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LIQUID TO BABY FOOD FADING IN THE TREATMENT OF FOOD REFUSAL

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In the current investigation, we identified two young children who consistently consumed liquids, but not baby food, after treatment with positive reinforcement for mouth clean (an indirect measure of swallowing) and physical guidance with re-presentation of food. We examined the effects of an 11-step stimulus fading procedure that involved gradually altering the concentration of liquid by adding baby food to the liquid. High levels of mouth clean were maintained in both children throughout fading, and increased mouth clean during probes of 100% baby food was obtained after conducting all 11 fading steps with one child and 6 of 11 fading steps with the second child. Negative vocalizations decreased during probes of 100% baby food after conducting the remaining fading steps with the second child. Gram intake of 100% baby food increased with both children after we completed all fading steps. Copyright © 2013 John Wiley & Sons, Ltd.

Investigators have used procedures that prevent escape or avoidance of bites such as non-removal of the spoon, physical guidance, and re-presentation of food to increase acceptance (e.g., Ahearn, Kerwin, Eicher, Shantz, & Swearingin, 1996; Bachmeyer et al., 2009; Cooper et al., 1995; Hoch, Babbitt, Coe, Krell, & Hackbert, 1994; Piazza, Patel, Gulotta, Sevin, & Layer, 2003), decrease expels, and increase swallowing (Ahearn et al., 1996; Coe et al., 1997; Sevin, Gulotta, Sierp, Rosica, & Miller, 2002). Used individually or in combination, these procedures are frequently effective but do not always result in decreased expels and increased mouth clean (a product measure of swallowing; Girolami, Boscoe, & Roscoe, 2007; Patel, Piazza, Santana, & Volkert, 2002). Thus, alternative or complementary procedures may be necessary to increase consumption with some children.

Stimulus fading is one method that clinicians have used to increase acceptance, decrease expels, and increase swallowing when other procedures are ineffective

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(e.g., Patel, Piazza, Kelly, Ochsner, & Santana, 2001; Shore, Babbitt, Williams, Coe, & Snyder, 1998). Consideration of the stimulus conditions under which acceptance, expels, and mouth clean are more *and* less likely to occur may increase the probability that stimulus fading will be effective. Some children engage in consumption or the approximation of consumption behavior in some stimulus conditions but not others (e.g., the child drinks liquids but does not eat solids). In such cases, stimulus fading can be used to transfer control of consumption from the stimulus associated with high levels of consumption to the stimulus associated with low levels of consumption. For example, Shore et al. (1998) identified children who consumed age-inappropriate textures of food but refused age-appropriate textures of food. Shore et al. used stimulus fading to alter the texture of the age-inappropriate food gradually until the children were consuming age-appropriate textures of food. Patel et al. (2001) identified a child who consumed water but not a calorically dense beverage. Patel et al. gradually introduced a high calorie additive and milk to the water until the child was consuming the high calorie beverage. Investigators have used similar stimulus fading procedures to increase the volume of food consumed (Freeman & Piazza, 1998; Hagopian, Farrell, & Amari, 1996; Najdowski, Wallace, Doney, & Ghezzi, 2003), increase consumption of non-preferred solids (Mueller et al., 2004) and liquids (Tiger & Hanley, 2005), increase consumption of liquids from a cup (Groff, Piazza, Zeleny, & Dempsey, 2011), and decrease spoon distance (Rivas, Piazza, Patel, & Bachmeyer, 2010).

Stimulus fading may be useful when children consume liquids but not solids. Johnson and Babbitt (1993) combined stimulus fading with positive reinforcement and putative extinction procedures to treat the food refusal of a child who only consumed liquids via baby bottle. The stimulus fading procedure consisted of presentation of diluted pureed food in a bottle, followed by presentation of undiluted pureed food in a bottle, and then presentation of pureed food on a spoon. Although acceptance of pureed food on a spoon increased, the contribution of stimulus fading to this outcome was unclear for a number of reasons. First, the investigators did not assess baseline levels of acceptance of pureed food on a spoon across all food groups. Second, the investigators introduced positive reinforcement, putative extinction, stimulus fading, and a utensil change simultaneously in the absence of an experimental design that permitted evaluation of the separate and combined effects of these multiple treatment components. Third, the investigators did not describe the components used during the procedure they referred to as extinction; thus, it is not clear what the feeder did during extinction or what the contribution of the putative extinction procedure was to the treatment effect. Fourth, acceptance of pureed food on a spoon maintained at high levels during a withdrawal of positive reinforcement and putative extinction after the investigators completed all fading steps with all food groups. The results obtained by Johnson and Babbitt raise the possibility that stimulus fading from liquids

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to solids may be a viable treatment option for children who accept liquids but refuse solids. However, more work is needed to determine if liquid-to-solid stimulus fading is effective for children who refuse solids but consume liquids.

The purpose of the current study was to replicate and extend the work of Johnson and Babbitt (1993) by systematically examining the effects of a stimulus fading procedure. The two children in the current investigation consistently consumed liquids but not baby food after treatment with positive reinforcement for mouth clean and physical guidance with re-presentation. Therefore, we added a stimulus fading procedure that involved gradually increasing the consistency of liquid until it was similar to baby food, using a constant feeding apparatus (a spoon).

METHOD

Participants and Setting

Two children who had been admitted to an intensive program at a pediatric rehabilitation hospital for the assessment and treatment of feeding problems participated. A physician cleared both children for oral feeding and ruled out any medical reasons for the ongoing feeding problems prior to treatment. Yuri was a 17-month-old male who was admitted for the assessment and treatment of food refusal and gastrostomy (G-) tube dependence. His medical history included esophagitis, gastroesophageal reflux disease (GERD), and failure to thrive. Upon admission, he was receiving 100% of his daily caloric needs via G-tube feedings. He refused solid food but accepted small quantities of water and juices. Kenny was a 4-year-old male diagnosed with Stickler syndrome, Pierre Robin syndrome (a condition associated with a smaller than typical jaw), and developmental delays including deafness, mild cerebral atrophy, and myopia. His medical history included GERD, Nissen fundoplication, a tracheotomy, and cleft palate repair. He was admitted for the assessment and treatment of food refusal and G-tube dependence. Upon admission, he was receiving 100% of his daily caloric needs via G-tube feedings. He refused all solids and liquids by mouth.

Trained therapists conducted all sessions in rooms with one-way observation and sound monitoring. A high chair, feeding utensils, toys, a bib, a timer, and data collection materials were present during all sessions. Because the typical developmental pattern of feeding involves progressing from liquids to baby food and both children had little to no experience with feeding prior to their admission, the program occupational and speech and language therapists recommended a diet consisting of Stage 2 baby foods and nectar-consistency liquids for both children.

Prior to this investigation, therapists implemented positive reinforcement for mouth clean (Patel, Piazza, Martinez, Volkert, & Santana 2002) and physical

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guidance (Ahearn et al., 1996) with re-presentation (Sevin et al., 2002) during sessions that included both Stage 2 baby foods and nectar-consistency juice during 17 (Yuri) and 35 (Kenny) sessions. Yuri and Kenny consistently consumed the nectar-consistency juice. Levels of expels were high (*M*s = 100% and 89% for Yuri and Kenny, respectively) and levels of mouth clean were low (*M*s = 0% and 11% for Yuri and Kenny, respectively) with baby foods. Negative vocalizations occurred during 100% of bites for Yuri. Mean session duration was 53 (Yuri) and 46 (Kenny) min. Mean gram intake of baby food was 0 for both children. We continued to implement positive reinforcement for mouth clean and physical guidance with re-presentation throughout this assessment, and the details of the procedure are presented later.

Response Definitions and Procedure

Trained observers used data collection forms to score the occurrence of acceptance, mouth clean, negative vocalizations, and expels for each bite presentation. Across all conditions, sessions lasted 10 min or until the child accepted and swallowed 20 bites, whichever came first. Therapists conducted four sessions with Kenny at each of three scheduled meals per day (8:30 AM, 12:00 PM, and 3:30 PM). Therapists conducted two sessions with Yuri at each of four scheduled meals per day (9:00 AM, 11:00 AM, 12:00 PM, and 4:00 PM).

The feeder presented 2.5 g of food on a small Mothercare spoon approximately once every 30 to 45 s. Observers scored a *presentation* when the feeder placed the spoon approximately 2.5 cm from the midline of the child's mouth accompanied by a verbal prompt to 'take a bite', not including the placement of the spoon near the mouth following re-presentation. The observer scored *acceptance* if the child opened his mouth so that the feeder could deposit the bite within 5 s of the presentation. The feeder delivered praise for acceptance.

If the child did not accept the bite within 5 s, the feeder applied gentle pressure to the child's mandibular joint with her index finger and thumb at the child's mouth and then deposited the bite into the mouth (physical guidance), unless the child was gagging and crying. In this case, the feeder held the spoon touching the child's lips until the gagging ceased and then deposited the bite. This procedure was based on the recommendations of the occupational and speech and language therapists who stated that depositing the bite while the child was gagging and crying simultaneously might increase the risk of aspiration. The feeder blocked and ignored inappropriate mealtime behavior (i.e., batting at or blocking the spoon, or turning the head 45° or greater away from the spoon).

When the entire bite entered the child's mouth for the first time (i.e., the first time the therapist presented each of the 20 bites), the observer activated a timer for 30 s.

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The therapist said, 'Show me' when the 30-s interval elapsed to determine if the child had swallowed and to provide the observers with the opportunity to score mouth clean or pack. Observers had one opportunity to score mouth clean or pack for each bite presentation and that opportunity occurred 30 s after the bite entered the child's mouth for the first time. Observers scored *mouth clean* if no food or drink larger than the size of a pea was in the child's mouth, unless the absence of food or drink at the 30-s check was due to expulsion. In this case, the observer scored an expel but not mouth clean or pack. The feeder delivered praise and a highly preferred toy on the basis of results of a paired-choice preference assessment (Fisher et al., 1992) for 15 s for mouth clean. The feeder presented the next bite immediately after whichever interval elapsed last, the 15-s access to preferred item or initial 30-s interval. For example, if the child showed that he swallowed 5 s after acceptance, the feeder immediately provided item access for 15 s and waited 10 s to present the next bite (completing the 30-s interval). If the child did not show that he swallowed until the first 30-s check, the feeder delivered reinforcement immediately after the check and waited to present the next bite until the 15-s reinforcement interval elapsed. Child participants complied with the therapist request of the mouth check for the majority of the bites.

If the child had food or drink larger than the size of a pea in his mouth at the first 30-s check, observers scored a *pack*. The feeder prompted the child to swallow, and the observer reset the timer for 30 s. The feeder continued to check the child's mouth and prompt the child to swallow every 30 s until no food or drink larger than the size of a pea was in the child's mouth. However, observers scored pack (and mouth clean) only once per bite presentation; thus, they did not score additional packs during these subsequent mouth checks for the same bite presentation, and they did not score mouth clean if the swallow of the bite occurred after the first 30-s mouth check. If holding food or drink in the mouth occurred when the session time elapsed, the feeder continued to deliver a verbal prompt to swallow for an additional 5 min or until no food or drink larger than the size of a pea was in the child's mouth, whichever came first. The feeder scooped the food or drink out of the child's mouth if more than the size of a pea was present in the mouth following the additional 5 min.

If the child spit out food or drink larger than the size of pea, observers scored an *expel* and the feeder re-presented expelled bites until the child swallowed the bite or 10 min elapsed. During re-presentation, the feeder used the spoon to scoop up the expelled food or drink from the child's face or bib and place it back into the mouth. If expulsion of the bite or drink occurred or food/drink remained in the mouth at the first 30-s check, the therapist re-presented the bite or drink and the observer scored expel when it occurred and pack at the 30-s check. If the child expelled the bite or drink, the therapist re-presented the bite or drink, and the child had no food or drink larger than the size of a pea in his mouth at the first 30-s check, the observer

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scored expel when it occurred and mouth clean at the 30-s check. If the child expelled the bite or drink, the therapist re-presented the bite or drink, and the child had no food or drink larger than the size of a pea in his mouth at the first 30-s check because he continued to expel throughout the interval, the observer scored expels when they occurred and neither mouth clean nor pack at the 30-s check.

Observers scored *negative vocalizations* once per presentation if the child cried or whined at any time after the bite presentation and before the next bite presentation. Kenny did not display negative vocalizations; thus, data are only shown for Yuri.

Acceptance and negative vocalization data were converted to a percentage after dividing the number of bites in which the behavior occurred by the total number of bites presented. Expels and mouth clean data were converted to a percentage after dividing the number of bites in which the behavior occurred by the total number of bites that entered the child's mouth. *Grams consumed* were measured using a Tanita 1475T scale and calculated as pre-session food or drink weight minus post-session food or drink weight minus spill (post-session weight of paper towels and bib absorbed with liquid and food minus pre-session weight of paper towels and bib).

Liquid versus Baby Food Baseline

The therapist presented nectar-consistency apple juice or Stage 2 baby food applesauce (a food that therapists presented, but the child did not consume during the previous intervention) in sessions conducted in a random order. We made the nectar-consistency apple juice by adding 6.2 cc of Thick-It® to each 59.2 cc of apple juice. The therapist presented apple juice and baby food applesauce in order to keep flavor constant and alter only one dimension (consistency) as opposed to altering both flavor and consistency.

Liquid to Baby Food Fading

Fading from nectar-consistency apple juice to Stage 2 baby food applesauce involved gradually increasing the consistency of liquid on the spoon until it was similar to a baby food consistency. The fading procedure included 11 steps (Table 1). The first step involved offering only nectar-consistency apple juice. The method for making the nectar-consistency apple juice remained the same throughout fading, 6.2 mL of Thick-It to 59.2 mL of apple juice. The fading procedure involved adding baby food to the nectar-consistency apple juice. Steps 2 through 7 involved offering a concentration of an additional 2.5 g of Stage 2 baby food applesauce per 59.16 mL of nectar-consistency apple juice at each successive step. Steps 8 through 10 involved offering a concentration of an additional 2.5 g of Stage 2 baby food applesauce to a volume of nectar-consistency apple juice that was decreased by 14.8 mL at each successive step. The final step

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Table 1. Liquid to baby food fading.

Fading step	Nectar-consistency[a] apple juice (mL)	Stage 2 baby food (g)
1	59.2	00.0
2	59.2	02.5
3	59.2	05.0
4	59.2	07.5
5	59.2	10.0
6	59.2	12.5
7	59.2	15.0
8	44.4	17.5
9	29.6	20.0
10	14.8	22.5
11	00.0	25.0

[a]The formula for making the nectar-consistency apple juice was 59.2 mL of apple juice mixed with 6.2 cc of Thick-it. The therapist then mixed the nectar-consistency apple juice with Stage 2 baby food in the proportions indicated earlier.

involved offering only Stage 2 baby food applesauce. The criterion for fading to the next step was three consecutive sessions with acceptance and mouth clean at or above 80% and expels at or below 20%. We included an additional criterion of negative vocalizations at or below 20% for Yuri following fading Step 6 because of continued high levels of negative vocalizations. After every two successful fading steps, the therapist conducted a probe of 100% Stage 2 baby food applesauce to assess if continued fading was necessary.

Interobserver Agreement

A second observer simultaneously but independently collected data during 35% and 60% of sessions for Yuri and Kenny, respectively. Interobserver agreement for the target behaviors of acceptance, expel, mouth clean, and negative vocalizations was assessed on a bite-by-bite basis and calculated by dividing the number of agreements (occurrence and nonoccurrence) by the total number of agreements (occurrence and nonoccurrence) plus disagreements and converting the ratio to a percentage. An occurrence agreement was defined as a bite in which both observers scored the occurrence of a target behavior. A nonoccurrence agreement was defined as a bite in which the observers did not score the occurrence of the target behavior. A disagreement was defined as a bite in which one observer scored the occurrence of and the other observer did not score the occurrence of the target behavior. Mean agreement for acceptance was 100% and 99.8% (range, 99% to 100%) for Yuri and Kenny, respectively. Mean agreement for expels was 94% (range, 86% to 100%) and 98% (range, 90% to 100%) for Yuri and Kenny, respectively. Mean agreement for mouth clean was 97% (range,

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93% to 100%) and 100% for Yuri and Kenny, respectively. Mean agreement for negative vocalizations was 98% (range, 87% to 100%) for Yuri.

Two observers simultaneously but independently recorded food, liquid, and spill weights from the scale before and after sessions and calculated gram intake as defined earlier for 35% and 60% of sessions for Yuri and Kenny, respectively. Interobserver agreement for gram intake was calculated on a session-by-session basis by dividing the number of agreements by the total number of agreements plus disagreements and converting the ratio to a percentage. An agreement was defined as a session in which both observers calculated identical gram intake. A disagreement was defined as a session in which the two observers calculated differing gram intake. Mean agreement for gram intake was 100% for both children.

Experimental Design

A multi-element design was used to compare the effects of consistency, nectar-consistency liquid versus Stage 2 baby food, on behavior using a constant presentation method (spoon). A brief experimental design with mini-reversals (Kennedy, 2005; Wacker, Berg, Harding, & Cooper-Brown, 2004) was used to evaluate the effects of gradually fading from spoon presentations of nectar-consistency liquid to Stage 2 baby food. The initial A phase was the Stage 2 baby food condition of the multi-element comparison. The liquid to baby food fading comprised each B phase. Individual sessions of 100% baby food after every two fading steps provided repeated mini-reversals to the 100% baby food baseline (i.e., repeated A′ phases).

RESULTS

Figure 1 depicts Yuri's mouth clean (top) and expels (bottom). Figure 2 depicts Yuri's negative vocalizations (top). The data for acceptance are not depicted but are available from the first author upon request. Levels of acceptance ($M = 95\%$) and mouth clean ($M = 79\%$) were high, and expels ($M = 23\%$) and negative vocalizations ($M = 27\%$) were low during the 100% nectar-consistency apple juice baseline. Mean acceptance was 57% during the 100% Stage 2 baby food applesauce baseline, mouth clean was 0%, and expels and negative vocalizations were 100%. Grams consumed (Figure 2, bottom) were higher during the 100% nectar-consistency apple juice baseline ($M = 15.2$) compared with the 100% Stage 2 baby food applesauce baseline ($M = 0.3$).

Acceptance and mouth clean remained above 80% ($M = 96\%$ and 99%, respectively), and expels remained below 20% ($M = 2\%$) during fading Steps 1 through 6 with Yuri with the exception of one session at fading Step 3 in which acceptance was below

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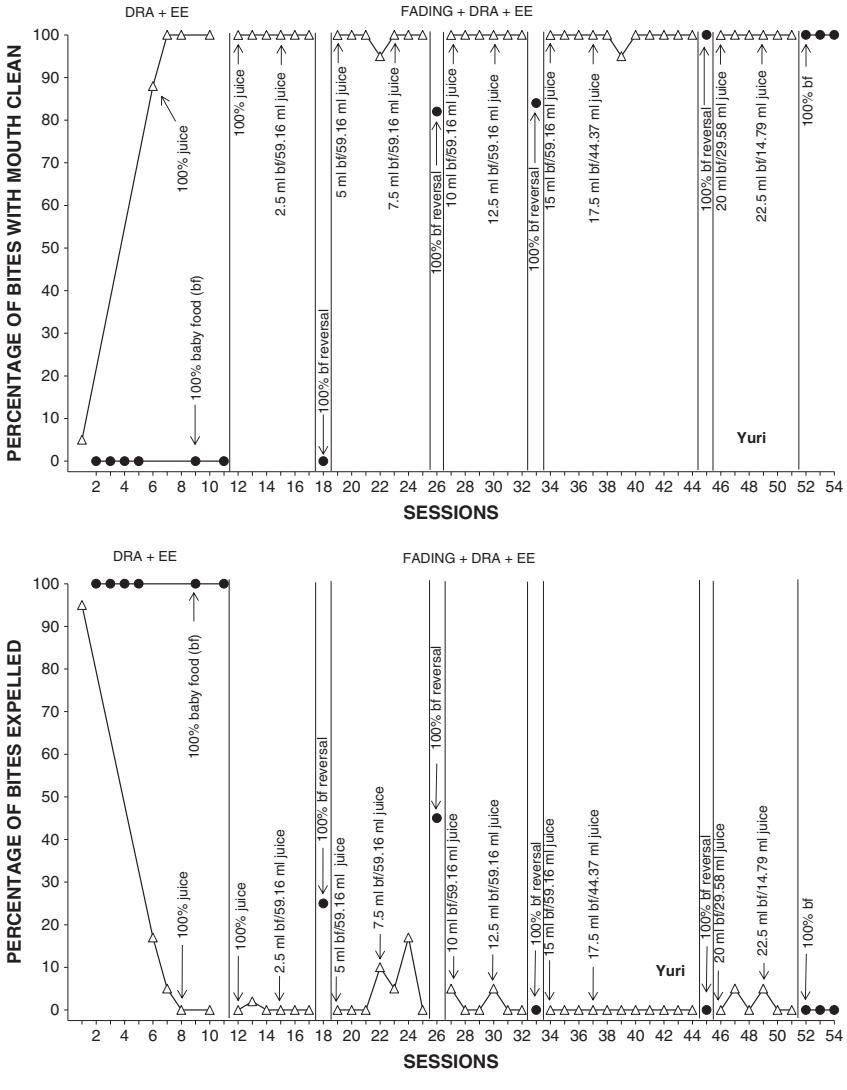

Figure 1. Percentage of bites with mouth clean (top) and percentage of bites expelled (bottom) for Yuri.

80%. Thus, criteria were met within four sessions at Step 3 and three sessions at all other steps between 1 and 6. During the mini-reversal sessions of 100% Stage 2 baby food applesauce following fading Steps 2 and 4, acceptance remained high (100% and 91%, respectively), and mouth clean increased (0% and 82%, respectively), but expels remained high (25% and 45%, respectively). Acceptance and mouth clean remained high (100% and 84%, respectively), and expels decreased (0%) during the mini-reversal session following fading Step 6, but negative vocalizations remained high (75%).

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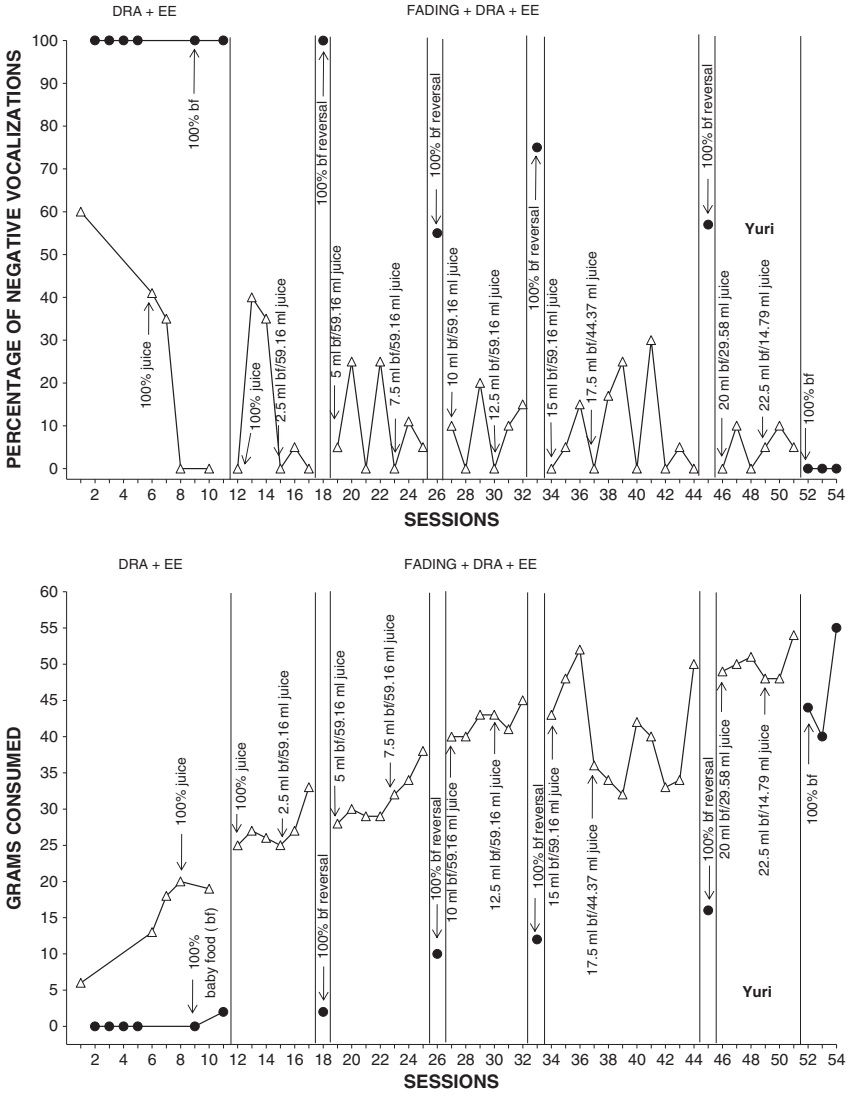

Figure 2. Percentage of bites with negative vocalizations (top) and grams consumed (bottom) for Yuri.

Therefore, we continued fading with an additional fading criterion of three consecutive sessions with negative vocalizations at or below 20%. Acceptance and mouth clean remained at or above 80% ($M = 99\%$), and expels and negative vocalizations remained at or below 20% ($M = 0.6\%$ and 7%, respectively) during fading Steps 7 through 10, except for two sessions at Step 8 with negative vocalizations between 20% and 30%. Thus, Yuri met the revised criterion within three sessions at Steps 7, 9, and 10 and

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within eight sessions at Step 8. Acceptance and mouth clean remained at 100%, and expels remained at 0% during the mini-reversal session of the 100% Stage 2 baby food applesauce following Step 8, but negative vocalizations remained high at 57%. During this session, the therapist was not able to present all 20 bites to Yuri because of the high level of negative vocalizations and the simultaneous occurrence of gagging. Therefore, grams consumed were lower for this session relative to the previous and subsequent fading sessions. Negative vocalizations decreased and remained at 0% during three consecutive sessions with 100% Stage 2 baby food applesauce (the terminal fading step) once the therapist conducted all fading steps. Acceptance and mouth clean remained at 100%, and expels remained at 0% during the final sessions of 100% Stage 2 baby food applesauce. Grams consumed remained higher during fading ($M = 38.3$ g) compared with mini-reversal sessions of 100% Stage 2 baby food applesauce ($M = 10$ g). Grams consumed increased with 100% Stage 2 baby food applesauce ($M = 46.3$ g) once the therapist completed all fading steps.

Figure 3 depicts Kenny's mouth clean (top) and expels (bottom). Levels of acceptance and mouth clean were high ($M = 95\%$ and 98%, respectively), and levels of expels were low ($M = 1.7\%$) during the 100% nectar-consistency apple juice baseline. Acceptance remained high ($M = 85\%$), but mouth clean remained low ($M = 0\%$), and expels remained high ($M = 100\%$) during the 100% Stage 2 baby food applesauce baseline. Grams consumed (Figure 4) were higher during the 100% nectar-consistency apple juice baseline ($M = 7.7$) compared with the 100% Stage 2 baby food applesauce baseline ($M = 0$).

Acceptance and mouth clean remained above 80% ($M = 99\%$), and expels remained below 20% ($M = 3\%$) throughout fading Steps 1 through 10 with Kenny, except for one session at Step 8 with expels at 38%. Thus, Kenny met criteria within four sessions at Step 8 and within three sessions at each of the other fading steps. Because of therapist error, the therapist conducted four sessions at Step 4 with Kenny, even though he met criteria within three consecutive sessions. Acceptance remained above 80% ($M = 98\%$), but mouth clean remained below 80% ($M = 27\%$), and expels remained at 100% during mini-reversal sessions of the 100% Stage 2 baby food applesauce throughout fading. Mouth clean of 100% Stage 2 baby food applesauce (the terminal fading step) immediately increased and remained at 100% once the therapist completed all other fading steps, and expels decreased to at or below 20% within three sessions. The apparent high levels of expulsion during the first 100% baby food session after we completed fading are, to some extent, an artifact of the data collection method. The data show that mouth clean and grams consumed increased even though percentage of expels was 100%. These data suggest that Kenny was expelling bites but then swallowing re-presented bites within 30 s of the bite entering his mouth. Although the total number of expels per bite probably decreased at this point, the data collection system was not sensitive to the change because observers scored the occurrence or nonoccurrence of expel for each bite

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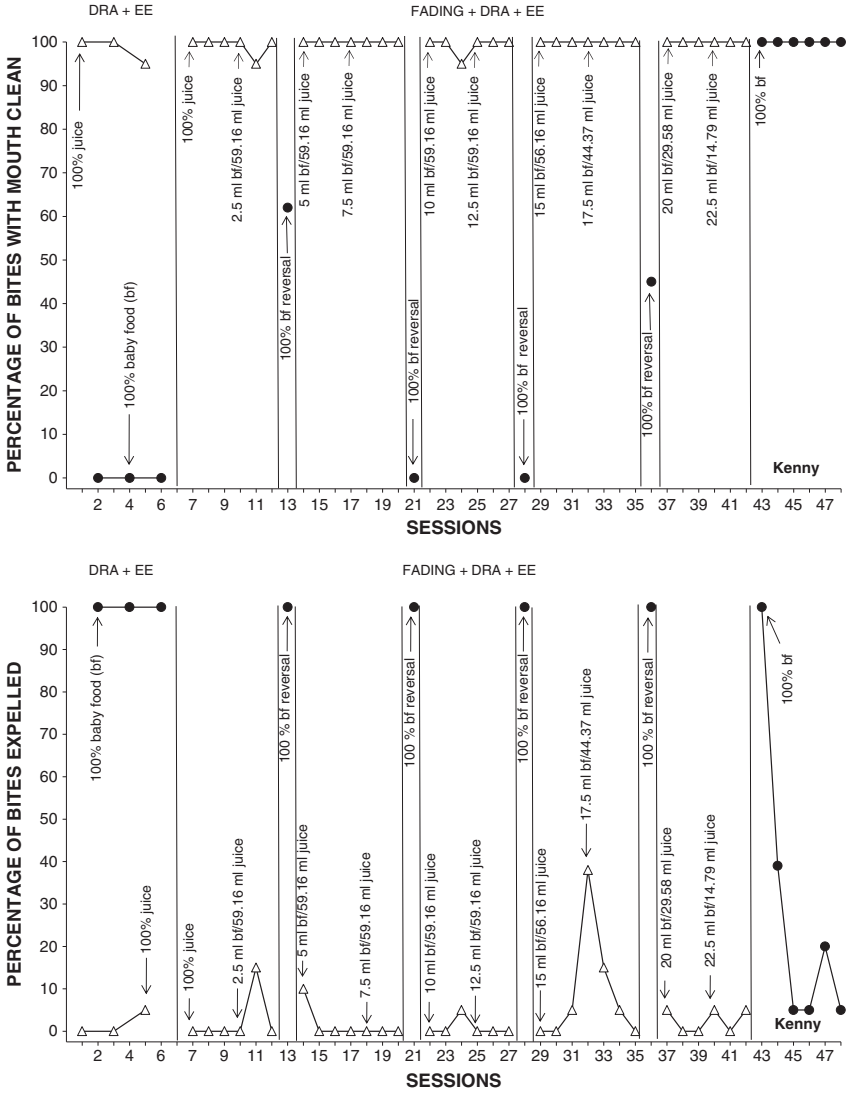

Figure 3. Percentage of bites with mouth clean (top) and percentage of bites expelled (bottom) for Kenny.

presentation. Grams consumed remained higher during fading ($M = 12.7$ g) compared with mini-reversal sessions of 100% Stage 2 baby food applesauce ($M = 4.5$ g). Grams consumed increased with 100% Stage 2 baby food applesauce ($M = 16.5$ g) once the therapist completed all fading steps.

The therapist introduced an additional 16 Stage 2 baby foods (i.e., a variety of fruits, vegetables, starches, and meats) successfully with both children after the liquid

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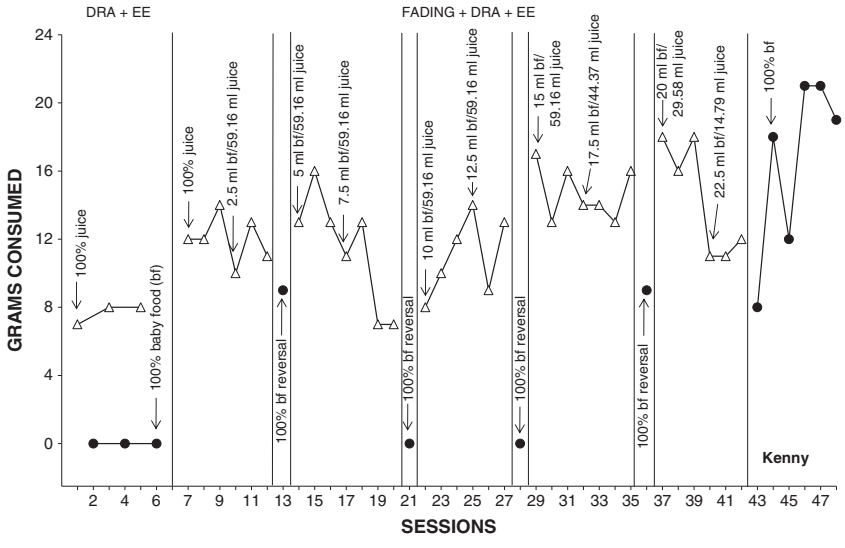

Figure 4. Grams consumed for Kenny.

to baby food fading treatment. Mean acceptance and mouth clean were 100%, and mean expels were 0% for both children. Mean negative vocalizations were 0% for Yuri. Data are available from the first author upon request. Upon discharge, Yuri and Kenny were consuming 100% and 67%, respectively, of their daily caloric needs through oral feedings of baby food and nectar-consistency liquid.

DISCUSSION

The purpose of this study was to investigate the use of fading to increase consumption of baby food when other procedures were ineffective and liquid consumption had been established. Prior to this study, both children consumed liquid from a cup and accepted but expelled baby food from a spoon following an intervention that included positive reinforcement, physical guidance, and re-presentation of expelled liquid or food. We conducted a subsequent analysis in which we compared levels of mouth clean, expels, grams consumed, and negative vocalizations during presentations of nectar-consistency apple juice versus applesauce baby food on a spoon. In this analysis, levels of expels were high, and levels of mouth clean were lower during baby food relative to liquid presentations, resulting in a higher level of liquid consumption for both children. The baseline comparison identified a condition under which spoon presentations resulted in high levels of consumption (i.e., nectar-consistency juice on a spoon) for both children and thus provided a starting point for stimulus fading.

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For both children, levels of each dependent measure were clinically acceptable during each phase of fading, but the magnitude of responding for all three dependent measures for Kenny, and at least three of four dependent measures for Yuri, *immediately* changed to counter-therapeutic levels during each mini-reversal to 100% baby food. Although levels of expels decreased and levels of mouth clean increased for Yuri over the course of the mini-reversals, his continued high levels of negative vocalizations and lower gram intake in those sessions necessitated the continued use of fading.

These data demonstrate one of the many challenges of the clinical treatment of children with feeding disorders in that a variety of appropriate (e.g., acceptance and mouth clean) and inappropriate (e.g., expels, crying, and vomiting) behavior may influence the extent to which the child has clinically acceptable eating behavior. Therefore, it may be necessary to assess responding across multiple measures on a continuous basis. In this case, it was important that clinically acceptable improvement occurred simultaneously across *all* dependent measures to ultimately treat the feeding problems of these two children.

This study replicates and extends the pilot work of Johnson and Babbitt (1993) by using a stimulus fading procedure that altered the concentration of liquid by adding baby food to the liquid. The Johnson and Babbitt study was limited because they did not (a) demonstrate functional control of the fading procedure, (b) isolate the effects of consistency (liquid versus solid) relative to a change in feeding apparatus (bottle versus spoon), or (c) describe the procedural components of the intervention in a manner sufficient for replication. The current findings extend the work of Johnson and Babbitt in three important ways. First, we conducted mini-reversals of 100% baby food on a spoon throughout fading, which replicated baseline levels of behavior and thus demonstrated functional control of fading. In the current study, we conducted mini-reversals only periodically to minimize potential negative carry over from the mini-reversals to the fading procedure. Fading is a process in which changes are made in a stimulus such that the individual does not detect the changes. Thus, conducting repeated baseline sessions of escape extinction and positive reinforcement may negatively affect the fading process if those sessions enhance the child's discrimination of the changes being made during fading. In addition, most caregivers do not find it acceptable to repeatedly conduct interventions (i.e., the 'baseline' escape extinction and positive reinforcement treatment) that we have shown to be ineffective as was the case for these two children. Given the length of exposure to extinction and reinforcement without treatment effects for both children (17 sessions with Yuri and 35 sessions with Kenny) prior to fading, it seems unlikely that improvement during the baseline mini-reversals to 100% baby food was a result of extinction or mere exposure. These differences between the fading intervention and the mini-reversals are consistent with the brief experimental design and

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demonstrate both the treatment effects of the fading intervention as well as the need to continue the fading process.

In addition, we used positive reinforcement and physical guidance with re-presentation during all conditions, demonstrating the additive effects of stimulus fading. Second, we used a constant feeding apparatus (spoon) throughout fading, demonstrating the effects of fading along one (consistency) rather than two (consistency and feeding apparatus) stimulus dimensions. Third, we provided a technological description of our treatment components, which will allow researchers and clinicians to replicate these procedures.

These data suggest that when other procedures are ineffective at increasing consumption of baby food and liquid consumption has been established, fading may be a viable alternative or adjunctive treatment. This is important clinically because not all caregivers will agree to implement treatments that are associated with high levels of inappropriate behavior (e.g., expels) or negative vocalizations, particularly if increases in desired behaviors (e.g., accepting and swallowing) do not occur immediately (Rivas, Piazza, Kadey, Volkert, & Stewart, 2011). For example, the mother of the child in the Rivas et al. study was reluctant to feed her son because he engaged in high levels of negative vocalizations during meals. Similarly, both children in the current study engaged in high levels of expels, and Yuri engaged in high levels of negative vocalizations during presentations of solids, which resulted in meals being more unpleasant for feeders and unproductive in that the child consumed less. In these situations, the caregiver may prefer a treatment like fading, even if it is associated with less rapid increases in consumption (Rivas et al., 2010). These data are important because they provide empirical support for this specific fading procedure, thus broadening the array of treatment options that clinicians can offer to families of children who refuse solids but consume liquids.

Within the emerging body of literature on fading treatments for feeding problems, procedures have been limited to fading across food texture (Shore et al., 1998), food volume (Freeman & Piazza, 1998; Hagopian et al., 1996; Najdowski et al., 2003), food and liquid type (Mueller et al., 2004; Patel et al., 2001; Tiger & Hanley, 2005), feeding utensil (Groff et al., 2011), and spoon distance (Rivas et al., 2010). There are numerous antecedent variables within the mealtime context that may influence the occurrence of mealtime behavior, and we cannot assume that results with particular antecedent dimensions (e.g., spoon distance) in the extant literature can be generalized across other antecedent dimensions (e.g., consistency) of the mealtime context. The challenges presented by children with feeding disorders are also varied, and fading across different antecedent dimensions may influence various mealtime problems differently. For example, texture fading may be effective for increasing a child's consumption of higher textures of food, but only if the child is already consuming lower textures of food. By contrast, texture fading may not be an appropriate treatment for a child who refuses to accept any solid food. In the current

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investigation, the liquid to solid fading procedure was appropriate for these two children because they consumed liquids but not solids. Thus, although the process of stimulus fading (i.e., making small, incremental changes in a stimulus) may be similar when it is implemented across different antecedent dimensions of the mealtime context, the purpose of, procedures for, and results of these various stimulus fading treatments for feeding problems are dissimilar, much like demand fading is dissimilar to restraint fading in the treatment of self-injurious behavior. That is, researchers would not conclude that the demonstration of an effective demand fading procedure as treatment for self-injurious behavior mitigates the need for an empirical demonstration of restraint fading as treatment for self-injurious behavior. Similarly, the successful demonstration of one type of fading as treatment for a specific type of feeding problem (e.g., texture fading for texture selectivity) does not mitigate the need for a demonstration of an alternative type of fading treatment for a different type of feeding problem (e.g., liquids to solids fading for solid refusal). Therefore, the existing body of literature does not yet fully delineate which of the numerous antecedent dimensions of the mealtime context stimulus fading is effective in treating the various challenging behaviors exhibited by children with feeding problems, under what conditions the various procedures are effective, and the mechanisms responsible for these effects. Consequently, more extensive work continues to be warranted on this topic.

One limitation of this study is that we only demonstrated the effectiveness of stimulus fading with one food with two participants. We were able to present additional flavors of Stage 2 baby foods immediately after we completed fading with applesauce. Presumably, the important dimension of the fading procedure was consistency, rather than flavor. Therefore, it stands to reason that once the children were swallowing one Stage 2 baby food, they would be able to swallow others. However, we did not demonstrate this empirically. Future studies should assess the necessity of fading along the dimensions of consistency and flavor with additional participants.

Second, because this was a clinical demonstration of the effects of stimulus fading on the consumption of solid food, we do not know why expels occurred with baby food and not liquid. One possible explanation is that baby food functioned as an establishing operation to increase and liquid functioned as an abolishing operation to decrease the effectiveness of escape or avoidance as reinforcement for expels (Michael, 1982). Additionally, different levels of response effort may be required to manipulate and swallow liquid and baby food. Another potential contributing factor may be whether the prerequisite skills necessary to successfully transition from liquid to baby food are present (Christopherson & Hall, 1978).

The underlying mechanism responsible for the effectiveness of treatment is also unclear. It is possible that stimulus fading produced a change in the motivating operation of escape or avoidance as negative reinforcement for expelling baby food. In addition, the individual role of stimulus fading is unknown because treatment

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involved combining stimulus fading with positive reinforcement plus physical guidance with re-presentation. The data from the baseline assessment of liquid versus baby food and the ongoing mini-reversal sessions of 100% baby food during fading showed that positive reinforcement plus physical guidance with re-presentation was not effective for increasing consumption of baby food. Therefore, it is reasonable to conclude that stimulus fading was either effective alone, or its efficacy may have occurred in combination with positive reinforcement plus physical guidance with re-presentation. An alternative explanation for the effectiveness of fading may be the children's oral motor skills improved with experience. Future research should examine fading from liquid to baby food, physical guidance with re-presentation, and positive reinforcement individually and in combination. More research also is needed to better understand the role of skill and motivation in the acquisition of baby food consumption using stimulus fading.

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