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ON THE RELATIVE CONTRIBUTIONS OF POSITIVE REINFORCEMENT AND ESCAPE EXTINCTION IN THE TREATMENT OF FOOD REFUSAL

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We compared the effects of positive reinforcement alone, escape extinction alone, and positive reinforcement with escape extinction in the treatment of the food and fluid refusal of 4 children who had been diagnosed with a pediatric feeding disorder. Consumption did not increase when positive reinforcement was implemented alone. By contrast, consumption increased for all participants when escape extinction was implemented, independent of the presence or absence of positive reinforcement. However, the addition of positive reinforcement to escape extinction was associated with beneficial effects (e.g., greater decreases in negative vocalizations and inappropriate behavior) for some participants.

DESCRIPTORS: food refusal, food selectivity, negative reinforcement, pediatric feeding disorders, positive reinforcement, escape extinction

A feeding disorder is diagnosed when a child fails to consume an adequate amount or variety of food to gain weight and grow. Negative reinforcement in the form of escape from or avoidance of eating is one variable that has been hypothesized to maintain feeding problems. This hypothesis has been supported by the results of several treatment studies that have shown that escape extinction is effective for treating food refusal (e.g., Ahearn, Kerwin, Eicher, Shantz, & Swearingin, 1996; Cooper et al., 1995, 1999; Hoch, Babbitt, Coe, Krell, & Hackbert, 1994; Patel, Piazza, Martinez, Volkert, & Santana, 2002). *Escape extinction* is a term that has been used to describe procedures that prevent the child from escaping the feeding situation (e.g., holding the spoon at the child's lips until the food is accepted or guiding the mouth open by applying gentle pressure to the jaw; Ahearn et al.; Cooper et al.; Hoch et al.).

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Despite the putative role of negative reinforcement in the maintenance of feeding problems, several studies have suggested that reinforcement-based procedures alone may be effective for increasing consumption (e.g., Riordan, Iwata, Finney, Wohl, & Stanley, 1984; Riordan, Iwata, Wohl, & Finney, 1980). For example, Riordan et al. (1980) treated the food refusal and selectivity of 2 females with developmental disabilities using preferred foods as reinforcement for consumption of nonpreferred foods. Similarly, Riordan et al. (1984) used positive reinforcement as treatment for the food refusal and selectivity of 4 children with disabilities. Riordan et al. suggested that positive reinforcement alone was responsible for the increases in acceptance for 3 participants. However, these data are difficult to interpret because refusal behaviors produced escape during baseline but were ignored during the positive reinforcement treatment, and physical guidance was required to increase acceptance for 1 participant. In addition, positive reinforcement alone may have been effective for the participants in Riordan et al. (1980, 1984) because acceptance of food was already established in these participants' repertoires. That is, the participants in these studies exhibited food selectivity (they ate some foods but not others) rather than total food refusal.

Hoch et al. (1994), Ahearn et al. (1996), and Patel et al. (2002) showed that escape extinction was important for increasing consumption initially. Patel et al. compared the effectiveness of differential positive reinforcement for acceptance relative to differential positive reinforcement for mouth clean (no visible food in the child's mouth 30 s after acceptance) for increasing consumption. Neither differential reinforcement procedure increased consumption. When differential positive reinforcement was combined with escape extinction, both acceptance and mouth clean increased, independent of whether reinforcement was provided for acceptance or mouth clean. Taken together, the results of Hoch et al., Ahearn et al., and Patel et al. suggested that escape extinction may be important for increasing consumption. However, the relative contribution of extinction was not clear because escape extinction was never implemented in the absence of reinforcement.

By contrast, Cooper et al. (1995) increased consumption using a treatment package and then removed treatment components systematically. This component analysis was useful for evaluating variables responsible for maintenance of eating. The contribution of escape extinction was evaluated with 3 of the 4 participants. Extinction appeared to be necessary for these 3 participants because acceptance declined when escape extinction was removed. However, escape extinction may not have been necessary to produce initial increases in acceptance because extinction was implemented in the context of multiple components (e.g., differential reinforcement). Cooper et al. also evaluated the effectiveness of differential and noncontingent reinforcement with toys and social attention with 2 participants. Differential reinforcement with toys, but not attention, was associated with lower levels of fingers in mouth and expulsion but no changes in acceptance for 1 participant. The removal of noncontingent toys and attention was associated with decreases in number of bites accepted for a 2nd participant. However, the reinforcement phases were not replicated with either participant. These results suggested that reinforcement-based components may have idiosyncratic effects across individuals.

The results of studies on the treatment of feeding disorders (Ahearn et al., 1996; Cooper et al., 1995; Hoch et al., 1994; Patel et al., 2002; Riordan et al., 1980, 1984) raise a number of questions about the relative effectiveness of positive reinforcement and es-

cape extinction. First, it is unclear whether positive reinforcement alone (in the absence of escape extinction) is effective for increasing consumption (Ahearn et al.; Hoch et al.; Patel et al.; Riordan et al., 1980, 1984) or whether positive reinforcement affects behavior idiosyncratically (Cooper et al.). If positive reinforcement alone is not effective in increasing acceptance of food, does positive reinforcement contribute to the effects of escape extinction? No studies to our knowledge have evaluated the effects of escape extinction with and without positive reinforcement for increasing consumption initially in children with feeding disorders. Therefore, the purpose of the current study was to evaluate the relative effects of escape extinction with and without positive reinforcement for increasing consumption.

METHOD

Participants and Setting

Four children who had been diagnosed with a pediatric feeding disorder participated. These children participated in the protocol because their primary presenting problem was total food refusal, they had identifiable preferred items to use as reinforcement, and parents of these children indicated that both differential reinforcement of alternative behavior (DRA) and escape extinction would be acceptable procedures. No other children participated in this protocol. Chris was a 4-year-old boy who had been diagnosed with global developmental delays, gastroesophageal reflux (GER), deficiencies in pancreatic enzyme activity, a history of iron deficiency, and failure to thrive (FTT). Cameron was a 23-month-old boy who had been diagnosed with severe immune deficiency secondary to adenosine deaminase deficiency, lymphopenia, and FTT. Zane was a 3-year-old boy who had been diagnosed with nystagmus, GER, and FTT. Zack was a 2-year-old boy who had been diagnosed with torticollis, GER, and FTT. The children had been admitted to an inpatient (Chris and Cameron) or an intensive outpatient (Zane and Zack) pediatric feeding disorders program for chronic food refusal and tube or bottle dependence. Upon admission to the program, these children were receiving most of their nutritional needs via bottle (Chris and Cameron) or tube (Zane and Zack). Bottle feedings for Chris and Cameron were presented throughout the day; however, these oral feedings did not occur 1 hr before and 30 min after their oral feeding. Tube feedings were administered only in the evenings for Zane and Zack.

All sessions were conducted in a room with a one-way mirror. A high chair, food and drink, and eating and drinking implements were present during all sessions. Toys were visible during reinforcement phases.

Dependent Variables and Data Collection

The major dependent variables were acceptance, mouth clean, inappropriate behavior, and negative vocalizations. During eating sessions, acceptance was scored if the entire bolus of food was in the child's mouth within 5 s of the presentation. During drinking sessions, acceptance was scored if any portion of the liquid entered the child's mouth within 5 s of the presentation. Data were collected on mouth clean (no visible food or liquid in the child's mouth 30 s after acceptance in the absence of expulsion). Data also were collected on inappropriate behavior (i.e., head turns, batting or blocking the spoon or cup) and negative vocalizations (at least 3 s of crying or whining). Data on acceptance, mouth clean, and inappropriate behavior were collected on laptop computers using an event-recording procedure. Data on negative vocalizations were recorded using a duration measure. The data for acceptance were converted to a percentage by dividing the number of occurrences

of acceptance by the number of bite or drink presentations multiplied by 100%. Mouth clean data also were converted to a percentage by dividing the occurrences of mouth clean by the number of bites or drinks that entered the child's mouth multiplied by 100%. Data on inappropriate behavior were converted to rate (responses per minute) by dividing the number of inappropriate behaviors by the duration of the meal in minutes. The data on negative vocalizations were converted to a percentage by dividing the duration of negative vocalizations by the total duration of the meal multiplied by 100%.

A second observer independently scored 38%, 34%, 24%, 34%, and 30% of sessions for Chris, Cameron, Zane, Zack (eating), and Zack (drinking), respectively. Some of the interobserver agreement data for negative vocalizations were lost when the data were archived for Zane, Zack (eating), and Zack (drinking). Therefore, interobserver agreement was available for 17%, 20%, and 13% of negative vocalizations for Zane, Zack (eating), and Zack (drinking), respectively. Interobserver agreements for acceptance, mouth clean, and inappropriate behavior were calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100%. Interobserver agreement for negative vocalizations was calculated by dividing the smaller duration by the larger duration and multiplying by 100%. The total interobserver agreements for acceptance were 94% (range, 86% to 100%) for Chris; 98% (range, 67% to 100%) for Cameron; 98% (range, 93% to 100%) for Zane; 96% (range, 73% to 100%) for Zack (eating); and 88% (range, 77% to 100%) for Zack (drinking). The total interobserver agreements for mouth clean were 92% (range, 71% to 100%) for Chris; 97% (range, 65% to 100%) for Cameron; 98% (range, 80% to 100%) for Zane; 93% (range, 75% to 100%) for Zack (eating); and 93% (range, 90% to 100%) for Zack (drinking). The total interobserver agreements for inappropriate behavior were 94% (range, 76% to 100%) for Chris; 97% (range, 72% to 100%) for Cameron; 100% for Zane; 98% (range, 76% to 100%) for Zack (eating); and 93% (range, 75% to 100%) for Zack (drinking). Interobserver agreements for negative vocalizations were 97% (range, 83% to 100%) for Chris; 92% (range, 65% to 100%) for Cameron; 99% (range, 93% to 100%) for Zane; 100% for Zack (eating); and 99% (range, 94% to 100%) for Zack (drinking).

Experimental Design and Procedure

A multielement design was used to compare levels of acceptance, mouth clean, inappropriate behavior, and negative vocalizations in the escape baseline and differential positive reinforcement for mouth clean plus escape (DRA plus escape) conditions. A multielement design also was used to compare responding under escape extinction and differential positive reinforcement for mouth clean plus escape extinction (DRA plus escape extinction) conditions. A reversal design was employed to evaluate the presence and absence of escape extinction (escape baseline and DRA plus escape versus escape extinction and DRA plus escape extinction).

Four foods, one from each food group (fruits, vegetables, starches, and meats), were presented in each session, and the order of food presentation was selected randomly prior to the session. However, the order of food presentation remained the same within a given session. Foods were presented at a pureed texture for Chris and Cameron and a wet ground texture for Zane and Zack, following recommendations from the speech or occupational therapist. In all conditions, bites were presented approximately every 30 s.

Three to four session blocks were conducted each day with two to three 5-min sessions (10 min to 15 min of total eating

time) per session block (for a total of 6 to 12 sessions per day) for Zane and Zack. Three session blocks were conducted each day with two to six 5-min sessions (10 min to 30 min total eating time) per session block (for a total of 12 to 18 sessions per day) for Chris. However, during escape extinction, the meal may have exceeded 5 min because the child was required to swallow the last bite presented before the session was terminated. For Cameron, sessions were bite based (20 bites), and three to four session blocks were conducted per day with one to two sessions per session block (for an average of six sessions per day). However, sessions were terminated after 1 hr. The mean session length was 294.2 s (range, 262 to 610 s) for Chris, 659.5 s (range, 377 to 908 s) for Cameron, 283.6 s (range, 264 to 312 s) for Zane, 310.3 s (range, 270 to 1,134 s) for Zack (eating), and 304.1 s (range, 271 to 544 s) for Zack (drinking). The mean numbers of bites presented were 9.7 for Chris, 20 for Cameron, 9.3 for Zane, 8.6 for Zack (eating), and 9 for Zack (drinking).

Escape baseline. The therapist presented a bite or drink approximately every 30 s from the initial acceptance. Brief verbal praise was delivered if the child accepted the bite or drink within 5 s of the presentation or had a mouth clean. No differential consequences were provided for expulsion or vomiting (i.e., bite presentation continued). If the child held the bite or drink in his mouth 30 s after acceptance, the therapist presented the next bite. If the child engaged in any inappropriate behavior (e.g., head turns, bats, blocks) or negative vocalizations (Zane and Zack only) during the presentation, the spoon or cup was removed for 15 s. If the child did not engage in any inappropriate behavior, the spoon remained at the child's lips for 30 s at which time a new bite or drink was presented. The next bite was presented immediately after the escape period or at the next 30-s interval.

Differential positive reinforcement for mouth clean plus escape (DRA plus escape). A reinforcer (e.g., access to preferred toys and attention) identified via paired-choice preference assessments (Fisher et al., 1992) was delivered following each mouth clean. Reinforcement was delivered for mouth clean because Patel et al. (2002) found no differences in levels of acceptance or mouth clean when differential reinforcement of acceptance was compared to differential reinforcement of mouth clean. All other procedures were identical to the escape baseline condition. The child had access to the reinforcer (i.e., toys on the highchair tray) for 15 s. Bites were presented on a fixed-time (FT) 30-s schedule independent of the delivery of reinforcement. Delays in the presentation rate as a result of the delivery of positive reinforcement would have confounded the delivery of positive and negative reinforcement (Lalli et al., 1999).

Escape extinction. Procedures were similar to the previous phase; however, inappropriate behavior and negative vocalizations no longer produced escape. Inappropriate behaviors were blocked if necessary to prevent escape from the bite presentation. Prior to this phase, physical guidance (Ahearn et al., 1996) and nonremoval of the spoon (Hoch et al., 1994) were described to the parents. Parents were asked to choose which procedure they would prefer to use with their child. Chris' and Cameron's parents chose physical guidance, and Zane's and Zack's parents chose nonremoval of the spoon, so these procedures were evaluated in this condition.

The therapist placed slight pressure on the mandibular joint if the bite was not accepted within 5 s of the presentation for Chris and Cameron (i.e., physical guidance, Ahearn et al., 1996). This procedure was implemented until the bite was deposited in the child's mouth. The therapist held the spoon or cup to Zane's or Zack's mouth until he took the

bite or drink (i.e., nonremoval of the spoon or cup; Hoch et al., 1994). If the child expelled the bite or drink, it was scooped up and re-presented for 30 s. The next bite was presented (after the initial 30 s) if the previous bite was in the child's mouth for at least 3 s. If the child held the bite or drink in his mouth 30 s after acceptance, the therapist presented the next bite. No differential consequences were provided for vomiting (i.e., bite presentation continued).

DRA plus escape extinction. A reinforcer (e.g., preferred toys and attention) was delivered following a mouth clean. The child had access to the reinforcer (i.e., toys on the highchair tray) for 15 s. All other procedures were identical to the escape extinction condition described for each participant (i.e., physical guidance for Chris and Cameron and nonremoval of the spoon or cup for Zane and Zack). Bite presentation continued on the FT 30-s schedule independent of reinforcement delivery.

Follow-up (Zane and Zack). Following treatment, the outcomes of treatment were shown to the parents, and parents were asked to choose the treatment they preferred (DRA plus escape extinction or escape extinction alone). Zane's and Zack's parents chose to implement escape extinction alone, so they were taught to use the escape extinction procedure in the clinic and at home. Follow-up sessions were conducted in the clinic for Zane and Zack at 1, 4, and 6 months, during which they were fed by their mothers. Self-feeding and regular textured food were introduced at the 6-month follow-up. Chris and Cameron also were provided with follow-up, but systematic data were not collected during the follow-up visits.

RESULTS

Data on acceptance, inappropriate behavior, and negative vocalizations are depicted in Figures 1 through 5 for all participants. For Chris (Figure 1), acceptance remained low during both ESC BL and DRA plus ESC. However, implementation of escape extinction resulted in increases in acceptance for both escape extinction and DRA plus escape extinction relative to ESC BL and DRA plus ESC. Inappropriate behavior was high and variable in both ESC BL and DRA plus ESC, remained high initially in the escape extinction condition and decreased immediately in the DRA plus escape extinction condition. Removal of escape extinction resulted in increases in inappropriate behavior, which decreased once escape extinction was reimplemented. Levels of negative vocalizations were equivalent across most phases. However, in the final escape extinction versus DRA plus escape extinction phase, negative vocalizations increased and were higher under escape extinction relative to DRA plus escape extinction. Instances of mouth clean (data not shown) were 100% when bites were accepted across all phases.

Results for Cameron (Figure 2) showed that acceptance increased once escape extinction was implemented (escape extinction vs. DRA plus escape extinction). Inappropriate behavior was high in both the escape baseline and DRA plus escape conditions and decreased once escape extinction was implemented. Levels of negative vocalizations were equivalent in the escape baseline and DRA plus escape conditions. Escape extinction was associated with a burst of negative vocalizations in the escape extinction condition but not in the DRA plus escape extinction condition (Lerman & Iwata, 1995), and levels of negative vocalizations were higher under escape extinction relative to DRA plus escape extinction. Mouth clean (data not shown) did not occur during escape baseline versus DRA plus escape and increased to 100% during both escape extinction and DRA plus escape extinction conditions.

Results for Zane are depicted in Figure 3.

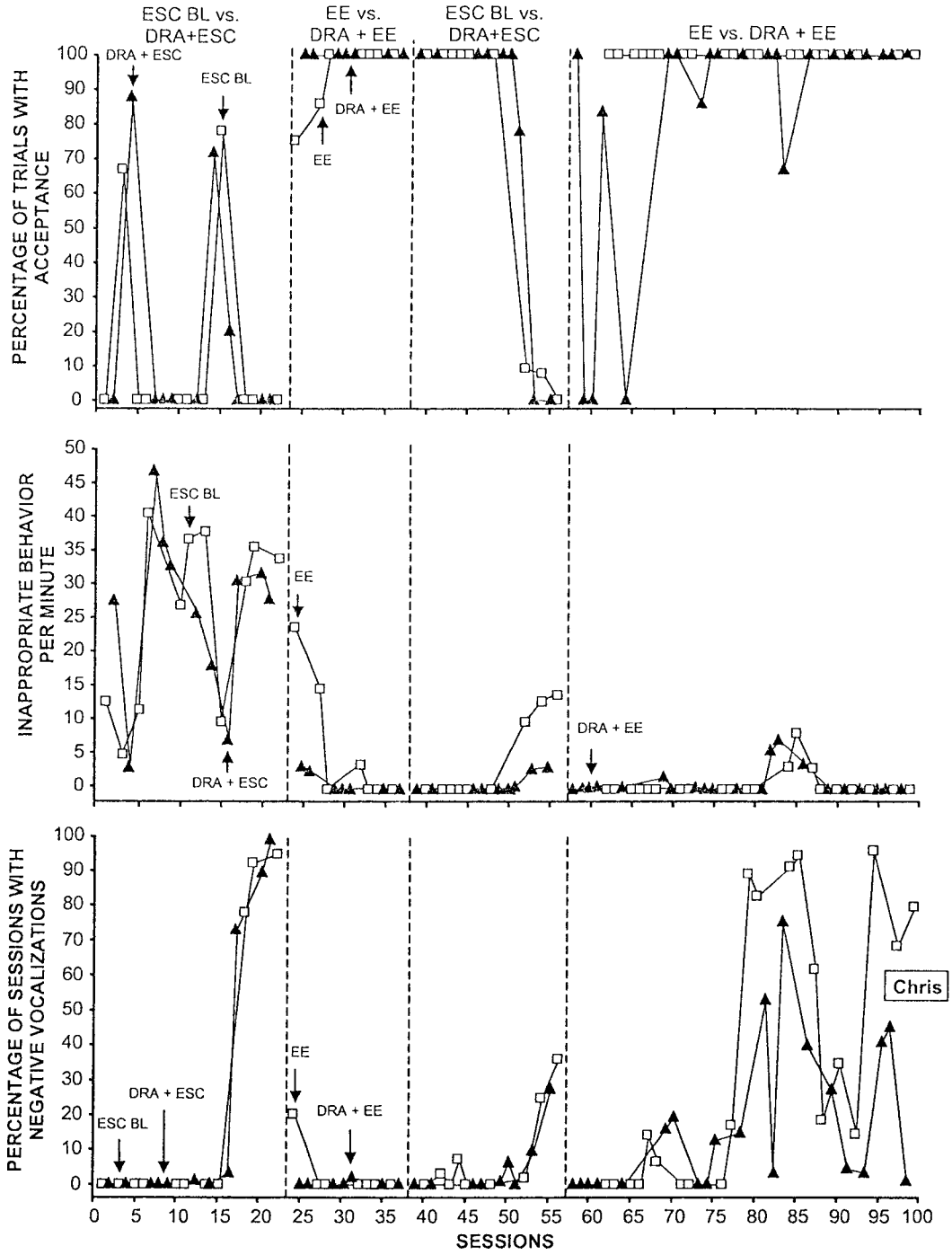

Figure 1. Percentage of trials with acceptance (top panel), inappropriate behavior per minute (middle panel), and percentage of the session with negative vocalizations (bottom panel) for Chris.

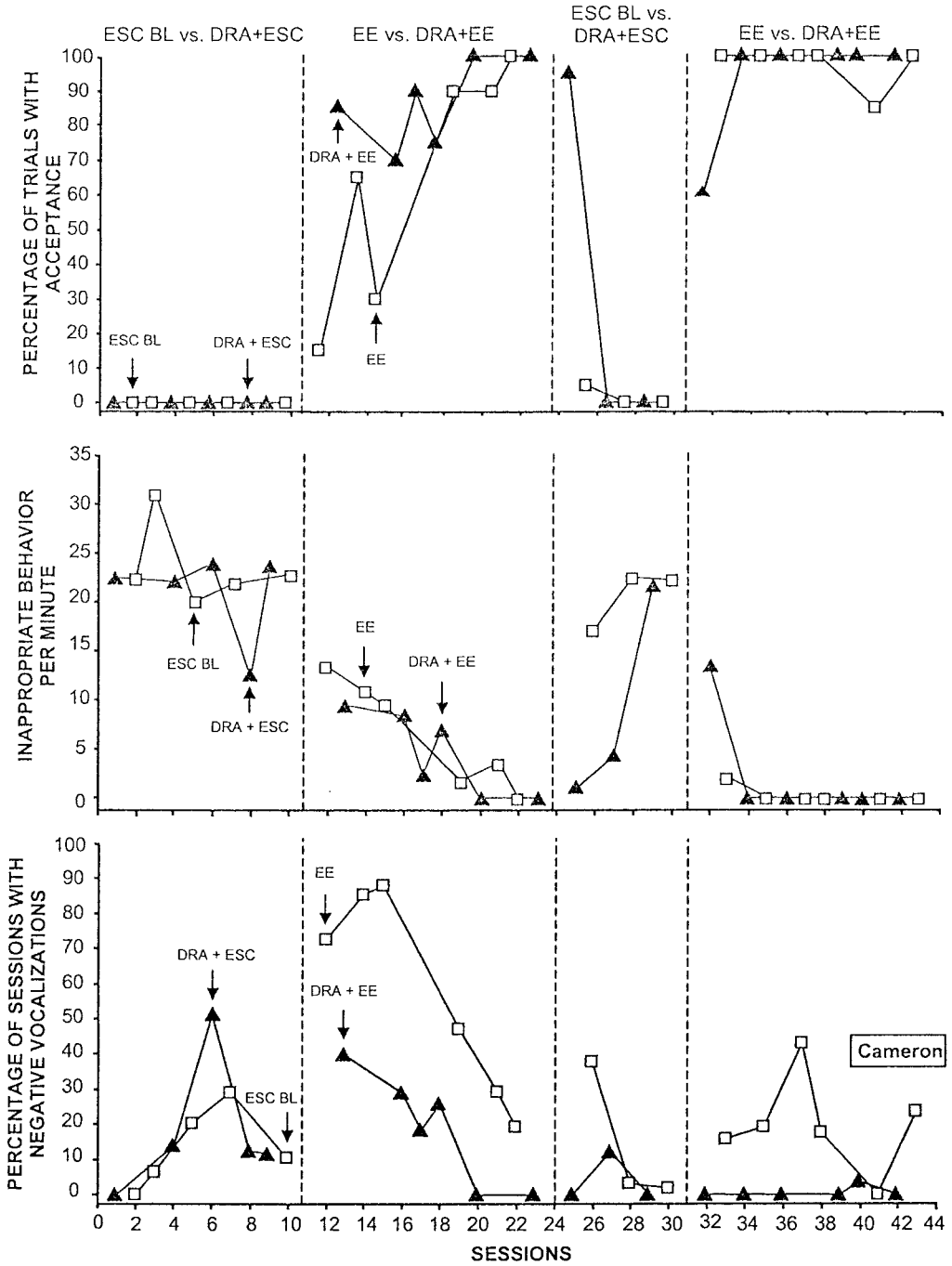

Figure 2. Percentage of trials with acceptance (top panel), inappropriate behavior per minute (middle panel), and percentage of the session with negative vocalizations (bottom panel) for Cameron.

Acceptance increased from 0% in baseline to near 100% when escape extinction was implemented. Initially, acceptance remained high across escape baseline and DRA plus escape when escape extinction was removed, but decreased to near-zero levels after 37 sessions. Acceptance increased again across both conditions when escape extinction was

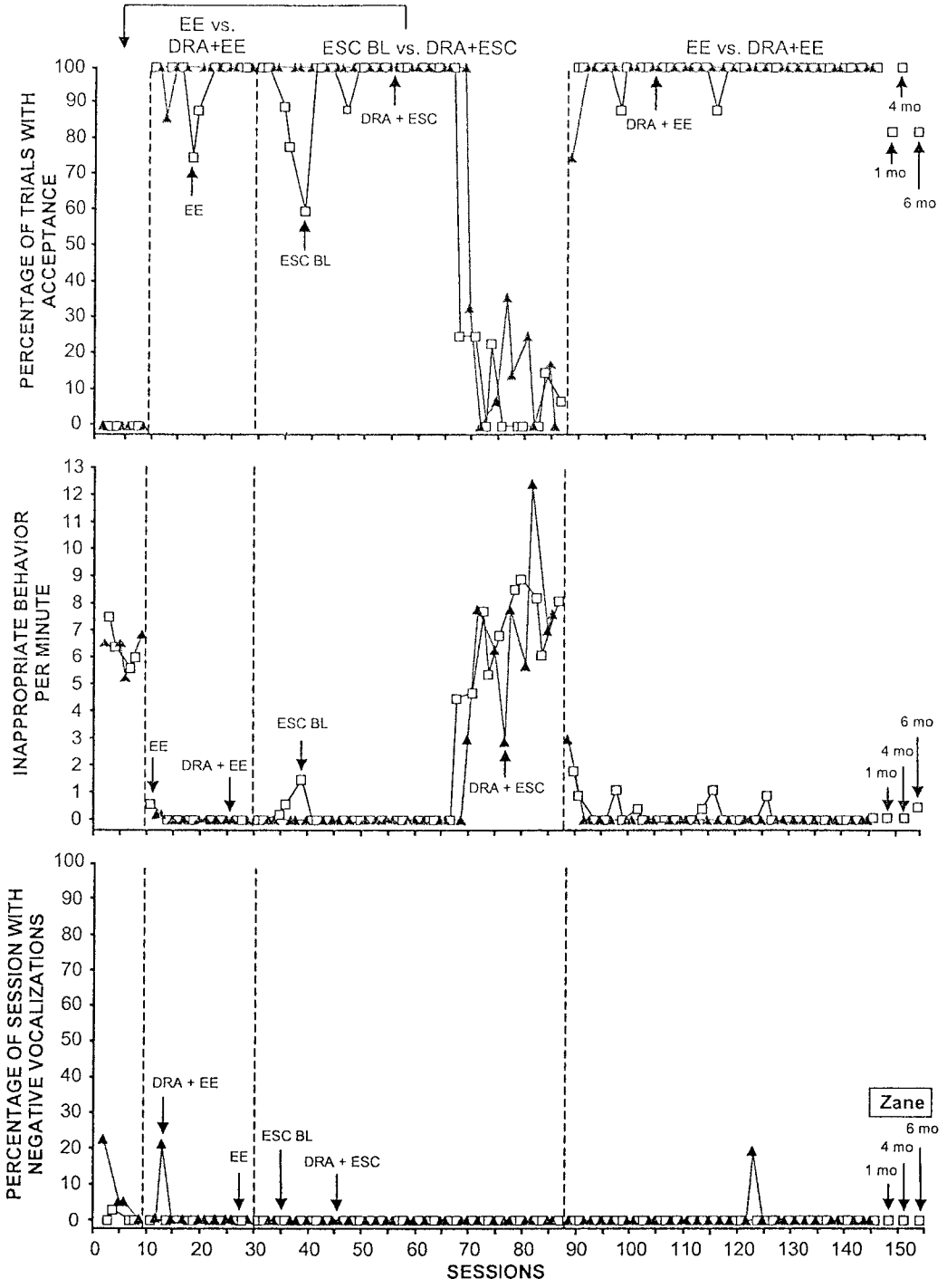

Figure 3. Percentage of trials with acceptance (top panel), inappropriate behavior per minute (middle panel), and percentage of the session with negative vocalizations (bottom panel) for Zane.

reimplemented and remained high during follow-up. Rate of inappropriate behavior was high during baseline and decreased to near zero during escape extinction and DRA plus escape extinction conditions, remaining low during follow-up. Negative vocalizations remained at near-zero levels throughout the analysis. Mouth clean (data not shown) remained high throughout the analysis and during follow-up.

Results for Zack (eating; Figure 4) showed that acceptance increased above 60% after 17 sessions during both escape extinction and DRA plus escape extinction and decreased below 80% after 12 sessions when escape extinction was removed. Acceptance increased when escape extinction was reimplemented and remained high during follow-up. Inappropriate behavior remained high during baseline, increased when escape extinction was implemented initially (showing a brief burst; Lerman & Iwata, 1995), and then decreased over time. Inappropriate behavior remained low during follow-up. A burst of negative vocalizations occurred in the escape extinction and DRA plus escape extinction conditions (Lerman & Iwata), but the behavior decreased to zero across both conditions after six sessions and did not occur for the remainder of the analysis. Mouth clean (data not shown) increased to 100% once escape extinction was implemented and remained high during follow-up.

For Zack (drinking; Figure 5), acceptance increased when escape extinction was implemented; however, levels of acceptance were slightly lower under escape extinction (M = 79.1%) relative to DRA plus escape extinction (M = 92.7%). Acceptance decreased when escape extinction was removed, increased when escape extinction was reimplemented, and remained high during follow-up. Inappropriate behavior was higher during escape extinction (M = 4.0 responses per minute) relative to DRA plus escape extinction (M = 1.8) and remained at zero during the 4-month follow-up. Negative vocalizations remained at near-zero levels throughout the analysis. Mouth clean (data not shown) increased when escape extinction was implemented, decreased when it was removed, and remained high during follow-up.

Upon discharge, Chris was consuming 100% of his needs via solids and liquids from a cup. He no longer required bottle feedings. Cameron was consuming most of his caloric needs via solids and liquids from a cup; however, he continued to consume three bottle feedings during the day. Zane and Zack were consuming 100% of their nutritional needs by mouth, and their tubes were removed. We advanced Zane's texture and self-feeding skills. Currently, he is consuming about half of an age-appropriate portion of regular textured foods using a self-feeder protocol (i.e., Zane feeds himself with utensils) and wet ground foods using a non-self-feeder protocol for the other half of his meal. Currently, Zack is consuming a full age-appropriate portion of regular textured food using a self-feeder protocol for all meals. Zack continues to consume drinks throughout the day.

DISCUSSION

We evaluated the effects of positive reinforcement, escape extinction, and a combination of positive reinforcement and escape extinction as treatment for feeding problems. In all cases, positive reinforcement was not effective in increasing consumption of food. However, consumption increased when escape extinction was implemented, independent of whether positive reinforcement was present or absent. Nevertheless, positive reinforcement when combined with escape extinction did appear to produce beneficial effects for some participants in terms of reductions in extinction bursts, lower levels of inappropriate behavior, and reduced crying.

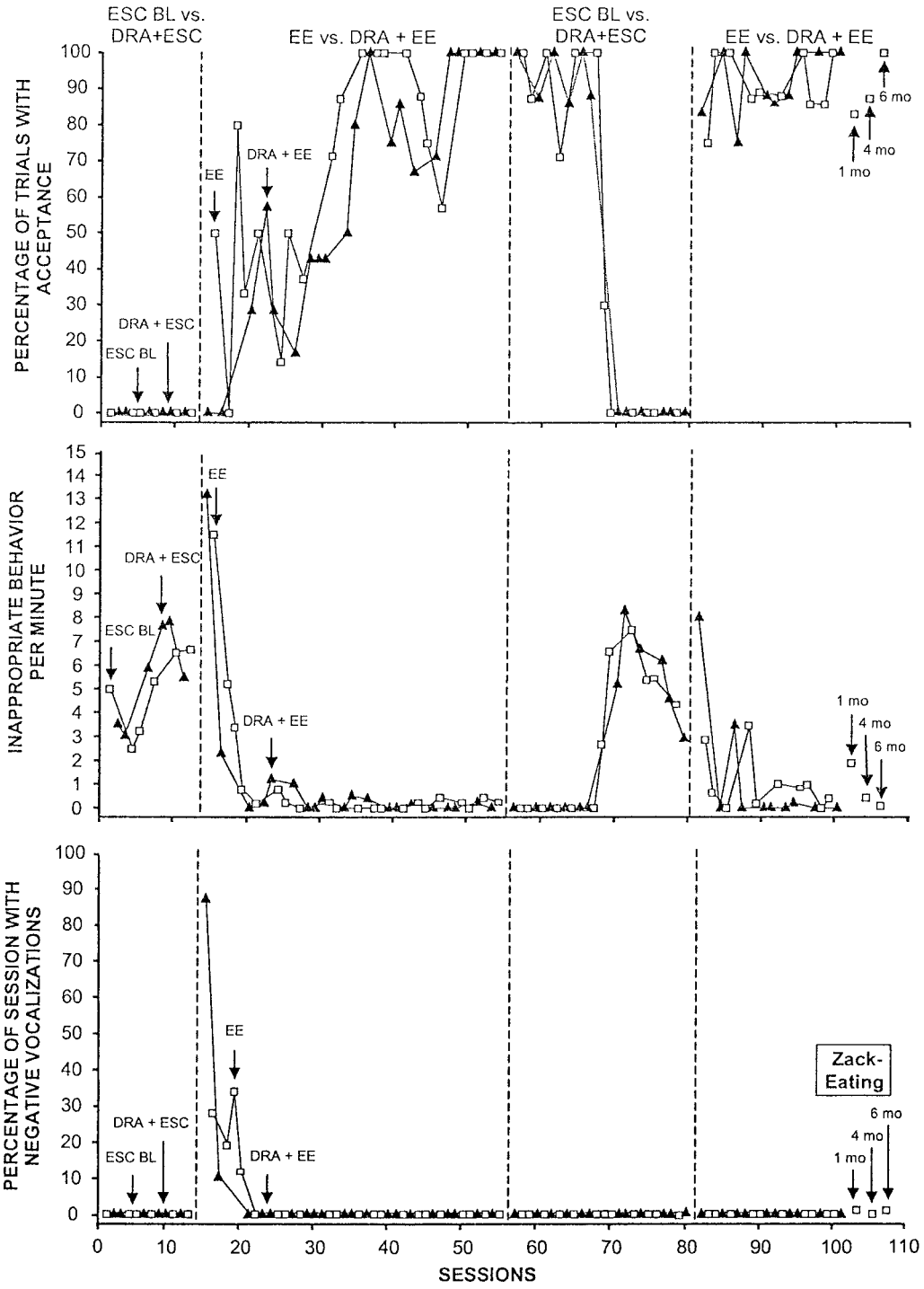

Figure 4. Percentage of trials with acceptance (top panel), inappropriate behavior per minute (middle panel), and percentage of the session with negative vocalizations (bottom panel) for Zack (eating).

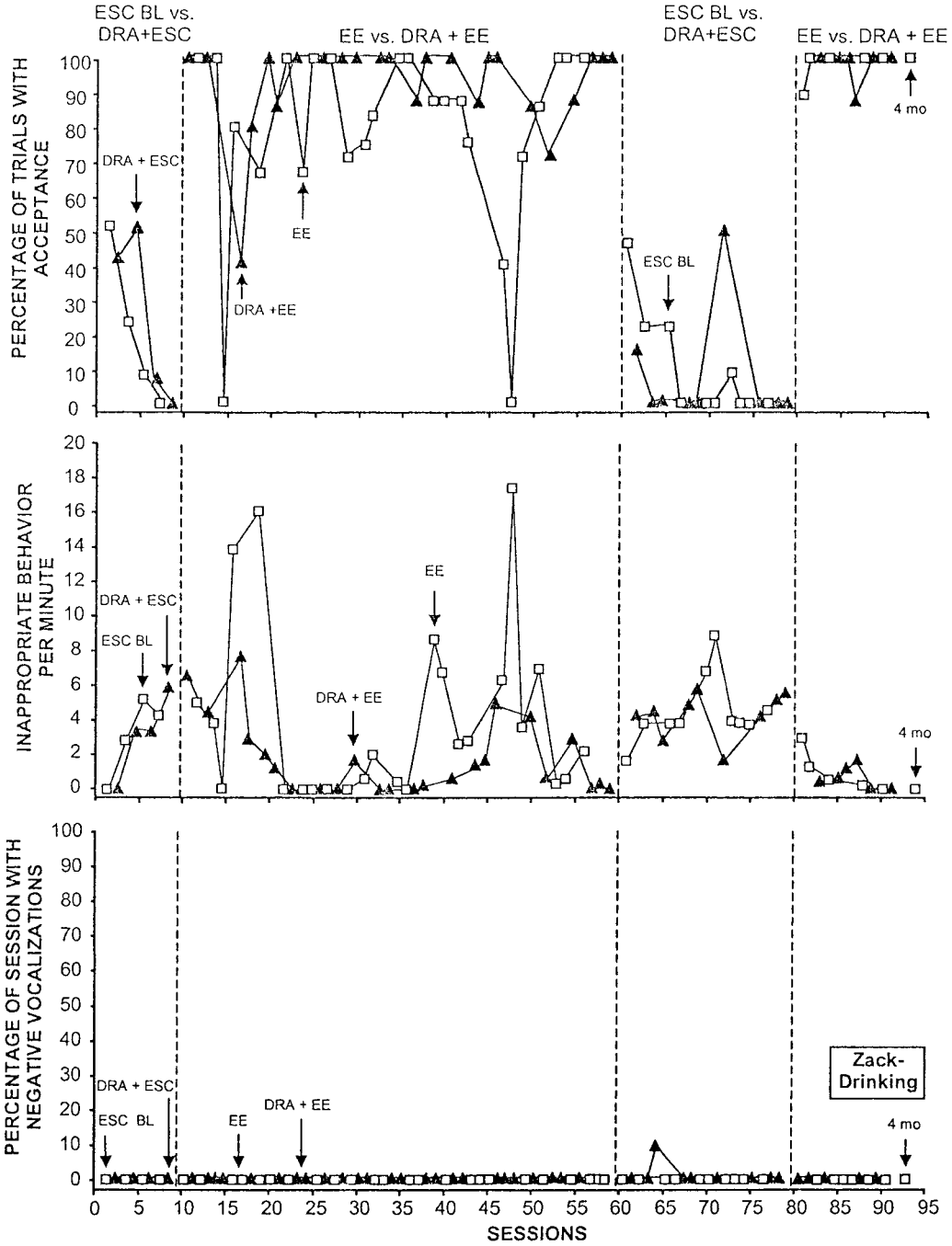

Figure 5. Percentage of trials with acceptance (top panel), inappropriate behavior per minute (middle panel), and percentage of the session with negative vocalizations (bottom panel) for Zack (drinking).

Similarly, Patel et al. (2002) showed that positive reinforcement alone was not effective for increasing the consumption of 3 children with a pediatric feeding disorder. When escape extinction was added to the positive reinforcement treatments, consumption increased for all participants. The data from the current investigation and Patel et

al. are also similar to those of Ahearn et al. (1996) and Hoch et al. (1994). By contrast, Riordan et al. (1980, 1984) reported that positive reinforcement in the form of food was effective in increasing acceptance.

One possible explanation for these discrepant findings is that all of the participants in the current study exhibited total food refusal, resulting in few opportunities to contact the reinforcement contingencies (Hoch et al., 1994). By contrast, the participants in Riordan et al. (1980, 1984) exhibited some level of acceptance and swallowing in baseline. Thus, participants with food selectivity may be more sensitive to differential reinforcement as a result of increased opportunities to contact reinforcement. By contrast, it may be necessary to use escape extinction procedures with children with total food refusal in baseline. However, Riordan et al. (1984) combined positive reinforcement with ignoring, so the relative contributions of reinforcement and ignoring were unclear in that investigation.

The positive reinforcement treatments also may have been ineffective due to the method by which preferred stimuli were selected. Even though the results of preference assessments have been shown to identify effective reinforcers for simple responses (Fisher et al., 1992), the results of preference assessments may not be effective for identifying stimuli that function to increase more complex responses such as eating (Piazza, Fisher, Hagopian, Bowman, & Toole, 1996; Roane, Lerman, & Vorndran, 2001).

Although positive reinforcement did not appear to influence levels of acceptance or mouth clean either alone or when combined with escape extinction, the addition of positive reinforcement to escape extinction may be beneficial for some individuals. For example, levels of inappropriate behavior were lower initially in the DRA plus escape extinction condition relative to escape extinction alone for Chris. In addition, the presence of differential reinforcement in the escape extinction treatment was associated with lower levels of negative vocalizations for Chris during the last phase. Increases in acceptance were higher initially during DRA plus escape extinction relative to escape extinction alone for Cameron, but these differences were not maintained over time. The addition of differential reinforcement to escape extinction was associated with lower levels of negative vocalizations for Cameron. Acceptance was more variable and inappropriate behavior was higher in the escape extinction versus DRA plus escape extinction conditions for Zack (drinking).

Nonremoval of the spoon (Cooper et al., 1995; Hoch et al., 1994) or physical guidance (Ahearn et al., 1996) was used based on parental preference. We conceptualized both procedures as escape extinction based on the hypotheses that (a) the feeding problems of the participants were maintained by negative reinforcement in the form of escape, and (b) both procedures prevented the participants from escaping the feeding situation. Both procedures appeared to produce similar results in terms of treatment effectiveness and effects on other behaviors. For example, even though we used physical guidance for Cameron and nonremoval of the spoon for Zack, both exhibited gradual reductions in behavior preceded by bursts, which is more consistent with extinction than punishment effects (Iwata et al., 1990). By contrast, Zane demonstrated an abrupt decrease in inappropriate behavior with no extinction burst, which is more consistent with punishment, even though nonremoval of the spoon has been conceptualized as escape extinction.

The extent to which nonremoval of the spoon or physical guidance functioned as escape extinction is unknown for a number of reasons. First, the reinforcer for inappropriate behavior was not identified for the participants. Even if we assume that food refusal

was maintained by negative reinforcement, we did not identify the specific properties of eating that established escape as reinforcement (Michael, 1982; Smith, Iwata, Goh, & Shore, 1995). For example, escape from or avoidance of the spoon may have functioned as reinforcement for food refusal for some participants. In these cases, nonremoval of the spoon may have functioned as extinction. By contrast, nonremoval of the spoon may not be an extinction procedure when the establishing operation is food in the mouth. In that case, physical guidance may be necessary to extinguish the relevant escape behavior.

The data from the current investigation provide some information about the effects of extinction as it applies to the characteristics of responding during the treatment of feeding problems (Lerman & Iwata, 1996). One of the most commonly noted attributes of extinction is the extinction burst. Lerman, Iwata, and Wallace (1999) defined the extinction burst as an increase in responding during any of the first three treatment sessions above that observed during all of the last five baseline sessions. Extinction bursts were observed for three of the 10 behaviors measured (i.e., inappropriate behavior and negative vocalizations across five data sets). Increases in agitated or emotional behavior (e.g., crying, pouting, fussing) are another characteristic of responding that has been associated with extinction (Lerman & Iwata, 1996). Increases in negative vocalizations occurred for Chris in the final phase of escape extinction and throughout implementation of escape extinction for Cameron and Zack (eating).

The data from the current investigation suggest a number of avenues for future research. One broad set of research questions should be aimed at continued evaluation of the effects of reinforcement in the treatment of feeding problems. The current investigation suggested that differential positive reinforcement produced idiosyncratic benefits for some participants. However, little is known about the effects of other reinforcement-based procedures such as noncontingent reinforcement and differential negative reinforcement in treatment of feeding problems.

A second broad set of research questions should be aimed at analyzing the functional characteristics of food refusal. Surprisingly few studies have been conducted on the functional analysis of feeding problems, even though such procedures have proven useful in prescribing effective interventions for other behavior disorders (Fisher, Piazza, & Page, 1989; Mace & Lalli, 1991; Piazza, Hanley, & Fisher, 1996; Thompson, Fisher, Piazza, & Kuhn, 1998). Identification of the reinforcers that maintain inappropriate mealtime behavior may prove equally useful for development of treatment for feeding problems.

In conclusion, results of the current investigation are similar to those on the treatment of other behavior problems in that the reinforcement-based procedures did not appear to be effective in the absence of extinction (Iwata, Pace, Cowdery, & Miltenberger, 1994; Mazaleski, Iwata, Vollmer, Zarcone, & Smith, 1993). Nevertheless, the addition of a positive reinforcement component may be helpful in reducing crying or inappropriate mealtime behaviors during escape extinction.

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STUDY QUESTIONS

1. Why might reinforcement-based interventions be more effective for children who exhibit food selectivity than for children who exhibit food refusal?

2. Explain how food refusal as a problem behavior may be maintained by (a) positive reinforcement and (b) negative reinforcement.

3. What were the dependent variables, and how were they defined?

4. Describe the procedures used during baseline conditions.

5. Describe the differential reinforcement (DRA) procedure.

6. What two variations of escape extinction were used, and how were they selected?

7. Briefly describe the general effects of DRA only and escape extinction only on food consumption.

8. What features of the data suggest that (a) extinction and (b) punishment were the mechanisms responsible for behavior change during escape extinction?

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