JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2010, **43,** 673–683 NUMBER 4 (WINTER 2010)

SPOON DISTANCE FADING WITH AND WITHOUT ESCAPE EXTINCTION AS TREATMENT FOR FOOD REFUSAL

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Little is known about the characteristics of meals that serve as motivating operations (MOs) for escape behavior. In the current investigation, we showed that the distance at which a therapist held a spoon from a child's lips served as an MO for escape behavior. Based on these results, we implemented spoon distance fading, compared fading with and without escape extinction (EE), and compared fading plus EE to EE alone. Initially, inappropriate mealtime behavior decreased during fading, but this effect was not maintained as fading progressed. Inappropriate mealtime behavior was lower initially when we combined fading and EE relative to EE alone, but acceptance increased more rapidly with EE than with fading plus EE. These results suggest that a number of mealtime characteristics might function as MOs for escape behavior and that analyses of MOs may be useful for developing treatments for food refusal.

Key words: fading, feeding disorder, food refusal, escape extinction, negative reinforcement, pediatric feeding disorders, stimulus fading

Over two decades of operant research have shown that negative reinforcement plays an important role in the maintenance of pediatric feeding problems (Bachmeyer et al., 2009; Patel, Piazza, Martinez, Volkert, & Santana, 2002; Piazza, Fisher, et al., 2003; Piazza, Patel, Gulotta, Sevin, & Layer, 2003; Reed et al., 2004) and that procedures based on negative reinforcement are effective as treatment (Ahearn, Kerwin, Eicher, Shantz, & Swearingin, 1996; Cooper et al., 1995; Hoch, Babbitt, Coe, Krell, & Hackbert, 1994; Patel et al., 2002; Piazza, Fisher, et al., 2003; Piazza, Patel, et al., 2003; Reed et al., 2004). For example, Piazza, Fisher, et al. conducted functional analyses with 15 individuals with feeding disorders and found that 90% of the participants whose functional analyses were differentiated displayed maintenance by escape from bite presentations. Piazza, Patel, et al. showed that escape extinction produced increases in acceptance and decreases in inappropriate mealtime behavior, whereas differential positive reinforcement (DRA) alone did not.

The fact that escape appears to be such an important reinforcer for children with feeding disorders suggests that some dimension of the mealtime environment serves as a motivating operation (MO, Laraway, Snycerski, Michael, & Poling, 2003) for escape from food presentation. For example, in the escape condition of the Piazza, Fisher, et al. (2003) investigation, therapists presented bites of food on a spoon on

This investigation was supported in part by Grant 1 K24 HD01380-01 from the Department of Health and Human Services, the National Institute of Child Health and Human Development.

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doi: 10.1901/jaba.2010.43-673

a fixed-time 30-s schedule, and inappropriate mealtime behavior (e.g., head turning, batting at the spoon) resulted in removal of the spoon. Presumably, the establishing operation (EO) for escape behavior was related to food presentation (e.g., the spoon, the smell or sight of the food); however, the authors did not identify the specific dimension of the mealtime environment that was aversive.

Smith, Iwata, Goh, and Shore (1995) described a method for evaluating the motivating properties of a stimulus, using self-injurious behavior (SIB) as an exemplar. After identifying nine individuals whose SIB was maintained by escape from instructions, they manipulated various properties of the instructions (e.g., rate, novelty, duration of instructional session) while maintaining constant consequence conditions (i.e., 30 s of escape from instructions). Responding was idiosyncratic in that specific antecedent manipulations functioned as MOs for some behaviors but not others. Results of the study showed that the strategy of manipulating antecedent conditions while maintaining constant consequent conditions was useful for evaluating the motivating properties of stimuli.

Reed, Dolezal, Cooper-Brown, and Wacker (2005) examined the relation between one child's disrupted sleep and food refusal. They observed that food refusal was higher following nights when the child had disrupted sleep, suggesting that disrupted sleep served as an MO for food refusal. This conclusion was tempered by the fact that the child's sleep was not manipulated experimentally (i.e., disrupted sleep was identified post hoc). Mueller, Piazza, Patel, Kelley, and Pruett (2004) showed that food acceptance was higher when therapists presented preferred rather than nonpreferred foods, even though the same consequences were delivered in both conditions. They then used a fading intervention by blending the preferred and nonpreferred foods in specified amounts. The ratio of preferred to nonpreferred food was decreased gradually until participants were consuming the nonpreferred foods in the absence of the preferred foods.

The study by Mueller et al. (2004) suggested that results of MO analyses could be used to prescribe treatment for children with feeding disorders. They used a fading procedure in which one characteristic of a stimulus (food quality) was altered gradually, such that participants continued to respond to the altered stimulus in the same manner as they did to the original stimulus (Terrace, 1963). Although participants accepted preferred but not nonpreferred foods during baseline, they accepted increasing ratios of nonpreferred to preferred foods during treatment and ultimately accepted the nonpreferred foods alone. Fading has been used to alter a variety of food-related characteristics, including volume (Freeman & Piazza, 1998; Hagopian, Farrell, & Amari, 1996; Najdowski, Wallace, Doney, & Ghezzi, 2003), texture or consistency (Babbitt, Shore, Smith, Williams, & Coe, 2001; Johnson & Babbitt, 1993; Shore, Babbitt, Williams, Coe, & Snyder, 1998), and solid (Mueller et al., 2004) or liquid (Patel, Piazza, Kelly, Ochsner, & Santana, 2001) preferences. However, the majority of these studies incorporated multiple treatment components; thus, the individual contributions of any one component were unclear (e.g., Freeman & Piazza, 1998; Johnson & Babbitt, 1993; Mueller et al., 2004; Najdowski et al., 2003; Shore et al., 1998). The purposes of the present investigation were (a) to evaluate the extent to which distance of the spoon from the child's lips functioned as an MO for escape behavior, (b) to examine the efficacy of a fading procedure that consisted of altering the distance of the spoon from the lips during food presentations, (c) to examine the efficacy of fading with escape extinction (EE), and (d) to compare the effects of fading plus EE with EE alone. We chose spoon distance because we observed clinically that caregivers of children with feeding problems engage in tentative feeding behavior (e.g., initially showing the child the spoon before attempting to present the spoon

to the child's lips). In these situations, some children do not exhibit inappropriate mealtime behavior or negative vocalizations until the caregiver presents the spoon closer to the child's lips. This observation coincides with basic research that has shown that distance of an aversive stimulus is negatively correlated with defensive responses in both humans and animals (e.g., Blanchard, Hynd, Minke, Minemoto, & Blanchard, 2001).

GENERAL METHOD

Participants, Setting, and Materials

Three children who had been admitted to a day-treatment program for pediatric feeding disorders participated. A physician cleared all children for oral feeding and ruled out any medical causes for the feeding problem prior to treatment. Sessions were conducted in rooms (4 m by 4 m) equipped with one-way observation windows and sound monitoring. Materials included utensils (e.g., baby spoon, teaspoon), seating equipment (e.g., high chair, booster seat), food trays, gloves, timers, and laptop computers.

Response Measurement and Data Collection

The dependent variables were inappropriate mealtime behavior, acceptance, and negative vocalizations. *Inappropriate mealtime behavior* was defined as turning the head 45 degrees or more away from the spoon, hitting the spoon or the feeder's arm or hand, or covering the mouth. *Acceptance* was defined as the child opening his or her mouth to allow the bite to pass the plane of the lips and enter the mouth within 5 s of the initial bite presentation. *Negative vocalizations* were defined as at least 3 s of crying or whining.

Prior to all data collection, observers were trained by a clinical supervisor and collected training data until they attained at least 80% agreement with a trained observer on three consecutive sessions. Observers used laptop computers to collect data on all dependent measures. Data on inappropriate mealtime behavior were collected using a frequency measure and were converted to a rate (responses per minute) by dividing the number of responses by the number of minutes in the session. The occurrence of acceptance was recorded for each bite presentation (therapist holding the spoon to the child's lips, excluding expelled bites), and these data were converted to a percentage after dividing the number of occurrences of acceptance by the number of bite presentations. Data on negative vocalizations were recorded using a duration measure and were converted to a percentage of total session after dividing the duration of negative vocalizations by the duration of the session.

Interobserver Agreement

Interobserver agreement was assessed by having two observers record data simultaneously but independently during 25%, 24%, and 38% of sessions for David, Ashley, and Oliver, respectively. Interobserver agreement for inappropriate mealtime behavior was calculated by dividing the number of exact agreements (a 10-s interval in which both observers scored the same frequency of inappropriate mealtime behavior) by the number of intervals and converting this ratio to a percentage. Mean agreement was 93% (range, 69% to 100%), 96% (range, 86% to 100%), and 96% (range, 68% to 100%) for David, Ashley, and Oliver, respectively.

Interobserver agreement for acceptance was calculated by partitioning each session into 10-s intervals, dividing the number of intervals during which both observers agreed on the occurrence or nonoccurrence of acceptance by the total number of intervals, and converting this ratio to a percentage. Mean agreement was 99.7% (range, 94% to 100%), 99% (range, 84% to 100%), and 98% (range, 89% to 100%) for David, Ashley, and Oliver, respectively.

Interobserver agreement for negative vocalizations was calculated by dividing the smaller duration by the larger duration and converting this ratio to a percentage. Mean agreement was

98% (range, 80% to 100%), 97% (range, 88% to 100%), and 96% (range, 71% to 100%) for David, Ashley, and Oliver, respectively.

General Procedure

We conducted five meals per day, with approximately 1 to 3 hr between each meal (e.g., 9:00 a.m., 10:30 a.m., 12:00 p.m., 2:30 p.m., 4:00 p.m.). Each meal lasted approximately 30 to 45 min and consisted of several sessions, with 1- to 2-min breaks between sessions. The therapist presented bites to the child for 5 min during all sessions except during EE, when the session continued until the child swallowed the last bite that entered his or her mouth within the initial 5-min session. The therapist presented two foods (vegetable, fruit) to David and Ashley and one food (banana) to Oliver. We selected these foods based on the physician's recommendations. Although none of the children had known food allergies, the physician wanted us to initiate treatment with foods to which the children had been exposed previously and then to introduce new foods later to assess potential allergic reactions. These foods were presented only in feeding sessions and not at other times. The therapist presented foods in a random order across sessions but in a fixed order within each session. The texture of presented food was baby food for Ashley and Oliver and pureed table food for David. The bolus size was a level baby spoon for Ashley and Oliver and a level small maroon spoon for David. Textures, utensils, and bolus sizes were based on the recommendations of the feeding program's occupational therapist.

Across all sessions, the therapist presented bites at the child's midline accompanied by a verbal prompt to "take a bite" approximately every 20 s to 30 s. The therapist delivered praise (e.g., "good job taking your bite") following acceptance. The therapist checked the child's mouth 30 s after a bite entered the child's mouth to determine if the child had swallowed it. The therapist delivered praise (e.g., "good job swallowing your bite") if no food larger than a pea was present in the child's mouth during the first check (the therapist did not deliver praise if the absence of food was due to expulsion). The therapist delivered a verbal prompt (e.g., "swallow your bite") if food larger than a pea remained in the child's mouth and repeated the prompt every 30 s until no food larger than a pea was in the child's mouth. An exception was made for Oliver, who had a history of gagging and vomiting. The occupational therapist recommended not allowing food to remain in Oliver's mouth for extended periods of time; therefore, we removed any food larger than a pea that was in his mouth 1 min after the bite entered his mouth. The therapist talked and played with the child throughout the session (except for David, per parental request).

Pretreatment distance sessions. The purpose of these sessions was to identify a spoon-presentation distance that was associated with low rates of inappropriate mealtime behavior as a starting point for fading. We assessed the child's behavior when the therapist presented the spoon at various distances from the child's lips, which were based on informal assessments conducted with each child prior to the pretreatment assessment. The distances assessed during the pretreatment sessions were 2.5 cm, 12.7 cm, 25.4 cm, and 61 cm for David; 2.5 cm, 12.7 cm, and 25.4 cm for Ashley; and 2.5 cm, 12.7 cm, 25.4 cm, and 38.1 cm for Oliver. We ensured that the therapist presented the spoon at the correct distance by placing small marks with measurements (e.g., 2.5 cm, 12.7 cm) on the child's tray.

General procedures for the pretreatment distance sessions were described above. The therapist placed the spoon at the child's midline at the specified distance from the child's lips, held the spoon for 30 s if the child did not engage in inappropriate mealtime behavior, and presented the next bite at the end of the interval. The therapist removed the spoon for 20 s if the child engaged in inappropriate

behavior and presented the next bite after the 20-s break. We used the distance associated with the lowest level of inappropriate behavior for the distance conditions of the baseline assessment, which were 61.0 cm, 12.7 cm, and 25.4 cm for David, Ashley, and Oliver, respectively.

Lips versus distance baseline. The purpose of this baseline was to establish that presentation of the spoon at the lips was associated with higher rates of inappropriate mealtime behavior relative to presentation at the distance identified in the pretreatment sessions. We used the procedure recommended by Smith et al. (1995) for evaluating the motivating effects of stimuli on behavior. That is, we manipulated the antecedent stimuli (spoon presentations) while holding the consequence for inappropriate mealtime behavior (escape from spoon presentations) constant. Procedures for the lips and distance baselines were identical to those described for the pretreatment distance sessions, except that the therapist presented the spoon at the child's lips in the lips condition.

Fading. The goal of fading was to present the spoon initially from a distance associated with low rates of inappropriate mealtime behavior and then to decrease the distance of the spoon from the child's lips gradually while maintaining low rates of inappropriate behavior. The criterion for decreasing the distance was three consecutive sessions with inappropriate behavior at or below 1 response per minute, negative vocalizations at or below 10% for distances between 61 cm and 4 cm, and acceptance at or above 80% when the spoon was faded to the child's lips (i.e., the only condition in which acceptance could occur). When this criterion was met, the therapist moved the spoon 2.5 cm (Ashley) or 5.1 cm (David and Oliver) closer to the child's mouth. Ashley's fading distances were smaller because her initial fading distance was only 12.7 cm. We used visual inspection of data to determine when to increase the distance of the spoon if the child did not meet the criterion for decreasing the distance. For example, if the child's inappropriate behavior was high and stable when the therapist presented the spoon 25.4 cm from the lips, we increased the distance of the spoon to the lips to the previous fading distance (e.g., 30.5 cm). Throughout this condition, the procedures were identical to those described previously.

Fading plus EE. Fading plus EE was identical to fading except that inappropriate mealtime behavior did not produce escape. The spoon followed the child's lips from the specified distance the entire 30-s interval if the child engaged in inappropriate behavior. Once the distance of the spoon had been faded to the child's lips, the therapist deposited the bite into the child's mouth and re-presented expelled bites. The criterion for fading was identical to that described above. Each time we changed phases, we presented the spoon at the distance implemented in the previous fading phase.

Lips baseline probes. We conducted probes during conditions that included fading to determine if continued fading was necessary (Patel et al., 2001). We conducted these probes using procedures described for the lips baseline condition after the child met criterion for decreasing the distance of the spoon once (Ashley) or twice (David and Oliver) consecutively. We returned to the fading procedure if the child's behavior during the probes did not meet the criterion. We continued with the probes and discontinued fading if the child's behavior met the criterion.

Escape extinction. The therapist followed the procedures described above for EE, but without the fading component.

STUDY 1

The purposes of Study 1 were (a) to evaluate inappropriate mealtime behavior during presentation of the spoon at the lips versus a specified distance from the child's lips when inappropriate behavior produced escape, (b) to determine whether inappropriate behavior would remain low and acceptance would

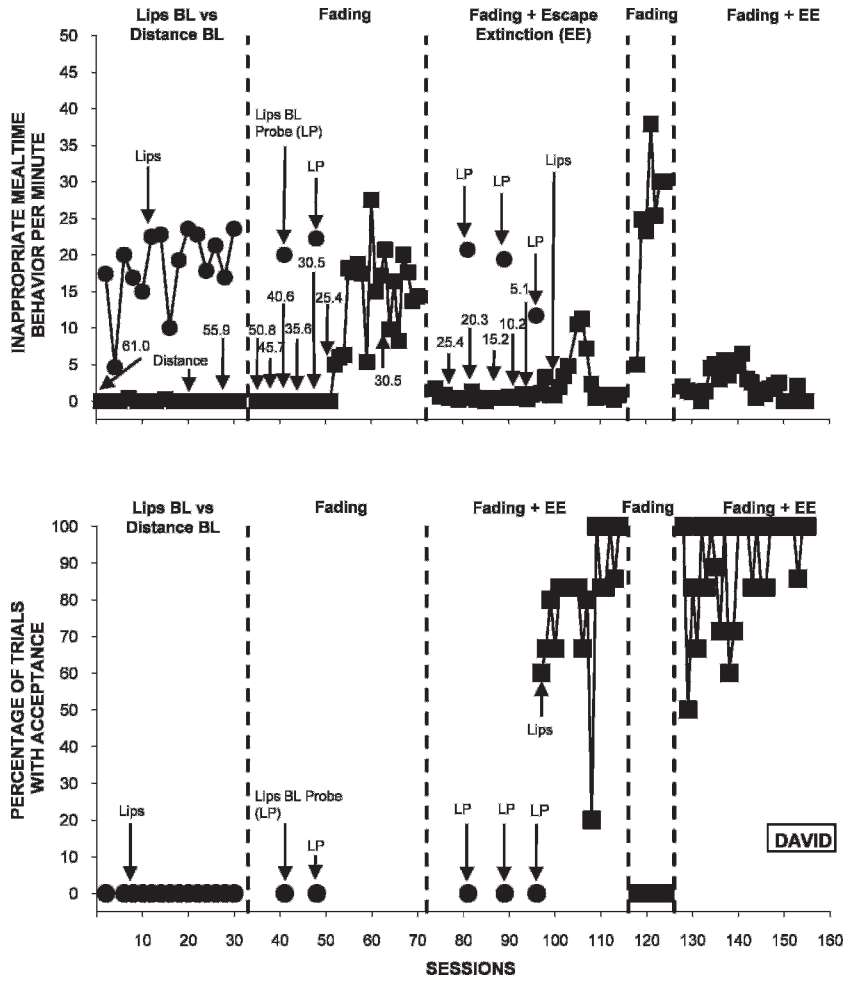

Figure 1. Inappropriate mealtime behavior per minute (top) and percentage of acceptance (bottom) for David.

increase during fading, and (c) to evaluate inappropriate behavior and acceptance during fading plus EE if fading was ineffective.

Participants

David was a 4.5-year-old boy with gastroesophageal reflux disease (GERD), failure to thrive, status post Nissen fundoplication, hypothyroidism, and bronchopulmonary dysplasia. He had been referred for poor oral intake and gastrostomy (G-) tube dependence. Ashley was a 5-month-old girl with typical cognitive development who had been diagnosed with failure to thrive. She had been referred for solid and liquid refusal and G-tube dependence.

Design

We used a combination of multielement and reversal (ABCA′C) designs. Baseline (A) was the comparison of presentation of the spoon at the lips versus a specified distance from the lips with escape as reinforcement for inappropriate mealtime behavior. Next, we introduced fading with periodic lips baseline probes (B). We added EE to fading (C) because fading did not decrease inappropriate behavior to acceptably low rates.

Results and Discussion

Figure 1 depicts the results for inappropriate mealtime behavior and acceptance for David.

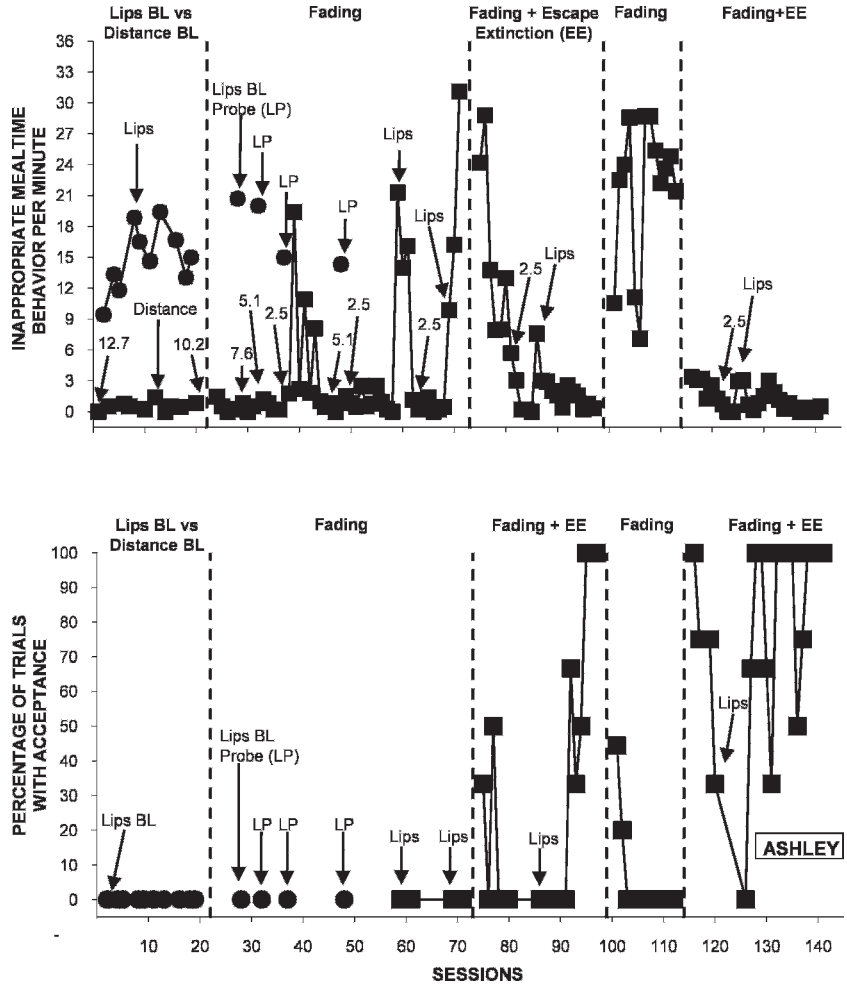

Figure 2. Inappropriate mealtime behavior per minute (top) and percentage of acceptance (bottom) for Ashley.

Figure 2 depicts the results for inappropriate mealtime behavior and acceptance for Ashley. During distance sessions, the child did not have the opportunity to accept bites; therefore, no data for acceptance appear on the graphs during these sessions. Inappropriate mealtime behavior remained high for David ($M = 34.4$ responses per minute) and Ashley ($M = 14.9$ responses per minute) in the lips baseline and low for David ($M = 1.4$) and Ashley ($M = 0.5$) in the distance baseline. We also calculated the percentage of bites escaped during baseline. For each bite presentation, we determined whether an inappropriate mealtime behavior occurred following the bite presentation, divided the number of occurrences of inappropriate behavior by the number of bites presented, and converted the ratio to a percentage. Mean percentage of bites escaped was 100% in the lips baseline and 40% for the distance baseline for David and 100% in the lips baseline and 23% for the distance baseline for Ashley. Acceptance was zero for both children.

Rates of inappropriate mealtime behavior initially were low for both children during fading. However, inappropriate behavior increased as the distance of the spoon from the child's lips decreased and remained high during the lips baseline probes. By contrast, fading plus EE resulted in decreased inappropriate behavior

and increased acceptance for both children. We examined whether the differences in behavior were a function of the rate of bite presentation. Rates of bite presentation were similar during fading (M = 1.8) and fading plus EE (M = 1.7) for David, but were higher during fading (M = 1.8) than during fading plus EE (M = 0.8) for Ashley. The lower rate of bite presentation in EE was a function of the higher rates of inappropriate behavior, which initially interfered with the therapist depositing the bite in Ashley's mouth. It is unlikely that this difference in rate of bite presentation explained the differences in behavior for Ashley. If anything, a higher presentation rate would be expected to be associated with higher rates of inappropriate behavior, which was not the case.

One hypothesized advantage of combining fading with EE is that the addition of fading might mitigate some potential negative side effects of extinction. This may have been the case for David, because inappropriate mealtime behavior decreased immediately when we added EE to fading. By contrast, inappropriate mealtime behavior was higher for Ashley when we added EE to fading, which may have been related to the fact that the spoon had been faded to her lips prior to the introduction of EE. It is possible that rates of inappropriate behavior might have been lower had we introduced EE with the spoon a greater distance from her lips and then faded the distance in combination with EE.

Although the results of Study 1 showed that inappropriate mealtime behavior decreased and acceptance increased during fading plus EE, it was not clear whether we would have observed the same results with EE alone. Therefore, we conducted a multielement comparison of fading plus EE and EE alone in Study 2.

STUDY 2

Participant

Oliver was a 10-month-old boy with typical cognitive development who had been diagnosed with failure to thrive and GERD. He had been referred for food and liquid refusal and G-tube dependence.

Design and Procedure

We used a combination of multielement and reversal (ABA′B) designs. Baseline (A) was a comparison of presentation of the spoon at the lips and 25.4 cm from the lips with escape as reinforcement for inappropriate mealtime behavior. Next, we compared fading plus EE with EE alone with lips baseline probes (B). The procedures for baseline, fading plus EE, and EE were identical to those described above.

Results and Discussion

Figure 3 depicts Oliver's rates of inappropriate mealtime behavior and acceptance. The results for lips versus distance baseline were identical to those of Study 1; rates of inappropriate behavior were higher in the lips baseline (M = 22.5 responses per minute) than in the distance baseline (M = 0.3). Mean percentage of bites escaped was 86% in the lips baseline and 20% in the distance baseline. Similar to the findings for Ashley, the rate of bite presentation was higher during fading plus EE (M = 1.5) than during EE alone (M = 0.6). The lower rate of bite presentation in EE was a function of the higher rates of inappropriate behavior, which initially interfered with the therapist depositing the bite in Oliver's mouth.

We conducted Study 2 to determine whether the addition of fading to EE would mitigate the negative side effects of EE. Fading plus EE did seem to have beneficial effects for Oliver in that fading plus EE was never associated with elevated rates of inappropriate mealtime behavior or negative vocalizations (data available from the second author). By contrast, initial implementation of EE was associated with higher rates of inappropriate behavior and negative vocalizations. However, when we reversed to the lips baseline and returned to the multielement comparison of fading plus EE and EE alone,

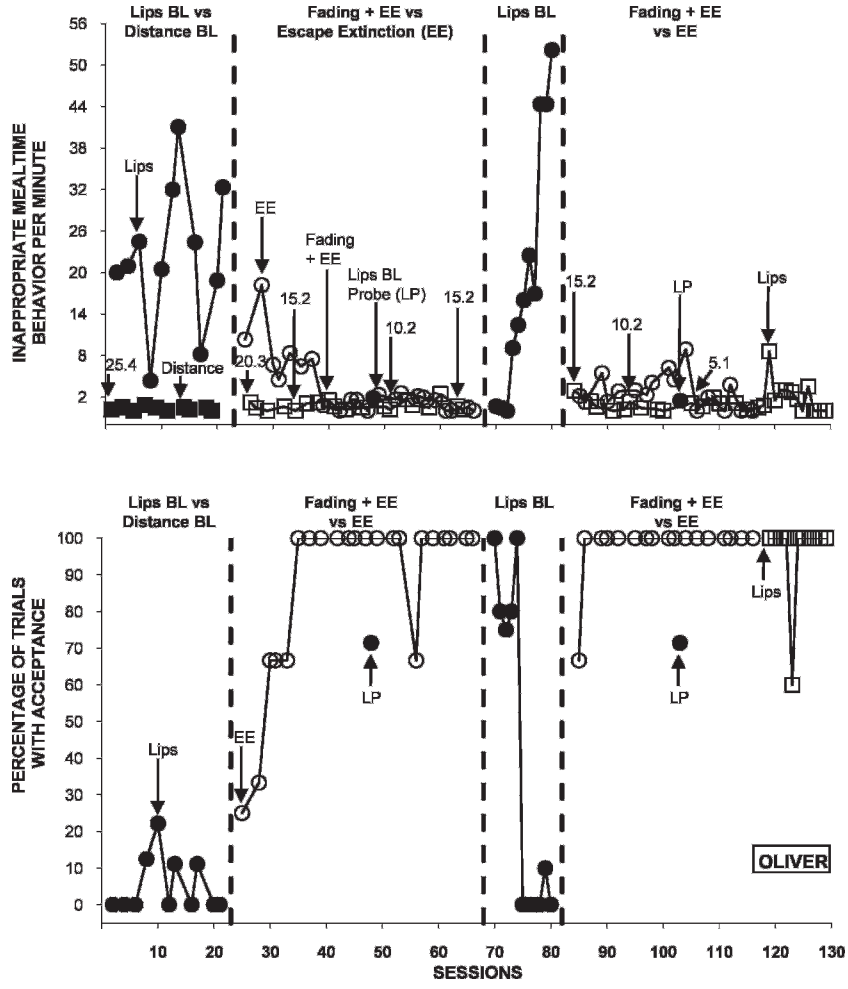

Figure 3. Inappropriate mealtime behavior per minute (top) and percentage of acceptance (bottom) for Oliver.

Oliver's rates of inappropriate behavior were similar in both conditions.

Even though low rates of inappropriate mealtime behavior were achieved quickly in fading plus EE, high levels of acceptance were not. High levels of acceptance (i.e., above 80%) did not occur in fading plus EE until we had conducted 93 sessions, whereas high levels of acceptance occurred in EE after six sessions. One limitation of these data is that fading plus EE and EE alone were implemented in a multielement design. Therefore, it is difficult to determine if the treatments would have been more or less effective if implemented in isolation.

GENERAL DISCUSSION

Although results of previous studies have shown that escape from eating functions as negative reinforcement for inappropriate mealtime behavior, there is little research that has examined specific mealtime characteristics that alter the effectiveness of escape as reinforcement. Recall that Smith et al. (1995) evaluated MOs for SIB by altering the characteristics of demands while maintaining constant consequence conditions. We extended this research by assessing the extent to which spoon distance functioned as an MO for inappropriate mealtime behavior. We varied the distance of the

spoon from the child's lips while providing escape following inappropriate mealtime behavior. Data from this analysis suggested that the presence of the spoon at the lips served as an EO to increase and the presence of the spoon at a distance from the lips served as an abolishing operation to decrease the effectiveness of escape as reinforcement for inappropriate behavior (Michael, 1982).

Next, we used the results of the MO analyses to implement distance fading, which was associated with immediate reductions in inappropriate mealtime behavior. However, inappropriate behavior increased as the distance of the spoon from the lips decreased. These findings correspond with results of previous research on the effects of demand fading without extinction on escape-maintained problem behavior during instructional contexts. For example, Zarcone, Iwata, Smith, Mazaleski, and Lerman (1994) observed a reemergence of problem behavior as fading progressed.

The data for Oliver suggested that fading plus EE was associated with lower rates of inappropriate mealtime behavior, which is consistent with literature that has shown that supplementary procedures (e.g., DRA, noncontingent reinforcement) may be helpful in reducing inappropriate behavior or negative vocalizations during EE (Lerman & Iwata, 1995; Lerman, Iwata, & Wallace, 1999; Piazza, Patel, et al., 2003; Reed et al., 2004). For example, Piazza, Patel, et al. (2003) showed that the addition of DRA to EE resulted in lower rates of inappropriate behavior and negative vocalizations for some participants. These findings may be helpful in expanding the array of treatments available to clinicians. Our clinical experience is that not all caregivers will agree to implement treatments that are associated with high levels of inappropriate behavior or negative vocalizations. In fact, some caregivers may terminate treatment if it "distresses" the child. In these situations, the caregiver may prefer a treatment like fading, even if it is associated with less rapid increases in acceptance. This would be most appropriate for children for whom volume of oral intake is not an immediate concern (e.g., a child with a G-tube).

One disadvantage of fading plus EE was that the time required to produce increases in acceptance was greater than that of EE alone. If rate of improvement is a primary concern (e.g., a child with failure to thrive), then fading plus EE may not be the best treatment option. Future research should examine how mitigation of negative side effects of extinction and treatment efficiency affects acceptability for the different components of the intervention.

Future research should continue to evaluate the role of negative reinforcement in the maintenance of inappropriate mealtime behavior. Data from the current study suggest that analyses of MOs can be used to identify specific characteristics of the meal that may alter the effectiveness of escape as reinforcement; therefore, future research should examine the establishing and abolishing effects of other mealtime variables (e.g., food type, food texture) on inappropriate behavior. Future research also should assess whether analyses of MOs can be used to develop treatments for pediatric feeding disorders in the presence and absence of EE.

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Received August 22, 2008
Final acceptance August 6, 2010
Action Editor, Brian A. Iwata