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FURTHER EXAMINATION OF FACTORS THAT INFLUENCE PREFERENCE FOR POSITIVE VERSUS NEGATIVE REINFORCEMENT

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Factors that influence choice between qualitatively different reinforcers (e.g., a food item or a break from work) are important to consider when arranging treatments for problem behavior. Previous findings indicate that children who engage in problem behavior maintained by escape from demands may choose a food item over the functional reinforcer during treatment (DeLeon, Neidert, Anders, & Rodriguez-Catter, 2001; Lalli et al., 1999). However, a number of variables may influence choice between concurrently available forms of reinforcement. An analogue for treatment situations in which positive reinforcement for compliance is in direct competition with negative reinforcement for problem behavior was used in the current study to evaluate several variables that may influence choice. Participants were 5 children who had been diagnosed with developmental disabilities and who engaged in problem behavior maintained by escape from demands. In the first phase, the effects of task preference and schedule of reinforcement on choice between a 30-s break and a high-preference food item were evaluated. The food item was preferred over the break, regardless of the preference level of the task or the reinforcement schedule, for all but 1 participant. In the second phase, the quality of the break was manipulated by combining escape with toys, attention, or both. Only 1 participant showed preference for the enriched break. In the third phase, choice of a medium- or low-preference food item versus the enriched break was evaluated. Three of 4 participants showed preference for the break over the less preferred food item. Results extend previous research by identifying some of the conditions under which individuals who engage in escape-maintained behavior will prefer a food reinforcer over the functional one.

DESCRIPTORS: choice, differential reinforcement, behavioral economics, positive reinforcement, negative reinforcement, escape-maintained behavior

Variables that influence choice between reinforcers, including the schedule, delay, and quality of the reinforcer and the effort required to gain access to reinforcement, have been examined in a number of studies (e.g., Koehler, Iwata, Roscoe, Rolider, & O'Steen, 2005; Neef, Shade, & Miller, 1994; Tustin, 1994; Vollmer, Borrero, Lalli, & Daniel, 1999). Research on choice is important to application because multiple reinforcers are often concurrently available in the natural environment.

Although choice between similar or identical reinforcers (e.g., two food items) has been arranged in most research in this area, an increasing number of applied studies have examined choice between qualitatively different reinforcers (e.g., a break from work or a food item; DeLeon et al., 2001; Lalli et al., 1999). Such an arrangement may arise when treatment

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is implemented with less than perfect integrity. For example, the teacher of a child with developmental disabilities may deliver praise and food reinforcers for completing tasks but permit escape from the task for disruptive behavior.

In Lalli et al. (1999), the effects of positive and negative reinforcement on problem behavior and compliance were examined with 5 children who engaged in problem behavior maintained by escape from demands. Treatment consisted of providing either negative reinforcement (i.e., a break from the task) or food for compliance while problem behavior continued to produce escape. Treatment with the food item was associated with greater reductions in problem behavior and higher levels of compliance than treatment with the functional reinforcer, even though escape was available for problem behavior. Thus, the participants chose the food reinforcer over the functional reinforcer when both were concurrently arranged.

The use of food reinforcers for appropriate behavior with children who engage in escape-maintained behavior has some advantages over the use of the functional reinforcer (escape) in classroom settings. For example, food can be delivered relatively quickly on rich schedules of reinforcement while the child continues to engage in academic tasks. Frequent breaks from a task may be impractical to implement and limit the child's participation in ongoing classroom activities. Nonetheless, food reinforcers must compete with escape for problem behavior when it is difficult for teachers to implement escape extinction with integrity. Examining variables that influence preference for food reinforcers over escape is important to maximize the likelihood of compliance with academic tasks when problem behavior continues to produce the functional reinforcer.

Although results of Lalli et al. (1999) suggested that some children prefer food over escape from demands, a number of variables may influence choice between these reinforcers during tasks. DeLeon et al. (2001), for example, examined choice between food and escape under increasing schedule requirements with a child who engaged in problem behavior maintained by escape. The participant was required to complete a number of tasks to choose between a food item or a break, while problem behavior no longer produced escape. The participant chose the food item more often than the break under low schedule requirements. However, preference switched to the negative reinforcer when the participant was required to complete 10 tasks before receiving the opportunity to choose a reinforcer. The authors hypothesized that the larger work requirement functioned as an establishing operation (EO) by momentarily altering the reinforcing value of the break. However, only 1 individual participated in the study. Thus, more research is warranted to evaluate choice between a break and food under increasing schedule requirements.

Further research also is needed on factors that may interact with the reinforcement schedule to alter choice between reinforcers. For example, in DeLeon et al. (2001), the relative value of escape versus food under the thin reinforcement schedule may have depended on the preference level of the task. Certain types of tasks may be more aversive than others, even though multiple tasks may be associated with problem behavior. Results of several studies indicate that individuals with developmental disabilities will engage in higher levels of problem behavior when required to complete less preferred tasks (Foster-Johnson, Ferro, & Dunlap, 1994; Vaughn & Horner, 1997). For example, Vaughn and Horner compared rates of problem behavior when participants were required to complete high- and low-preference tasks. Although both tasks produced some problem behavior, the low-preference tasks were associated with much higher rates of problem behavior. Thus, relative to food reinforcement,

a break from some tasks (more aversive, less preferred, or both) may be more valuable than a break from other tasks as the schedule requirement increases.

The quality of the break and food item in the DeLeon et al. (2001) and Lalli et al. (1999) studies also may have influenced choice between reinforcers. In both studies, a highly preferred food reinforcer was available concurrently with a break alone (i.e., no attention or toys were available during the break). Previous research has shown that children with escape-maintained behavior may prefer escape to an enriched environment (i.e., a break with toys) over escape alone (Golonka et al., 2000; Zarcone, Fisher, & Piazza, 1996). In Golonka et al., for example, treatment for negatively reinforced problem behavior was more effective when compliance produced an enriched break rather than a break alone. Both participants also chose the enriched break more often when the breaks were available concurrently for task compliance. Results of Pizza et al. (1997) showed that treatment with multiple functional reinforcers (i.e., a break combined with tangible items or attention) was more effective than treatment with a single reinforcer (i.e., a break alone) for children who engaged in multiply controlled problem behavior. In the natural environment, a break from demands may be combined with access to toys or attention from adults or peers (i.e., a higher quality break). Therefore, further research should evaluate whether a more natural, higher quality form of escape alters preference for a food reinforcer over a break.

Alternatively, the quality of the food reinforcer may influence choice between reinforcers. In Lalli et al. (1999) and DeLeon et al. (2001), highly preferred food items were identified via systematic preference assessments. These food reinforcers may have been of higher quality than those typically used in the natural environment because teachers and parents are less likely to conduct systematic preference assessments when selecting food reinforcers. The extent to which choice between a food item and a break depends on the preference level of the food item should be evaluated in further research.

The purpose of this study was to extend previous research on reinforcer choice (DeLeon et al., 2001; Lalli et al., 1999) by examining how preference for either a food item or a break would be influenced by the schedule requirements, preference level of the task, and variations in the quality of the reinforcer. The methodology was arranged as an analogue of treatment situations in which both task compliance and problem behavior produce reinforcement. The primary interest of this bridge study was on reinforcer choice rather than on the treatment of problem behavior. In the first phase, DeLeon et al. was replicated and extended by evaluating choice between food and escape when reinforcement was delivered contingent on compliance to either high-preference or low-preference tasks. In the second and third phases, the quality of the break and food item was manipulated to examine how this factor influences choice under relatively thin schedules of reinforcement.

METHOD

Participants, Settings, and Materials

Five children, aged 4 to 8 years, participated in the study. Participants had been diagnosed with developmental disabilities, autism, or both and had been referred for the treatment of inappropriate behavior that interfered with task completion. Table 1 displays each participant's problem behavior. All of the children were reported to have some visual discrimination skills. Larry, Sam, Mary, and Scott communicated vocally using complete sentences and followed three-step instructions. Casey had been diagnosed with moderate mental retardation, communicated through gestures or by guiding people towards objects, and followed some one-step instructions (e.g., ''sit down''). None of the participants had any sensory or

Table 1
Problem Behavior for Each Participant and Preference Assessment Results

Participant	Problem behavior	High- and low-preference foods	High-preference toys	High- and low-preference tasks
Casey	Aggression, SIB	Ginger cookie and Rice Chex®	Bumble ball® and disco ball	Putting pieces in a puzzle and matching letters
Larry	Aggression, disruption, inappropriate vocalizations	Carob chip and raisin	Children's book and a video	Receptive identification of colored bears and stringing beads
Sam	Aggression, disruption	Sour cream and onion Pringles® and Gummy Bears® and regular Pringles® and dried apples	Mardi Gras beads and Bumble Ball®	Receptive identification of animals and letter puzzle
Mary	SIB, inappropriate vocalizations	Fruit snack, apricot (medium-preference food item), and strawberry juice	Mardi Gras beads and squishy ball	Stringing beads and shape puzzle
Scott	Aggression, disruption, inappropriate vocalizations	M&Ms® and dried apple	Light-up snake and play tools	Peg board and receptive identification of opposites

physical deficits except Mary, who had been diagnosed with visual impairments. Sam began taking stimulant medication during the third phase (i.e., at Session 113). A functional analysis was conducted prior to the study to identify the variables that maintained problem behavior. Only participants whose problem behavior was maintained by escape from demands were included in the study.

All assessment and treatment sessions were conducted in an unused room at the participant's school or in therapy rooms at a university-based early intervention program for children with autism. The rooms contained a desk and chair, chairs for data collectors, and any relevant session materials. The therapist and data collectors were present during all sessions. Sessions were conducted the same time each day with each participant. All sessions were conducted prior to lunch or at least 1 hr after lunch.

Response Measurement and Reliability

Frequency data on reinforcer choice, problem behavior, and compliance were collected via laptop computers by trained observers during all assessment and treatment sessions. Reinforcer choice was defined as pointing to or touching one of two coupons or items associated with the reinforcer after a verbal prompt. Inappropriate behavior (see Table 1) included aggression (i.e., hitting, pushing, scratching, pinching, and pulling hair), disruption (i.e., throwing materials, flopping, crying, and spitting), self-injury (i.e., hand biting, arm biting, and head and body hitting), and inappropriate vocalizations (i.e., whining, screaming, and saying "no"). Compliance was defined as completing a demand within 5 s of a verbal or model prompt.

A second independent observer collected data during 36% to 54% of sessions for each participant. Interobserver agreement was calculated for reinforcer choice, problem behavior, and compliance by dividing the total number of occurrence agreements across consecutive 10-s intervals by the total number of occurrence agreements plus disagreements and multiplying by 100%. Mean interobserver agreement for reinforcer choice, problem behavior, and compliance across participants was 98% (range, 60% to 100%), 94% (range, 50% to 100%), and 99% (range, 90% to 100%), respectively.

General Procedure

Preference assessments. Assessments were conducted to identify preference rankings of tangible items, food items, and tasks based on procedures described by Fisher et al. (1992) and Lattimore, Parsons, and Reid (2002). Tangible items, food items, and tasks were assessed separately. Highly preferred tangible items were included in specific

conditions of the functional analysis and in Phases 2 and 3. The highest ranked food items were used in certain conditions of the functional analysis and during all phases of the study. The lowest ranked food items were used in Phase 3 (a medium-preference food item also was evaluated for Mary in Phase 3). The task preference assessment included tasks that were delivered during the demand condition of the functional analysis. During each trial of the task preference assessment, two tasks were placed in front of the participant, and the participant was instructed to "pick one." When the participant pointed to or touched one task, the nonchosen task was removed, and the participant was prompted to complete three responses from the task that was chosen. For example, if stringing beads was selected, the participant was required to string three beads. Problem behavior was exposed to extinction during preference assessment trials. The task that the participant chose most often was designated the high-preference task; the task that was chosen least often was designated the low-preference task. High- and low-preference tasks were used in Phase 1. Table 1 displays the results of the preference assessments conducted with each participant. Additional preference assessments (i.e., multiple stimulus without replacement) were conducted throughout the study with various participants (i.e., Sam, Larry, and Scott; see further discussion below) based on procedures described by DeLeon and Iwata (1996).

Functional analysis. A functional analysis of problem behavior was conducted based on procedures described by Iwata et al. (1994). Functional analysis conditions included attention, demand, toy play, tangible, and no interaction (Casey and Mary only). Sessions (10 min each) were randomly alternated in a multielement design. Additional assessments (i.e., pairwise comparisons) were conducted with Sam and Scott to clarify functional analysis results. A pairwise comparison of food and toy play conditions was conducted with all participants to determine if access to food was a functional reinforcer for problem behavior. During the food condition, participants were given presession access to a highly preferred food. Food was removed at the beginning of the session and returned for 20 s contingent on the target behavior.

Discrimination training. Prior to baseline, the participant was taught to discriminate between two coupons (Sam, Scott, and Larry) or two three-dimensional items (Mary and Casey) and to touch the coupons or items to obtain the designated reinforcer. Coupons were used for participants whose teachers reported that they could discriminate among different pictures. Items were used for participants who did not reportedly possess such discrimination skills. If three-dimensional items were used, one item represented the break (e.g., a timer) and the other item represented the food (e.g., a bag of food). During discrimination training, the therapist physically guided the participant to choose one coupon or item and delivered the consequence associated with the coupon or item (i.e., either a 30-s break from discrimination training or a small piece of food). After physically guiding the participant to pick each coupon or item a minimum of five times, the therapist required the participant to comply with one instruction (e.g., string one bead) and then permitted the participant to choose between the two coupons or items. This procedure was conducted a minimum of three times. The therapist then asked the child to point to or say the coupon or item associated with either a break or food item. If the child could accurately perform this activity twice for each coupon or item, discrimination training was completed. If the participant did not accurately discriminate between the coupons, discrimination training was conducted with items in place of the coupons, and training continued until the criteria above were met. Following discrimination training, probes were conducted daily prior to sessions to ensure that the participant's choice remained under dis-

criminative control of the two coupons or items. During daily probes, the therapist forced a choice for each coupon or item once and repeated the last step of discrimination training.

Experimental Design

High-preference and low-preference tasks were alternated in a multielement design during Phase 1. The effects of the schedule on reinforcer choice also were evaluated in a reversal design in Phase 1. During Phase 2, the parameters of the break were manipulated using a reversal design. In Phase 3, the effects of reinforcer quality on choice were evaluated using a reversal design.

Phase 1

Procedure

The purpose of Phase 1 was to evaluate preference for reinforcers under increasing schedule requirements with high- versus low-preference tasks. High- and low-preference tasks were alternated in a multielement design. During all sessions, the experimenter presented instructional trials using a graduated three-step prompting procedure (verbal, model, physical prompts). No programmed consequences were provided for problem behavior (i.e., problem behavior was exposed to extinction).

Baseline (no reinforcement). Sessions with the most and least preferred tasks were conducted a minimum of five times each. No programmed consequences were provided for compliance. Five trials were conducted during each session. The purpose of baseline was to evaluate levels of compliance and problem behavior in the absence of reinforcement for appropriate behavior.

Reinforcer choice. All procedures were the same as in baseline, but reinforcement was provided for task compliance. The participant had the opportunity to choose between two reinforcers contingent on compliance following a verbal or model prompt. The number of times the participant was required to complete the task to gain access to reinforcement was gradually increased on a fixed-ratio (FR) schedule beginning with FR 1. Each session ended when the participant had received five opportunities to choose between reinforcers.

When the participant had complied with the required number of demands (depending on the schedule), the therapist placed both coupons or items on the table at equal distances from the participant. The therapist said, ''pick one.'' If the participant chose the snack coupon or item, the participant was given a small piece of a highly preferred food. The next demand began immediately after delivery of the food item so that the positive reinforcer was not confounded with a break from the task. If the participant chose the break coupon or item, the therapist turned away from the participant and provided a 30-s break from task demands. All participants chose a coupon or item within 5 s of the initial verbal prompt to pick one.

When reinforcer choice remained stable for at least three sessions under FR 1, the schedule was increased to FR 2. Reinforcer choice was considered stable if it varied by 20% or less from one session to the next. The schedule continued to be increased (FR 2, FR 5, FR 10, FR 20, FR 40) if choice remained stable for at least three consecutive sessions under each schedule value until preference appeared to change (e.g., switched from the food item to the break) or until the schedule reached FR 40. If preference changed at or before the schedule reached FR 40, FR 2 and the highest schedule requirement for that participant was replicated.

Phase 2

Procedure

All of the children participated in Phase 2 because results of Phase 1 indicated a preference for the food item under relatively thin reinforcement schedules (e.g., FR 20 or FR 40). The purpose of Phase 2 was to examine how preference would change if the break contained access to other positive reinforcers. Because the parameters of the break were manipulated, the conditions most likely to increase the value of the

break were in effect during this phase. Thus, the low-preference task and the thinnest schedule under which the food reinforcer was consistently preferred over the break were used. All other procedures were identical to those in Phase 1.

Baseline. Data from the last phase in Phase 1 (i.e., when the highest schedule requirement reached by the participant was replicated) served as the baseline data for Phase 2, with two exceptions. First, an additional baseline was conducted with Sam when a change in setting occurred following Phase 1. The baseline for Phase 2 was conducted in the new setting. Second, a relatively rich schedule (FR 5) was chosen as the baseline schedule for Scott because reinforcer choice in Phase 1 was somewhat variable even under rich schedules of reinforcement (e.g., the replication of FR 2). Thus, a baseline phase with this schedule was implemented during Phase 2.

Reinforcer choice. Highly preferred tangible items (i.e., toys), therapist attention, or both were systematically combined with the break. When the break was selected, the therapist removed the task materials, provided the two most highly preferred toys, or delivered attention (i.e., conversation) for 30 s. The separate effects of attention and tangible items during the break were evaluated for 1 participant to identify the particular variables (attention, tangible items, or both) that were responsible for the change in preference. This evaluation was followed by a reversal to the break only (i.e., baseline) and replication of the break plus the relevant variable (attention).

Phase 3

Procedure

Four of the 5 children (Sam, Scott, Casey, and Mary) participated in Phase 3 because they continued to show preference for the food item over the enriched break in Phase 2. The purpose was to examine how preference would change if the quality of the food item was manipulated.

Baseline. Data from the last phase in Phase 2 (when the participant could choose between the high-preference food item and the enriched break) served as the baseline data for Phase 3, with the exception of Mary, who was the first to participate in Phase 3. We hypothesized that a lower preference food item would lead to a complete switch in preference to the enriched break even when a denser schedule of reinforcement was in place (e.g., FR 10). Therefore, we began Phase 3 under the FR 10 schedule with Mary only. When her preference did not change, the same reinforcement schedules that had been implemented in Phase 2 were used for the remaining participants.

Reinforcer choice. Participants could choose between a low-preference food item or an enriched break (i.e., a break with access to two highly preferred toys and adult attention). A medium-preference food item (i.e., food item ranked in the middle of the items in the food preference assessment) also was evaluated with Mary only. If participants chose the enriched break more often than in baseline, a reversal to the high-preference food item was implemented. Following the reversal, the low-preference food item was reinstated to replicate the change in preference.

The procedures conducted in Phase 3 were modified for Sam after a change in preference from the low-preference food to the break was not replicated (i.e., Sam chose the low-preference food over the break). An additional preference assessment was conducted to identify a food item that was less preferred than the current food item. The least preferred food item that Sam would consume was evaluated as the second low-preference food item. We also hypothesized that the enriched break may have acquired some aversive properties during the course of the study (e.g., Sam began to push the toys away and wouldn't talk with the therapist during the break). Therefore, choice between the food items and a nonenriched break (i.e., a 30-s break with no toys and attention) was evaluated at the end of the phase.

RESULTS

Functional Analysis

Results of the functional analysis and pairwise comparisons are presented in Figure 1. Casey's functional analysis suggested that problem behavior was maintained by negative reinforcement in the form of escape from demands. Initially, rates of problem behavior were highest in the play and demand conditions. However, results were more clearly differentiated during the last 14 sessions of the assessment, with the highest rates of problem behavior occurring during the demand condition. During the pairwise comparison of food and toy play conditions, higher rates of problem behavior occurred in the toy play condition than in the food condition, suggesting that the behavior was not maintained by access to food. Nonetheless, food cannot be excluded as a possible maintaining reinforcer because problem behavior was observed in the food condition and no food was provided in the toy play condition. Larry exhibited the highest rates of problem behavior during the tangible and demand conditions of the functional analysis, suggesting that his problem behavior was maintained by access to tangible items and escape from demands. Results of the pairwise comparison of food and toy play conditions indicated that problem behavior was not maintained by access to food items. Sam's results suggested that his problem behavior was maintained by adult attention and escape from demands. However, the rate of problem behavior began to increase during the last two sessions of the tangible condition, so a pairwise comparison of the tangible and toy play conditions then was conducted. Results indicated that problem behavior was also maintained by access to toys. The pairwise comparison of toy play and food conditions suggested that problem behavior was not maintained by access to food items. Results of Mary's multielement functional analysis and the pairwise comparison of food and toy play conditions indicated that problem behavior was maintained by escape from demands and not by access to food items. In the first phase of Scott's functional analysis, the highest rates of problem behavior occurred in the tangible condition, suggesting that problem behavior was maintained by access to toys. Problem behavior was also somewhat elevated during the attention condition, increasing to high levels during the final attention session. Due to the nature of the problem behavior during this session (i.e., severe aggression), additional attention sessions were not conducted. Because parent reports and previous observations in the classroom suggested that problem behavior may have been maintained by escape from demands, additional sessions with demand and toy play conditions were conducted to further evaluate this potential function. Results of the pairwise comparisons suggested that problem behavior was sensitive to negative reinforcement and access to food items.

Phases 1, 2, and 3

The primary dependent variable was reinforcer choice, which is depicted in Figures 2 through 6. Due to the lengthy nature of the evaluation, data from Phase 1 are graphed separately from the data collected during Phases 2 and 3 for each participant. However, data from Phase 1 that served as the initial baseline condition for Phase 2 are reproduced in the second graph for some participants. Results for the two secondary dependent variables (i.e., problem behavior and compliance) are briefly summarized below (session data are available by contacting the first author).

Choice. Overall, Casey showed a strong preference for the food over the break during Phase 1, even under the highest schedule requirement (Figure 2). Although responding was variable under his first exposure to FR 40, Casey showed a clear preference for the food item when FR 40 was replicated. Choice between reinforcers was similar across the high- and low-preference tasks. When attention and

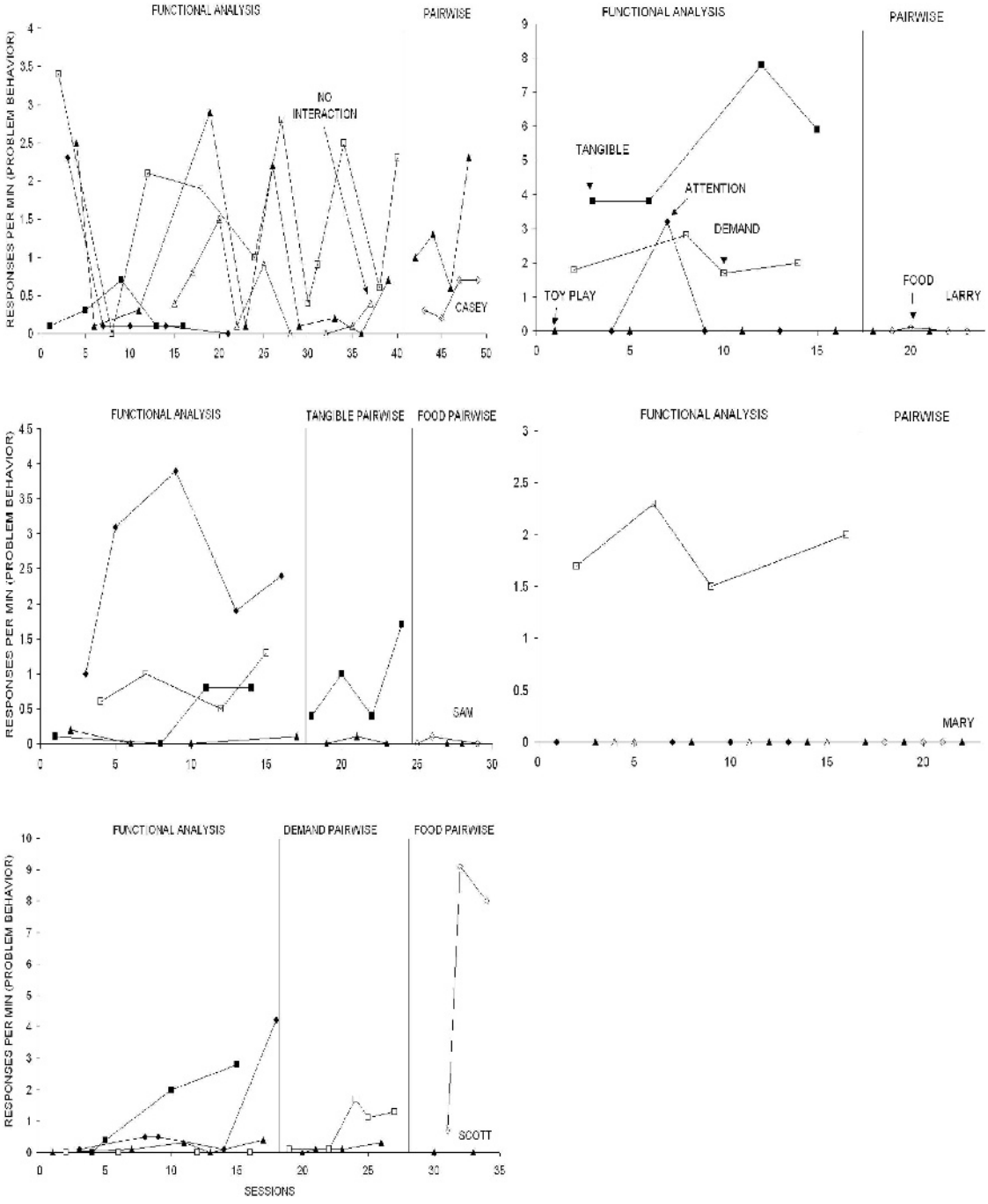

Figure 1. Responses per minute of problem behavior across conditions of the multielement functional analyses and pairwise comparisons for Casey, Larry, Sam, Mary, and Scott.

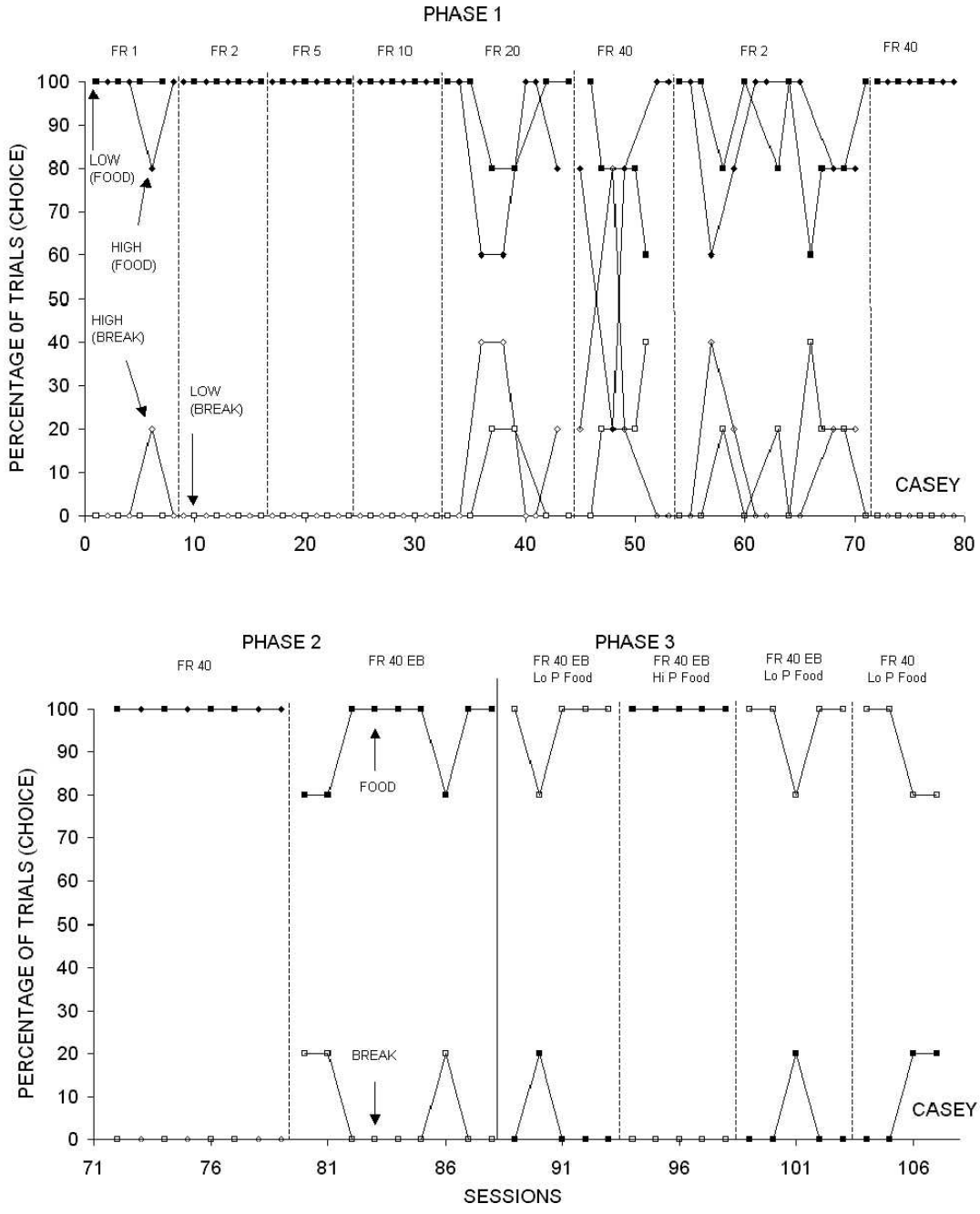

Figure 2. Percentage of trials in which Casey chose the food versus the break across increasing schedule requirements in Phase 1 (top); low = low-preference task; high = high-preference task. Percentage of trials in which Casey chose either the high-preference food or the low-preference food versus the break during Phases 2 and 3 (bottom). EB = enriched break (break with tangible items and attention).

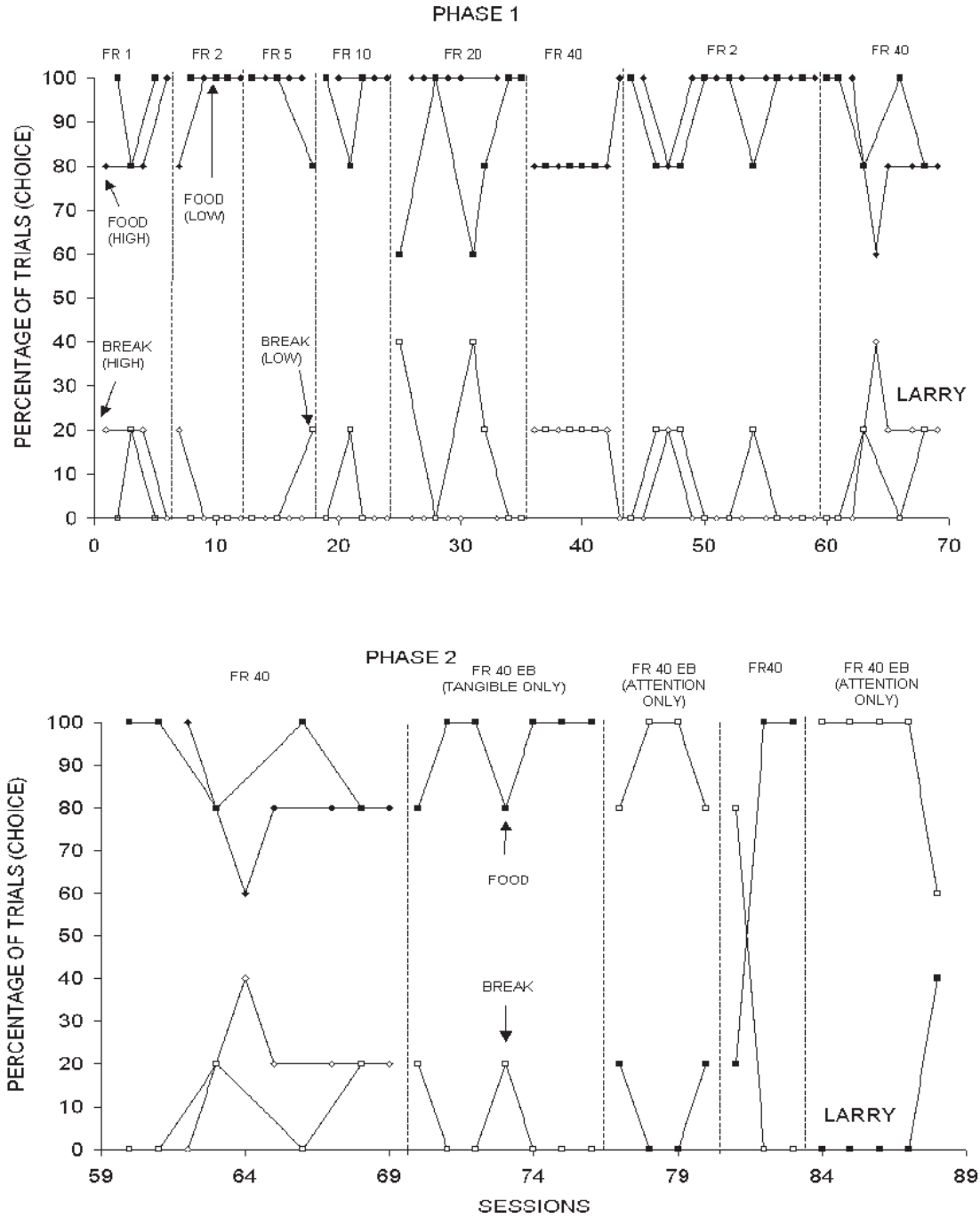

Figure 3. Percentage of trials in which Larry chose the food versus the break across increasing schedule requirements in Phase 1 (top); low = low-preference task; high = high-preference task. Percentage of trials in which Larry chose either the high-preference food or the enriched break (EB) during Phase 2 (bottom).

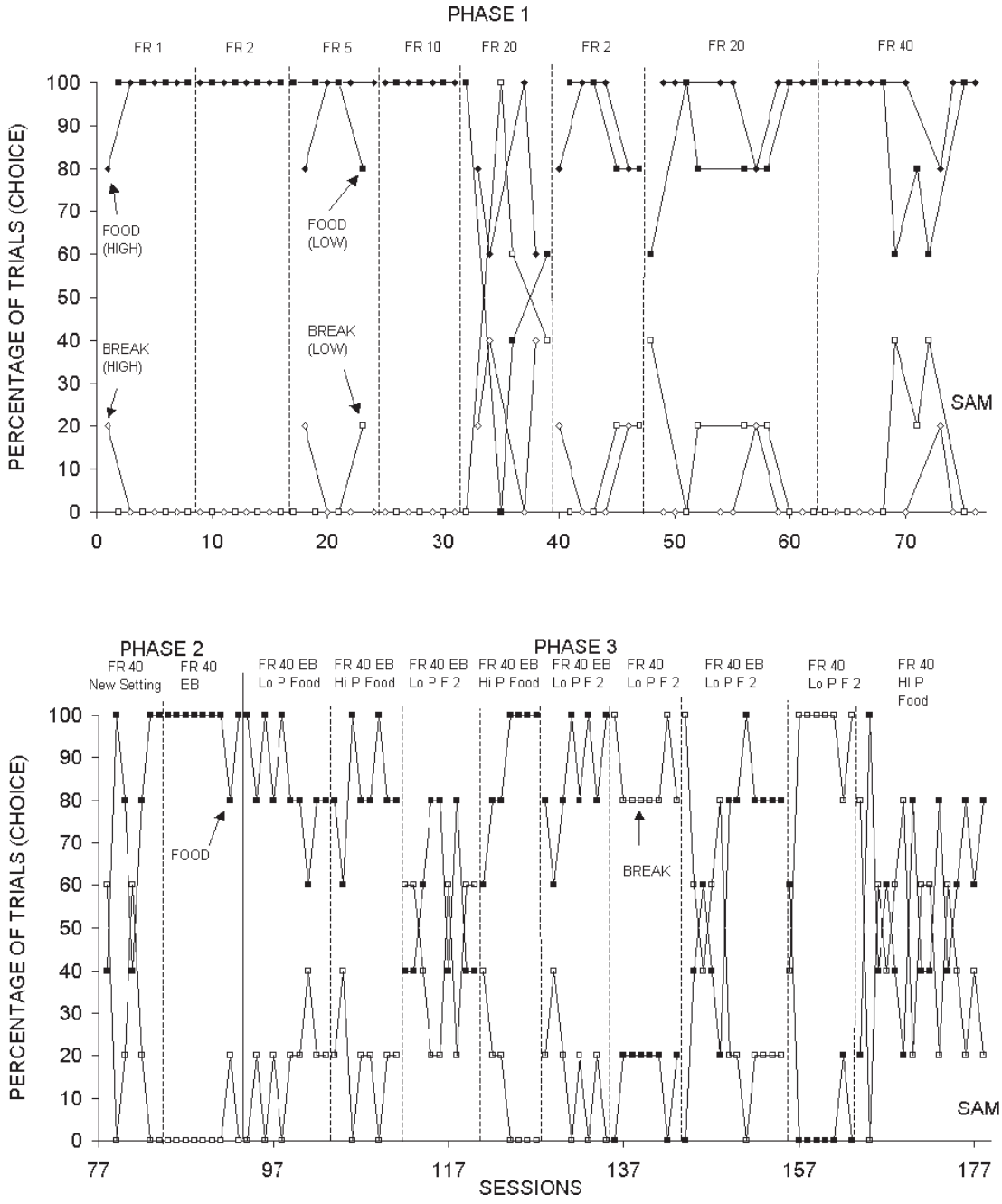

Figure 4. Percentage of trials in which Sam chose the food versus the break across increasing schedule requirements in Phase 1 (top); low = low-preference task; high = high-preference task. Percentage of trials in which Sam chose either the high-preference food or the low-preference food versus the break during Phases 2 and 3 (bottom). EB = enriched break (break with tangible items and attention); Lo P F 2 = second low-preference food item.

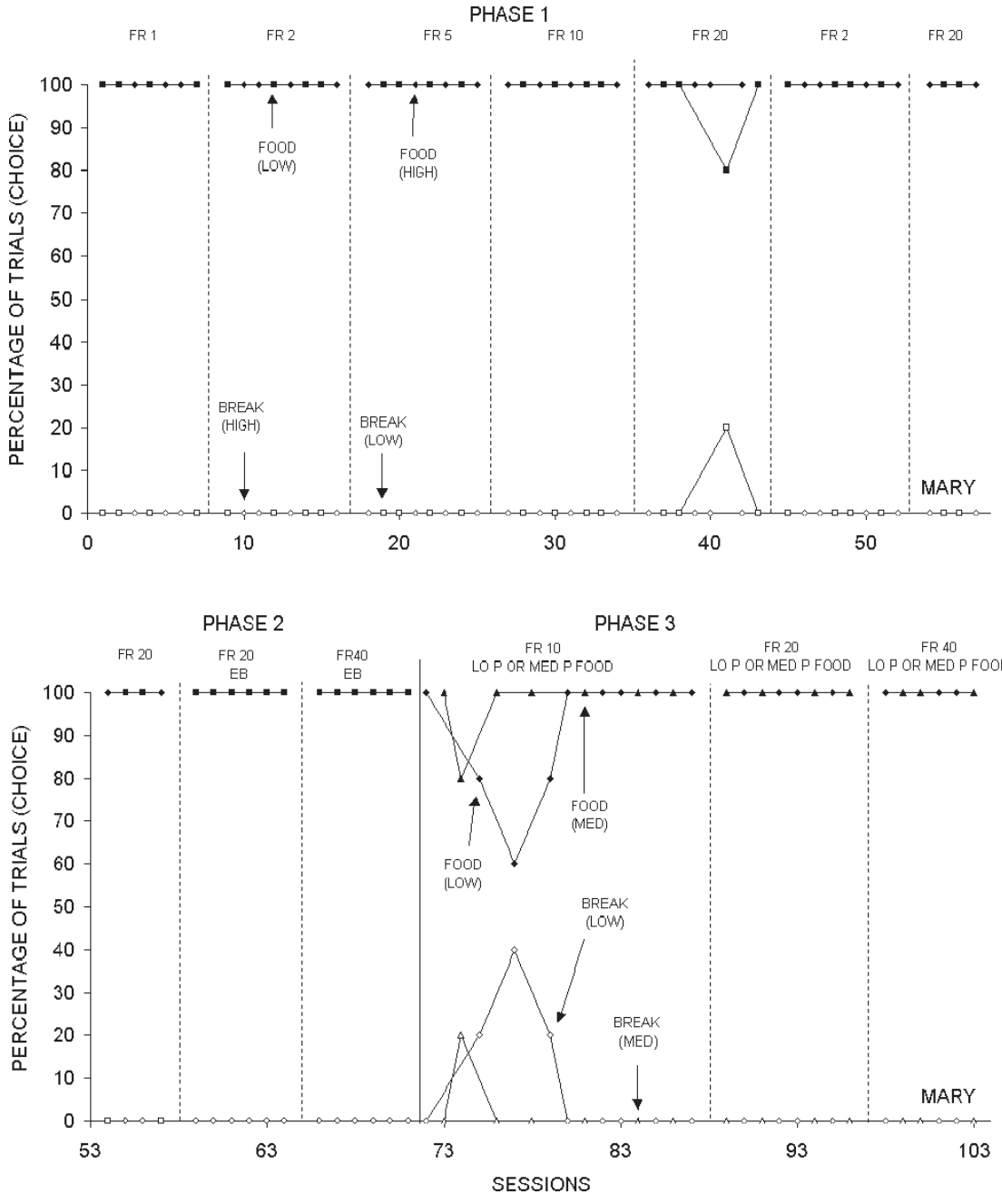

Figure 5. Percentage of trials in which Mary chose the food versus the break across increasing schedule requirements in Phase 1 (top); low = low-preference task; high = high-preference task. Percentage of trials in which Mary chose either the high-preference food, medium-preference food, or the low-preference food versus the break during Phases 2 and 3 (bottom). EB = enriched break (break with tangible items and attention); med = medium-preference food item; low = low-preference food item.

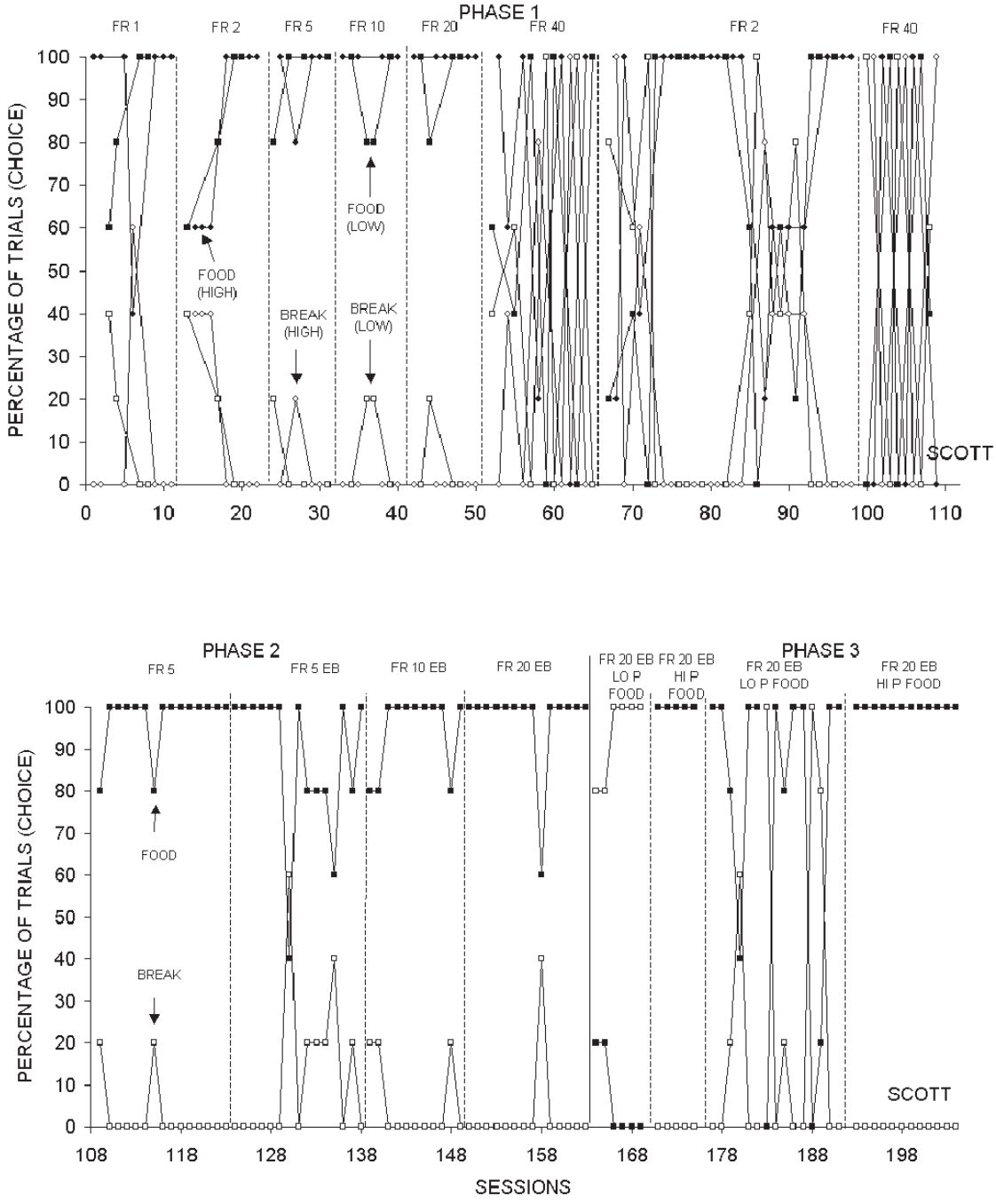

Figure 6. Percentage of trials in which Scott chose the food versus the break across increasing schedule requirements in Phase 1 (top); low = low-preference task; high = high-preference task. Percentage of trials in which Scott chose either the high-preference food or the low-preference food versus the break during Phases 2 and 3 (bottom). EB = enriched break (break with tangible items and attention).

highly preferred toys were added to the break during Phase 2 (i.e., the enriched break), he continued to show preference for the food item (Figure 2). Therefore, it was unnecessary to evaluate the individual components of the enriched break. In Phase 3, Casey showed a preference for the break when the lower preference food and either an enriched break or a nonenriched break (last condition) were available concurrently.

Results for Larry also indicated a clear preference for the food item over the break under all schedules of reinforcement in Phase 1 (Figure 3). The break was chosen more often during the low-preference task under the FR 20 schedule. However, choice responding was similar for both tasks under the FR 40 schedule. During Phase 2, Larry preferred the food item to the break unless attention was delivered during the break (Figure 3).

Sam showed a preference for the food item over the break, regardless of the preference level of the task, until the schedule reached FR 20 in Phase 1 (Figure 4). Under the initial FR 20 schedule, preference was variable and unstable; however, he showed a clear preference for the food item to the break when the FR 20 schedule was reintroduced. In fact, preference for the food item was maintained even when the schedule was increased to FR 40. Although choice was fairly similar across both tasks, Sam was more likely to choose the break over the food when working on the low-preference task under FR 20 and FR 40. Sam's choices for the food versus the break under FR 40 were somewhat more variable when this condition was conducted in a new setting as the baseline for Phase 2 (Figure 4). However, he showed a consistent preference for the food item when he could choose between the food and an enriched break. When the first low-preference food item was introduced (i.e., ranch-flavored Pringles®) during Phase 3, preference was more variable than it had been during baseline, although he continued to show preference for the food item. When the second low-preference food item (i.e., dried apple) was introduced, preference became more variable. Sam chose the enriched break more than the food item during some of the sessions. However, he chose the food over the enriched break when the second low-preference food was reintroduced.

Anecdotal observations suggested that the enriched break may have acquired some aversive properties for Sam. He began to push the toys away and would not talk with the therapist during the break. Choice between the low-preference food item and a nonenriched break was conducted to evaluate this hypothesis. Sam immediately showed a change in preference from the food to the nonenriched break, and these results were replicated. In the last panel of Phase 3, Sam did not show a consistent preference for either the high-preference food or the nonenriched break until the last few sessions, during which he chose the food somewhat more than the break.

Mary consistently showed a clear preference for the food item over the break, regardless of the reinforcement schedule or preference level of the task in Phase 1 (Figure 5). Preference for the food persisted even when the enriched break was introduced and the schedule was increased from FR 20 to FR 40 in Phase 2 (Figure 5). When she could choose between a low- or medium-preference food and the enriched break under FR 10 in Phase 3, she initially began to choose the break over the food on some trials. However, exclusive preference for the food returned after the fifth session and was maintained throughout the rest of the phase, despite an increase in the schedule to FR 40.

During Phase 1, Scott's preference for the food over the break was initially somewhat variable, but he consistently chose the food more often than the break as the schedule was increased to FR 20 (Figure 6). Preference became highly variable when the schedule was increased to FR 40. Although Scott chose the food item more than the break in the majority

of sessions, he showed exclusive preference for the break during some of the sessions, and these results were replicated. Results were similar across low- and high-preference tasks. A relatively rich schedule (FR 5) was chosen as the baseline schedule for Phase 2 because preference was somewhat variable even under rich schedules of reinforcement (e.g., the replication of FR 2). Scott showed a preference for the food over the nonenriched break during baseline. When the enriched break was introduced, he continued to show preference for the food even when the schedule was increased to FR 10 and FR 20. When the low-preference food item was first introduced during Phase 3, preference switched from the food to the enriched break. However, Scott's choices were highly variable during the replication phase. He showed exclusive preference for the break in some sessions, although he chose the food item more than the break in the majority of sessions. This variability was not observed when the high-preference food was reintroduced in the final phase, during which he showed exclusive preference for the food.

Problem behavior and compliance. For all participants, compliance remained relatively high throughout all phases of the study. Four participants engaged in very little problem behavior after an initial decrease in responding during Phase 1. Casey exhibited higher rates of problem behavior under thinner schedules of reinforcement during all phases even though behavior was on extinction. Rates of problem behavior were near zero under the rich schedules of reinforcement but increased under the FR 40 schedule in each phase. Rates of problem behavior were slightly higher during low-preference tasks for Larry, Sam, and Scott.

DISCUSSION

Of 5 children with autism who displayed problem behavior that was maintained by escape from demands, all but 1 (Scott) showed a clear preference for food over a brief break from tasks, regardless of the reinforcement schedule. Scott, Mary, Casey, and Sam showed preference for the food item even when attention and tangible items were available during the break. Larry displayed a change in preference when attention was available during the break. Of the 4 children who participated in Phase 3, 3 (Sam, Casey, and Scott) showed a change in preference when the quality of the food item was manipulated. However, Mary continued to choose the medium- and low-preference food over the break, despite increases in the schedule to FR 20 and FR 40. Together, these results extend previous research by further evaluating the conditions under which individuals who engage in escape-maintained behavior prefer a food reinforcer over a functional one.

The present investigation was arranged as an analogue of treatment situations in which positive reinforcement for appropriate behavior is in direct competition with negative reinforcement for problem behavior. Nonetheless, the relative potency of food as a reinforcer in this study and in previous research (DeLeon et al., 2001; Lalli et al., 1999) has a number of implications for the use of reinforcement as part of treatment for escape-maintained behavior. Results suggest that teachers and parents should consider using highly preferred positive reinforcers when it is difficult or inconvenient to deliver the functional reinforcer (escape) for appropriate behavior or to withhold escape contingent on problem behavior (e.g., the person is too large to guide physically). Providing preferred food reinforcers contingent on compliance may effectively increase compliance, even if problem behavior continues to produce access to a break. However, food items chosen randomly rather than via systematic preference assessments may not effectively compete with escape-maintained behavior. Results also suggest the importance of assessing preference for positive versus negative reinforcement under different conditions. Preference for highly preferred food reinforcers may be influenced by

additional variables such as the effort required to gain access to the food item or delays to reinforcement. Future research should evaluate how additional parameters of reinforcement influence the effectiveness of food reinforcers during treatment of escape-maintained behavior.

These findings add to the literature on reinforcer choice and preference in several ways. First, previous studies comparing choice between positive and negative reinforcement did not specifically assess or manipulate the preference level of the task, an important EO for negative reinforcement (DeLeon et al., 2001). Results from the current investigation suggest that the preference level of the task may not necessarily affect preference for food over a break. It should be noted that all tasks included in the assessment were those that had occasioned problem behavior during the functional analysis. Thus, the relevant EO should have been in effect. However, extinction for problem behavior may have masked differences in choice during high- and low-preference tasks. Alternatively, food may have been such a potent reinforcer that the participants preferred the food reinforcer over the functional reinforcer, regardless of the EO for the break. Another possible explanation is that the EOs associated with the two tasks were fairly similar. High- and low-preference tasks were identified via a task choice assessment. A better method for identifying variations in task preference would have been to evaluate the amount of problem behavior and compliance associated with each task. In a relevant study, Vaughn and Horner (1997) evaluated rates of problem behavior during high- and low-preference tasks with individuals with severe disabilities. Higher rates of problem behavior were observed when students were required to complete less preferred tasks. In addition, the high-preference tasks were consistently chosen over the low-preference tasks when students were permitted to choose between tasks.

Second, the present investigation evaluated choice between a food reinforcer and multiple functional reinforcers. In previous investigations (DeLeon et al., 2001; Lalli et al., 1999), participants could choose between a food item and a break alone, although some children may prefer escape to an enriched environment over escape alone (Golonka et al., 2000; Piazza et al., 1997). Furthermore, it is unlikely that attention or toys would be unavailable during work breaks in the natural environment. (The participants in the present investigation were allowed to play with toys during breaks in their classroom setting.) Therefore, evaluating preference for food versus a break alone may have limited the generality of previous research findings. Although the problem behavior of 3 children (Sam, Scott, and Larry) was maintained by attention or tangible items in addition to escape from demands, only Larry shifted preference from the food reinforcer to the break when attention and tangible items were added to the break during Phase 2. Interestingly, Larry preferred the break when attention was delivered during the break, even though results of his functional analysis indicated that problem behavior was maintained by tangible items but not by attention. One possible explanation for this finding is that the type of attention manipulated in the functional analysis (reprimands) did not function as a reinforcer, unlike other forms of attention (e.g., physical attention, praise).

Results of Phase 3 for Sam indicated that attention may have become aversive because he chose the low-preference food item over the break only when the break was enriched with toys and attention. Adult attention may have become aversive over the course of the study because it was repeatedly paired with demands. It is also possible that Sam became satiated by attention, because attention was delivered continuously in the form of demands prior to the break, with praise and conversation delivered during the break. Results for 1 partic-

ipant in a study by Vollmer and Iwata (1991) suggested that attention switched from a reinforcing stimulus to an aversive stimulus after the individual was repeatedly exposed to 15 min of presession attention. The participant began running away from the therapist and threw items at the therapist who was attempting to deliver attention. However, another possible explanation is that Sam began receiving stimulant medication during this phase. Previous research suggests that stimulant medication may function as an abolishing operation for attention-maintained problem behavior (Northup et al., 1999). Thus, the provision of stimulant medication during Phase 3 may have decreased the value of attention or tangible items, resulting in Sam's preference for the food over the enriched break.

Third, the present investigation adds to the literature by replicating DeLeon et al. (2001) with multiple participants. For the 1 participant in the DeLeon et al. study, preference for food switched to the break under thin schedules of reinforcement (i.e., FR 10), although this result was not replicated within subject. In the present investigation, choice was somewhat more variable under the thinner reinforcement schedules for 3 participants in Phase 1 (Sam, Casey, and Scott); however, all participants usually preferred the food to the break when a potent food item was identified via a systematic preference assessment and the break was not combined with other positive reinforcers. In addition, the increased variability in choice under the thinner schedules was not replicated within subject for Casey and Sam, a finding reported by DeLeon et al. It is possible that the EO for the break decreased as a result of repeated exposure to the task under thin reinforcement schedules. That is, the task may have become less aversive after the participant had been exposed to numerous instructional trials (e.g., Smith, Iwata, Goh, & Shore, 1995). If so, a break from the task may have become less valuable, decreasing the likelihood that the participant would choose the break over the food.

Results of the study also can be understood by considering some concepts drawn from behavioral economics, specifically the degree of demand elasticity for the reinforcers and the type of economy. Demand elasticity is determined by changes in consumption of a reinforcer as the price of the reinforcer is manipulated. Demand is considered relatively elastic if consumption of the reinforcer is readily influenced by changes in the price of the reinforcer (e.g., increases or decreases in the schedule). The nature of the commodity (essential or nonessential) is one variable that can influence demand elasticity (Hursh, 1984). Essential commodities, such as food, usually have few substitutes. Toys and breaks from work are probably nonessential commodities. In the present study, participants may have continued to prefer the food item under thin schedules of reinforcement, even when other reinforcers were added to the break, because the food item was an essential commodity. The type of economy (open or closed) also may influence responding during choice situations. Individuals may not engage in a response at the same rate in experimental sessions if the commodity is available independent of responding outside the session (an open economy) rather than if the commodity is available only for responding during the session (a closed economy; Hursh, 1978). The participants in the present study typically had access to numerous breaks outside the experimental sessions, including a break immediately prior to and immediately following the sessions. This approximation of an open economy may account for the relative elasticity of escape. Although food also was available outside the sessions, participants may not have had access to the specific food items that were used as reinforcers.

One limitation of the study was the failure to demonstrate experimental control over choice responding with most of the participants in Phase 1, with all but 1 participant in Phase 2, and with Mary in Phase 3. For these partici-

pants, choice was not highly or consistently sensitive to the variables that were manipulated in these phases, an outcome that was not anticipated due to previous research on these factors. A multiple baseline across participants design could be implemented in future studies to demonstrate experimental control during manipulations of the schedule value. In the event that choice responding is not sensitive to manipulations of the independent variable, choice between the currently preferred reinforcer and no reinforcement could be implemented to demonstrate experimental control.

Several of the findings were not replicated within subject in Phase 1, as noted previously. In addition, an apparent change in preference from the food to the break was not replicated for Scott in Phase 3. These failures to replicate may indicate that uncontrolled variables influenced the results. In fact, these results and those of DeLeon et al. (2001) suggest that choice between food and breaks may be influenced by additional variables that were beyond the scope of the present study (e.g., recent history with certain schedules, decreased aversiveness of the task). Future research should investigate why preference for reinforcers under increasing schedule requirements may fluctuate over time.

An additional limitation was that participants were able to escape the analogue instructional context earlier by choosing the food item over the break because session duration was trial based. Thus, the participants' choice behavior may have reflected a greater sensitivity to molar escape contingencies (the total session duration) than to the immediate (molecular) contingencies. In addition, the schedule of reinforcement was not thinned past FR 40. Due to the participants' schedules, daily sessions were limited to 1-hr time blocks. One session under the FR 40 schedule required approximately 45 min to complete for most participants. Thus, thinner schedules likely would have required prohibitive session lengths. A final limitation was that food appeared to be a functional reinforcer for Scott's problem behavior and could not be excluded as a maintaining reinforcer for Casey's behavior. Nevertheless, the results for Casey and Scott were similar to those for the other participants.

Results of the present investigation have several implications for future research. More research is needed to identify factors that may influence preference for competing reinforcers. One possible area of future research involves evaluating other aspects of escape from demands. For example, lengthier breaks may be more likely to compete with food reinforcers as the work requirements increase. Additional research on economic variables (i.e., open and closed economies, increasing unit price) could be conducted to evaluate the factors that influence choice. For example, food reinforcers evaluated within session could be available following experimental sessions to determine whether choice between a food item and a break would be influenced by postsession reinforcement. Comparing choices when reinforcers are immediate versus delayed would be another important area of research. For example, children who show a preference for immediate food over an immediate break could be given a choice of two different tokens while completing the schedule requirements of a task. One token would be exchangeable for food and the other would be exchangeable for a break following the completion of the task. Would preference change when reinforcers are delayed under the token economy? Variables that may be responsible for fluctuations in preference over time (e.g., repeated exposure to increasing schedule requirements; gradual increases in the schedule) also should be evaluated.

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