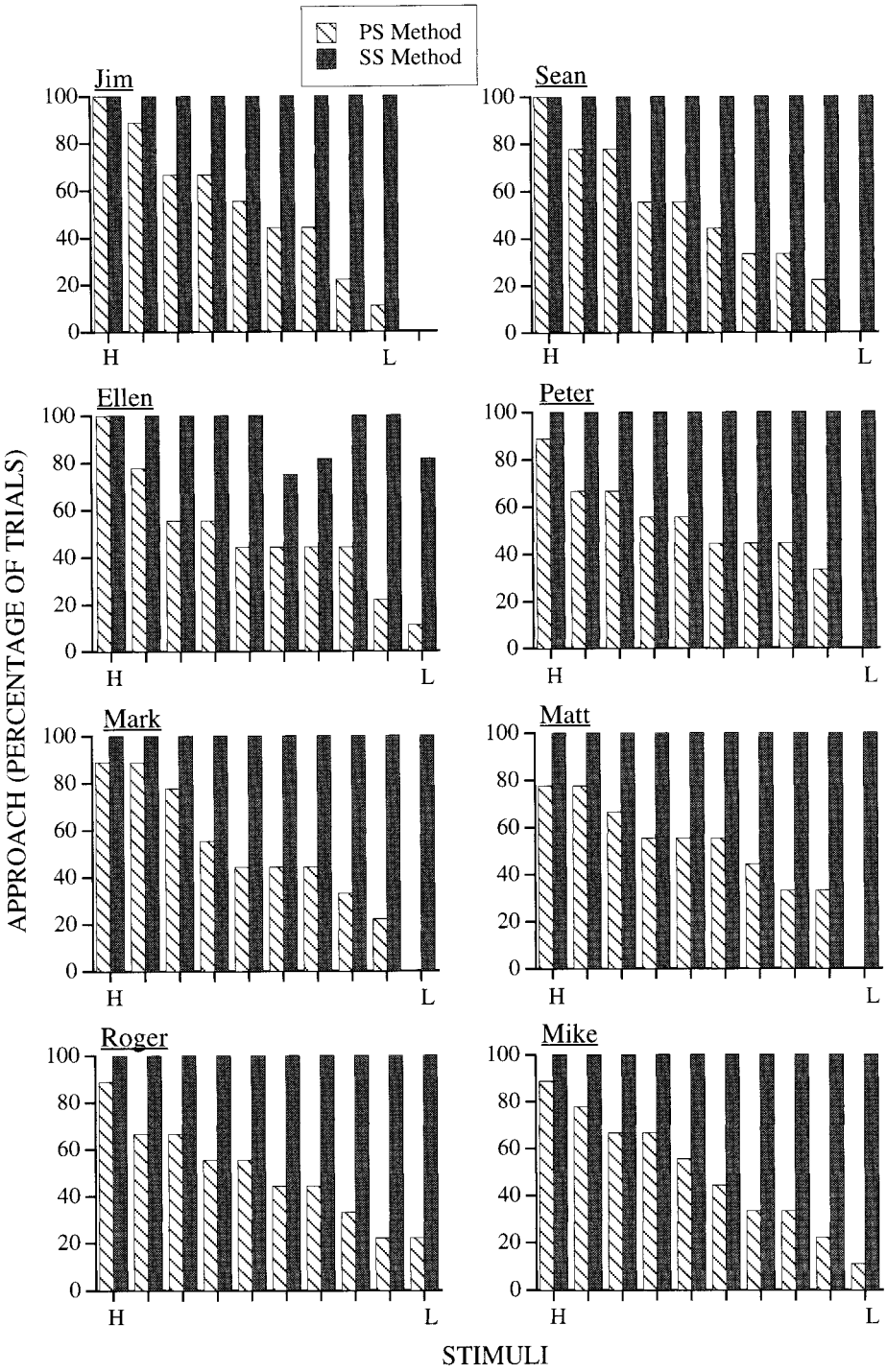

Figure 1. Percentage of trials on which stimuli were approached during preference assessments conducted via SS (single-stimulus) and PS (paired stimulus) presentation methods. Stimuli are arranged from left to right in descending order, based on approach responses during the PS assessment. Stimuli designated H (high preference) and L (low preference) were used in Phase 2 of the study.

and were placed on a table approximately 0.7 m in front of the participant and approximately 4 cm apart from each other. The pads of paper were used only for Ellen because she exhibited high rates of switch pressing at the outset of the study when no consequences were forthcoming. Thus, to increase the response effort necessary to obtain reinforcement, we required Ellen to write the letter E on the pad to obtain the specific item associated with that pad.

Response Measurement and Reliability

An observer recorded the frequency of switch presses or writing using either a handheld computer (Assistant, Model A102) or paper and pencil. A second observer collected data independently during an average of 39.5% of the sessions. In comparing observers' records, agreement percentages were calculated by first dividing session time into 10-s intervals. For each interval, the smaller number of recorded responses was divided by the larger number; these fractions were averaged across the session and multiplied by 100% to yield the percentage of agreement between the two observers. Mean interobserver agreement for pressing (writing) on the HP panel (pad) was 94.7% (range, 88.6% to 100%). Mean interobserver agreement for pressing (writing) on the LP panel (pad) was 95.3% (range, 88.3% to 99.8%). Interobserver agreement percentages on rate of reinforcer delivery were also calculated for 5 of the 8 participants. Mean interobserver agreement for HP item delivery was 91.8% (range, 80.3% to 100%). Mean interobserver agreement for LP item delivery was 94.2% (range, 86% to 100%).

Pretraining

Sessions were conducted prior to baseline to establish panel pressing (or letter writing) in participants' repertoires and to expose them to the consequences for responding on each of the two different colored panels (pads). Ten trials were conducted during each session. Training was implemented in three phases, and the criterion for moving from one phase to the next phase was 90% correct responding for three consecutive sessions. During the first phase, a plate containing the HP item was placed directly behind one of the panels (pads). The other panel (pad) had nothing behind it. The experimenter randomly alternated the food item behind the two different panels (pads) across trials to insure that the individual correctly pressed the panel (or wrote on the pad) associated with the food item and did not show a position preference, and provided vocal and gestural response prompts as needed. If the individual pressed the panel with enough force to illuminate the light or to make a clicking sound, or if the participant wrote an entire letter E on the pad, the experimenter delivered the reinforcer. If the individual did not press the panel, did not press it with enough force, pressed the incorrect panel, or did not write a complete letter E on the correct pad, the experimenter physically guided the participant to exhibit the correct response and then began the next trial. During Phase 2, the response prompts were faded and then eliminated. During Phase 3, sessions were conducted with the HP item behind one of the colored panels (pads) and the LP item behind the other panel (pad). Because incorrect responding was not possible during Phase 3, there were no specific criteria for completion of this phase, and the phase was terminated after five sessions. The purpose of this last phase was to familiarize the participant with the specific contingencies associated with the two different panels (pads).

Concurrent-Schedule Baseline

Throughout this and all subsequent conditions, sessions lasted for 10 min. During this condition, two different colored panels (pads) were placed in front of the partici-

pant. There were no food items behind the panels (pads), and responding on either panel (pad) produced no consequences. Attempts to press both panels simultaneously were blocked.

Concurrent-Schedule Reinforcement

As in the previous condition, both of the panels (pads) were placed in front of the individual. A plate containing the HP item was located behind one of the panels (pads), and a plate containing the LP item was located behind the other panel (pad). Responses on the panel (pad) that had the HP item behind it resulted in access to the HP item, whereas responses on the panel (pad) with the LP item behind it resulted in access to the LP item. All responses were reinforced on a fixed-ratio (FR) 1 schedule. Attempts to press both panels simultaneously were blocked.

Single-Schedule Baseline

At the beginning of each session, the panel (pad) associated with the LP item in the previous condition was placed in front of the participant. The other panel (pad) was either hidden from view by a cardboard box or was not present. There were no items behind the panel (pad), and responding on the available panel (pad) did not produce any consequences.

Single-Schedule Reinforcement

During this condition, the same panel (pad) available during the single-schedule baseline was placed in front of the participant. A plate with the LP item was located behind the available panel (pad). Responses on the panel (pad) produced access to the LP item on an FR 1 schedule.

Experimental Design

The effects of reinforcement on free-operant responding were examined in reversal designs. Following the pretraining phase, participants were exposed first to the concurrent-schedule baseline and reinforcement conditions and later to the single-schedule baseline and reinforcement conditions. This sequence was use to minimize potential bias toward the LP stimuli. That is, if participants were exposed first to the single-schedule (LP) condition and a reinforcement effect was observed, it is possible that a history of responding for the LP stimulus might produce a carryover effect during a subsequent condition in which the LP and HP stimuli were available concurrently. By presenting the concurrent condition first (and assuming that participants showed preference for the HP stimuli during this condition), historical effects associated with the LP stimuli would be minimized and, if any carryover effect were to occur, it would result in lower response rates during the LP reinforcement condition. This sequence introduced potential bias against the LP condition but was selected as a conservative approach to the assessment of LP reinforcement effects.

Results

Results obtained for Jim, Ellen, Mark, and Roger, expressed as responses per minute, are shown in Figure 2. Response rates for these 4 participants were consistently low during the initial concurrent baseline, when no consequences were provided for responding on either of the two switch panels or pads of paper. During the concurrent-reinforcement condition, these participants showed almost exclusive preference for the panel (pad) associated with the HP stimulus. Responding decreased again during the single-schedule baseline, when no consequences were provided for responding on the panel (pad) previously associated with the LP stimulus. During the final condition, in which responding produced access only to the LP stimulus, response rates for 3 of the 4 participants (Jim, Ellen, and Roger) were simi-

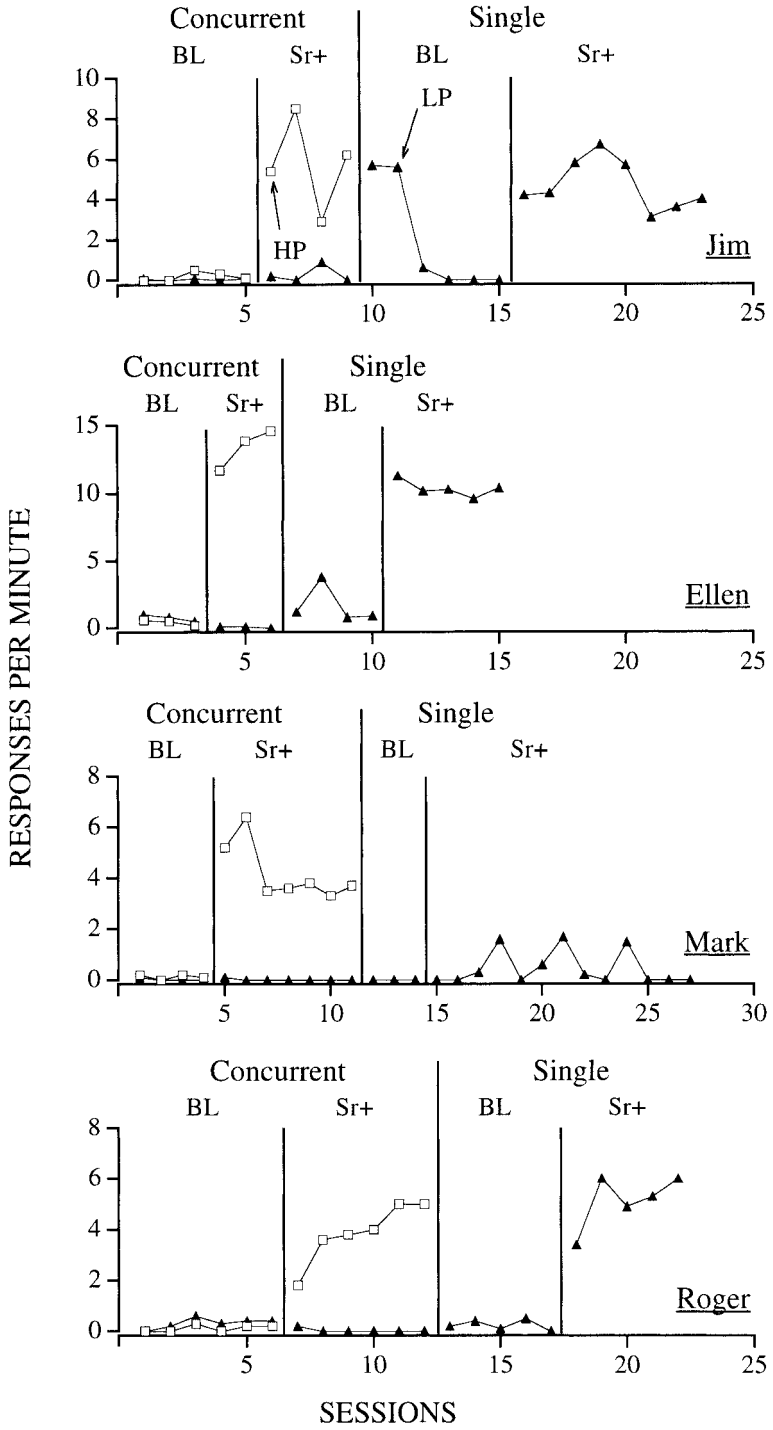

Figure 2. Responses per minute during concurrent-schedule and single-schedule conditions (baseline and reinforcement) for Jim, Ellen, Mark, and Roger.

lar to those observed during the previous concurrent-reinforcement condition. Mark was the exception: His response rates during the single-schedule condition were much lower than they were during the concurrent condition and eventually reached zero.

Results obtained for Sean, Peter, Matt, and Mike are shown in Figure 3. Following the concurrent-schedule baseline, during which responding on both panels was low, Peter and Matt showed consistent preference for the HP stimulus during the concurrent-reinforcement condition. Sean also showed preference for the HP stimulus at the beginning and at the end of this condition; midway through the condition, however, his responding on the panel associated with the LP stimulus increased temporarily. Following a return to baseline, during which Sean's, Peter's, and Matt's responses on the panel previously associated with the LP stimulus occurred at very low rates, their response rates for the LP stimulus during the single-schedule reinforcement condition either matched (Sean and Matt) or exceeded (Peter) those previously observed for the HP stimulus. Mike's results differed considerably from those obtained for all other participants. When exposed to the first (concurrent-schedule) reinforcement condition, Mike showed no preference for the HP stimulus. Instead, his responding alternated such that response rates under both options were generally similar: During 4 of the 10 sessions in this condition, Mike chose the LP stimulus more often than he chose the HP stimulus. His increase in responding for the LP stimulus during the concurrent-schedule reinforcement condition seemed to indicate a reinforcement effect for the LP stimulus; therefore, Mike was not exposed to the single-schedule conditions.

GENERAL DISCUSSION

In Phase 1 of this study, preference for a variety of edible items was assessed using two methods of stimulus presentation. When participants were given the option of approaching or not approaching stimuli presented singly (SS method), they generally approached all stimuli most or all of the time. By contrast, when participants had the option of selecting one stimulus from a concurrently presented pair (PS method), their selections favored some stimuli over others and resulted in a more varied distribution. In Phase 2, we examined the reinforcing effects of stimuli assessed in Phase 1. For each participant, one stimulus was designated as HP because it was approached frequently when presented under both the SS and PS methods; another stimulus was designated as LP because it was approached frequently (or always) under the SS method but infrequently or not at all under the PS method. When the HP and LP stimuli were available on concurrent FR 1 schedules of reinforcement, 7 of the 8 participants showed preference for the HP stimulus (Mike showed no preference). When these 7 participants were later exposed to a condition in which only the LP stimulus was available on a single FR 1 schedule, 6 of them exhibited response rates similar to those observed under the previous concurrent schedule (Mark showed no reinforcement effect for the LP stimulus). These results extend and clarify findings previously reported by Fisher et al. (1992) and suggest different strategies for identifying reinforcers depending on the goal of assessment.

In the Fisher et al. (1992) study, all 4 participants showed preference for HP over LP stimuli when both were available under concurrent schedules. We replicated these results with 7 of the 8 participants, 6 of whom (Jim, Ellen, Mark, Roger, Peter, and Matt) showed almost exclusive preference for the HP stimulus. These results are consistent with a large body of basic research indicating that concurrent schedules are highly sensitive as measures of preference (see Fisher & Ma-

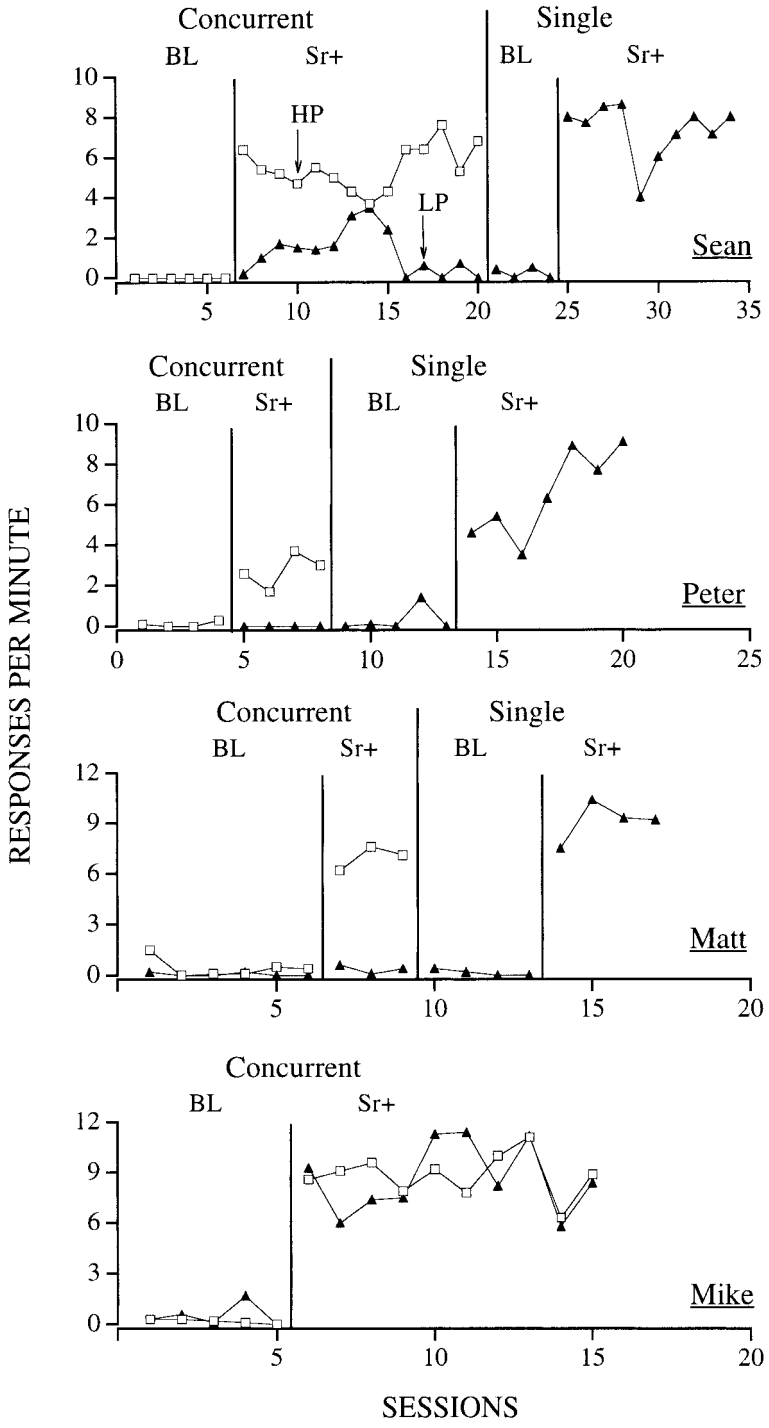

Figure 3. Responses per minute during concurrent-schedule and single-schedule conditions (baseline and reinforcement) for Sean, Peter, Matt, and Mike.

zur, 1997, for a recent discussion of the advantages of concurrent schedules). However, 1 of our participants, Mike, showed no preference when HP and LP stimuli were concurrently available during the reinforcer assessment, even though he rarely selected the LP stimulus during the PS preference assessment. Although his results were clearly different than those obtained for other participants, they suggest that preferences may not always emerge even under concurrent schedules.

Because participants in the Fisher et al. (1992) study were not exposed to conditions in which only the LP stimuli were used as consequences, conclusions about the reinforcing efficacy of LP stimuli per se could not be drawn. To evaluate the absolute reinforcing effects of LP stimuli, we exposed 7 participants (those who showed preference for HP stimuli under concurrent schedules) to an arrangement in which responses produced access only to LP stimuli and observed rates of responding in 6 of the participants that were similar to those observed for HP stimuli under concurrent schedules. In other words, although LP stimuli did not compete with HP stimuli when both were available (concurrent arrangement), the LP stimuli produced similar results in the absence of HP stimuli (single arrangement). This finding was most clearly illustrated in the data for Sean, Peter, and Matt. Their response rates for LP stimuli under the single-schedule arrangement were as high as or higher than their response rates for HP stimuli under the concurrent-schedule arrangement (see Figure 2), even though they never selected the LP stimuli during the PS preference assessment (see Figure 1). It is highly unlikely that the LP stimuli would have been selected as potential reinforcers for these individuals given the results of their PS assessments. One participant, Mark, rarely engaged in switch pressing when the LP stimulus was available under the single-schedule arrangement. Thus, results of his SS assessment produced at least one false positive: the item selected as the LP stimulus. Unfortunately, it is unclear whether other stimuli ranked high from his SS assessment but low from his PS assessment would have functioned as reinforcers because only the stimulus with the most discrepant rankings was tested.

Results obtained in this study indicate that the outcomes of reinforcer identification procedures can be affected by both the methods used to initially identify stimuli and by the methods used to evaluate their reinforcement effects. The PS method of assessment yielded distinct rankings among stimuli based on actual preferences (i.e., comparisons between pairs of stimuli). Subsequently, results under the concurrent-schedule arrangement showed that stimuli frequently selected during the PS assessment (HP stimuli) were preferred to stimuli rarely selected during the PS assessment (Mike was the exception). That is, results from the concurrent-schedule condition generally verified preferences already shown during PS assessments with a different response. Thus, concurrent-choice arrangements may be an ideal method for identifying which of several potential reinforcers might be the most preferred. However, because such arrangements are insensitive to absolute reinforcement effects associated with the less preferred stimulus, they are prone to false negative predictions by excluding some stimuli that may function as reinforcers.

By contrast, the SS method yielded high percentages of approach by most participants to most stimuli, and results obtained under the single-schedule arrangement indicated that these stimuli functioned as reinforcers (Mark was the exception). Thus, the SS method combined with the single-schedule condition seemed best suited to the identification of any reinforcement effect, which may be helpful if an individual's se-

lective approach behavior (e.g., bias) results in a restricted number of potential reinforcers. That is, the SS method and single-operant assessment may be helpful in identifying reinforcers for individuals who, for a variety of reasons, have few high-preference stimuli. The SS method and single-schedule assessment may also be helpful in establishing a larger pool of reinforcers, which may be varied to help prevent satiation during the implementation of reinforcement-based training or treatment programs. Occasionally, however, the SS method may yield false positive predictions by including some stimuli that do not function as reinforcers even though they are approached often. Also, as demonstrated in this study and by Fisher et al. (1992), knowing that a stimulus functions as a reinforcer provides no information about its efficacy relative to other reinforcers.

The present results also suggest that reinforcer *preference* and reinforcer *potency* are not always synonymous. Data indicated that the PS method yielded a better index of preference than did the SS method, as evidenced by the more varied distribution of rankings obtained with the PS method. These results were confirmed subsequently when HP and LP stimuli were available under the concurrent-schedule arrangement. However, the LP stimuli under the single-schedule arrangement maintained response rates as high as those maintained by the HP stimuli under the concurrent arrangement, suggesting that the LP stimuli were about as potent as the HP stimuli with respect to their reinforcement effects. These effects, however, were limited to the conditions of the present study. Additional requirements for responding, such as those imposed by manipulations of either response effort (e.g., Cuvo, Lerch, Leurquin, Gaffaney, & Poppen, 1998) or reinforcement schedules (DeLeon, Iwata, Goh, & Worsdell, 1997), may differentially affect both choice (preference) and the ability of a reinforcer to maintain performance (potency).

Finally, results obtained in this study, as well as those recently reported by Roane et al. (1998), who evaluated a free-operant, multiple-stimulus presentation method, suggest that a variety of objectives may be achieved by using methods that are best designed to answer particular questions (e.g., How might one identify many reinforcers? How might one identify the most preferred reinforcer? How might one do either in the minimum amount of time?). A separate question entirely is how to maximize the effectiveness of one or more given reinforcers under everyday conditions. To do so may require additional procedures such as reinforcer deprivation (Vollmer & Iwata, 1991) or variation (Egel, 1981), choice options available at every reinforcement opportunity (Fisher, Thompson, Piazza, Crosland, & Gotjen, 1997), or the use of reinforcement schedules that are likely to be implemented during treatment (DeLeon et al., 1997). Thus, by selectively combining technologies for reinforcer identification with those designed to maximize effective reinforcer usage, behavior change under a given set of conditions may be more readily achieved.

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Received March 23, 1999
Final acceptance August 15, 1999
Action Editor, Joseph E. Spradlin

STUDY QUESTIONS

1. What are meant by the terms *false positive* and *false negative* when used in reference to the outcomes of preference assessments?

2. What factors might account for uniformly high approach responses across stimuli that are presented singly during a preference assessment? Also, although not discussed by the authors, what factors might account for roughly equivalent approach responses across stimuli that are presented in pairs?

3. Why might two-choice concurrent schedules mask the reinforcing effects of one of the stimuli?

4. Describe the similarities and differences between the single-stimulus (SS) and paired-stimulus (PS) methods of stimulus presentation.

5. What general patterns of responding were observed during the SS and PS assessments, and how were the individual data used to select high-preference (HP) and low-preference (LP) stimuli?

6. Describe the procedures used to evaluate the reinforcing effects of the HP and LP stimuli, and summarize the results that were obtained.

7. Based on the results of the reinforcer test conducted in Phase 2, what can be concluded about the predictive validity of the SS and PS preference assessment methods?

8. For what purposes do the SS and PS methods seem most well suited?

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