*COMPARISON OF UPRIGHT AND FLIPPED SPOON PRESENTATIONS
TO GUIDE TREATMENT OF FOOD REFUSAL*

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The current study examined the effects of bite placement with a flipped versus upright spoon on expulsion and mouth clean (product measure of swallowing) in the treatment of 3 children diagnosed with a pediatric feeding disorder and oral-motor deficits. For all 3 participants, extinction in the form of nonremoval of the spoon led to improvements in inappropriate mealtime behavior and acceptance of bites; however, re-presentation did not reduce expulsion or improve mouth clean. Results showed a lower level of expulsion and higher percentage of mouth clean during flipped spoon presentations and re-presentations for all participants. Findings from follow-up analyses supported transitioning back to an upright spoon in all 3 cases, although the time required for this to occur differed across participants.

Key words: alternating treatments, antecedent manipulation, bite presentation, expulsions, escape extinction, flipped spoon, pediatric feeding disorders, oral-motor deficits

Escape extinction in the form of nonremoval of the spoon (NRS) or physical guidance is a well-supported treatment for chronic food refusal among children with pediatric feeding disorders (e.g., Patel, Piazza, Martinez, Volkert, & Santana, 2002; Piazza, Patel, Gulotta, Sevin, & Layer, 2003). Both procedures increase food acceptance by targeting inappropriate mealtime behavior (e.g., pushing away food; head turning) maintained by negative reinforcement (i.e., escape from bite presentations). That is, the feeder persists with a bite presentation by keeping food at the lips (NRS) or guiding the mouth open using gentle jaw pressure (physical

guidance), thereby eliminating escape. For children with minimal or no oral intake, escape extinction promotes exposure to food and increases the probability of contact with the primary and secondary reinforcement associated with eating (Hoch et al., 2001). However, alternative topographies of food refusal, such as pushing bites out of the mouth (i.e., expulsion), holding food in the mouth (i.e., packing), gagging, or vomiting, may persist (Girolami, Boscoe, & Roscoe, 2007) or arise during the course of treatment (Gulotta, Piazza, Patel, & Layer, 2005) despite improvements in acceptance. In such cases, social consequences may not maintain these behaviors, but they may persist as a result of an oral-motor deficit. Additional behavioral interventions may be necessary to establish swallowing.

Re-presentation, or recovering expelled food and placing it back into the mouth, represents an additional form of escape extinction that has

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been demonstrated to increase consumption when frequent expulsion maintained by negative reinforcement disrupts consumption in some cases (Ahearn, Kerwin, Eicher, Shantz, & Swearingin, 1996; Coe *et al.*, 1997). For example, Ahearn *et al.* (1996) reported improvement in acceptance and a decline in expulsion associated with the use of re-presentation in combination with both NRS and physical guidance for two of three children with chronic food refusal. Expulsion remained unchanged for a third participant, and the authors did not evaluate the relative contribution of re-presentation to address expulsion. Coe *et al.* (1997) examined the relative impact of different treatment elements on the percentage of trials with acceptance, expulsion, and swallowing for two children with food refusal and gastrostomy (G-) tube dependence. During treatment, the authors sequentially introduced a series of procedures to address different refusal topographies (*i.e.*, refusal to accept, expulsion). Treatment involving NRS plus differential reinforcement (DRA) increased acceptance and improved swallowing for one participant, but expulsion remained high in both cases. The addition of re-presentation of expelled bites to the NRS plus DRA package reduced expulsions to near zero levels and increased swallowing for both children.

Treatment that involves continual presentation and re-presentation of food minimizes escape and ensures contact with food until swallowing occurs; however, packing may still hinder intake (Gulotta *et al.*, 2005; Sevin, Gulotta, Sierp, Rosica, & Miller, 2002) or expulsion may persist despite the use of this treatment element (Ahearn *et al.*, 1996; Girolami *et al.*, 2007). For example, Sevin *et al.* (2002) and Gulotta *et al.* (2005) reported increased packing following the use of a treatment package that consisted of either NRS or physical guidance plus re-presentation to address total food refusal. In both studies, swallowing was achieved only after the introduction of a redistribution procedure that typically involved collecting food held in the mouth and placing it

onto the tongue using a Nuk brush at 15-s intervals. Although the operant mechanism responsible for this effect was not isolated in either study, Gulotta *et al.* noted that, if packing represents refusal topography for avoiding consumption, then redistribution may function as a form of positive punishment for packing (*i.e.*, holding food in the mouth is followed repeatedly by food placement of tongue) or negative reinforcement (*i.e.*, improved intake occurring as a result of learning to avoid the procedure by swallowing). Avoidance of the procedure, however, did not appear to be responsible for improvements in swallowing for two of the four participants in Gulotta *et al.* Although food remained in the mouth for less time, the children required one to two redistributions per bite (on average) to produce a swallow. Improvements also did not remain after the procedure was removed, with packing increasing for all four participants. Given this combination of factors, Gulotta *et al.* asserted that, in some cases, redistribution may facilitate swallowing by helping with bolus formation and placement on the tongue, but it may not necessarily result in permanent skill acquisition or function as a form of extinction for packing. These studies, however, did not evaluate the relative contribution of bite placement on swallowing, expulsion, or packing.

Results from recent studies (Girolami *et al.*, 2007; Sharp, Harker, & Jaquess, 2010; Volkert, Vaz, Piazza, Frese, & Barnett, 2011) highlight the potential contribution of bite placement on the tongue to improve swallowing when used in combination with other behavioral elements. Girolami *et al.* (2007) demonstrated that, after acceptance stabilized through the use of NRS, presenting and re-presenting bites with a Nuk brush resulted in decreased expulsion when compared to bites presented and re-presented with an upright spoon. The authors also noted that, although expulsion improved via the altered presentation method, the behavior persisted even with the re-presentation contingency, suggesting

that expulsion likely was not maintained exclusively by negative reinforcement. By the end of treatment, Girolami et al. reported that expulsion remained low following the transition back to a spoon for the initial presentation; however, the researchers continued re-presentation with a Nuk brush, and no follow-up assessment was conducted after the reintroduction of the upright spoon to clarify whether placement with a Nuk brush was necessary to promote swallowing in the long term. In addition, the length of time necessary to reintroduce the upright spoon was not evaluated systematically.

Sharp et al. (2010) compared the effectiveness of different presentation methods (upright spoon vs. flipped spoon vs. Nuk brush) in decreasing expulsion and increasing mouth clean without the use of re-presentation during treatment of a child with food refusal and oral-motor deficits. Prior to the analysis, a treatment package that consisted of NRS and noncontingent access to preferred items was associated with improvements in acceptance and inappropriate mealtime behavior during meals. The child, however, expelled all bites, and no mouth cleans were observed. Altering bite presentation to include placement onto the middle of the tongue with the flipped spoon or Nuk brush increased mouth clean and decreased expulsion. Expulsion and mouth clean remained relatively unchanged with the upright spoon. However, changes in bite presentation did not lead to clinically significant improvements in these behaviors during the analysis.

Volkert et al. (2011) evaluated the use of a flipped spoon in a treatment package that consisted of redistribution and swallow facilitation to address packing. Swallow facilitation involved the application of downward pressure on the back of the tongue while simultaneously dragging the flipped spoon forward. Prior to the introduction of swallow facilitation, NRS was effective in increasing acceptance; however, packing emerged when the texture of the food was increased. For both participants, packing

decreased (and mouth clean concurrently increased) with the implementation of the flipped spoon treatment package. The level of improvement varied across participants. One participant achieved zero levels of packing, and packing was lower but remained variable for the second participant. The authors hypothesized that oral-motor deficits may have contributed to the second participant's more gradual response to treatment (vs. learning to avoid the flipped spoon by swallowing), noting that he appeared to require the aid of the flipped spoon to swallow.

The available research indicates that modifying bite placement, in combination with consequence-based procedures, may improve swallowing among some children with pediatric feeding disorders who also have oral-motor deficits. Past studies have varied in the level of improvement documented with a flipped spoon, and research has yet to evaluate whether the use of modified bite placement can be eliminated following clinically significant improvements in oral intake. The purpose of the current study was to extend Sharp et al. (2010) by comparing the effectiveness of different presentation methods (upright spoon vs. flipped spoon) in decreasing expulsion and increasing mouth clean in a treatment package that also included re-presentation for expulsion. We also sought to reassess the impact of bite placement on mouth clean and expulsion at discharge and during follow-up visits to evaluate the transition back to an upright spoon over time.

METHOD

Participants, Setting, and Materials

The participants were three children who had been admitted to an intensive interdisciplinary day-treatment program for the assessment and treatment of chronic food refusal and 100% G-tube dependence. Joshua and Jimmy were 2-year 1-month-old twin brothers whose medical history included prematurity, bronchopulmonary dysplasia (BPD), gastroesophageal reflux

disease (GERD), development delay, and visual impairment. Greg was a 2-year 9-month-old boy whose medical history includes prematurity, GERD, BPD, patent ductus arteriosus, developmental delay, cerebral palsy, and Grade 4 intraventricular hemorrhage following birth. In all three cases, inappropriate mealtime behavior and frequent expulsions consistently hindered adequate consumption. Prior to admission, a swallow study and occupational therapy examination indicated that all three children could swallow smooth pureed-texture foods safely, but they also noted difficulty retaining food in the mouth due to tongue protrusions, drooling, or limited lip closure.

Trained therapists conducted sessions in rooms (3 m by 3 m) equipped with one-way mirrors and an adjacent observation room for data collection. Each treatment room included a high chair (Joshua and Jimmy) or booster seat (Greg), food, table, feeding utensils (small maroon spoons; plastic coated baby spoon), bib, serving tray, and a scale with an intake log.

Data Collection and Interobserver Agreement

The primary dependent variables were expulsion and mouth clean. *Expulsion* was defined as the presence of food greater than the size of a pea visible outside the mouth after the bite entered the child's mouth, and included instances when a child actively pushed food from the mouth as well as when it passively dripped out. *Mouth clean* was defined as no residual food larger than the size of a pea remaining inside the mouth within 30 s after the food initially was deposited. We did not score a mouth clean if the child's mouth was clean due to an expulsion at the 30-s mark. We recorded the frequency of expulsion and the occurrence or nonoccurrence of mouth clean for each bite. During all meals, a trained observer collected data on a computer using an event-recording program. A trial began when the feeder deposited a bite in the mouth and ended when no food larger than pea size was visible in the mouth. Within a trial, we coded expulsion

following initial presentation as well as subsequent expulsion following re-presentation. We divided the number of expulsions by the number of trials conducted in each session to yield the average number of expulsions per bite. We calculated the percentage of bites with mouth cleans by dividing the number of trials in which this behavior occurred by the total number of bites that entered the mouth and converting that number to a percentage.

An independent observer collected reliability data using the same event-recording program for 30%, 30%, and 27% of the sessions for Joshua, Jimmy, and Greg, respectively. Exact agreement coefficients were calculated by dividing the number of agreements on the occurrence of a behavior by agreements plus disagreements and multiplying by 100%. We defined an exact agreement as both observers recording the same frequency of a target response in a given 10-s interval. Mean interobserver agreement for expulsion was 96% (range, 80% to 100%) for Joshua, 95% (range, 79% to 100%) for Jimmy, and 94% (range, 83% to 100%) for Greg. Mean interobserver agreement for mouth clean was 95% (range, 82% to 100%) for Joshua, 98% (range, 58% to 100%) for Jimmy, and 96% (range, 83% to 100%) for Greg.

Design

We compared mouth clean and expulsion across upright and flipped spoon presentations using alternating treatments and reversal designs. A was treatment with an upright spoon, B was the presentation assessment comparing the flipped spoon to the upright spoon (initial and discharge), and C was treatment with a flipped spoon. The number of phases during treatment differed across participants (Joshua, ABCBCBCA; Jimmy, ABCBA; and Greg, ABCBCBA).

Procedure

Admission lasted 8 weeks (Monday through Friday), and we conducted one 30-min and three 45-min meal blocks each day. Thirty

minutes separated the breakfast and morning snack meal blocks, lunch occurred 45 min after the morning snack, and dinner took place 2.5 hr after lunch. We divided meal blocks into five-bite sessions, with three to nine sessions conducted per meal. The number of sessions conducted during a meal block varied based on expulsion. Although it was possible, we did not terminate a session prior to completing all five bites due to expulsion or packing within the allotted time, ending all meals based on the time allotted for that block.

We identified highly preferred leisure items (e.g., toys and videos) using a paired-choice preference assessment (Fisher et al., 1992). Access to these items was dependent on the treatment protocol (described below). We presented a total of 16 foods (four fruits, four vegetables, four starches, and four proteins) that caregivers had nominated, under the guidance of a registered dietician, to match the family's eating patterns. For each meal, the feeder randomly selected one food from each group and presented these four foods (in random order) at a pureed texture. The order of presentation remained the same within a given session.

Treatment with upright spoon. All treatment packages included NRS and re-presentation of expulsion with a bolus size of 1 cc per bite presented on a small maroon spoon. With NRS, the feeder placed the spoon at the child's lips, followed the lips with the spoon in response to head turning (i.e., moving the head more than 45° away from the spoon), blocked disruptions (e.g., pushing away the spoon, touching the feeder's arms), and deposited the bite immediately once the mouth was open. If the child expelled the bite, the feeder re-presented the food by quickly scooping the bolus from the face or bib with the spoon and placing it back into the mouth. The feeder continued to re-present the bite until it was retained. Once the bite entered the child's mouth, the feeder checked the mouth every 30 s, unless an expulsion (and re-presentation) was

occurring, using a three-step prompting procedure (i.e., verbal: "show me"; gestural: "show me like this" plus modeling opening the mouth; physical: "show me" plus gentle pressure applied to the side of the teeth with a baby spoon). Movement through this sequence occurred in 5-s intervals. If the child packed the bite (i.e., held it in the mouth longer than 30 s), the feeder continued to check for the presence of food in the mouth every 30 s until no food larger than pea was visible, at which time the feeder immediately presented the next bite. If a child continued to pack a bite of food at the end of the allotted time for a meal block, the protocol consisted of removing the bite from the mouth and terminating the meal; however, this did not occur during the analysis. The feeder provided verbal praise (i.e., "Great job taking your bite") if the child accepted the entire bite within 5 s of the initial presentation and when no food larger than the size of a pea was visible in the child's mouth regardless of time (clean mouth). In addition, the feeder provided Joshua and Jimmy with noncontingent access to preferred items throughout the meal. Greg's treatment package involved DRA for acceptance, with the feeder providing access to a preferred item for 20 s after Greg accepted the bite regardless of time.

Initial comparison of flipped spoon and upright spoon presentation. To assess the impact of bite presentation method on expulsion and mouth clean, we compared the upright spoon to the flipped spoon. The analysis occurred after 12 days in treatment for Jimmy and Joshua and 30 days of treatment for Greg. The lag between the onset of treatment and the initial presentation assessment reflected the length of time required to achieve stability in 5-s acceptance and inappropriate mealtime behavior during treatment with an upright spoon using the protocol described above. The time required for Greg's behavior to reach stabilization also was affected by illness during the admission.

The feeder presented all bites at midline using a bolus size of 1 cc. We alternated

presentation methods between sessions, with the order randomly selected prior to each meal. The intervention packages described above remained in place throughout the analysis for all three children. The feeder re-presented expelled bites in the same manner as the initial presentation for each bite. During upright spoon presentations, the feeder immediately deposited the bite after the child opened his mouth and closed the lips around the spoon or instantaneously scraped the bolus on the upper lip or teeth if necessary due to an open mouth posture and lack of lip closure. During flipped spoon presentations, the feeder placed the spoon midline following acceptance, flipped the spoon over 180°, and deposited the food onto the middle of the tongue by applying gentle downward pressure along with a concurrent wiping motion, dragging the spoon toward the lips. We used small maroon spoons during upright spoon presentations, which was the utensil selected at the onset of treatment for all participants. We changed the utensil to a coated baby spoon during flipped spoon presentations due to pragmatic considerations regarding the ease of turning the spoon inside the mouth (i.e., the spoon is narrower, particularly at the handle).

Treatment with flipped spoon. We used the results of the presentation assessment to select the optimal presentation method based on differentiation in the level of mouth clean and expulsion favoring the flipped spoon. We then initiated bolus fading to maximize the volume of food presented on the spoon. During this process, the feeder systemically increased bite volume (1 cc, 2 cc, 4 cc, 5.4 cc) using the following decision rule: 75% or more sessions meeting preestablished criteria for two meal blocks. The criteria included 80% or greater 5-s acceptance and mouth cleans, as well as low rates of expulsion (≤ 1) and inappropriate mealtime behavior (≤ 2) per bite. We modified Greg's bolus fading criteria to involve slightly less stringent criteria (i.e., one meal block rather than two; moving from a level to a heaping bolus) to maximize volume while considering

the length of time remaining in treatment. During this process, we also added a DRA for mouth clean to Joshua's protocol after he experienced a decline in mouth clean when the bolus was increased to 5.4 cc, and we were unable to regain stability by reducing the bolus size. This involved the feeder providing access to a preferred item for 20 s after food no longer was visible in Joshua's mouth regardless of time. No such modifications were necessary for Jimmy and Greg. For all three participants, we also addressed additional treatment goals (e.g., caregiver training, generalization) during this phase after the terminal bite size was achieved.

Discharge comparison of flipped spoon and upright spoon presentation. Near the end of the admission, we conducted a second presentation assessment to determine if treatment gains could be maintained after the transition back to an upright spoon. The analysis occurred after 34 days in treatment for Joshua, 25 days in treatment for Jimmy, and 39 days in treatment for Greg. Variation in the timing of the second assessment reflected the length of time required to achieve stability in behavior at the terminal bite volume (including inappropriate mealtime behavior and negative vocalizations) and to address additional treatment goals. We implemented the same overall structure as the first presentation assessment. The intervention packages developed over the course of treatment remained in place throughout the analysis (NRS plus DRA for clean mouth plus re-presentation for Joshua; NRS plus noncontingent access plus re-presentation for Jimmy; NRS plus DRA for acceptance plus re-presentation for Greg). The discharge presentation assessment also involved the bite volume achieved during bolus fading (about 5.4 cc).

Follow-up analysis. Stability following treatment was assessed during follow-up clinic visits conducted 2 months, 5 months, and 9 months after discharge for all three participants. An additional follow-up visit was conducted with Greg at 3 months. Meals were conducted by

primary caregivers during follow-up appointments.

After the participants had been discharged from the day-treatment program, we asked caregivers to complete a 45-item questionnaire that assessed three broad measures of social validity (i.e., program satisfaction, treatment gains, social acceptance) rated on a 5-point Likert-type scale (1 = *quite dissatisfied/totally disagree/definitely not*; 5 = *extremely satisfied/totally agree/definitely*).

RESULTS

Data on mouth clean and expulsion are depicted in Figures 1 through 3 for all participants. The figures display the last 10 sessions of treatment with the upright spoon prior to the initial presentation assessment. All participants demonstrated increased acceptance and decreased inappropriate mealtime behavior per bite during meals in response to the multicomponent treatment package with the upright spoon (data not shown). Despite improvement in acceptance and inappropriate mealtime behavior, a high level of expulsions per bite interfered with intake for all three participants ($M = 12$, range, 9.3 to 15.2 for Joshua; $M = 5.4$, range, 3.2 to 9.5 for Jimmy; $M = 2.9$, range, 2.3 to 3.7 for Greg). Joshua and Jimmy demonstrated low levels of mouth clean ($M = 12.4\%$, range, 0% to 30% for Joshua; $M = 44.1\%$, range, 0% to 80% for Jimmy) during upright spoon presentations. Greg's percentage of bites with mouth clean was variable ($M = 80\%$, range, 40% to 100%).

During the initial presentation assessment, all three participants experienced significant improvements in mouth clean ($M = 90\%$, range, 60% to 100% for Joshua; $M = 78.3\%$, range, 40% to 100% for Jimmy; $M = 95\%$, range, 80% to 100% for Greg), which coincided with a decline in the mean number of expulsions per bite ($M = 1.2$, range, 0.6 to 2.0 for Joshua; $M = 2.2$, range, 1.4 to 3.8 for Jimmy; $M = 1.3$, range, 0 to 2.0 for Greg) during presentations

and re-presentations with the flipped spoon. Mouth clean and expulsion remained unchanged with the upright spoon. We noted no difference in gram consumption between presentation methods across sessions (data available from the first author). The average session duration across all three participants was greater with the upright spoon ($M = 410$ s, range, 214 s to 581 s) than with the flipped spoon ($M = 273$ s, range, 199 s to 426 s) during this phase, indicating that the participants required more time to complete five bites while consuming approximately the same volume of food with the upright spoon.

Based on the results of this initial assessment with all three participants, we selected the flipped spoon as the sole presentation method for use during treatment and when fading the bolus. Given the relative length of this treatment phase (Joshua: 103 sessions; Jimmy: 156 sessions; Greg: 230 sessions), the figures summarize data for each bite volume. To calculate this, we divided the number of expulsions by the total number of trials per bite volume to yield an average number of expulsions for each volume. We calculated the percentage of bites with mouth clean for each bite volume by dividing the number of trials on which this behavior occurred by the total number of bites that entered the mouth for a particular volume and converting that number to a percentage. All three participants achieved a bite volume equal to about 5.4 cc by the end of this phase. Percentage of bite with mouth clean ($M = 98.2\%$, range, 90% to 100% for Joshua; $M = 100\%$ for Jimmy; $M = 99.6\%$, range, 90% to 100% for Greg) and mean number of expulsions per bite ($M = 1.9$, range, 0.4 to 3.3 for Joshua; $M = 0.9$, range, 0.1 to 2.4 for Jimmy; $M = 0.5$, range, 0 to 1.6 for Greg) remained stable at this volume of intake for more than 150 bite presentations prior to the discharge presentation assessment. Increased oral intake resulted in significant feeding tube reductions for all three participants (51% reduction for Joshua, 62% reduction for

Figure 1. Percentage of trials with mouth clean (top) and mean number of expulsions per bite (bottom) for Joshua. The first flipped phase presents the averages for each bite volume, summarizing a total of 230 sessions (2 cc: 77 sessions; 4 cc: 84 sessions; 5.4 cc: 69 sessions). PA = presentation assessment.

Jimmy, and 47% reduction for Greg). For Jimmy and Greg, cup drinking also contributed to their intake during meals, a goal addressed for Joshua during follow-up outpatient visits.

During the presentation assessment conducted before discharge, mouth clean and the mean number of expulsion per bite remained unchanged with the flipped spoon for all three participants; however, the children differed in their response to bites presented with an upright spoon. All three children experienced an increase in mean number of expulsions per bite during bites presented with an upright spoon. Joshua and Jimmy also experienced an initial drop in mouth clean. For Joshua, mean number of expulsions per bite remained high and stable

($M = 10.7$, range, 8.2 to 12.4) and mouth clean remained variable ($M = 40\%$, range, 20% to 60%) for bites presented with an upright spoon throughout the analysis. Levels of both behaviors were similar to those observed during the initial presentation assessment. We discontinued the assessment after a clear pattern of stability to address additional treatment goals (i.e., caregiver training; generalization) prior to discharge. During Joshua's final day of admission (5 days later), we conducted a brief reassessment after parent training and generalization were complete. Behaviors with both methods of presentation remained unchanged during these six sessions. We resumed treatment with a flipped spoon following both analyses.

Figure 2. Percentage of trials with mouth clean (top) and mean number of expulsions per bite (bottom) for Jimmy. The first flipped phase presents the averages for each bite volume, summarizing a total of 156 sessions (2 cc: 28 sessions; 4 cc: 8 sessions; 5.4 cc: 120 sessions). The second upright phase presents the average of forty sessions per point, summarizing a total of 200 bite presentations. PA = presentation assessment.

During the second presentation assessment, Jimmy's mean number of expulsions per bite initially occurred at levels similar to the first presentation assessment, and mouth clean improved slightly from the near-zero levels previously observed. As the analysis proceeded, expulsions per bite dropped to less than 2 ($M = 3.1$; range, 0.6 to 12.2) and mouth clean increased to 100% ($M = 90.5\%$; range, 40% to 100%). Based on the assessment results, we reintroduced the upright spoon as the sole presentation method for use during treatment. Given the relative length of this treatment phase (240 sessions), the figure displays the average

for 40 sessions per point (involving a total of 200 bite presentations). The mean number of expulsion per bite continued to decrease, approaching levels achieved with the flipped spoon prior to discharge, and mouth clean stabilized near 100%.

For Greg, the second presentation began with a mean number of expulsions per bite at a level similar to those observed during the first presentation assessment, but dropped to around 1; mouth clean ($M = 97.5\%$; range, 80% to 100%) was high and stable. Both trends represented an improvement over the pattern observed during the first presentation assessment. Nonetheless, the

Figure 3. Percentage of trials with mouth clean (top) and mean number of expulsions per bite (bottom) for Greg. The first flipped phase presents the averages for each bite volume, summarizing a total of 103 sessions (2 cc: 15 sessions; 5.4 cc: 88 sessions). PA = presentation assessment.

assessment was discontinued based on caregiver preference for the flipped spoon. Clinical observation also suggested lack of improvement in oral-motor patterns that would promote sustained levels of intake not captured during data collection, most notably tongue protrusions, associated with upright spoon presentations. These observations are discussed in more detail below.

Before the first follow-up appointment, Joshua transitioned back to an upright spoon following a series of periodic probes conducted by his parents within 3 weeks of discharge. Per caregiver report, probes consisted of presenting a few bites with an upright spoon at the beginning of each meal and gradually increasing the number of bites based on low levels of expulsion.

Caregivers did not record data systematically or follow a clinic-derived protocol during this time period. Mouth clean remained high, and no expulsion was observed at the 2-month appointment with the upright spoon. Jimmy's behavior also remained stable with the upright spoon, with levels of mouth clean nearing 100% and levels of expulsion close to zero during the 2-month follow-up. The family maintained these gains at the 5- and 9-month appointments with both children. Both children also achieved self-feeding skills and further reductions in tube feedings. We reassessed Greg's readiness to transition back to an upright spoon at each follow-up appointment. Expulsion and mouth clean remained relatively unchanged from

predischarge levels during flipped spoon presentations. However, expulsion per bite continued to disrupt meals during bites with the upright spoon at the 2-month appointment (expulsions > 1 per bite). Expulsion persisted (although at lower levels) at the 3-month appointment, at which time we encouraged the family to increase the number of bites with the upright spoon (i.e., initially beginning each meal with the first five bites with the upright spoon and doubling the number of bites after low levels of expulsion for three consecutive meals) gradually. By the 5- and 9-month appointments, all bites were presented on an upright spoon, mouth clean remained high, and expulsion approached zero.

Results of the satisfaction questionnaire indicated that all families were extremely satisfied with treatment ($M = 5$). All families reported a positive change in their child's mealtime behaviors ($M = 4.3$; range, 4.3 to 4.4), and they all indicated that treatment was acceptable for addressing their child's feeding difficulties ($M = 4.7$; range, 4.4 to 4.9). Items, however, did not specifically assess caregiver preference for spoon presentation methods.

DISCUSSION

Results of the current investigation showed clinically significant improvements in mouth clean and a concomitant decline in expulsion following the addition of the flipped spoon presentation to treatment packages that consisted of NRS, re-presentation, and reinforcement. Prior to the analysis, presentation on an upright spoon yielded frequent expulsion of food such that two children demonstrated near-zero levels of mouth clean, and a third showed variable levels below clinical targets. The introduction of the flipped spoon resulted in a significant reduction in expulsions per bite for all three children. These improvements coincided with rapid improvement in mouth clean, which remained at high levels during treatment. These findings provide further support for the effectiveness of altering bite presentation, a relatively simple antecedent

modification that can optimize food placement on the tongue and may help to facilitate swallowing in some children with feeding disorders. The positive effect of the intervention package was reflected by the increased volume of food consumed per session, and all three children received more than 50% of their nutritional needs by mouth by the end of treatment. In addition, caregiver training was completed successfully so that treatment gains transferred to the home setting, suggesting that the flipped spoon procedure can be generalized to feeders and settings beyond trained therapists in highly structured settings. Finally, follow-up data indicated that families were able to maintain improvements in feeding behavior following discharge (with two children transitioning back to the upright spoon), and posttreatment satisfaction questionnaires reflected a high degree of social validity associated with treatment. This represents the first study to document the transition back to an upright spoon following clinically significant improvement in oral intake using the flipped spoon procedure.

The level of improvement documented in the current study greatly exceeds that reported by Sharp et al. (2010), which resulted in small increases in mouth clean and modest declines in expulsion associated with the use of a flipped spoon. A key difference between the current investigation and Sharp et al., however, is that the current study incorporated flipped spoon presentations into a treatment package that included re-presentation. Girolami et al. (2007) achieved clinically significant improvement in expulsion with modified placement, and re-presentation was included throughout that analysis. Therefore, it appears that, to maximize the effectiveness of the flipped spoon procedure, treatment packages may need to include additional elements (e.g., re-presentation) to help to ensure continued contact with food and repeated opportunities for consumption. This may be a particularly important consideration for children with significant oral-motor deficits. Participants in this line of research were described as showing poor oral-motor skills,

characterized by frequent tongue protrusions, drooling, intermittent lip closure, and frequent expulsion of food (Sharp *et al.*; Girolami *et al.*). For children who display this pattern of oral-motor skills, the flipped spoon procedure may help to facilitate swallowing by assisting with bolus formation, but it does not necessarily ensure retention of food in the mouth. It should be noted, however, that we did not examine the effects of food placement with and without re-presentation. More research is needed to identify which subset of children with feeding disorders may be the most appropriate candidates for modified bite presentation, including what subject characteristics (e.g., lack of lip closure, frequent tongue protrusions) may warrant the use of this type of procedure at the onset of treatment.

It is noteworthy that, prior to the initial presentation assessment, expulsion persisted at high levels despite the use of re-presentation in all three cases. Previous investigators (e.g., Ahearn *et al.*, 1996; Coe *et al.*, 1997; Gulotta *et al.*, 2005) conceptualized expulsion as a behavior maintained by negative reinforcement (i.e., a behavior that provides escape from swallowing food), with re-presentation functioning as a form of escape extinction. Not all research findings, however, have supported such a conceptualization. Sharp *et al.* (2010) reported declines in expulsion after modifications in bite placement without the use of extinction. Findings from Girolami *et al.* (2007), along with those of the current study, also provide evidence that expulsion may not be maintained exclusively by negative reinforcement. In both studies, the behavior persisted despite the use of re-presentation. If re-presentation functioned as extinction, one would have expected an extinction curve in expulsion data, as was observed by Sevin *et al.* (2002). Expulsions declined in the present study only with the flipped spoon, raising questions regarding the operant mechanisms that are responsible for this change. One possibility, highlighted by Girolami *et al.*, is that placement of the bolus onto the middle of the tongue may make it more difficult for the child to expel the bite

while simultaneously decreasing the response effort required for swallowing. An alternate explanation is that modifying the placement of food onto the tongue may compensate for behaviors that are missing from the chain necessary for swallowing by assisting with bolus formation and posterior movement.

Future studies should evaluate the possible function of expulsion and the exact mechanism that is responsible for the observed treatment effect, perhaps by assessing different levels of re-presentation (e.g., NRS, NRS plus limited re-presentation; NRS plus continued re-presentation) and the methods of presentation (e.g., upright, flipped, side placement). In addition, it will be important to determine how the location of placement on the tongue (i.e., central vs. posterior) influences feeding behaviors across different utensils (Nuk brush, flipped spoon). For example, Volkert *et al.* (2011) suggested that the high level of mouth clean achieved with the flipped spoon plus swallow facilitation, when compared to the findings reported by Sharp *et al.* (2010), may be related to the location of placement on the back of the tongue (i.e., swallow facilitation). However, the current study achieved high levels of mouth clean with placement in the center of the tongue. The study also is limited by the use of different spoons during flipped and upright spoon presentations, which highlights the need to investigate the impact of utensil type (as well as other utensils) in treatment outcomes. For example, the narrower surface and shallower bowl of the baby spoon may allow more precise bolus formation and, as a result, require less effort in facilitating a swallow.

It also will be important for researchers to identify the mechanisms that are responsible for promoting changes in oral-motor patterns that permit the transition from a flipped spoon to an upright spoon. Clinical observations during the second presentation assessment and follow-up indicate that changes in oral-motor skills may have occurred over time (e.g., increased efficiency with bolus formation, increased tongue mobility, increased labial seal with suction);

however, it is unclear why the children achieved this milestone at different times (Jimmy, 26 days; Joshua, 61 days; Greg, more than 180 days), and the present data-recording procedures were not set up to capture what behaviors beyond expulsion and mouth clean emerged during this process. Possible explanations include naturally occurring reinforcement of key behaviors in the swallowing chain, increased coordination of nuero-motor responses, or even the passage of time alone. Expansion of data-collection procedures to include variables such as mouth closure, tongue coordination or movement, tongue protrusion, food retraction (with lips or tongue), and food retention (e.g., latency to expel) may help to elucidate possible mechanisms that are responsible for improved mealtime performance. It also would be beneficial to include oral-motor examinations at each treatment change to assess continued areas of strength and deficits.

Taken together, the current results further support the use of a flipped spoon in the treatment of pediatric feeding disorders and add to a growing body of research that indicates that the method of food presentation may influence consumption during meals, including bite size (Kerwin, Ahearn, Eicher, & Burd, 1995), simultaneous presentation (i.e., blending; Ahearn, 2003), and texture (Patel, Piazza, Santana, & Volkert, 2002). These antecedent-based strategies can be used in combination with consequence-based elements (e.g., NRS, representation) to develop highly specific treatment packages that target the operant function of food refusal while possibly compensating for oral-motor deficits and reducing the motivating operations for food refusal. Going forward, it will be important to evaluate specifically the social validity of alternative bite placement as treatment for pediatric feeding disorders and expand the behaviors measured during the course of a feeding intervention. This process will require new techniques, behavioral measures, and tools for the assessment and treatment of pediatric feeding disorders, and will necessitate

continued interdisciplinary collaboration to optimize measurement techniques and expand the technology available to address pediatric feeding disorders.

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