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ASSESSING POTENCY OF HIGH- AND LOW-PREFERENCE REINFORCERS WITH RESPECT TO RESPONSE RATE AND RESPONSE PATTERNS

BECKY PENROD, MICHELE D. WALLACE, AND EDWIN J. DYER

UNIVERSITY OF NEVADA, RENO

Previous research has suggested that the availability of high-preference stimuli may override the reinforcing efficacy of concurrently available low-preference stimuli under relatively low schedule requirements (e.g., fixed-ratio 1 schedule). It is unknown if similar effects would be obtained under higher schedule requirements. Thus, the current study compared high-preference and low-preference reinforcers under progressively increasing schedule requirements. Results for 3 of the 4 participants indicated that high-preference stimuli maintained responding under higher schedule requirements relative to low-preference stimuli. For 1 participant, high-preference and low-preference stimuli were demonstrated to be equally effective reinforcers under increasing schedule requirements. Implications with respect to rate of performance and response patterns are discussed.

DESCRIPTORS: positive reinforcement, preference assessments, progressive ratio, response effort

A number of researchers have examined methods for assessing stimulus preferences and deciding the degree to which such preferences are predictive of the reinforcing effects of those stimuli (see Cannella, O'Reilly, & Lancioni, 2005, for a review). Various preference assessment methods differ in terms of the manner in which the stimuli are presented, with stimuli presented individually (Pace, Ivancic, Edwards, Iwata, & Page, 1985) or in pairs (Fisher et al., 1992), or with multiple stimuli presented concurrently (DeLeon & Iwata, 1996; Roane, Vollmer, Ringdahl, & Marcus, 1998; Windsor, Piche, & Locke, 1994). In general, preference assessments produce a relative ranking of stimulus preferences that is based on the relative amount of time with which the stimuli were manipulated or the number of times one stimulus was chosen relative to other stimuli. An implication of such rankings is that stimuli that are more highly preferred (e.g., chosen on 80% of presentations) are more effective reinforcers than those that are identified as less preferred (e.g., chosen less than 20% of presentations).

Although stimuli identified as highly preferred (HP) have been shown to be more effective reinforcers when compared to those that are less preferred (LP; e.g., Fisher et al., 1992; Roane et al., 1998), recent investigations have evaluated the reinforcing efficacy of LP stimuli in the absence of HP stimuli more closely. Roscoe, Iwata, and Kahng (1999) evaluated the reinforcing effectiveness of HP and LP stimuli identified through two preference assessments (based on the methods described by Pace et al., 1985, and Fisher et al.). The relative reinforcing effects of HP and LP stimuli were evaluated in both single- and concurrent-operants arrangements. In the single-operant arrangement only the LP stimulus was available, whereas the HP and LP stimuli were available simultaneously in the concurrent-operants arrangement. Results indicated that LP stimuli were not as effective as HP stimuli when both were available (i.e., concurrent-operants arrangement). However, when LP stimuli were evaluated in a single-operant arrangement, these stimuli produced increases in responding that

Address correspondence to Michele D. Wallace, California State University, Los Angeles, Charter College of Education, Division of Special Education and Counseling, KH C1064, Los Angeles, California 90032 (e-mail: mdenicew@yahoo.com).

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were similar to levels observed with HP stimuli in the concurrent arrangement. That is, when evaluated in a single-operant paradigm, the LP stimuli were as effective as HP stimuli in terms of reinforcement efficacy, which suggested that the concurrent availability of the HP stimuli masked the potential reinforcement effects associated with LP stimuli.

It should be noted that in the Roscoe et al. (1999) investigation the reinforcing effects of the LP stimuli were assessed using a fixed-ratio (FR) 1 schedule of reinforcement only. Thus, it is unknown whether LP stimuli would function as effective reinforcers under increasing schedule requirements. Previous research has shown that two reinforcers may produce similar levels of responding under low schedule requirements but different levels of responding as schedule requirements increase (DeLeon, Iwata, Goh, & Worsdell, 1997; Roane, Lerman, & Vorndran, 2001; Tustin, 1994). For example, Tustin evaluated preference for attention and combined visual and auditory stimulation under various schedule requirements in a single-operant arrangement. Response rates were similar when reinforcement was delivered continuously (i.e., on an FR 1 schedule); however, when schedule requirements increased (e.g., FR 10), one stimulus was associated with higher levels of responding. Similar results were obtained by DeLeon et al., who showed that when two edible stimuli were concurrently available, a greater preference for one item over the other was observed as the schedule requirements increased.

Roane et al. (2001) evaluated variations in preference between two reinforcers under increasing schedule requirements by assessing two highly ranked stimuli under progressive-ratio (PR) schedules. In a PR schedule, response requirements increase within the course of a single session, thus allowing for a relatively rapid evaluation of reinforcing efficacy under increasing response requirements. Within PR schedules, relative reinforcement effects are identified by comparing the obtained break point for each stimulus (i.e., the last schedule requirement completed; Hodos, 1961). Using stimuli that were preferred similarly based on the results of a preference assessment (Fisher et al., 1992), Roane et al. showed that one stimulus was associated with greater response persistence than the other under increasing schedule requirements for all participants. These findings suggested that although two reinforcers may be equally effective when assessed under low schedule requirements (e.g., FR 1), they may not be equally effective when assessed under increasing schedule requirements.

Given the results of previous research, which suggests that HP and LP stimuli may be equal in terms of reinforcer efficacy when delivered under dense schedules (e.g., FR 1; Roscoe et al., 1999) and the finding that two stimuli may be associated with different response outputs under increasing schedule requirements (e.g., DeLeon et al., 1997; Roane et al., 2001; Tustin, 1994), the purpose of the current study was to determine the extent to which LP stimuli would function as reinforcers under increasing schedule requirements.

METHOD

Participants and Setting

Four children participated in this study. Sam was a 5-year-old boy who had been diagnosed with autism, Cedar was a 5-year-old girl who had been diagnosed with autism, Elliot was an 8-year-old boy who had been diagnosed with Asperger disorder, and Aden was a 5-year-old boy who had been diagnosed with attention deficit hyperactivity disorder. All sessions were conducted in a room (3.7 m by 4.6 m) that contained a table, chairs, and other materials that varied depending on the experimental condition in effect (described below).

Response Measurement and Interobserver Agreement

The target response for each participant was chosen based on their individual skill deficits.

Two different responses were chosen for each participant to evaluate the reinforcing efficacy of the LP or HP stimuli. The target response for Sam was visually tracking a moving object (i.e., a circular blue card in the HP condition or a triangular green card in the LP condition). This response was defined as Sam's hand touching any part of the card after the experimenter changed its location. The target response for Cedar consisted of picking up either one red bean (HP condition) or one kidney bean (LP condition) with her thumb and index finger and placing the bean into a small hole (approximately the size of a dime) cut into the top of a container. For Elliot the target response consisted of picking up either one kidney bean (HP condition) or one red bean (LP condition) with a pair of tweezers, using his thumb and index finger as if holding a pencil, and placing the bean into a plastic container. Aden's target response was tracing either the first (HP condition) or the second half (LP condition) of the alphabet by moving a pencil along the dotted lines of each letter, such that when he was finished, the traced letter correctly resembled the appropriate form of the letter. Sam, Cedar, and Elliot had no history with the responses that we selected. Consequently, these 3 participants received preexperimental training using either a least-to-most prompting hierarchy (Sam and Elliot) or stimulus fading (Cedar). Aden had practiced tracing the alphabet in his regular schooling and demonstrated similar precision with the first and second halves of the alphabet during preexperimental observations.

In addition to the abovementioned responses, data also were collected on reinforcer delivery, which was defined as the experimenter placing an edible reinforcer directly in front of the participant (Elliot, Cedar, and Aden) or directly into the participant's mouth (Sam).

Handheld computers equipped with Observe software were used to collect data on the frequency of the target responses and reinforcer delivery. Interobserver agreement was calculated using a block-by-block method. Specifically, the number of 10-s intervals during which observers disagreed (on the occurrence or nonoccurrence of the response) was subtracted from the total number of intervals. For each of the disagreement intervals, the smaller frequency count within the interval was divided by the larger frequency count within the interval to yield a partial agreement measure for each interval. These values then were added to the number of intervals during which the observers agreed. This number was divided by the total number of intervals in each session and multiplied by 100% to yield a percentage of agreement.

A second observer simultaneously but independently collected data during 50% of all sessions. Mean interobserver agreement for target responses was 94% for Sam (range, 82% to 100%), 95% for Cedar (range, 88% to 100%), 95% for Aden (range, 78% to 100%), and 94% for Elliot (range, 83% to 100%). Mean agreement for reinforcer delivery was 91% for Sam (range, 76% to 100%), 97% for Cedar (range, 88% to 100%), 94% for Aden (range, 85% to 100%), and 94% for Elliot (range, 77% to 100%).

Preference Assessment

Two preference assessments were conducted to determine each participant's preference for 10 food items. Before conducting the preference assessments, each food item was sampled by the participants. For all participants, the preference assessments were conducted in a specific order (described below), and all preference assessments were conducted at least 2 hr before or after meals. Foods assessed during the preference assessments were available to the participants only during the experimental sessions.

Single-stimulus method. For the single-stimulus (SS) preference assessment, the procedures described by Pace et al. (1985) were followed in which each item was presented singly, 10 times each, in a counterbalanced order over the course of five sessions. The stimulus was placed on a

plate approximately 0.7 m in front of the participant. If the participant reached for the item, he or she was allowed to consume the item. If 5 s elapsed without the participant reaching for the item, the experimenter prompted the participant to pick up the food and consume it. The trial was then repeated. If again there was no response, the experimenter removed the item and presented the next food. The SS assessment was conducted first for all participants.

Paired-choice method. A paired-choice (PC) preference assessment also was conducted for each participant following the procedures described by Fisher et al. (1992). During this assessment, each of the same 10 foods used in the SS assessment was paired once with every other food in a counterbalanced order. Specifically, two food items were placed on separate plates next to each other approximately 0.7 m in front of the participant. The participant was allowed access to whichever food he or she reached for, and the food that was not selected was removed. Attempts to reach for both foods at once were blocked, and the plates were withdrawn briefly and re-presented. If the participant did not reach for either food, the experimenter prompted the participant to sample both items, and the trial was repeated. If again the participant did not reach for either food, the experimenter removed both items and presented the next set of foods.

Based on the results of the preference assessments, HP and LP stimuli were identified for each participant. The HP stimulus was the food item approached most frequently during both assessments. Specifically, stimuli chosen between 80% and 100% of trials during both the SS and PC assessments were identified as the HP items. The LP stimuli were those items for which there was the largest difference between the two assessments. Specifically, stimuli chosen between 80% and 100% of trials during the SS assessment but less than 40% of trials during the PC assessment were selected as LP items.

Reinforcer Assessment

Baseline. During baseline, materials needed for engaging in the response in either the HP or the LP condition, depending on which condition followed, were placed in front of the participant, and there were no programmed consequences for the emission of the target response. Throughout this and all subsequent conditions, the therapist told Aden that he could respond if he wanted to but that he did not have to respond. Sam, Cedar, and Elliot did not receive any verbal prompts throughout the study. All baseline sessions were 10 min in duration, and two to four sessions were conducted per day.

FR 1 conditions. During the FR 1/HP condition, the therapist delivered the HP item to the participant on an FR 1 schedule following the emission of the target response. The FR 1/LP condition was identical to the FR 1/HP condition, with the exception that the therapist delivered the LP item to the participant following each response emitted on an FR 1 schedule. All FR 1 sessions were 10 min in duration. During the FR 1 conditions, two to four sessions were conducted daily.

PR conditions. During the PR-HP condition, the therapist delivered the HP item following the completion of a progressively increasing response requirement. Specifically, the therapist implemented a PR schedule based on the procedures described by Roane et al. (2001) in which the therapist delivered the HP item on an FR 1 schedule, which then increased to FR 2, and then to FR 3, and continued in this fashion until no responding occurred for 3 min in any given session. The therapist conducted two trials for each schedule requirement to prevent rapid ratio strain (as described by Roane et al.).

The PR-LP condition was identical to the PR-HP condition, with the exception that the therapist presented the LP item rather than the HP item contingent on responding using a PR schedule. The same PR schedule was in effect for both the HP and LP stimuli.

Based on the 3-min termination criterion, the duration of sessions during the PR conditions varied as a function of response persistence. There was no limit imposed on the duration of each session; however, no session continued for more than 1 hr for any participant. Across participants, the mean session durations were 24 min and 17 min during the PR-HP condition and PR-LP condition, respectively. Based on time constraints, one PR session was conducted per day for each participant.

Experimental Design

The experimental conditions described above were arranged in a multiple baseline design across participants. The HP and LP conditions were introduced in a counterbalanced order across participants. That is, 2 participants were exposed to the HP conditions first followed by the LP conditions, and the other 2 participants were exposed to the LP conditions followed by the HP conditions.

Data Analysis

The relative reinforcement effects of HP and LP stimuli were evaluated by comparing response rates associated with each stimulus across conditions and the average break point associated with each stimulus under the PR schedules. A response rate for each session was determined by dividing the total number of responses by the session duration (in minutes) to yield the number of responses per minute. Based on differences between the types of schedules in effect, the response rates in the two FR conditions and those obtained in the two PR conditions were compared separately. During the PR conditions, the average break point for each stimulus was determined by adding the obtained break points (i.e., the last schedule requirement completed) across sessions for the HP and LP items independently and then dividing this value by the total number of sessions. In addition, cumulative records were generated to determine if different patterns of responding were associated with HP and LP stimuli. The cumulative number of responses across the PR-HP and PR-LP conditions was determined by adding the total number of responses from the first session to the total number of responses from the second session and so on.

RESULTS

Preference Assessments

Results from the preference assessments are depicted in Figure 1. HP stimuli (i.e., stimuli chosen frequently during both assessments) were peanut butter balls for Sam, cheese crackers for Cedar, rice crispy treats for Elliot, and chocolate chip cookies for Aden. LP stimuli (i.e., stimuli chosen frequently during the SS preference assessment but rarely during the PC preference assessment) were pretzels for Sam, licorice for Cedar, cheese crackers for Elliot, and raisins for Aden.

Reinforcer Assessment

Figure 2 depicts the results of the reinforcer assessments. During baseline, Sam rarely engaged in the target response ($M = 0.4$ responses per minute). During the FR 1/LP and the FR 1/HP conditions, rates of responding increased relative to baseline. Rates of responding were slightly higher in the FR 1/LP condition ($M = 5.0$) than in the FR 1/HP condition ($M = 3.1$). During the PR-LP condition, rates of responding were lower ($M = 1.9$) than during the PR-HP condition ($M = 5.7$). During the PR-LP condition, the obtained break points for each session were as follows: FR 5, FR 7, FR 8, FR 6, FR 3, FR 6, FR 6; with an average break point of FR 6. The obtained break point for each session of the PR-HP condition was as follows: FR 13, FR 18, FR 16, FR 6, and FR 13, and the average break point was FR 13.

Similar results were obtained for Cedar. During baseline, Cedar rarely engaged in the response ($M = 0.2$ responses per minute). Similar levels of responding were observed in both the FR 1/LP and FR 1/HP conditions (*M*s

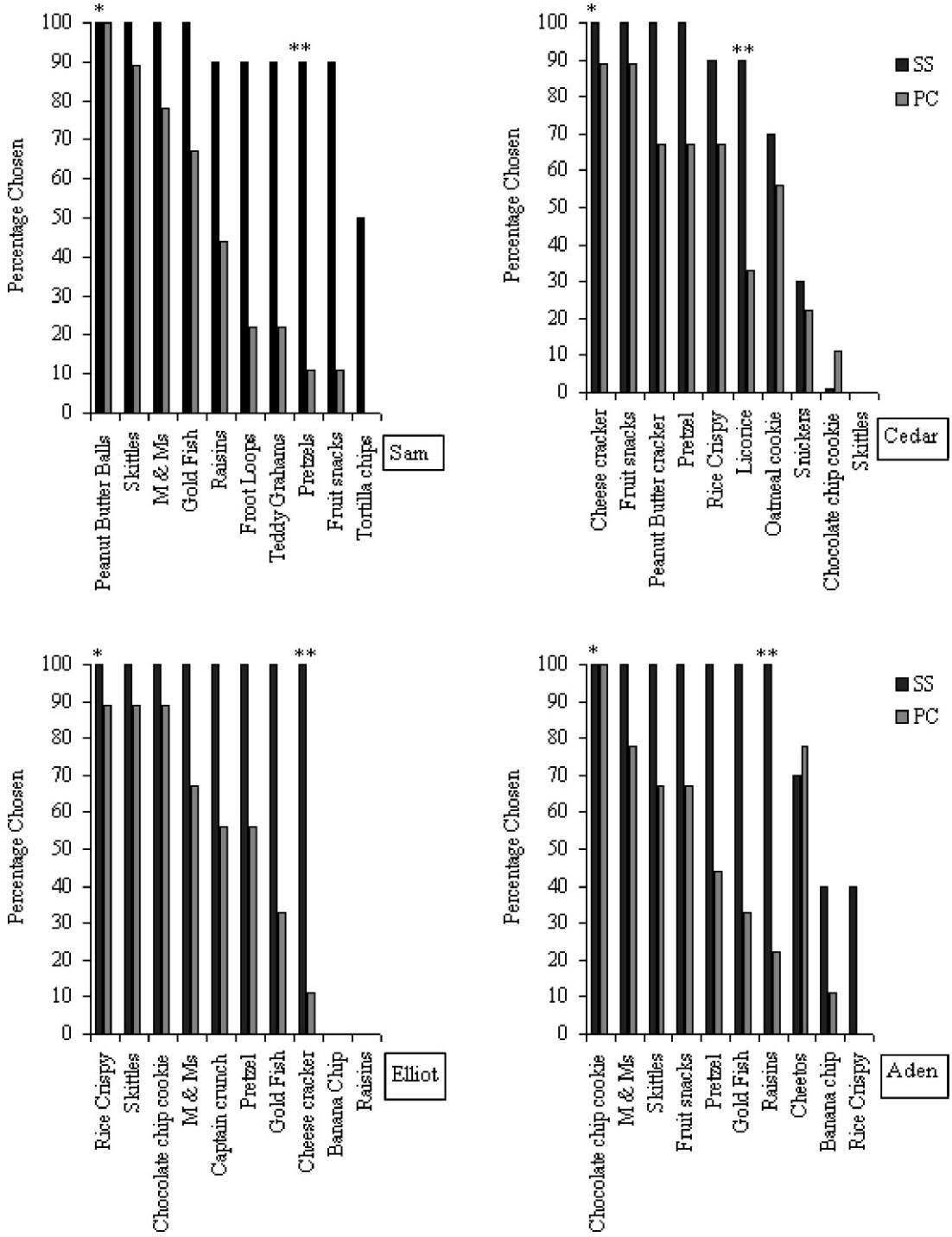

Figure 1. Percentage of edible items chosen during the SS and PC preference assessments for Sam, Cedar, Elliot, and Aden. The single asterisk denotes the HP stimuli, and the double asterisk denotes the LP stimuli.

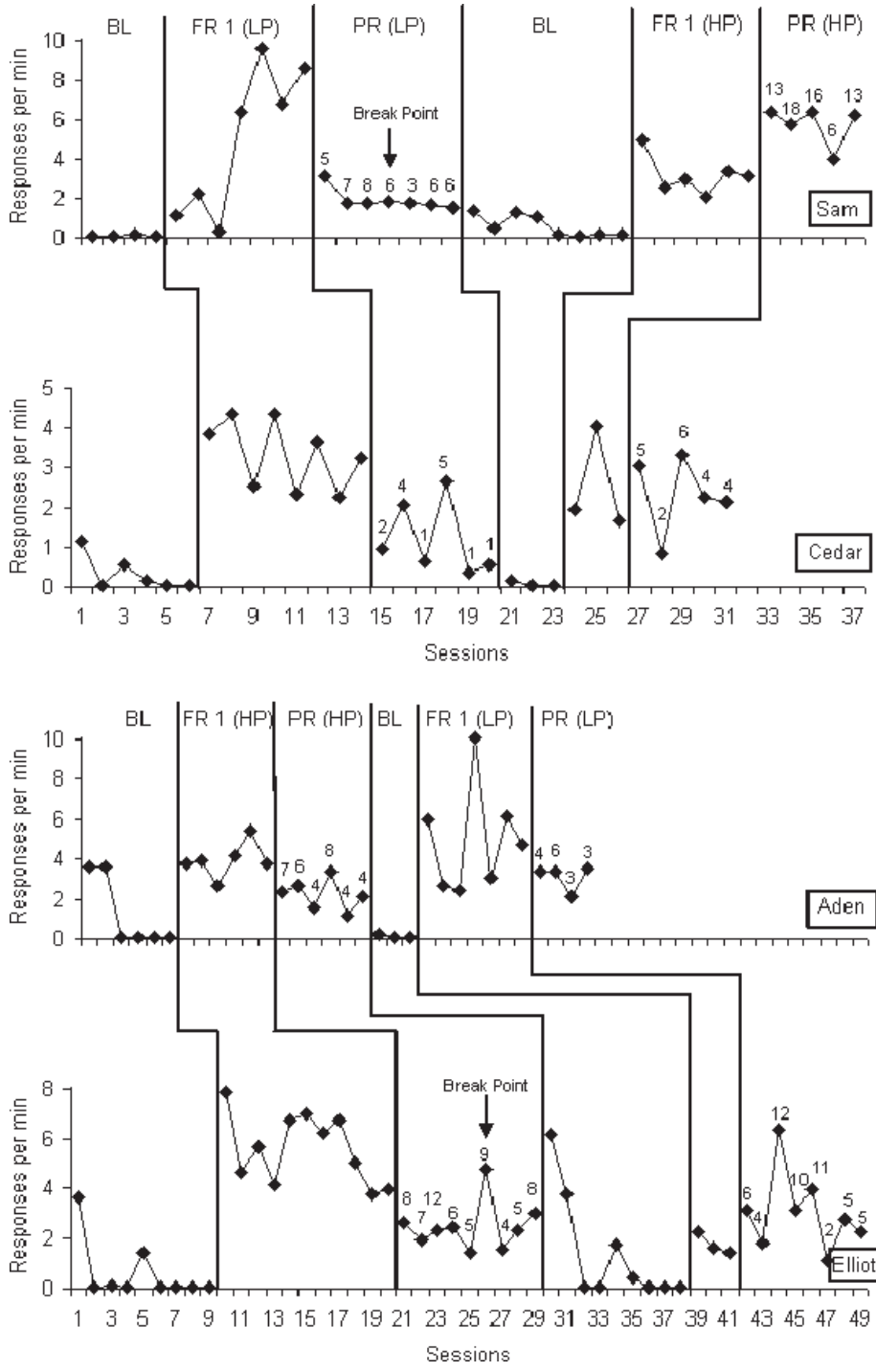

Figure 2. Responses per minute of the target response for Sam, Cedar, Aden, and Elliot during baseline, FR 1, and PR sessions with HP and LP reinforcers.

= 3.3 and 2.5 responses per minute, respectively). Lower rates of responding occurred in the PR-LP condition ($M = 1.2$) than in the PR-HP condition ($M = 2.3$). The average break point during the PR-LP condition was FR 2, and the break point for each session was FR 2, FR 4, FR 1, FR 5, FR 1, and FR 1. The average break point during the PR-HP condition for Cedar was FR 4, and the break points for each session were FR 5, FR 2, FR 6, FR 4, and FR 4.

During baseline, Aden rarely engaged in the target response ($M = 0.8$ responses per minute). During the FR 1/HP and the FR 1/LP conditions, rates of responding increased relative to baseline and were lower in the FR 1/HP condition ($M = 3.9$) than in the FR 1/LP condition ($M = 5.0$). Rates of responding were slightly lower in the PR-HP condition ($M = 2.2$) than in the PR-LP condition ($M = 3.1$). The average break point was FR 6 for the PR-HP condition, and the obtained break points for each session were FR 7, FR 6, FR 4, FR 8, FR 4, and FR 4. The obtained break points for each session during the PR-LP condition were FR 4, FR 6, FR 3, and FR 3, and the average break point was FR 4.

For Elliot, baseline rates of responding were low ($M = 0.9$ responses per minute). During the FR 1/HP and the FR 1/LP conditions, rates increased relative to baseline and were higher in the FR 1/HP condition ($M = 5.6$) than in the FR 1/LP condition ($M = 1.7$). During the PR-HP condition, rates of responding were somewhat lower ($M = 2.5$) than those observed in the PR-LP condition ($M = 3.0$). The break points for each session during the PR-HP condition were FR 8, FR 7, FR 12, FR 6, FR 5, FR 9, FR 4, FR 5, and FR 8, and the average break point was FR 7. The average break point during the PR-LP condition was FR 7, and the break points for each session were FR 6, FR 4, FR 12, FR 10, FR 11, FR 2, FR 5, and FR 5.

It should be noted that although similar response rates and break points were observed under the PR conditions for most participants, session length and overall response output varied greatly across the PR-HP and PR-LP conditions. To illustrate, for Sam the total session duration was approximately 219 min, with a total of 377 responses across seven sessions during the PR-LP condition, as opposed to a total duration of approximately 183 min, with a total of 1,083 responses across five sessions during the PR-HP condition. Similar patterns were observed for Cedar (i.e., 48 min of total session time and 73 total responses in the PR-LP condition, 57 min of total session time and 141 responses in the PR-HP condition), Aden (i.e., 38 total minutes and 118 total responses in the PR-LP condition, 114 total minutes and 259 responses in the PR-HP condition), and Elliot (i.e., 157 total minutes and 546 total responses in the PR-LP condition, 264 total minutes and 643 responses in the PR-HP condition). Thus, across participants the means for the PR-LP condition were 116 min and 279 responses ($M = 2.4$ responses per minute) and were 155 min and 532 responses ($M = 3.4$) for the PR-HP condition.

Cumulative Responses

Cumulative records allow a direct inspection of rate and changes in rate otherwise not possible with other types of graphs. Specifically, relative rates of responding can be determined by visually comparing the slopes of two performances; if the slope of one performance is steeper than the other, this indicates a higher response rate. In addition, cumulative records reveal patterns of responding (i.e., break and run) not shown by a typical line graph.

The top panel of Figure 3 depicts the cumulative number of responses across all sessions during the PR-LP and PR-HP conditions for Sam. During the PR-HP condition, Sam consistently responded across the sessions and the slope of the line was steep, but during the PR-LP condition, responding was accompanied by more breaks and thus the slope of the line was not as steep. Even though the pattern of responding was fairly stable during both the PR-HP and the PR-LP conditions, it should be

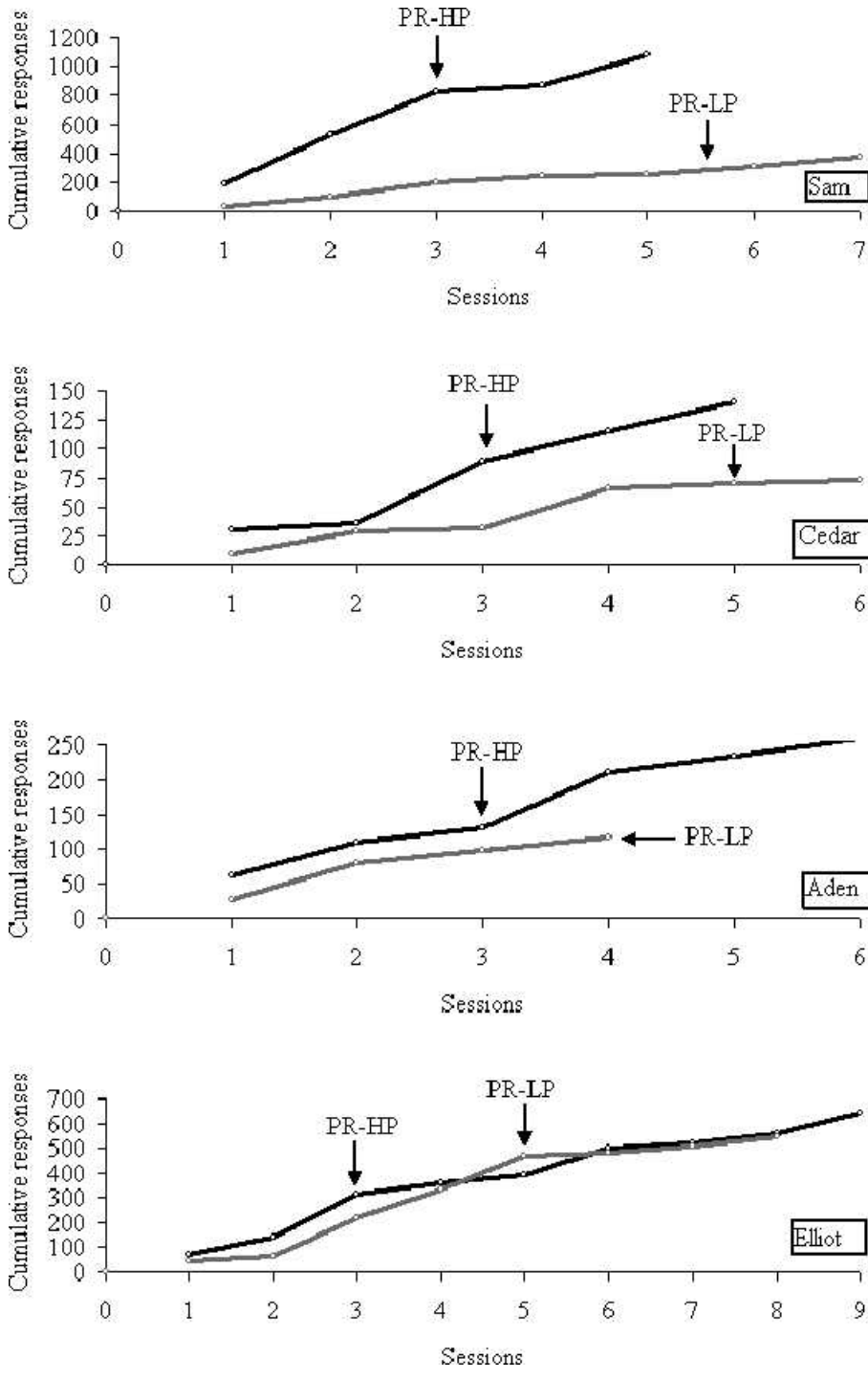

Figure 3. Cumulative number of responses across sessions during the PR-HP and PR-LP conditions for Sam, Cedar, Aden, and Elliot.

noted that more responding occurred in a shorter period of time and in fewer sessions during the PR-HP condition.

The second panel of Figure 3 depicts the same data for Cedar. During the PR-HP condition, Cedar consistently responded across the PR-HP sessions and responding was accompanied by more breaks in the PR-LP condition. Again, a greater number of responses was observed in fewer sessions during the PR-HP condition.

The third panel of Figure 3 depicts the same data for Aden. During the PR-HP condition, Aden consistently responded and the slope of the line was steep. Although initially the slope of the line during the PR-LP condition resembled the slope during the PR-HP condition, pausing was observed after Session 3, which is denoted by divergence in the slopes of the two lines thereafter.

The bottom panel of Figure 3 depicts the same data for Elliot. Similar patterns of responding were observed during both the PR-LP and PR-HP conditions, in that the slopes of the lines were similar, suggesting that the HP and LP stimuli were equally effective in maintaining responding under increasing schedule requirements.

In summary, results indicated that baseline rates of responding were low for all 4 participants. When an FR 1 schedule was in effect, responding increased relative to baseline in both the LP and HP conditions for all participants. For Sam and Aden, higher rates of responding were observed under the FR-LP condition than under the FR-HP condition; for Elliot, higher rates of responding were observed under the FR-HP condition than under the FR-LP condition. Cedar was the only participant for whom similar rates of responding were observed under both the LP and HP conditions when an FR 1 schedule was in effect. When a PR schedule was implemented, responding maintained under both the LP and HP conditions for all participants; however, more responding occurred under the PR-HP condition than under the PR-LP condition for 3 of the 4 participants (Sam, Cedar, and Aden). For these participants, the average break point was lower in the LP condition than in the HP condition; however, in general, the difference in break points was minimal. Specifically, for 2 participants (Cedar and Aden) the difference in break points was within two responses of one another (e.g., FR 4 in the PR-LP condition and FR 6 in the PR-HP condition for Aden), and for 1 participant (Elliot), the average break point was identical in both PR conditions.

DISCUSSION

Results of the current study replicated those of Roscoe et al. (1999) by demonstrating that LP stimuli maintained responding during FR 1 schedules of reinforcement for all participants. Moreover, the current results extended those obtained by Roscoe et al., in that the LP stimuli used in the current investigation also maintained responding under PR schedules of reinforcement. It is noteworthy that, although LP stimuli functioned as reinforcers under both FR 1 and PR schedules, the LP stimuli were generally not as effective as the HP stimuli in terms of response persistence under increasing PR schedules. Nevertheless, the current results suggest that LP stimuli may function as effective reinforcers in a variety of contexts.

Roane et al. (2001) demonstrated that higher rates of responding were associated with one of two stimuli under increasing schedule requirements, suggesting that even though two stimuli may be equally effective reinforcers for low-effort responses, one stimulus may be more effective than the other for high-effort responses. The current results support those of Roane et al., in that both LP and HP stimuli were similarly effective under low schedule requirements, yet under higher schedule requirements one stimulus (the HP item) was generally the more effective reinforcer. The current results also highlight the use of PR schedules when conducting reinforcer assessments. PR schedules

provide information on the amount of responding an individual will emit to obtain a particular reinforcer, which may be important for clinicians who wish to thin the schedule of reinforcement for a particular response while still maintaining fluent responding.

The current results suggest that HP reinforcers result in different patterns of responding than those observed when LP reinforcers are used. Specifically, results of this study indicated that there was less pausing between responses under conditions with HP reinforcers than there was under conditions with LP reinforcers. This may have implications for those who work with children in school settings. Given that the delivery of HP reinforcers results in steady patterns of responding with little or no pausing between responses relative to LP stimuli, it is possible that the likelihood of a child engaging in other behavior (e.g., problem behavior) during such pauses may be minimized through the use of HP reinforcers. Future research might examine the extent to which HP and LP reinforcers differ in terms of the patterns of responding they produce under conditions in which other distracting tasks or activities are available.

The outcomes of the current investigation, combined with those of Roscoe et al. (1999), also have implications for determining what preference assessment methods researchers and practitioners employ. For example, an SS preference assessment may identify several highly preferred stimuli, and subsequent reinforcer assessments under low schedule requirements (e.g., FR 1) may verify such stimuli to be effective reinforcers. Given this possibility, the SS assessment may be more appropriate when stimuli are intended to be used as reinforcers for low-effort responses (e.g., maintenance tasks). By contrast, under situations in which more strenuous response requirements are in place, it may be necessary to conduct a PC preference assessment, because this type of assessment results in a more differentiated ranking of stimuli than does the SS method. Furthermore, the PC assessment has been shown to predict the relative reinforcing value of various stimuli (Fisher et al., 1992; Piazza, Fisher, Hagopian, Bowman, & Toole, 1996).

It is important to note that the response rates obtained during the reinforcer assessment should be interpreted within the context of the different reinforcement schedules in effect across conditions. In the current study, response rates in the FR conditions were generally higher than those in the PR conditions; hence, one might conclude that the PR conditions did not demonstrate as significant of a reinforcement effect as the FR conditions. However, responding under increasing schedule requirements generally results in more postreinforcement and interresponse pausing, which increases session length and decreases response rate. Thus, it is difficult to make direct comparisons of response rates obtained under different types of schedules. Nevertheless, the current results suggest that relative preference (i.e., HP or LP stimuli) did not affect responding under low schedule requirements (i.e., FR 1); however, under increasing schedule requirements, HP stimuli resulted in more responding relative to LP stimuli.

A potential limitation of the current study is that during the reinforcer assessment, the presence of discriminative stimuli may have been responsible for the increase in responding that was observed over baseline levels. Specifically, the presence of food may have occasioned responding in that it was visible to participants. Another potential limitation of this study is that, for all participants, slightly different responses were chosen for the LP and HP conditions; this was done in an effort to enhance discrimination between these conditions, however, it is possible that greater response persistence was observed under the PR-HP condition not because the HP stimulus was a more potent reinforcer but because participants had a preference for the task associated with the PR-HP condition or the task materials present during this condition. Future research should address these limitations as well as other variables (e.g., response-effort

manipulations; Zhou, Goff, & Iwata, 2000) that may affect responding for qualitatively different reinforcers under PR schedules.

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