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Evaluation Of Intensive Behavioral Interventions For Severe Avoidant/Restrictive Food Intake Disorder In Young Children

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ACCEPTANCE

This dissertation, EVALUATION OF INTENSIVE BEHAVIORAL INTERVENTIONS FOR SEVERE AVOIDANT/RESTRICTIVE FOOD INTAKE DISORDER IN YOUNG CHILDREN, by EMILY KATE RUBIO, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education & Human Development, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty.

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EVALUATION OF INTENSIVE BEHAVIORAL INTERVENTIONS FOR SEVERE AVOIDANT/RESTRICTIVE FOOD INTAKE DISORDER IN YOUNG CHILDREN

by

EMILY KATE RUBIO

Under the Direction of Andrew Roach, Ph.D.

ABSTRACT

Children with avoidant/restrictive food intake disorder (ARFID) may refuse to consume an adequate variety and/or volume to maintain expected physical growth and cognitive performance (Kerwin, 1999; American Psychiatric Association, 2013). This disorder can result from complicated medical histories or diagnoses of autism or related disorders and is distinct from eating disorders which include obsessive thoughts about food and body image. These children often are medically and physically able to consume food or liquid by mouth but may engage in inappropriate mealtime behavior (IMB; e.g., turning head, hitting spoon) to escape or avoid eating. Behavioral interventions like positive reinforcement and escape prevention have been shown to increase consumption and decrease IMB in children with ARFID. However, for some children, these interventions are insufficient in treating food/liquid refusal, especially passive refusal (e.g.,

clenching mouth while sitting still). In these cases, physical guidance procedures may be utilized to prompt the child's mouth open to deposit food or drink. Research indicates that these procedures are effective and are rated as acceptable by caregivers; however, additional research is warranted. Chapter one is a systematic literature review of behavioral treatments of ARFID using physical guidance procedures as an open-mouth prompt to increase food acceptance and discussed limitations and implications for practice and future research. Based on the invasive nature of physical guidance, this study provides recommendations for researchers and clinicians to increase the quality of their treatment evaluations. Chapter two replicated an existing physical guidance procedure, the finger prompt (e.g., Rubio et al., 2020), and compared its efficacy and acceptability to that of a clinically utilized procedure, a spoon prompt, that had not yet been empirically evaluated. This study used an alternating treatments design embedded within a multiple baseline design across three participants to evaluate and compare the two treatments. We also defined and measured passive refusal as a primary dependent variable. Findings of this study indicated both prompts were effective in increasing bite acceptance for two participants. Caregivers perceived the finger prompt to be more acceptable. Researchers discuss limitations and future directions based on results of the study.

INDEX WORDS: ARFID, pediatric feeding disorders, behavioral intervention, food acceptance, inappropriate mealtime behavior, passive refusal, physical guidance

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1 A SYSTEMATIC REVIEW OF PHYSICAL GUIDANCE PROCEDURES AS AN OPEN-MOUTH PROMPT TO INCREASE ACCEPTANCE FOR CHILDREN WITH PEDIATRIC FEEDING DISORDERS

Up to 40% of all children experience some problematic mealtime behaviors (Manikam & Perman, 2000; Mayes & Volkmar, 1993). Mild feeding problems can commonly be treated with general nutritional recommendations, parent education and training, and outpatient speech or occupational therapy (Kerwin, 1999). However, if these problems are not transient and become chronic, they can lead to weight loss, malnutrition, or both; impaired cognitive, emotional, or academic functioning; high medical costs and dependence on enteral feedings; and a strained parent-child relationship (Volkert & Piazza, 2012). In these cases, a more intensive inpatient or day treatment multidisciplinary approach may be warranted to meet the child's nutritional needs or to accomplish tube weaning (Schwartz, 2000; Sharp et al., 2017).

Avoidant/restrictive food intake disorder (ARFID), or pediatric feeding disorder, is a general psychiatric diagnosis. An ARFID diagnosis involves the persistent failure to meet nutritional and/or energy needs as a result of either an avoidance or restriction of oral consumption of food (American Psychiatric Association [APA], 2013; Sharp et al., 2017; González et al., 2018). Characteristics of a feeding disorder often include one or a combination of the following: oral motor deficiencies which contribute to failure to advance to developmentally appropriate textures (e.g., a 10-year old only eating pureed food); selectivity by type, texture, or both (e.g., child only eats starches, no protein, fruit, or vegetables); gagging and/or vomiting; spitting food out; holding food in the mouth for an extended period of time; lack of self-feeding skills; inappropriate mealtime behavior (IMB; e.g., child turns head, hits spoon away); and/or food refusal (e.g.,

the child's only oral intake is liquid formula, the child is dependent on tube feedings for survival; Kerwin, 1999; Schwartz, 2000; Sharp, et al., 2017; Volkert et al., 2016; Volkert & Piazza, 2012).

Children diagnosed with a feeding disorder often engage in active food refusal, like inappropriate mealtime behavior, to escape food presentation or eating (Cooper et al., 1995; Piazza, Fisher, et al., 2003; Piazza, et al., 2002). For example, a child may learn that engaging in IMB, such as turning the head away from the bite, physically prevents food from entering the mouth or that vomiting may lead to the caregiver ending the meal. In both scenarios, the child engages in a behavior that allows escape or avoidance of eating; thus, IMB is negatively reinforced, and the child is likely to engage in these behaviors in the future to prevent eating. Although research has traditionally described and reported on more active topographies of food refusal, passive topographies have been noted. Thus, food refusal can be organized into two topographical categories: *active* and *passive*. Active food refusal, or IMB, includes turning the head away from the spoon/food, pushing at the feeder's hand, and disruptions like throwing food and/or utensils. Passive food refusal has been described as holding out for the bite, typically by teeth-clenching or lip-pursing, or keeping the mouth closed until a predetermined time limit is met (Kadey et al., 2013; Rubio et al., 2015; Rubio et al., 2020).

Behavioral interventions are the most empirically supported treatments for pediatric feeding disorders (Sharp, Jaquess, et al., 2010). Common behavior-analytic interventions for food refusal include positive reinforcement (e.g., Piazza, Patel, et al., 2003), noncontingent access to preferred items or activities (e.g., Reed et al., 2004), escape prevention (nonremoval of the spoon; e.g., Hoch et al., 1994), and fading (e.g., Shore et al., 1998). However, the most universal treatment component includes escape prevention, or nonremoval of the spoon, as IMB is most

commonly maintained by escape (Piazza, Fisher, et al., 2003). During nonremoval of the spoon, the therapist holds the spoon to the child's mouth until the bite is accepted or the predetermined time limit is reached (preventing escape; e.g., Hoch et al., 1994). Following the initial implementation of treatment or sometimes following an extinction burst (Piazza, Patel, et al., 2003; Reed et al., 2004), levels of active IMB may decrease, yet food acceptance does not increase. In these cases, passive food refusal may emerge or co-occur with active refusal, where the child does not accept the bite by teeth-clenching or lip-pursing or simply not opening the mouth until a time limit is met, thereby still not eating and passively avoiding bite acceptance. When passive food refusal occurs, further intervention is often warranted (Kadey et al., 2013; Rubio et al., 2015; Taylor, 2018, Rubio et al., 2020).

Adding a physical guidance procedure to nonremoval of the spoon may be necessary to truly prevent escape, especially in the case of passive food refusal, because these procedures are designed to prompt the mouth open to deposit food or drink. A physical guidance procedure involves an open-mouth prompt implemented by the feeder (i.e., feeder prompts or guides the child's mouth open manually or with a utensil) contingent on refusal to accept food following a specified period of time from bite presentation (typically 5 s). However, if the child accepts food independently, both nonremoval of the spoon and physical guidance are avoided (Ahearn et al., 1996). Although active and passive food refusal are necessary to treat and may accompany non-acceptance, researchers and practitioners often focus their primary dependent variable on increasing food intake (e.g., acceptance, mouth cleans, grams consumed; Sharp, Jaquess, et al., 2010), which more directly yields beneficial clinical outcomes (e.g., weight gain, tube weaning). Therefore, it is important to investigate the efficacy of existing physical guidance procedures in increasing food acceptance.

Forty years ago, the literature began referencing the use of physical guidance as a component in the treatment of food refusal typically with a comment explaining that the mouth was physically guided open so that food could be deposited; however, no further details were provided to explain how the procedure occurred, and the physical guidance procedure was never evaluated alone (e.g., Ives et al., 1978; Riordan et al., 1984). Since then, researchers have expanded work on physical guidance procedures, providing more detailed descriptions. However, only a small number of studies have demonstrated that physical guidance is effective in the treatment of pediatric feeding disorders, although physical guidance may be commonly practiced in clinical settings, warranting further evaluation (Borrero et al., 2013). A literature review of treatments for pediatric feeding disorders reported that 20.8% of the studies assessed utilized physical guidance as a treatment element (Sharp, Jaquess, et al., 2010); however, several of these identified studies mentioned a physical guidance procedure as a treatment element but did not adequately describe or directly evaluate the procedure (e.g., DeMoor et al., 2007; Didden et al., 1999; Kahng et al., 2003; Luiselli & Gleason, 1987; Patel et al., 2002; Piazza et al., 2002); thus, a current summary of existing physical guidance research and additional research on these procedures is necessary.

Therefore, the purpose of this review was to provide a synthesis of current behavioral treatments of pediatric feeding disorders (i.e., ARFID) using physical guidance as a primary focus to increase food acceptance and characteristics of participants receiving these types of interventions. Due to the intrusive nature of physical guidance (i.e., touching or applying gentle pressure in or around a child's mouth), we describe each physical guidance procedure identified in each article, participant characteristics, the extent to which researchers evaluated the quality and rigor of the single-case methodology used to evaluate each intervention; study descriptors,

including the extent to which researchers have assessed interobserver agreement, procedural integrity, social validity, fading, and follow-up, and provide recommendations for practice and future research.

METHOD

Search Procedures

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (Moher et al., 2015), we conducted a systematic search of articles published in English language scholarly peer-reviewed journals targeting the treatment of feeding disorders using physical guidance (see Figure 1 for results and summary). The process consisted of searching medical and psychological electronic databases using combinations of the keywords: *feeding disorder*, *food refusal*, *physical guidance*, and *prompt* (i.e., ["feeding disorder*[1]" OR "food refusal"] AND ["physical guidance" OR "prompt"]). We included Academic Search Complete, APA PsycInfo, ERIC, and MEDLINE databases in the search. The search included articles through July 6, 2020. We did not set a starting year parameter for the search due to the anticipated limited sample size.

Inclusion and Exclusion Criteria

Following the removal of duplicate articles, we screened titles and abstracts for exclusionary criteria. Exclusionary criteria included: reviews, conference proceedings, opinion articles, editorials, guidelines, topics unrelated to treatment of feeding disorders or food refusal (e.g., assessment, eating disorders), articles that lacked at least one demonstration of experimental

[1]Truncation (*) ensured the search included all forms of the word (e.g., disorder* includes disorder and disorders).

control with physical guidance as a primary independent variable and a measure of acceptance as a primary dependent variable, and the absence of a physical guidance procedure. After the initial screening, we assessed full-text articles for eligibility in cases where abstracts referencing a physical guidance procedure was mentioned. We included studies if they (a) systematically evaluated the use of a well-defined (i.e., procedure and contingencies involved in the procedure are described technically enough so that a trained reader could replicate the procedure [Baer et al.,1968]) physical guidance procedure that functioned as an open-mouth prompt to increase acceptance (including bites consumed or latency to acceptance) as the primary focus of the study; (b) utilized single-case experimental design as research suggests this is the most commonly used research methodology for evaluating treatment of pediatric feeding disorders (Sharp, Jaquess, et al., 2010); and (c) demonstrated at least one example of experimental control with a measure of acceptance as evidenced by distinct differentiation among data paths (i.e., level, trend, variability) across varying conditions within a treatment evaluation (e.g., Ganz & Ayres, 2018). We searched the references within selected articles where the full text was assessed for additional relevant sources. We considered additional articles in the initial screening if the title or abstract suggested the article may target treatment of feeding disorders using physical guidance.

Data Extraction, Variables Coded, and Intercoder Agreement

We used a systematic procedure with a standardized protocol (available from first author upon request) and Microsoft Excel spreadsheet to code physical guidance procedures used by the investigators, participant demographics, and study descriptors from the articles that met inclusion criteria. We coded quality indicator characteristics using the Single-Case Analysis and Review Framework (SCARF; Ledford et al., 2016). Procedures are described below.

The first and second authors independently searched the literature, reviewed, and screened potential articles using the criteria described above for 100% of articles. We coded an agreement if both coders recorded an article met criteria for inclusion. We calculated intercoder agreement for article inclusion by taking the number of agreements divided by the number of agreements plus disagreements multiplied by 100 to yield a percentage agreement. Intercoder agreement for article inclusion was 100%. The researchers also coded descriptive variables listed below during the review process. We scored intercoder agreement for descriptive information for 88% of the variables across all participants in each article. We coded an agreement if both coders recorded the same descriptive variable or feature (e.g., feeding skill, feeding concern, treatment setting) present in each article (i.e., occurrence). Intercoder agreement was 99% (range, 80% to 100%) across descriptive variables. If there was a disagreement, the coders discussed discrepancies and reached consensus on inclusion. To review discrepancies, the coders met to discuss sections of articles involving disagreement, discussed their approach to coding, and then reached agreement regarding the data to be included in the current review. For example, if the primary coder reported a reason for referral as tube dependence but the secondary coder reported it as liquid dependence, the coders agreed on the data to include. The intercoder agreement calculation would still reflect a disagreement for that variable. Calculation methods for intercoder agreement for the SCARF characteristics (characteristics coded available upon request, or see Ledford et al., 2016 for original list) were identical to those described above and calculated for 30% of experimental designs, equaling 96.7% agreement (range, 82% to 100%).

Physical Guidance Procedures Described by Article

We coded and described each physical guidance procedure evaluated within each article that met final inclusion criteria. These included the jaw prompt, finger prompt, Nuk prompt, and side deposit.

Participant Characteristics

We coded participant characteristics including sex, age, feeding skill (i.e., non-self-feeder, self-feeder), solids texture, liquids refusal as focus, feeding concern (i.e., reason for feeding referral; e.g., current feeding tube, liquid dependence, food selectivity), medical concern (current and/or chronic), treatment setting, and primary feeder during treatment evaluations. We could have coded more than one response per characteristic. For example, if authors reported a participant had a current feeding tube and food selectivity, we coded both characteristics under feeding concern.

Quality Indicator Coding

We then used a modified version of the SCARF (http://vkc.mc.vanderbilt.edu/ebip/scarf/) as a tool to evaluate the quality and outcomes for each single-case design evaluation described within each study reviewed. Specifically, we used this tool to assess measures of experimental rigor (i.e., inter-observer agreement, procedural integrity and sufficiency of data [e.g., demonstration of effect]); measures of quality of measurement and reporting (i.e., descriptions necessary for replication [e.g., participant characteristics, setting], ecological and/or social validity, measures of maintenance and/or [response or stimulus] generalization); and primary outcomes for each evaluation identified. Primary outcomes referred to the study's effects based on standards defined by the What Works Clearinghouse (2017; i.e., immediacy of an effect, consistency of data patterns across similar phases, overlap, level, trend, and variability) and visual analysis. An evaluation with strong effects must have consistent changes in similar conditions, either

minimal overlap or decreases in overlap over time, and clear change in level, trend, and/or variability. When any of these requirements are missing, the evaluation demonstrates weaker effects. We selected this tool as it was developed from widely used single-case quality indicators including those described by Horner et al. (2005) and the What Works Clearinghouse (2017) and also provides rigor scores and visual analyses via scatterplots for a hierarchical determination of quality among a group of studies.

We included a single-case design if visual analysis indicated that the design included two conditions with at least three opportunities to demonstrate effects of an intervention, in accordance with the SCARF requirements. In cases where a single-case design included multiple evaluations for a participant, we independently assessed each one using the SCARF. For example, if a participant's single-case design had an alternating treatments design embedded within a reversal design, we scored four evaluations independently for rigor, quality of measurement, and primary outcome (i.e., the alternating treatments evaluation would compare Treatment A to Treatment B and vice versa, a reversal evaluation would compare baseline to Treatment A, and a reversal would compare baseline to Treatment B). We counted the rigor and quality scores assigned to the alternating treatments design evaluations, containing two physical guidance procedures (Borrero et al., 2013; Rubio et al., 2015) twice, once for each procedure. We individually scored differentiation between data paths for the presence or absence of effects, for each procedure in accordance with the SCARF scoring criteria for other designs.

In accordance with the SCARF scoring, we independently recorded measures of rigor and quality of measurement for each evaluation. Each of the aforementioned measures contained between three and seven yes/no questions. For example, the first question under sufficiency of data asked if each of the primary conditions contained at least three data points. If the answer was

"yes," we awarded a score of 1, and "no" answers received a score of 0. We obtained an overall quality and rigor score by averaging the rigor score and the quality of measurement and reporting score, with the rigor score weighted twice, because of its importance to the believability of the data. The overall quality and rigor score ranged from 0.0 (i.e., no evidence) to 4.0 (i.e., highest-quality evidence). The SCARF considers overall quality and rigor scores above a 2.0 as having high-quality evidence. We rated primary outcomes on a scale from 0.0 (i.e., no-effect/weak effect) to 4.0 (i.e., positive effects), also in alignment with the SCARF instructions. Primary outcome scores depended on the total number of demonstrations of a therapeutic effect or contra-therapeutic effects. We calculated an average score for rigor, quality of measurement, overall rigor and quality, and primary outcome for each of the six physical guidance procedures. We modified an item within the SCARF that originally assessed the presence of formal test results to better apply the item to a feeding context. Therefore, coders instead edited this item to indicate whether authors reported that the participant was deemed medically safe to eat orally and/or was being monitored by a medical team at the time of the study.

We separated physical guidance procedures by type (i.e., jaw prompt, finger prompt, Nuk prompt, side deposit) and variation. We calculated overall quality and rigor and primary outcomes for each physical guidance procedure and subsequent variations. We further analyzed primary outcomes with respect to overall quality and rigor, and categorized evaluations into groups based on quality of evidence and effects. We entered scores into the SCARF spreadsheet that automatically populated and depicted graphed scores on a scatterplot divided into quadrants. We plotted the primary outcome measure on the *y-axis* and the overall study quality and rigor on the *x-axis* for primary outcomes. The SCARF populated evaluations demonstrating low-quality evidence of positive effects into the first quadrant (upper left-hand section). The second quadrant

(upper right-hand section) contained evaluations with high-quality evidence of positive effects. The third quadrant (lower left-hand section) contained evaluations of low-quality evidence of negative or minimal effects and the fourth quadrant (lower right-hand section) contained evaluations of high-quality evidence of negative or minimal effects. Evaluations containing low-quality evidence should be interpreted with caution and skepticism; therefore, further analyses that looked at averages across types of physical guidance procedures included only those evaluations with high-quality evidence.

Study Descriptors

We then coded study descriptors including experimental design, individualized treatment components including type of physical guidance and additional treatment elements that were evaluated or used (i.e., nonremoval of the spoon, differential social attention, differential reinforcement of alternative behavior [DRA], noncontingent access to preferred item or activity [NCA]), and primary and corollary dependent variables measured. We also coded whether researchers reported measures of IOA, procedural integrity, social validity (related to caregiver social acceptability or preference), procedures to fade out physical guidance, and/or follow-up information.

RESULTS

We identified 48 articles during the initial database search and 11 additional articles through other sources (e.g., citations or reference sections within articles identified through the database search; Figure 1). We excluded 26 articles following removal of duplicates. Therefore, we assessed 33 articles for inclusion and excluded 20 based on title and abstract screening. We then assessed 13 full-text articles for inclusion, excluded one due to lack of a systematic

evaluation, and excluded three due to insufficient description of physical guidance procedures. Nine articles met final inclusion criteria for this review and included 22 total participants (20 with systematic evaluations of physical guidance procedures).

Quantitative analyses of quality and rigor using the SCARF tool included only the datasets of 20 of 22 total participants. We excluded one participant from Kerwin et al. (1995) because the investigators did not include physical guidance in their treatment; and although physical guidance was included in the treatments for both participants in Ahearn et al. (2001), they used an AB design for one participant whose data we excluded for failure to attempt to replicate results of the physical guidance procedure (Kratochwill et al., 2013). Three articles (i.e., Ahearn et al., 1996; Borrero et al., 2013, Rubio et al., 2015) contained multiple evaluations within a single participant dataset that were independently assessed using the SCARF. Borrero et al. (2013) demonstrated the highest total number of physical guidance evaluations at 16 of 35 independent single-case evaluations (46%), followed by Rubio et al. (2015) with six evaluations (17%) and Ahearn et al. (1996) with four evaluations (11%). We identified two evaluations (6%) in Kerwin et al. (1995), Kadey et al. (2013), and Taylor (2020), and one evaluation (3%) in Ahearn et al. (2001), Taylor (2018), and Rubio et al. (2020). Two studies (Borrero et al., 2013 and Rubio et al., 2015) contained a total of six alternating treatments designs comparing two physical guidance procedures that we each assessed for primary outcomes (12 evaluations total). In sum, we assessed the rigor, quality of measurement, and primary outcomes of 35 evaluations of various physical guidance procedures. We coded qualitative study descriptors across the 20 participants.

Physical Guidance Procedures Described by Article

We identified four different physical guidance procedures evaluated in the literature, including a jaw prompt, finger prompt, Nuk prompt, and side deposit, with some variations (i.e.,

jaw and finger prompts), described below. For reporting purposes, we will differentiate between variations of the jaw prompt and finger prompt by referring to the jaw prompt first described in Kerwin et al. (1995) as *jaw prompt (version 1)*, the jaw prompt procedure in Borrero et al. (2013) as *jaw prompt (version 2)*, the finger prompt in Rubio et al. (2015) as *finger prompt (version 1)*, and the finger prompt in Rubio et al. (2020) as *finger prompt (version 2)*.

Jaw Prompt

Kerwin et al. (1995; version 1) first described a physical guidance procedure they termed "physical guidance of the jaw." They defined this procedure as "physically guiding the mouth open by applying gentle pressure to the mandibular junction of the jaw and placing the spoon into the open mouth" (p. 252). The therapist implemented the jaw prompt after 5 s of the child refusing to take the bite. Ahearn et al. (1996) and Ahearn et al. (2001) replicated the jaw prompt using the same procedural definition as Kerwin et al. (1995).

Borrero et al. (2013; version 2) evaluated the use of a jaw prompt and compared it to another physical guidance procedure, the finger prompt (described below). They described the jaw prompt procedure as "the therapist held the bite at the child's lips if bite acceptance did not occur (after 5 s of nonremoval of the spoon) and applied the jaw prompt while continuing to hold the spoon at the child's lips. Slight pressure was applied to the mandibular junction of the jaw with the thumb and forefinger until the bite could be deposited or the maximum session duration (i.e., time cap) was reached" (p. 267). The authors noted that the "jaw prompt did not physically guide the mouth open." This definition differs from the previously mentioned definitions of a jaw prompt in this way.

Rubio et al. (2015) replicated the jaw prompt procedure described by Borrero et al. (2013) and compared it to a finger prompt (described below). The jaw prompt showed minimal

efficacy, and thus, researchers implemented additional treatment components to increase acceptance (i.e., the *side deposit*, described below).

Finger Prompt

As briefly mentioned above, Borrero et al. (2013; version 1) compared the efficacy of the jaw prompt to a physical guidance procedure they termed "finger prompt." The investigators defined the finger prompt as "the therapist placing his or her finger between the cheek and upper gumline until the child opens his or her mouth to allow the placement of the bite of food" (p. 267). The therapist implemented the finger prompt after 5 s of the child refusing to take the bite. Rubio et al. (2015) evaluated a finger prompt in comparison to a jaw prompt (described above), replicating the finger prompt procedure described by Borrero et al. (2013).

Rubio et al. (2020; version 2) evaluated a variation of a finger prompt. They described the finger prompt procedure as "the therapist used a non-latex and powder-free gloved index finger (or pinky finger, deemed more appropriate by the treatment team for Molly due to the size of her mouth), with the finger nail no longer than the fingertip to prevent injury to the lips, gums, or inner cheek, from the hand not holding the spoon to the mouth. The therapist then inserted and slid the finger inside the child's mouth with the nail towards the inner check and the fleshy side along the upper gum line, being careful to not allow the finger to fall below the teeth, with a motion that took the tip of the finger to the back of the last molar (one stroke) and forward to the canines (next stroke). The therapist provided strokes at approximately one stroke per second to avoid friction on the gums until the mouth was open wide enough to deposit the entire bolus." (p. 7-8). The therapist implemented the finger prompt after 5 s of the child refusing to take the bite. This definition differs from the previously mentioned definition of a finger prompt in that it was in motion.

Side Deposit

Rubio et al. (2015) provided an alternative physical guidance procedure for passive refusal when the other procedures (i.e., NRS, NCA, jaw prompt, and finger prompt) were ineffective. They defined the "side deposit" as the therapist transferring "the bolus from the spoon to a Nuk brush, keeping the utensils as close to the mouth as possible. The therapist then simultaneously implemented the finger prompt (version 1) procedure and used the Nuk brush to roll the bolus of food on the inside of the cheek by gently shifting the straightened finger away from the gumline horizontally to create space for the Nuk to be inserted and rolling the Nuk brush towards the cheek and away from the gumline (if her mouth was not open)" (p. 237). They implemented the side deposit in conjunction with the finger prompt following 5 of refusal for one participant following initial bite presentation. For the other participant, they implemented the finger prompt following 5 s of refusal, and then implemented the side deposit at 10 s of refusal, as she sometimes accepted bites with the finger prompt.

Taylor (2018) replicated the side deposit previously described by Rubio et al. (2015). Because the participant was a self-feeder, Taylor (2018) implemented a hand-over-hand procedure to guide the child's hand holding the spoon to his mouth at 5 s of non-acceptance while implementing nonremoval of the spoon. At 10 s of non-acceptance, the therapist implemented a finger prompt procedure as described by Borrero et al. (2013), and then at 15 s of non-acceptance, the therapist implemented a side deposit procedure as described by Rubio et al. (2015).

Taylor (2020) replicated the side deposit procedure described by Rubio et al. (2015) and Taylor (2018) with two participants identified as self-feeders. Taylor (2020) extended prior research by evaluating the side deposit with regular texture foods. Prior to the side deposit, Taylor (2020) first implemented the finger prompt (version 1) with one participant. However, the finger

prompt was deemed ineffective, and the side deposit was implemented to increase consumption. In this study, therapists presented regular texture bites using their fingers to place the bite inside the child's cheek within the space created using the finger prompt (version 1). The Nuk brush was used to deposit naturally lower textured bites (e.g., yogurt) via side deposit.

Nuk Prompt

Kadey et al. (2013) evaluated a physical guidance procedure using a Nuk brush (i.e., a flexible, plastic brush marketed as a baby tooth brush; Sharp, Hanker, & Jaquess, 2010; Girolami et al., 2007) they termed "Nuk prompt" which "involved the feeder [therapist] maneuvering the Nuk brush between the lips, sliding it between the child's cheek and teeth just past the last molar, and turning it approximately 10 degrees from the teeth while keeping it firmly positioned against the child's gums" (p. 1463). Once there was an opening in the mouth, the therapist deposited the food or drink inside the mouth. For one participant (non-self-feeder), the therapist implemented the Nuk prompt after 5 s of the child refusing to take the bite. The therapist provided the other participant (self-feeder) 5 s to take the bite independently. At 5 s of non-acceptance, the therapist implemented hand-over-hand and nonremoval of the spoon or cup, and at 10 s of non-acceptance, the therapist implemented the Nuk prompt.

Participant Characteristics

Participant characteristics across studies are reported in Table 1. Across the nine articles, we identified 20 participants with single-case designs for whom physical guidance procedures were systematically evaluated, 13 male (65%) and seven female (35%), between the ages of 14 to 108 months (M = 46 months, SD=25), all of whom received medical clearance to consume food orally. The majority of participants were non-self-feeders (n = 15, 75%), and investigators presented solids at a pureed texture (n = 12, 60%). Most participants were referred for bottle

and/or liquid dependence (n = 12, 60%). Other notable feeding concerns included food selectivity (n = 9, 45%) and the presence of a feeding tube at the time of admission (n = 5, 25%). All participants also presented with comorbid medical concerns, including a history of failure to thrive, prematurity, food allergies, gastroesophageal reflux disease (GERD) and other gastrointestinal problems, and cardiovascular or pulmonary concerns, with the most prevalent being a diagnosis of a neurodevelopmental disability (n = 13, 65%). Participants were enrolled in programs to address feeding concerns across a variety of treatment settings. Investigators implemented physical guidance procedures in a day treatment setting for nine of the 20 participants (45%), an inpatient hospital for six participants (30%), an outpatient setting for two participants (10%), and in the participant's home for three (15%). The primary feeders during treatment evaluations were trained therapists for all participants.

Single-Case Analysis Design and Framework Quality Indicator Measures

The SCARF characteristics outlining the overall quality of measurement and rigor across evaluations are presented in Table 2 and a graphical representation of the primary outcomes with respect to overall quality and rigor measures for each evaluation can be seen in Figure 2. Based on the result of the SCARF, the side deposit possessed the highest quality evidence of positive effects with an overall quality and rigor score of 3.0 and a primary outcome score of 4.0. The finger prompt (version 2) also contained higher than average overall quality and rigor (M=2.9) and a primary outcome score of 4.0. All other physical guidance procedures contained at least one evaluation considered high-quality evidence of positive effects and fell at or above the mean score for overall quality and rigor (M=2.6). Four physical guidance procedures (jaw prompt [version 1 and 2], finger prompt [version 1], and Nuk prompt) each had one evaluation that demonstrated low-quality evidence of positive effects with regard to primary outcomes and should be

interpreted with caution. For this reason, we did not include low-quality evaluations in the final analysis. That is, of the 35 evaluations, we drew conclusions from 31 evaluations that were categorized as having high-quality evidence per the SCARF. No physical guidance evaluations contained low-quality evidence of negative or minimal effects.

Overall, 58% (n = 18) of the physical guidance evaluations with high-quality evidence reported positive effects, and 42% (n = 13) contained high-quality evidence of negative or minimal effects. One hundred percent of evaluations for the finger prompt (version 2) and side deposit contained high-quality evidence of positive effects. Only 50% (n = 3) of jaw prompt (version 1) evaluations yielded high-quality evidence of positive effects. The jaw prompt (version 2) and finger prompt (version 1) contained high-quality evidence of positive effects for 33% (n = 3) and 56% (n = 5) of evaluations, respectively. However, eight evaluations in Borrero et al. (2015) demonstrated equal efficacy of the jaw prompt (version 2) and finger prompt (version 1) at decreasing latency to acceptance and contributed to the total number of evaluations with high-quality evidence of negative or minimal effects. Three of five jaw prompt (version 2) evaluations (60%) and all five finger prompt (version 1) evaluations (100%) contained high-quality evidence of positive effects when we removed the evaluations with equal efficacy. By adjusting for these comparisons, we discovered 81% (n = 22) of the physical guidance evaluations produced positive effects and 19% (n = 5) contained negative or minimal effects at increasing acceptance, all of which were the jaw prompt (version 1 and 2). Our findings suggest that of the high-quality evidence present for physical guidance procedures, most procedures appear to be effective at increasing acceptance for children with pediatric feeding disorders. However, both variations of the jaw prompt produced mixed findings with studies containing evaluations that produced only positive effects (Ahearn et al., 2001; Borrero et al., 2013; Kerwin et al., 1995), one study

reporting both positive effects and negative or minimal effects (Ahearn et al., 1996), and another study reporting only negative or minimal effects (Rubio et al., 2015), suggesting additional treatment components or alternative procedures may be necessary.

When we scored individual evaluations, several observations on measures of rigor and quality of measurement were noted (scores may be obtained from the first author). No studies indicated that data collectors were blind to the study's conditions, and studies with low scores for sufficient data either did not contain at least three data points per condition (Borrero et al., 2013, Kadey et al., 2013; Kerwin et al., 1995) or discontinued the evaluation due to ineffective treatment outcomes (Rubio et al., 2015). Lack of procedural integrity appeared to heavily contribute to low scores of rigor across most physical guidance evaluations. All investigators conducted evaluations with children referred for the assessment and treatment of pediatric feeding disorders (i.e., ecological validity) and reported that participants were determined medically safe to orally consume food and/or were being monitored by a medical team at the time of the study. All evaluations scored well for participant, condition, and dependent variable descriptions. Rubio et al. (2015, 2020) and Taylor (2018) administered and reported the results of a survey to assess social validity of the physical guidance procedure among caregivers. Additionally, Ahearn et al. (1996, 2001), Borrero et al. (2013), and Taylor (2020) assessed social validity through anecdotal report of consumer preference. Investigators assessed stimulus generalization in a variety of ways, including varying the size of bites, and foods that were presented, conducting treatment both in clinic and at home, as well as with trained therapists and caregivers. Although Kadey et al. (2013) independently evaluated the effects of a Nuk prompt on both eating and drinking, the researchers did not assess for generalization across responses. No studies assessed for response generalization. Few studies also assessed for maintenance during follow-up sessions. The total

count of follow-up visits conducted varied between one and an estimated 14 visits between 1 week and 36 months post-discharge across studies.

Study Descriptors

A summary of treatment evaluations that systematically evaluated physical guidance procedures is presented in Table 3. Among the 20 participants for whom physical guidance was systematically evaluated, investigators used a reversal design (n = 12, 60%) to evaluate experimental control more often than an alternating treatment design (n = 9, 45%) or multiple-baseline design (n = 8, 40%). The jaw prompt was the most frequently evaluated physical guidance procedure (n = 12, 60%), followed by the finger prompt (n = 9, 45%), the side deposit (n = 5, 25%) and the Nuk prompt (n = 2, 10%). Investigators always implemented physical guidance procedures with additional treatment components including, nonremoval of the spoon and differential social attention (n = 20, 100%), differential reinforcement (n = 13, 65%), and noncontingent access (n = 5, 25%) using tangibles.

Table 3 provides a summary of primary dependent variables and corollary behaviors tracked in each article. The primary dependent variable used by investigators to measure efficacy of the physical guidance procedure among all studies was a variation of acceptance, as this was part of our inclusion criteria. Investigators most commonly measured latency to acceptance (average time in s from when bite is presented to bite acceptance; 60% of participants), followed by rapid acceptance (i.e., percentage of bites accepted independently within 5 s of bite presentation; 55%), and bites consumed (i.e., percentage of bites prescribed with a mouth clean [15%] or percentage of bites accepted at any time out of the total number of bites prescribed for the session [10%]). The most commonly reported corollary behaviors tracked by investigators were IMB

(60% of participants) followed by expulsions (40%), negative vocalizations (25%), refusal (20%), disruptions (15%), and self-injury (10%).

Table 3 also provides a summary of IOA, procedural integrity, social validity, fading, and follow-up procedures across participants in each article. Authors reported IOA for 100% of the participants with systematic evaluations (n = 20) and reported procedural integrity for 60% (n = 12) of participants. Authors reported social validity of physical guidance procedures for 80% (n = 16) of participants. Authors used a survey for only 30% (n = 6) of participants and anecdotal reports of preference for 50% (n = 10) of participants. Finally, authors reported fading procedures for 5% (n = 1) and follow-up data for 55% (n = 11) of participants.

DISCUSSION

Participant Characteristics

Children requiring physical guidance to increase acceptance may have different characteristics than children whose acceptance increases with antecedent-based interventions and/or nonremoval of the spoon plus reinforcement procedures. Seventeen of the 20 participants included in this review were non-self-feeders. Children with the skills to self-feed may have more experience eating than non-self-feeding children which could contribute to less severe food refusal. Additionally, 60% of the participants who required physical guidance were bottle or liquid dependent which may also indicate that this population is more difficult to treat, as they begin treatment eating very little or not eating at all. Only one study (Kadey et al., 2013) used physical guidance to address liquid refusal. The published literature on treating liquid refusal is sparse, and evaluating physical guidance treatments for liquid refusal, even fewer. Thus, this area warrants more research as oftentimes children present with both solid and liquid refusal (Borrero et

al., 2010). Finally, the majority of participants were treated in day treatment (45%) or inpatient (30%) settings indicating that physical guidance is being used with children with severe enough presenting problems they have been admitted to an intensive program with medical oversight. Future research should consider comparing characteristics (e.g., medical histories, age, food selectivity versus food refusal, active and/or passive refusal, etc.) of children who require more invasive interventions like physical guidance to those who respond to less invasive interventions (e.g., antecedent manipulations, nonremoval of the spoon plus reinforcement). While the mean age of children in this review was around 4 years old, it would be interesting to investigate whether physical guidance may be used more for older children as there is a longer history of negative reinforcement (e.g., IMB maintained by escape from the meal) and possibly decreased skills from inexperienced eating, and thus, IMB is more resistant to extinction.

Trained therapists implemented sessions during the treatment evaluations for all participants, aligning with previous recommendations. Although therapists taught caregivers to conduct treatment protocols following increased acceptance in Kadey et al. (2013), Rubio et al. (2020), and Taylor (2020), caregivers either minimally implemented or did not implement the physical guidance procedure as the child did not meet the contingency for physical guidance or because the investigators removed physical guidance at the time of caregiver training. Furthermore, authors of the remaining studies reported that caregiver training occurred following treatment evaluations, but they provided minimal outcome data. Additional research evaluating caregiver training of physical guidance implementation is warranted.

Single-Case Analysis and Review Framework Quality Indicator Measures

The believability of data within a single-case evaluation is foundational in identifying high-quality research. Quality indicator tools, such as the SCARF, provide both an objective

measure of quality for published research and outline for future research. Evaluations that scored lower on overall rigor and quality of measurement frequently neglected to include procedural integrity and social validity measures. Few studies also assessed for generalization and maintenance; generalized outcomes were most often not assessed, and thus high-quality evidence of these effects are generally unknown.

Overall, physical guidance appears to be effective with variability in overall rigor and quality of measurement among different procedures. Of the six procedural variants identified in the current literature, two highly effective procedures included the finger prompt (version 2) as described by Rubio et al. (2020) and the side deposit combined with the finger prompt (version 1; Rubio et al., 2015). Alternatively, the jaw prompt (version 1) described by Kerwin et al. (1995) and the jaw prompt (version 2) described by Borrero et al. (2013) produced overall mixed findings with high-quality evidence of both positive and negative or minimal effects. The success rate of a treatment is one consideration when prescribing behavioral interventions and evaluating the combined present literature can inform such decisions. Researchers and clinicians seem to be moving away from the jaw prompt in favor of the finger prompt. Although we found evidence of overall strong outcomes for physical guidance, we did not find consistent high quality and rigor of studies. Thus, additional high-quality, rigorous studies are needed for researchers to be more confident in these results. Variability among evaluations, specific to presence of procedural integrity, social validity measures, stimulus generalization, response generalization, and maintenance, suggests several areas for improvement in future research.

Study Descriptors

We identified an important procedural discrepancy in the definition of the jaw prompt. All studies described the jaw prompt as the therapist gently guiding the child's mouth open,

indicating some kind of pulling of the lower jaw downward, with the exception of Borrero et al. (2013). Borrero et al. described the therapist as remaining in a stationary position after implementing physical guidance. Further, Rubio et al. (2020) evaluated a variation of the finger prompt in which the finger was in motion. This is different from the finger prompt first described by Borrero et al. (2013) and later used in conjunction with the side deposit procedure (Rubio et al., 2015; Taylor, 2018, 2020). Rubio et al. (2015) and Taylor (2020; Benoît only) also utilized a finger prompt and found it to be ineffective without the addition of the side deposit. Future research should consider comparing procedural variations of the jaw and finger prompts to assess for potentially differing efficacy and acceptability outcomes, as some procedures could be perceived as more invasive than others.

Six of the nine articles attempted reinforcement/antecedent-based interventions (i.e., NCA, DRA, DSA) prior to nonremoval of the spoon, and with the exception of three articles (i.e., Ahearn et al., 1996; Ahearn et al., 2001 [TM]; Borrero et al., 2013), all studies attempted nonremoval of the spoon with contingent or noncontingent access to preferred items or activities and/or contingent access to social attention following acceptance prior to physical guidance. In accordance with Behavior Analyst Certification Board (BACB) Code 4.09 (Least Restrictive Procedures), behavior analysts have an ethical duty to review and recommend the least restrictive procedures (BACB, 2014). Exceptions may be made when rapid acquisition of acceptance is urgent and outweighs risks of more invasive or putative procedures (e.g., Borrero et al., 2013). For example, a child who is liquid dependent and begins refusing formula has no alternative way of accessing nutrition orally, leading to nasogastric tube or surgical gastrostomy tube placement. However, some studies have evaluated physical guidance procedures prior to less intrusive interventions for other reasons, like an attempt to control for carryover effects in a research setting

(Ahearn et al., 2001). We still caution that physical guidance procedures are implemented in a least restrictive sequence unless medically or ethically necessary. Again, these procedures should always be implemented initially by trained therapists in structured supervised environments and combined with positive reinforcement (Kerwin, 1999).

Overall, investigators measured the primary dependent variables similarly, but we identified some discrepancies (Table 3). Four studies defined acceptance differently (Borrero et al., 2013; Rubio et al., 2015; Taylor, 2018; Taylor, 2020; i.e., depositing the entire bite past the plane of the lips at any time) and did not report rapid/active acceptance (i.e., opening the mouth willingly within 5 s of spoon presentation and accepting the bite) as the other studies did. The rationale was likely that bite consumption was the important variable in these studies—whether the bites were consumed at all rather than quickly (i.e., within 5 s of the bite presentation). These differences make it difficult to compare outcomes of efficacy. For example, a study measuring acceptance at any time may yield the appearance of a more rapid increase in acceptance compared to measuring rapid acceptance. Future research could investigate which measure of acceptance is a more sensitive method to evaluate the effect of physical guidance or determine if there is a substantial difference.

Physical guidance procedures may be especially useful for decreasing escape when a child clenches his or her mouth shut when food or drink is presented (e.g., passive refusal). Five of the nine articles mentioned using physical guidance to treat passive refusal exhibited by participants; however, passive refusal was never directly measured. Kadey et al. (2013), Rubio et al., (2015, 2020), and Taylor (2018, 2020) reported observing passive refusal with participants defined as low or no acceptance with low or no IMB, but Rubio et al. (2015) were the only researchers to indirectly measure passive refusal as time spent passively refusing (i.e., latency to

bite acceptance occurring when a bite was presented to the child's mouth but never consumed with low or zero levels of IMB). A problem exists with previous definitions of passive refusal in that it is described as an absence of behavior, which is inherently difficult to measure, rather than a behavior that is actually exhibited. Rather than attempting to capture the child not accepting bites while not engaging in IMB, clinicians and researchers should shift measurement to what is occurring instead. Rubio et al. (2020) attempted to expand the existing definition of passive refusal by including observable behavior within the definition. For example, a criterion for participating in Rubio et al. (2020) included engaging in IMB or passive refusal, defined as lip-pursing, mouth closure, or teeth-clenching with low or no IMB; however, this study did not directly measure these responses. Future research should consider directly measuring passive refusal as the frequency or duration of mouth closure, lip-pursing, and/or teeth-clenching (Rubio et al., 2020) concurrent with primarily stationary head and limbs. This could improve reporting of and potentially treatment of this topography of refusal, as this review suggests that passive refusal may warrant different treatment approaches.

Procedural Integrity

Only five articles reported procedural integrity measures (Borrero et al., 2013; Rubio et al., 2015; Taylor, 2018; Rubio et al., 2020; Taylor, 2020). This is concerning as these procedures can be difficult to implement due to timing criteria (e.g., when the finger prompt and subsequent side deposit should occur in relation to refusal) and due to a level of subjectivity involved regarding pressure (e.g., jaw prompt). Safeguards when implementing the finger prompt such as cutting the therapist's nails so they do not pass the fingertip (to minimize risk to the child) and placement of the finger along the gumline (to minimize the risk of being bitten), can also be conceptualized as procedural integrity.

Social Validity

All behavior-analytic interventions should include some form of social validity assessment, especially those as invasive as physical guidance (Schwartz & Baer, 1991). Out of the nine articles discussed, seven assessed social validity through consumer preference (Ahearn et al., 1996; Ahearn et al., 2001; Borrero et al., 2013; Taylor, 2020) or survey administration (Rubio et al., 2015; Taylor, 2018; Rubio et al., 2020). Within those studies, 13 out of 14 caregivers reported that they approved of or preferred a physical guidance procedure. While it is commendable that researchers assessed an indicator of social validity at all, we recommend using a more quantifiable measure of social validity in the future so that potential change in intervention perception can be directly measured, methods can be replicated, and reliability and validity of measurement can be strengthened (Schwartz & Baer, 1991). Future research should better assess and report procedural integrity and social validity measures. Further, Borrero et al. (2013) posited that the finger prompt may be a preferable alternative to the jaw prompt as the finger prompt could also physically guide the mouth open without the use of "pressure" on the child's face and mandibular joint. In Taylor (2020), a parent verbally expressed minimal acceptability for a side deposit procedure that included the Nuk brush and preferred the manual side deposit, as they found it "more portable (did not require specialized equipment) and less atypical and stigmatizing in the community" (p. 8). Researchers should consider comparing social validity across different physical guidance procedures and their variations.

Fading and Follow-up

Behavioral interventions should be faded out if possible (Baer, et al., 1968); however, only one study provided detailed steps for fading physical guidance. Kadey et al. (2013) systematically faded the Nuk prompt, graduating through a series of steps with fewer and fewer

physical prompts as the child demonstrated more independent acceptance of bites. Probe sessions without physical guidance could also be conducted following stable acceptance to determine whether physical guidance remains necessary. Reinforcement can also be arranged so that it is only provided contingent on independent acceptance without physical guidance. It is likely that fading procedures were not needed in some of these studies as independent acceptance was consistently occurring, and physical guidance was not needed often enough to require fading. With that, collection of follow-up data to determine if and how frequently physical guidance procedures are being used post-discharge would be useful. Follow-up data were only reported for 55% of participants in the reviewed studies (Kerwin et al., 1995; Ahearn et al, 1996; Kadey et al., 2013; Taylor, 2018; Rubio et al., 2020, Taylor, 2020). All studies reported some caregiver training of physical guidance procedures prior to discharge. Future research should report follow-up data to assess rapid acceptance and therapist/caregiver use of physical guidance following discharge to determine the longitudinal need for physical guidance and whether fading procedures are warranted.

Limitations

There are several limitations of this review that should be noted. Per the inclusion criteria, this review only assessed articles in which experimental control was demonstrated with acceptance in at least one evaluation with a well-defined physical guidance procedure as the primary independent variable. Therefore, some articles that mentioned a physical guidance procedure as a treatment adjunct and one article that did not demonstrate experimental control (Silbaugh et al., 2018) were not included in our assessment. Failure to include and assess these studies could overestimate actual treatment effects and strengthen the file drawer phenomenon with physical guidance research (Shadish et al., 2016). We recommend researchers conduct more

prospective studies evaluating these procedures, as it is likely that many of these studies pursued publication following positive results during typical clinical care.

The SCARF is one of several single-case experimental design quality indicator tools, and there is currently no "gold standard" quality indicator tool for single-case designs (see Zimmerman et al., 2018 for a brief overview of tools). We selected the SCARF for its specificity to variables of quality and rigor and its production of quantitative matrices to draw qualitative and quantitative conclusions on the methodology of current research and areas for improvement. However, this tool may still be considered in a preliminary stage of research (Wendt & Miller, 2012; Zimmerman et al., 2018). Therefore, this review may have benefitted from using a more established quality indicator tool (e.g., What Works Clearinghouse guidelines) alongside the SCARF to compare results.

Finally, our assessment of 35 physical guidance evaluations (23 evaluations, 12 of which involved a comparison of two physical guidance procedures) is a relatively small sample size, especially considering the smaller sample of variants. The sample size was sufficient to produce valid results but may limit the generalizability of our conclusions.

Additional Recommendations for Future Research and Practice

Effective implementation of physical guidance may lead to more rapid acquisition of acceptance with fewer corollary behaviors, resulting in avoidance or escape from physical guidance and access to enjoyable contexts such as social praise, access to preferred tangibles, and/or escaping the meal context after eating has occurred (e.g., Ahearn et al., 1996; Borrero et al., 2013). However, the administration of procedures to prompt an open mouth is invasive and should be used with caution. Therefore, we agree with previous recommendations that physical guidance should be used in a multidisciplinary setting, following medical clearance or ongoing

medical oversight (if appropriate), and under the supervision of a clinician with experience treating severe food refusal using a behavior-analytic approach. Notably, 75% of participants underwent treatment in an inpatient or day treatment setting, implying appropriate multidisciplinary oversight of procedures. However, authors of the remaining studies provided additional information, indicating sufficient oversight. Again, authors have recommended that physical guidance be supervised by professionals with advanced training or who are highly-trained (e.g., Kadey et al., 2013; Taylor, 2018; Rubio et al., 2020; Taylor, 2020). Going forward, it may be beneficial to describe supervisors' training or define "advanced training" so that readers, practitioners, and researchers are more informed before attempting physical guidance (e.g., doctoral-level behavior analyst with six years of experience in a clinic setting assessing and treating pediatric feeding disorders).

Although authors did not directly report side effects of physical guidance, some may occur. Active refusal (IMB) and negative vocalizations may increase upon initial implementation of an intervention change like physical guidance. To lessen the likelihood or intensity of these behaviors, clinicians should consider decreasing the demand of eating or drinking by presenting a small bolus of food or liquid to start and providing noncontingent access to preferred items or activities throughout mealtimes. To promote the safety of both the feeder (e.g., risk of finger being bitten during finger prompt) and child (e.g., risk of being poked in the gums with the therapist's finger or Nuk brush), clinicians should implement physical guidance procedures as described under the supervision of experienced supervisors and medical oversight. If bleeding or other minor injury occurs to the child's mouth, the clinician should stop the intervention immediately and seek medical attention. If the trained clinician is implementing the physical guidance as intended, there should be no or low risk of injury to the therapist or child. However, physical

guidance may be difficult to implement safely if a child is engaging in excessive head turning, pushing away or swatting at the feeder or spoon, or covering his or her mouth. Therefore, physical guidance may be better indicated for treating passive refusal, as the child is predominately stationary.

Finally, researchers may wish to understand the mechanism responsible for the effectiveness of each of these physical guidance procedures. Future research may seek to determine whether effectiveness is due to negative reinforcement (i.e., complying to escape or avoiding aversive contact) or punishment (e.g., finger prompt decreasing IMB). It may also be beneficial to attempt to understand why some physical guidance procedures may be ineffective (e.g., Kahng et al., 2003; Rubio et al., 2015) to help guide treatment decisions.

Conclusion

Overall, physical guidance procedures in conjunction with nonremoval of the spoon and reinforcement have been shown to be effective in decreasing active and passive IMB and increasing food acceptance in children with severe feeding difficulties while also being acceptable to caregivers. However, to date, there are few articles evaluating each of these procedures with the exception of the jaw prompt. This is problematic because these procedures are likely practiced clinically without sufficient research supporting their efficacy. Thus, much more research is warranted to replicate previous studies and answer the questions that have arisen during this review of the literature. Going forward, it is imperative that researchers assess the social validity and procedural integrity of each procedure and determine whether physical guidance continues to be effective or necessary (or warrants fading out) over time.

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Table 1

Summary of Participant Characteristics Across Studies

	Kerwin et al. (1995)	Ahearn et al. (1996)	Ahearn et al. (2001)	Borrero et al. (2013)	Kadey et al. (2013)	Rubio et al. (2015)	Taylor (2018)	Rubio et al. (2020)	Taylor (2020)	Total (%)
Participants										
Study Total	3	3	2	4	2	2	1	3	2	22 (100)
PG Systematically Evaluated	2	3	1	4	2	2	1	3	2	20 (91)
Sex *n* (%)										
Male	1 (50)	1 (33)	1 (100)	4 (100)	1 (50)	0	1 (100)	2 (66)	2 (100)	13 (65)
Female	1 (50)	2 (66)	0	0	1 (50)	2 (100)	0	1 (33)	0	7 (35)
Age (mo)										
Mean	45	37	48	37	72	30	108	34	54	46
Standard Deviation	21	5		21	50	8		18	8	25
Range	30-60	33-42		14-60	36-108	24-36		14-45	48-60	14-108
Feeding Skill *n* (%)										
Non-self-feeder	2 (100)	3 (100)	1 (100)	3 (75)	1 (50)	2 (100)	0	3 (100)	0	15 (75)
Self-feeder	0	0	0	1 (25)	1 (50)	0	1 (100)	0	2 (100)	5 (25)
Solids Texture *n* (%)										
Puree	2 (100)	3 (100)	1 (100)	1 (25)	1 (50)	1 (50)	0	3 (100)	0	12 (60)
Junior	0	0	0	2 (50)	0	1 (50)	0	0	0	3 (15)
Wet-ground/Fork-mashed	0	0	0	0	0	0	1 (100)	0	1 (50)	2 (10)
Regular/Table	0	0	0	1 (25)	1 (50)	0	1 (100)	0	2 (100)	5 (25)
Liquids Refusal as Focus *n* (%)	0	0	0	0	2 (100)	0	0	0	0	2 (10)
Feeding Concern *n* (%)										
Current Feeding Tube	1 (50)	0	1 (100)	1 (25)	0	0	0	2 (66)	0	5 (25)
Food Selectivity	0	0	0	1 (25)	2 (100)	0	1 (100)	3 (100)	2 (100)	9 (45)
Bottle/Liquid Dependent	1 (50)	3 (100)	0	2 (50)	1 (50)	2 (100)	1 (100)	1 (33)	1 (50)	12 (60)
Medical Concern *n* (%)										
History of Failure-to-thrive	1 (50)	0	1 (100)	1 (25)	0	1 (50)	0	1 (33)	0	5 (25)
Prematurity	1 (50)	1 (33)	0	1 (25)	0	2 (100)	0	1 (33)	0	6 (30)
GERD	2 (100)	1 (33)	1 (100)	2 (50)	1 (50)	1 (50)	0	1 (33)	0	9 (45)
Food Allergies	0	0	0	0	1 (50)	0	0	1 (33)	0	2 (10)
Other GI Problem	1 (50)	3 (100)	0	1 (25)	0	1 (50)	1 (100)	1 (33)	0	8 (40)
Cardio/Pulmonary	0	1 (33)	0	0	0	2 (100)	0	0	0	3 (15)

	Kerwin et al. (1995)	Ahearn et al. (1996)	Ahearn et al. (2001)	Borrero et al. (2013)	Kadey et al. (2013)	Rubio et al. (2015)	Taylor (2018)	Rubio et al. (2020)	Taylor (2020)	Total (%)
DD/ASD/Neurological	1 (50)	2 (66)	0	1 (25)	2 (100)	2 (100)	1 (100)	2 (66)	2 (100)	13 (65)
Treatment Setting *n* (%)										
Inpatient	2 (100)	3 (100)	1 (100)	0	0	0	0	0	0	6 (30)
Day Treatment	0	0	0	4 (100)	0	2 (100)	0	3 (100)	0	9 (45)
Outpatient	0	0	0	0	2 (100)	0	0	0	0	2 (10)
In-Home	0	0	0	0	0	0	1 (100)	0	2 (100)	3 (15)
Primary Feeder *n* (%)										
Trained Therapist	2 (100)	3 (100)	1 (100)	4 (100)	2 (100)	2 (100)	1 (100)	3 (100)	2 (100)	20 (100)
Caregiver	0	0	0	0	0	0	0	0	0	0

Note: Includes data from 20 participants with single-case designs for whom physical guidance procedures were systematically evaluated. PG = Physical guidance, GERD = Gastroesophageal reflux disease, GI = Gastrointestinal, DD = Developmental delays, ASD = Autism spectrum disorder

Table 2

SCARF Primary Measures

Category	Physical Guidance Procedure	*N* (%)	Overall Quality and Rigor	Primary Outcome
High-quality Evidence of Positive Effects	Jaw Prompt (version 1)	3 (50)	2.5	3.7
	Jaw Prompt (version 2)	3 (33)	2.6	4.0
	Finger Prompt (version 1)	5 (56)	2.5	3.2
	Finger Prompt (version 2)	1 (100)	2.9	4.0
	Nuk Prompt	1 (100)	2.2	4.0
	Side Deposit	5 (100)	3.0	4.0
Total		18 (58)	2.6	3.9
High-quality Evidence of Negative or Minimal Effects	Jaw Prompt (version 1)	3 (50)	2.4	0.0
	Jaw Prompt (version 2)	6 (67)	2.7	0.0
	Finger Prompt (version 1)	4 (44)	2.5	0.0
Total		13 (42)	2.5	0.0
Low-quality Evidence of Positive Effects	Jaw Prompt (version 1)	1	1.4	3.0
	Jaw Prompt (version 2)	1	1.8	4.0
	Finger Prompt (version 1)	1	1.8	4.0
	Nuk Prompt	1	1.6	4.0

Note: N equals the number of evaluations for a procedure by category. Percentages equal the percentage of evaluations, by type of physical guidance procedure, that fell into each category and were derived from 31 evaluations with high-quality evidence for each physical guidance procedure.

Table 3

Summary of Study Descriptors

	Kerwin et al. (1995)	Ahearn et al. (1996)	Ahearn et al. (2001)	Borrero et al. (2013)	Kadey et al. (2013)	Rubio et al. (2015)	Taylor (2018)	Rubio et al. (2020)	Taylor (2020)	Total (%)
Experimental Design (*n*)										
Alternating Treatment	0	3	0	4	0	2	0	0	0	9 (45)
Multiple Baseline	1	3	0	0	1	0	0	3	0	8 (40)
Reversal	1	0	1	4	1	2	1	0	2	12 (60)
Physical Guidance Procedure (*n*)										
Jaw Prompt (version 1)	2	3	1	0	0	0	0	0	0	6 (30)
Jaw Prompt (version 2)	0	0	0	4	0	2	0	0	0	6 (30)
Finger Prompt (version 1)	0	0	0	4	0	2	0	0	0	6 (30)
Finger Prompt (version 2)	0	0	0	0	0	0	0	3	0	3 (15)
Nuk Prompt	0	0	0	0	2	0	0	0	0	2 (10)
Side Deposit	0	0	0	0	0	2	1	0	2	5 (25)
Additional Treatment Procedures (*n*)										
Nonremoval of the Spoon	2	3	1	4	2	2	1	3	2	20 (100)
Differential Social Attention	2	3	1	4	2	2	1	3	2	20 (100)
Differential Reinforcement	2	3	1	1	0	1	1	2	2	13 (65)
Noncontingent Access	0	0	0	1	1	1	0	1	1	5 (25)
Primary Dependent Variable(s) (*n*)										
Acceptance within 5 s	2	3	1	0	2	0	0	3	0	11 (55)
Bites Consumed (Acceptance)	0	0	0	0	0	2	0	0	0	2 (10)
Bites Consumed (Mouth clean)	0	0	0	0	0	0	1	0	2	3 (15)
Latency to Acceptance*	0	0	0	4	0	2	1	3	2	12 (60)
Corollary Responses (*n*)										
Inappropriate mealtime behavior	0	0	0	4	2	2	1	3	0	12 (60)
Refusal	2	0	0	0	0	0	0	0	2	4 (20)
Disruptions	0	2	1	0	0	0	0	0	0	3 (15)
Expulsion	2	2	1	0	0	0	1	0	2	8 (40)
Negative Vocalizations	0	2	1	0	0	0	0	0	2	5 (25)
Self-injury	0	2	0	0	0	0	0	0	0	2 (10)
Interobserver Agreement (*n*)	2	3	1	4	2	2	1	3	2	20 (100)
Procedural Integrity (*n*)	0	0	0	4	0	2	1	3	2	12 (60)

	Kerwin et al. (1995)	Ahearn et al. (1996)	Ahearn et al. (2001)	Borrero et al. (2013)	Kadey et al. (2013)	Rubio et al. (2015)	Taylor (2018)	Rubio et al. (2020)	Taylor (2020)	Total (%)
Social Validity (*n*)										
Anecdotal	0	3	1	4	0	0	0	0	2	10 (50)
Survey	0	0	0	0	0	2	1	3	0	6 (30)
Fading (*n*)	0	0	0	0	1	0	0	0	0	1 (5)
Follow-up (*n*)	2	2	0	0	1	0	1	3	2	11 (55)

Note: Includes data from 20 participants with single-case designs for whom physical guidance procedures were systematically evaluated.

*Scored acceptance at any time, with clinical goal of 5 s (Borrero et al., 2013; Sally in Rubio et al., 2015; Taylor, 2020) and 10 s (Cat in Rubio et al., 2015).

Figure 1

PRISMA Flow Diagram of Included and Excluded Articles

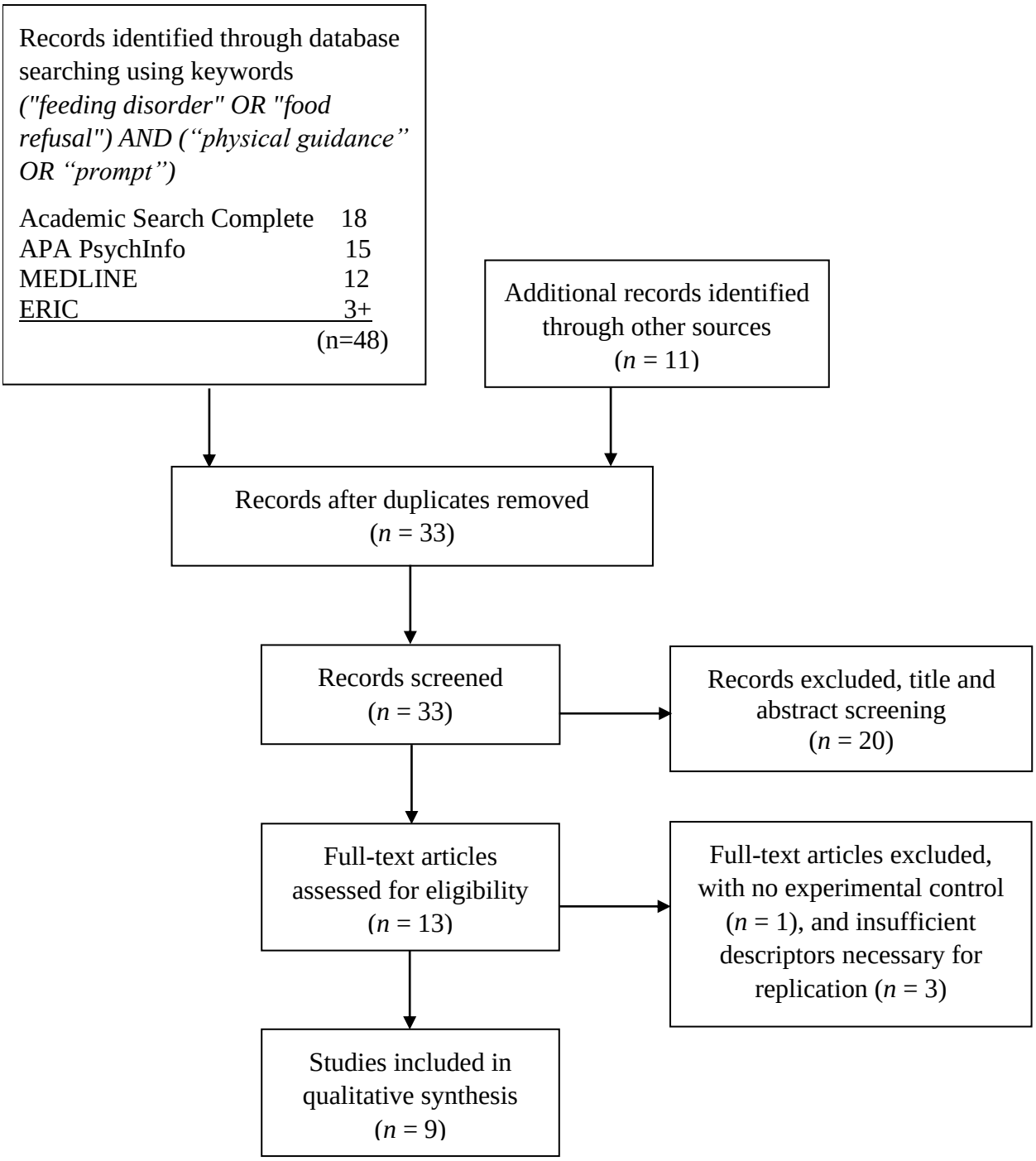
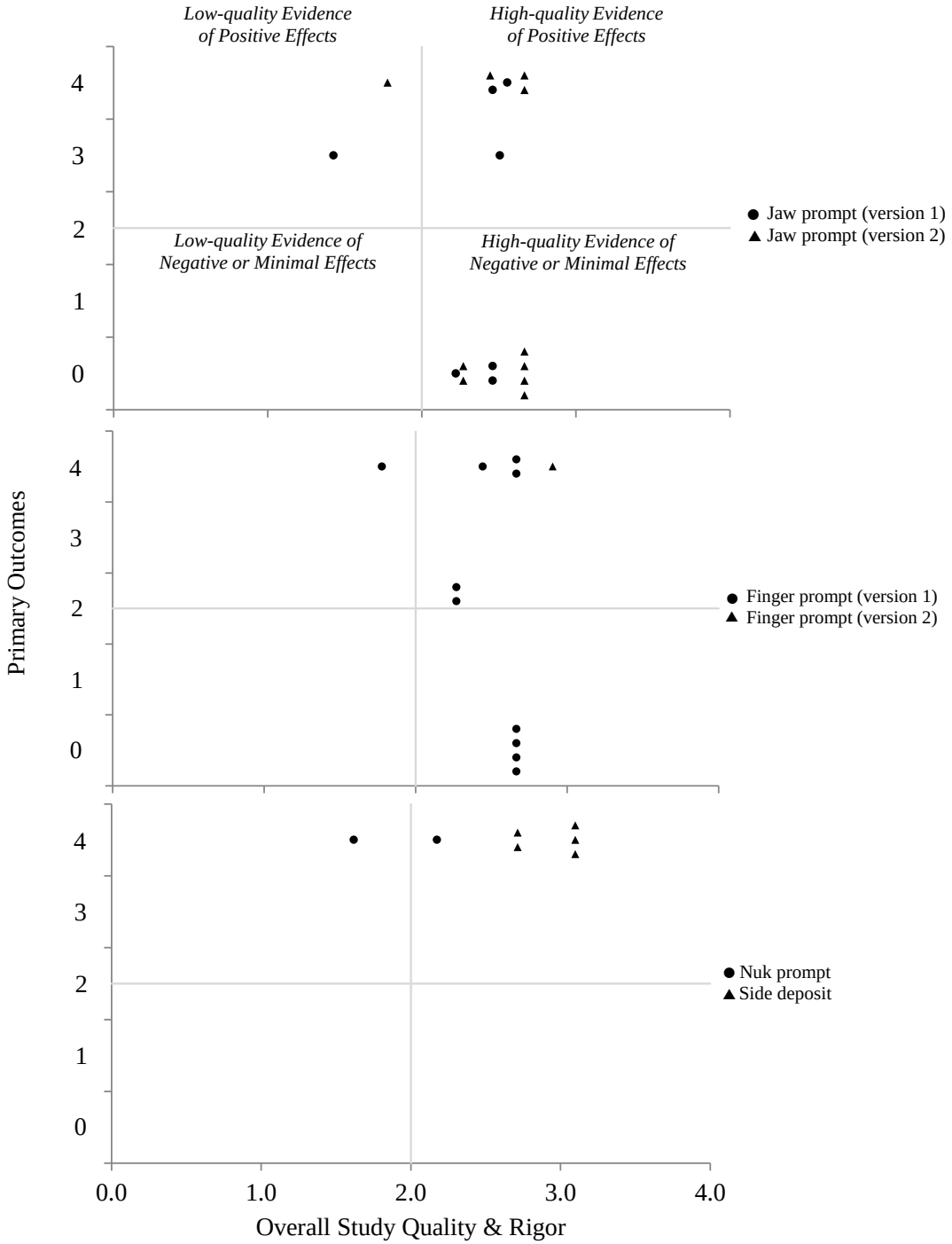


Figure 2

SCARF Scatterplots of Primary Measures across Physical Guidance Procedures



Note: Scatterplot of the SCARF overall quality and rigor scores (continuous scale of 0.0 to 4.0) for each evaluation by primary outcome score (ordinal scale of 0 to 4). Four categorical quadrants are denoted by horizontal and vertical lines

2 EVALUATION OF TWO PHYSICAL GUIDANCE PROCEDURES IN THE TREATMENT OF AVOIDANT/RESTRICTIVE FOOD INTAKE DISORDER

Children diagnosed with Avoidant/Restrictive Food Intake Disorder (ARFID) may refuse to consume an adequate variety and/or volume to maintain expected physical growth and cognitive performance and frequently experience faltering growth, nutritional deficiencies, enteral tube feeding dependence, and impaired psychosocial functioning (Kerwin, 1999; Schwartz, 2000; American Psychiatric Association, 2013). Feeding disorders often result from complicated medical histories or diagnoses of autism and related disorders. Feeding disorders are also distinct from eating disorders which include obsessive thoughts about food and body weight and are mostly diagnosed in adolescents and adults (American Psychiatric Association, 2013). Children with feeding disorders are often medically and physically able to consume food or liquid by mouth but may engage in inappropriate mealtime behavior (IMB; e.g., turning the head, pushing or batting the spoon with food away, touching the feeder's feeding hand or arm during bite presentation) to escape or avoid eating.

Applied-behavior-analytic interventions like positive reinforcement and escape prevention in the form of nonremoval of the spoon (NRS) are effective to increase consumption and decrease inappropriate mealtime behavior in these children (Sharp et al., 2010). However, for some children, these interventions are insufficient in treating IMB as well as more passive refusal (e.g., pursing lips while sitting still). In these cases, physical-guidance procedures may be utilized to prompt the child's mouth open to deposit food or drink. These procedures are implemented by a feeder during bite presentations to gently prompt or guide a child's mouth open when the child is refusing to accept food or drink and are often implemented when less invasive behavior-analytic interventions are not effective to increase food acceptance and reduce IMB. Research presented

in Chapter 1 (Rubio et al., 2021) suggests that physical-guidance procedures are efficacious in the treatment of pediatric feeding disorders/ARFID and are rated as acceptable by caregivers (e.g., jaw prompt, Ahearn et al., 2001; finger prompt, Borrero et al., 2013 and Rubio et al., 2020; Nuk prompt, Kadey et al., 2013; side-deposit, Rubio et al., 2015). Most recently, Rubio et al. (2020) evaluated a finger prompt variation (version 2; Rubio et al., 2021) and found it to be effective in decreasing food refusal and increasing acceptance in children with pediatric feeding disorders (Rubio et al., 2020). However, researchers only evaluated this prompt with three participants within a single study, thus, additional research is warranted to continue assessing this promising intervention.

Some physical-guidance procedures may be implemented clinically, contributing to the practice-based evidence of the procedures (Cook & Cook, 2016) but without any empirical evaluation to support their use. Therefore, it is important that these potentially invasive procedures are investigated to determine efficacy, acceptability, and safety. For example, the spoon prompt is currently being used clinically at an intensive multidisciplinary feeding program in the southeast with minimal evaluation. As Rubio et al. (2021) recommended, it may also be beneficial to compare different prompts to determine if one may be more appropriate for differing topographies of food refusal (e.g., passive versus active refusal) or perceived as more acceptable by stakeholders.

Further, recent research has described the efficacy of physical-guidance prompts in treating more passive food refusal (i.e., keeping mouth closed shut while sitting stationary [i.e., no IMB/active refusal] during a bite presentation; Kadey et al., 2013; Taylor, 2018; Rubio et al., 2020). Rubio et al. (2015) attempted to indirectly measure passive refusal as latency to bite acceptance when a bite of food was presented but never consumed with low or zero levels of IMB.

This first documented attempt to measure passive refusal was commendable but problematic as it refers to a lack of behavior rather than a directly observed behavior, making this construct difficult to measure. Rubio et al. (2020) defined passive refusal more directly as lip-pursing or teeth-clenching with low or no IMB, however, this study did not actually measure passive refusal. Finally, as noted in Chapter 1 (Rubio et al., 2021), additional research evaluating physical-guidance procedures, including procedural integrity, social validity, and follow-up, is warranted.

Therefore, the primary purpose of this study was to assess the efficacy and acceptability of one type of physical prompt, a spoon-prompt procedure, to increase food acceptance and decrease food refusal in children with ARFID, and to compare the effects with those of a finger prompt version 2. A secondary aim of this study was to extend previous research by directly measuring passive refusal (i.e., child sitting still with mouth closed/teeth clenched, exhibiting no or low levels of inappropriate mealtime behavior). This study also extended the literature by replicating a previously evaluated physical-guidance procedure (i.e., finger prompt version 2), evaluating a novel physical-guidance procedure (i.e., spoon prompt), assessing procedural integrity of the interventions, assessing caregiver and therapist social validity, and defining and measuring a quality of passive refusal. This study was approved by the Institutional Review Board of Children's Healthcare of Atlanta. The research questions for this study are as follows:

1. Is the spoon prompt procedure, a clinically utilized intervention, effective in increasing food acceptance and decreasing food refusal in children with ARFID?
2. Is the finger prompt version 2 as efficacious as previously demonstrated in increasing food acceptance and decreasing food refusal?
3. Is the previously researched finger prompt version 2 more or less effective than the spoon prompt in facilitating rapid acceptance in children with severe ARFID?

4. Do caregivers and therapists find one intervention more acceptable than the other?
5. Can passive refusal be defined and directly measured as a main dependent variable, improving upon previous researchers' indirect measures?

METHOD

Participants, Setting, and Materials

This was a prospective study (vs. retrospective review) and consecutive case series (e.g., Rooker et al., 2013), where we treated participants as they qualified for the study. In this prospective study, we recruited participants between September 22, 2020 and February 22, 2021. During the recruitment period, 66 children were admitted to the day-treatment program across the two participating clinical sites. Five children met inclusion criteria to participate. The clinical team did not notify the study team of a potential participant before implementing the finger prompt clinically, therefore, this child was disqualified from entering the study. We consented four caregiver-child dyads. One of the four participants began accepting bites in baseline and did not meet criteria to continue the study. Therefore, the final sample included three participants.

Inclusion and Exclusionary Criteria

Inclusion Criteria. Children were eligible for participation in the study if they (a) were admitted to an Intensive Multidisciplinary Intervention (IMI) Program in the Southeast for treatment due to ARFID as evidenced by dependence on enteral feeding, oral nutritional supplements, faltering growth, or severe food selectivity associated with nutritional deficiency; (b) between the ages of one and six years old; (c) were deemed a safe oral feeder (e.g., no/low risk of aspiration) following a multidisciplinary evaluation and formal documentation of safe swallowing; (d) had a typical treatment sequence that first introduced an escape baseline with 30-s bite

intervals and 30-s escape (following IMB), followed by the introduction of escape extinction and bolus fading (e.g., empty spoon, 0.1 cc, 0.5 cc, 1 cc) in the form of NRS combined with reinforcement-based procedures (i.e., differential reinforcement for acceptance or noncontingent access to a preferred item or activity); (e) exhibited less than 80% rapid acceptance (i.e., accepting the bite within 5 s of presentation) for at least three out of four sessions following the introduction of NRS and reinforcement associated with presence of IMB and/or passive food refusal; (f) and were then presented with a bolus size of at least 0.1-cc spoon of pureed food.

Exclusion Criteria. We did not consider individuals for participation in the study if they did not meet the inclusion criteria above and their previous treatment sequence involved a physical guidance procedure.

Once enrolled, study inclusion criteria required that they continue to engage in IMB and/or passive food refusal (i.e., observed lip pursing/mouth closure/teeth clenching with low or zero levels of IMB) following the introduction of the baseline condition.

Participants

Reese was a 4-year-old Caucasian boy diagnosed with failure-to-thrive, autism spectrum disorder, and hypoxic brain injury. Prior to treatment, Reese ate a few bites of pepperoni, cheese, and goldfish crackers per day and was dependent on G-tube feeds of Boost Kid's Essentials 1.0 to meet 100% of his caloric and nutritional needs. Reese pushed away food, expelled, gagged, vomited, threw tantrums, and hit and kicked others during meals, which limited his oral intake.

Willow was a 2-year-old African American girl who had a preterm birth (29 weeks) and was diagnosed with short gut syndrome, bronchopulmonary dysplasia, vomiting, and speech delay. Prior to treatment, Willow ate approximately two bites of pureed foods per day and was dependent on TPN and G-tube feedings of Elecare Jr to meet 100% of her caloric needs. Willow

turned her head from the food, pushed the food or spoon away, refused to open her mouth, packed food, gagged, and vomited during meals that limited her oral intake.

Bruce was a 5-year-old year-old Latinx boy diagnosed with Down syndrome, hypothyroidism, cleft lip and palate, dysphagia, insomnia, cyclical vomiting, constipation, obstructive sleep apnea, and lingual tonsil hypertrophy. Prior to treatment, Bruce did not consume any food by mouth and drank a few sips of water per day. He was dependent on G-tube feedings of Pediasure 1.0 to meet 100% of his caloric needs. Bruce expelled food, turned his head from the food, failed to chew food, gagged, vomited, and threw tantrums during meals that limited his oral intake.

Setting

Trained therapists conducted all sessions in a 3 m x 3 m treatment room within two clinical sites in the IMI program equipped with a one-way observation window, a chair for the therapist, a table, appropriate food (e.g., type, texture), and potential reinforcers identified via preference assessment or parent report (if appropriate for specific interventions). Each child sat in age- or developmentally-appropriate seating (i.e., Beyond Abiie wooden high chair for Reese, a high-chair for Willow, and a Rifton activity chair for Bruce) identified by the program's occupational or speech therapist, and the therapist sat directly across from him or her with all session materials available within arm's reach.

Data storage. We entered and stored behavioral data in standard Excel spreadsheets typically used during treatment within the IMI program. The spreadsheets were saved in a password-protected shared drive accessible only by clinic staff, and the primary investigator.

Informed Consent. One of the investigators obtained caregiver consent prior to the collection of any study data. The consent procedure included the following: (a) provided the consent

forms to caregivers with a verbal summary of the contents of all paragraphs, and (b) a description of alternatives to participating in the study (not to take part, use of other treatments, and obtaining similar treatment through other clinical services). The consenter informed caregivers that declining participation would not influence their ability to pursue other treatments and that they are free to withdraw from the study at any time. Caregivers were given the opportunity to ask questions, obtain answers to their questions, and given a signed copy of the consent form. Participants did not receive any financial benefits resulting from this study. The consenter asked the caregiver to sign and date the consent form once all questions were answered.

The children in this study were between the ages of two and five years of age and had developmental delays. Given the age and developmental level of the subjects, it was unlikely that participants were able to provide assent. The clinician conducting the consent procedure made a judgment about the child's capacity to provide assent.

Caregivers consented to video recording within the consent document. We informed caregivers that the video recordings were part of the study (for reliability assessment of the therapist feeding the child) and for typical clinical purposes (to review procedures). If caregivers were willing, video recordings would be used for training purposes (e.g., presentations at professional meetings, training new therapists). Caregivers indicated agreement or disagreement with the additional use of the videos directly on the consent form. The use of the videos for quality assessment and evaluation of spoken language was required for study participation. However, agreement to use the videos for training was not required for study participation.

Ethical Considerations. The consenter informed the caregivers that children may become upset when given foods that they do not want to eat. We attempted to avoid this by only using small bites of food, talking to and playing with the participants, giving them breaks and

toys they like. Children may have experienced discomfort from the therapist's finger in the mouth or from the spoon producing pressure on teeth. The study team monitored adverse events and asked parents at each visit if there had been any change in the child's behavior. As part of each child's typical clinical care, a multidisciplinary team, including a speech-language or occupational therapist specializing in oral motor therapy monitored oral motor structure and function and reported any changes or concerns during the interventions. No adverse events were reported during this study.

The less common risk and discomfort expected in this study was the risk of a breach of confidentiality. We tried to reduce this risk as much as possible. A study number rather than a name was used on study records wherever possible. Any information that was stored on a computer was located on a secure server. Participant information was password protected. All study staff were trained to keep information private.

Data Collection, Response Measurement, and Reliability

The primary feeding therapists, who were also trained data collectors, recorded responses from within the session room using paper and pencil data collection (except *passive refusal* and *latency to acceptance* which were scored from video recordings as they are not standard behaviors scored live by feeding therapists at this clinic). A second trained data collector recorded responses either live from within a connecting observation room, or later via video recording. Senior feeding therapists trained all therapists to collect data by reviewing operational definitions, scoring alongside the data collector while reviewing agreed and disagreed upon codes, then scoring independently until the data collector was reliable for at least three sessions across multiple patients. Since passive refusal was a novel behavior to code, the primary author reviewed the definition and examples and non-examples of passive refusal with data collectors for the study.

Observers scored *rapid acceptance*, defined as the entire bolus entering the mouth (with the exception of a pea-sized amount for Reese and Bruce) within 5 s of the therapist presenting the spoon to the child's lips. We converted rapid acceptance into a percentage by dividing the number of bites rapidly accepted by the number of bites presented. Observers scored *IMB*, defined as the child turning his or her head at least 45 degrees from the utensil, touching the therapist's arm below the elbow, pushing the utensil away, or covering the mouth. Observers scored *passive refusal*, defined as the occurrence of lip pursing, teeth clenching, or closed mouth for 5 consecutive seconds or longer while sitting stationary (i.e., without engaging in IMB) during a bite presentation. We converted IMB and passive refusal into a percentage by dividing the number of bites with at least one instance of IMB or passive refusal by the total number of bites presented. Observers scored *negative vocalizations*, defined as crying or whining for 3 consecutive seconds or longer, which was converted to percentage of bites with negative vocalizations out of total bites presented. Observers scored *latency to acceptance*, defined as time it takes in seconds for the bite to be deposited in the child's mouth following bite presentation, which was converted to average latency to bite acceptance.

Researchers assessed interobserver agreement (IOA) for the dependent variables by having trained observers, including the primary author and feeding technicians or specialists employed at the clinic with at least a bachelor's degree, either score the occurrence or nonoccurrence of the variables. The researcher calculated IOA by taking agreements (i.e., both observers will either score the occurrence or nonoccurrence of each) for each 5-bite session divided by agreements plus disagreements and multiplying by 100 to obtain a percentage. A second, independent observer coded data on 33% of baseline sessions for Reese, 75% of sessions for Willow, and 56% of sessions for Bruce. Observers coded data on 40% of finger-prompt sessions for

Reese, 55% of sessions for Willow, and 46% of sessions for Bruce; and 40% of spoon-prompt sessions for Reese, 48% of sessions for Willow, and 51% of sessions for Bruce. Mean IOA for rapid acceptance for baseline and treatment sessions was 95.5% for Reese (range: 80%–100%), 100% for Willow, and 93.1% for Bruce (range: 60%–100%). Mean IOA for IMB for baseline and treatment sessions was 97.8% for Reese (range: 80%–100%), 91.0% for Willow (range: 60%–100%), and 89.7% for Bruce (range: 40%–100%). Mean IOA for passive refusal for baseline and treatment sessions was 100% for Reese, 100% for Willow, and 100% for Bruce.

Observers scored procedural integrity for 33% of sessions during baseline and 30% during treatment sessions for Reese, 50% of sessions during baseline and 31% during treatment sessions for Willow, and 30% of sessions during baseline and 31% during treatment sessions for Bruce. The researcher used a binary system (i.e., behavior occurred or did not occur) to calculate procedural integrity to determine if the therapist implemented each treatment procedure as intended during each session. The number of correct procedures was divided by the total number of opportunities for each procedure to be implemented in a session and multiplied by 100. We analyzed therapist implementation of following procedures: bite presentation, finger prompt, spoon prompt, nonremoval of the spoon, and tangible delivery. We coded bite presentations by scoring whether the therapist presented the correct bite size, prompted the child to take a bite simultaneous with presenting the bite to their mouth, and implemented NRS (as the therapist keeping the spoon at the lips (at most 2.5 cm from the lips if child is engaging in IMB) until the child accepted the bite or until 2 min elapsed). We coded a correctly implemented physical prompt by observing each component of each procedure. For both procedures, we coded whether the therapist implemented the prompt 5 s after the initial spoon presentation and if they kept the prompt in place until the child accepted the bite or until 2 min elapsed. For the finger prompt, we

coded whether they inserted the gloved index finger along the child's upper gum line, moved their finger to the back of the last molar and forward to the canines one stroke per second. For the spoon prompt, we coded whether they placed the tip of the coated spoon between the canine and pre-molar area with the bowl of the spoon facing down, turned the spoon back and forth applying gentle pressure until the child opened their mouth enough for bite deposit. We coded correct tangible delivery if the therapist provided the tangible at the prescribed times for each child. Mean procedural integrity for all measures was 92.5% (range: 81.0%-98.0%) for Reese, 99.2% (range: 90%–100%) for Willow, and 99.9% (range: 97.9%–100%) for Bruce.

We also calculated IOA for procedural integrity data for each condition for each participant by having a second, independent, data collector review and score at least 25% of coded session videos for each condition. The researcher calculated IOA by taking agreements (i.e., both observers scored the occurrence of a treatment procedure when it should have occurred) divided by agreements plus disagreements and multiplying by 100 to derive a percentage or by dividing the smaller value by one observed by the larger value by the other observer and multiplying by 100 to derive a percentage. Procedural integrity IOA averaged 90% (range: 64.2%–100%) for Reese, 94% (range: 72%–100%) for Willow, and 100% for Bruce.

Procedure and Experimental Design

We used an alternating treatments design embedded within a nonconcurrent multiple baseline design across three participants to evaluate the effects of the finger and spoon prompts. Of the patients admitted to the IMI program, we anticipated a small population of eligible participants and were unsure when a participant would become eligible in relation to a previous participant (e.g., one participant may complete baseline and treatment comparison before a subsequent participant is enrolled in the study); thus, the nonconcurrent (versus concurrent) multiple

baseline design was utilized (Watson & Workman, 1981). Following baseline procedures, we alternated two treatments, the finger prompt and the spoon prompt, within the intervention phase of the multiple baseline design for each participant. To reduce possible biases or order effects, foods, bolus size, and potential reinforcers remained the same for each treatment for each child throughout the evaluation. We randomly selected the order of the first and subsequent treatments implemented for each child by using permuted block randomization to ensure equal balance of treatment across all sessions. However, if the third participant entered the study, and one of the treatments had not been randomly selected to start first, we would have selected that treatment to ensure that each treatment will have the opportunity to be implemented first at least once, and all remaining sessions would be counterbalanced; however, this did not occur.

We planned to conduct the evaluation with a minimum of 3 children (maximum of 10). As this was single-case research, we did not need many participants or to randomize or compare outcomes to a control group, as each participant was their own control (i.e., their progress will be compared to their baseline performance). Research utilizing single-case design has been deemed rigorous enough to demonstrate efficacy with only a few participants (Chambless & Hollon, 1998). Additionally, the population of children with feeding disorders is small and the etiology of the disorder may vary across children; therefore, single-case research may be most appropriate for this study, to evaluate a treatment with a small number of participants.

General procedure (NRS + noncontingent access [NCA] or differential reinforcement of acceptance).

We replicated previous procedures from Rubio et al. (2020). The therapist presented five bites of the same four pureed foods on a maroon spoon for each child (i.e., one from each of the following food groups if appropriate: fruit, vegetable, grain/starch, protein) at a 1.0-cc (1/2-level)

bolus on large maroon spoon for Reese, a 0.1-cc (rice-size) bolus on large maroon spoon for Willow, and 0.5-cc (¼-level) bolus on a large maroon spoon for Bruce during each session. The clinical team selected the foods for each participant from the initial 16 foods that were selected by caregivers and the dietician at the beginning of each child's admission and did not introduce any new foods during the evaluation. Each child's bolus size was determined based on how far they progressed during the bolus fading process during their typical treatment prior to the physical guidance comparison. Following the treatment comparison, researchers resumed bolus fading.

At the beginning of each child's admission, the clinical team conducted a paired-choice preference assessment to determine preferred items or activities to be used as potential reinforcers during treatment (Fisher et al., 1992). At the beginning of each meal and after every 5 to 10 bite presentations, the therapist conducted a brief choice assessment using two of the items that participants selected at least 50% of the time or items nominated by the family or team during the admission. The therapist presented each bite using nonremoval of the spoon (NRS; touching the spoon to the child's lips at midline until the bite was accepted). If the child did not accept the bite within 2 min following initial presentation, the therapist removed the bite and moved on to the next bite presentation to expose participants to each food with a session maximum duration of 10 min. The therapist provided differential reinforcement of acceptance (DRA) occurring at any time following bite presentation by providing brief labeled praise for all children and access to a preferred item upon acceptance for Reese and Willow and noncontingent access to a preferred item or activity throughout the session for Bruce. For Reese and Bruce, the therapists checked for a mouth clean 30 s after they accepted a bite by verbally prompting the child, "show me." If the child did not show 5 s after the verbal prompt, the therapist prompted, "show me like this, say ahh" and modeled an open mouth (however, due to COVID-19, all therapists wore

masks so the participants could not directly see the therapists' open mouth). If the child did not show 5 s after the model prompt, the therapist used a coated baby spoon to prompt the child's mouth open (i.e., the spoon prompt). If the child's mouth was clear within 30 s, the therapists would provide labeled praise (e.g., "great job swallowing!"). Therapists did not check for mouth cleans for Willow as her bite size was too small. Therapists re-presented expels for Reese before the study, so therapists continued this component throughout the study. That is, if more than a pea-sized amount of food previously accepted was visible outside the plane of his lips, the therapist scooped the bite of expelled food or a new bite with the utensil and presented back to his lips. Total meal length was 40 min, and the therapist conducted multiple 5-bite sessions within a meal. However, on occasion, the bite number in a session may have varied when the therapist began a session at the end of the meal block and ran out of time to complete an entire 5-bite session (e.g., if they started new session, but only had one or two bites, this would become a 6- or 7-bite session. If they were able to present three or four bites, that would become a shorter session 3- or 4-bite session).

Baseline. The feeder followed the general procedure. For all participants, this phase began immediately after meeting inclusion criteria and continued for at least three sessions and until rapid acceptance was 60% or less for three out of four sessions without an increasing trend with or without IMB. This phase was staggered across time for each participant, inherent in the multiple baseline across participants design. We implemented these procedures to determine whether participants would respond to typically effective intervention first like NRS plus reinforcement (e.g., Rubio et al., 2020) before moving on to physical prompting. Reese had been admitted to the program for 33 days (748 sessions) prior to beginning the study. Willow had been

admitted for 3 days (19 sessions) prior to beginning the study. Bruce had been admitted for 14 days (239 sessions) prior to beginning the study.

Finger prompt. The feeder followed the general procedure, except that after 5 s without acceptance due to not opening mouth with or without IMB, the therapist implemented the finger prompt procedure. To implement the finger prompt, the therapist used procedures described by Rubio et al. (2020). The therapist used a non-latex and powder-free gloved index finger, with the fingernail no longer than the fingertip to prevent injury to the mouth, from the hand not holding the spoon to the mouth. The therapist then inserted and slid their finger inside the child's mouth with the nail towards the inner check and the fleshy side along the upper gum line, being careful to not allow the finger to fall below the teeth, with a motion that takes the tip of the finger to the back of the last molar (one stroke) and forward to the canines (next stroke). The therapist provided strokes at approximately one stroke per second to avoid friction on the gums until the mouth was open wide enough to deposit the entire bolus. The therapist kept the bite at the lips throughout the procedure and used the finger prompt when presenting expelled bites for Reese. The finger prompt remained in place until the bite was accepted or 2 min elapsed. Although, the finger was in the mouth, participants could still keep their lips pursed or mouths clenched shut, avoiding bite placement. We implemented the finger prompt across at least six meal blocks.

Spoon prompt. The therapist followed the general procedure, except after 5 s without acceptance due to not opening mouth with or without IMB, the therapist implemented the spoon prompt procedure. Using a small coated spoon with the bowl of the spoon facing downward, the feeder placed the tip of the spoon at the corner of the child's lips and inserted the spoon between the teeth (contacting the gap behind the canine and pre-molar). The feeder turned the spoon

(clockwise if using right hand or counterclockwise if using the left hand), applying gentle, upward pressure on the upper teeth, until the bowl of the spoon is facing the feeder or until the child opens the mouth. If the child's teeth were clenched tightly, the feeder continued attempting to insert and turn the spoon. The feeder continued to keep the spoon with food presented at the child's mouth (with the not holding the coated spoon) until the food was placed in the child's mouth. The therapist kept the bite at the lips throughout the procedure and used the spoon prompt when presenting expelled bites for Reese. The spoon prompt remained in place until the bite was accepted or 2 min elapsed. We implemented the spoon prompt across at least six meal blocks for Willow and Bruce and five for Reese.

Social Validity. Following the consent process, the researcher provided the caregiver with a description and video of a role play of both the finger and spoon prompts. Then, we provided the caregiver with a questionnaire asking them to select their preference between the finger and spoon prompts (Appendix C). Then, following our treatment evaluation (i.e., observed stable trends in acceptance, IMB, and passive refusal in both treatment conditions), we provided the social validity questionnaires to caregivers to complete after observing their child's treatment comparison. Items of the social validity questionnaire were rated on a 1-to-5 Likert scale, with higher scores indicating greater acceptability, with the exception of the final statement in which a higher rating indicated lower acceptability (see Appendices A and B). We also administered a questionnaire asking caregivers and therapists to select their preference between the two interventions that were being compared. (Appendices D and E).

Caregiver training. After the study and once participants were rapidly accepting bites at a level bolus (at least 1 cc) with therapists feeding, therapists trained caregivers using procedures described Rubio et al. (2019). Therapists trained caregivers on their child's individualized

protocol components using strategies based in behavioral skills training (e.g., Seiverling, Williams, Sturmey, & Hart, 2012), and were required to meet mastery criteria for each step (i.e., three out of four consecutive 5-bite sessions with 80% or greater accuracy) before moving on to the next step of training. Therapists first trained caregivers to collect their child's behavioral data while the therapist feeds the child, then implement the child's intervention in the treatment room while the therapist provided immediate feedback, then implement the protocol alone in the room while collecting data with the therapist providing feedback as needed.

Follow-up. To assess how participants were performing following the study and before discharging from the day treatment program, researchers analyzed caregiver and child mealtime behavior data collected during the last five sessions of each child's admission (around 3 weeks after the study evaluation for Reese, 9 weeks after for Willow, and 3 weeks after for Bruce).

Fading. Previous research suggests that participants rarely require physical-guidance procedures by the time of their scheduled program discharge. However, we planned to provide each child's team with strategies to assist in fading out the physical guidance procedure if warranted (e.g., probe sessions without physical guidance) and report whether fading procedures were implemented and/or whether physical guidance was still required at pre-discharge and post-discharge follow-up time points.

RESULTS

Results of the treatment comparison are shown in Figure 1 (percentage of rapid acceptance), Figure 2 (percentage of IMB), Figure 3 (average latency to acceptance in s) and Figure 4 (percentage of bites with passive refusal). During baseline, Reese engaged in moderate levels of rapid acceptance (*M*=26.7%, range: 20%–40%) and IMB (*M*=93.3%, range: 80%–100%)

of bites, and accepted bites in a mean of 10.9 s (range: 10.6 s–11.2 s). He did not engage in passive refusal (0%). With the finger prompt, Reese engaged in overall low levels of rapid acceptance (*M*=12%, range: 0%–40%) and accepted bites in a mean of 19.3 s (range: 13.2 s–23.4). His low acceptance was attributed to issues with clearing the food off of the spoon and tongue thrusting. He engaged in variable, but overall, moderate levels of IMB (*M*=74%, range: 20%–100%). He did not engage in passive refusal (0%). With the spoon prompt, Reese similarly engaged in low levels of rapid acceptance (*M*=10%, range: 0%–20%) and accepted bites in a mean of 21.8 s (range: 11.8 s–28.0 s). He engaged in overall higher levels of IMB (*M*=82%, range: 60%–100%). He did not engage in passive refusal (0%).

During baseline, Willow did not rapidly accept any bites (0%), engaged in high levels of IMB (*M*= 95%; range: 80%–100%) of bites, and ultimately did not accept any bites. She engaged in passive refusal during 100% of bites. With the finger prompt, Willow engaged in initially low and then, overall, high levels of rapid acceptance (*M*=68.6%, range: 0%–100%) and accepted bites in a mean of 5.2 s (range: 2.9 s–42.7). She engaged in initially high then low to moderate levels of IMB (*M*=20.7%, range: 0%–100%). She engaged in initially high levels of passive refusal that then decreased to low levels (*M*=28.7%, range: 0%–100%). Willow responded similarly with the spoon prompt and engaged initially low then slightly higher levels of rapid acceptance (*M*=65.2%, range: 0%–100%) and accepted bites in a mean of 4.1 s (range: 1.1 s–11.5 s). She engaged similar levels of IMB (*M*=19.3%, range: 0%–100%). She engaged in initially moderate to high then low levels of passive refusal (*M*=35.7%, range: 0%–100%).

During baseline, Bruce engaged in variable levels of rapid acceptance (*M*=65.9% range: 0%–100%), engaged in overall low levels of IMB (*M*=11.5%, range: 0%–60%) of bites, and accepted bites in a mean of 4.7 s (range: 2.1–8.5 s). He engaged in low to moderate levels of

passive refusal (*M*=19.9%, range: 0%–60%). With the finger prompt, Bruce engaged in variable but, overall, high levels of rapid acceptance (*M*=85.7%, range: 40%–100%) and accepted bites in a mean of 3.5 s (range: 1.9 s–7.8 s). He engaged in overall low levels of IMB (*M*=5%, range: 0%–60%). He engaged in overall low levels of passive refusal (*M*=14.8%, range: 0%–60%). With the spoon prompt, Bruce engaged in variable but, overall, high levels of rapid acceptance (*M*=89.63%, range: 60%–100%) and accepted bites in a mean of 3.3s (range: 1.4 s– 6.6 s). He engaged in similarly low levels of IMB (*M*=5.2%, range: 0%–20%). He engaged in low levels of passive refusal (*M*=11.5%, range: 0%–60%).

Following the treatment comparison, the clinical teams proceeded with the prompt that each caregiver selected for their child, including the finger prompt for Willow and spoon prompt for Bruce. Reese's topography of refusal and presentation of non-acceptance included using his tongue to thrust the spoon out of his mouth following any part of the spoon entering his mouth, leading to difficulty clearing the food from the spoon and lower rapid acceptance as the therapist needed to replace the spoon in his mouth multiple times. Reese's clinical team did not move forward with a prompt after the evaluation and proceeded with an alternative bite presentation (i.e., underloaded spoon; the feeder measured the bolus with a syringe on the bottom of a small maroon spoon, held the spoon, food-side up until the mouth was open, then flipped the spoon onto the tongue, swiping the food along the tongue and out of the mouth) in attempt to increase rapid acceptance. Finally, the participating clinical teams did not report consistently needing the prompts at discharge, therefore, we did not provide assistance with fading.

Social Validity

Results of the social validity questionnaires are depicted in Tables 1 through 5.

Pre-Treatment

For the pre-treatment choice/preference assessment (prior to observing the prompts with their children), 66.7% of caregivers (2 of 3; Reese and Willow's caregivers) reported they found the finger prompt more acceptable and found the spoon prompt more invasive. Bruce's caregiver reported she found the spoon prompt more acceptable and the finger prompt more invasive.

Post-Treatment

For the post-treatment choice/preference assessment, caregivers' responses remained the same: 66.7% of caregivers (2 of 3) reported they found the finger prompt more acceptable and found the spoon prompt move invasive. Bruce's caregiver who preferred the spoon prompt over the finger prompt commented: "he doesn't like having his mouth touched by fingers or hands." For this assessment, 66.7% of therapists (2 of 3) reported they had no opinion regarding the treatment they found more acceptable, and 100% of therapists perceived the finger prompt to be more invasive.

Some discrepancies between the therapist and caregiver choice/preference assessment post-treatment occurred. Willow's therapist reported she felt that Willow performed better with the spoon prompt, and Willow's mother reported she performed better with the finger prompt. Willow's therapist commented, "I believed the client performed better with spoon prompt because it was less aversive and did not induce emesis. However, I believe the aversiveness of the finger prompt is what motivated the client to begin rapidly accepting bites." Also, all therapists rated the finger prompt as more invasive while most caregivers rated the spoon prompt as more invasive. Reese's therapist and caregiver both agreed the finger prompt would be easier to implement. Willow's caregiver felt the finger prompt would be easier to implement than the spoon prompt, but her therapist felt the spoon prompt was easier to implement than the finger prompt.

Bruce's caregiver felt the spoon prompt would be easier to implement than the finger prompt, but his therapist felt the finger prompt was easier to implement that the spoon prompt.

Overall, caregivers agreed that the finger prompt was acceptable (*M*=4.1) and disagreed that it was invasive (*M*=2.0). Overall, caregivers responded neutrally about whether the spoon prompt was acceptable (*M*=3.1) and agreed that it was somewhat invasive (*M*=3.7).

Follow-up

Predischarge follow-up data, which included the final 5 sessions of each child's day treatment admission, are depicted in in Figures 1 and 2. Reese's final protocol included NRS, DRA for acceptance, re-presentation of expels, and a 2-min move on using an underloaded spoon. For Reese, rapid acceptance was 84% (range: 80%–100%) and IMBs were 4% (range: 0%–20%) upon discharge from the program, and there were no physical prompts in his final protocol. Reese was consuming 7 new foods (2 proteins, 1 starch, 3 fruits, and 1 vegetable) at a .75 cc bolus on an underloaded small maroon spoon (i.e., the food was collected and deposited using the underside of the spoon). Willow's final protocol included NRS, NCA, and the finger prompt. For Willow, rapid acceptance was 100% and IMBs were 0% upon discharge from the program. The finger prompt was part of her final treatment package; however, she was not requiring the prompt to take bites upon discharge from the program. Willow was consuming 11 new foods (3 proteins, 3 starches, 2 fruits, and 3 vegetables) at a 1.0-cc bolus on a large maroon spoon. Bruce's final protocol included NRS, NCA, re-presentation of expels, response cost for packing, and a spoon prompt. For Bruce, rapid acceptance was 96% (range: 80%–100%) and IMBs were 0% upon discharge from the program. The spoon prompt was part of his final treatment package, and he was occasionally requiring the prompt to take bites upon discharge from the program.

Bruce was consuming 6 new foods (2 proteins, 2 starches, 2 fruits, and 2 vegetables) at a 0.5 cc bolus on a large maroon spoon

DISCUSSION

This study prospectively evaluated the efficacy and acceptability of two physical guidance procedures in the treatment of ARFID: a previously studied finger prompt (version 2), and a clinically utilized spoon prompt. We found that the spoon prompt was effective in increasing rapid acceptance and decreasing IMB and passive refusal to clinically appropriate levels for two children with food refusal. We replicated the previously evaluated finger prompt variation (version 2) and found similar outcomes as the original study (Rubio et al., 2020) and similar efficacy as the spoon prompt for two participants. For both Willow and Bruce, the finger prompt and spoon prompt appeared to be similarly effective at increasing rapid acceptance and decreasing IMB and passive refusal. Therefore, we asked caregivers to select the prompt they would like to proceed with for their child. Willow's caregiver selected the finger prompt, while Bruce's caregiver selected the spoon prompt. For one participant, Reese, neither prompt was effective at increasing rapid acceptance because clearing the spoon rather than opening the mouth was the primary factor impeding rapid acceptance. Results of the social validity measures indicated that two out of three caregivers viewed the finger prompt as more acceptable and less invasive than the spoon prompt, while all therapists viewed the finger prompt as more invasive. Finally, to our knowledge, this study was the first to directly measure passive refusal as a primary dependent variable.

Prospective Research in a Clinic Setting

There were several challenges related to conducting prospective research in a clinical setting where research participants were also receiving clinical care. Although the present clinic has standard practices manualized, providers use clinical judgement when making treatment decisions, which does allow for some variability in intervention selection. For example, Reese's provider stated their next step with or without the study would be a physical guidance prompt. Technically he met inclusion criteria to enter the study, however, his topography of refusal (i.e., thrusting the spoon out with his tongue) may have triggered a different treatment approach by a different provider. In an effort to avoid using physical prompts when they are not warranted, we could provide the recommendation to treat lip closure or assess a modified bolus placement (e.g., EZ spoon or Nuk brush) first if difficulty clearing the spoon or inappropriate tongue movements are preventing acceptance.

After admitting Reese into the study and realizing physical open-mouth prompts were likely inappropriate to treat his topography of refusal, we learned that our inclusion criterion of low to moderate rapid acceptance may have been too broad, and that in the future we could specify the non-acceptance should be due to clenched teeth or pursed lips during at least some bite presentations.

Overall, the study, including baseline and the treatment comparison was brief, lasting 2 days (6 meal blocks total; 1 meal in baseline and 5 to 6 in treatment) for Reese before determining his presentation was inappropriate for the study, 2 days (8 meal blocks total; 1 meal in baseline and 7 in treatment) for Willow before rapid acceptance increased to high levels in both conditions, and 4 days (12 meal blocks total; 4 meals in baseline and 8 in treatment) for Bruce before rapid acceptance increased to consistently high levels in both conditions. Both prompts increased rapid acceptance and decreased passive refusal and IMB for Willow and Bruce in a

matter of 2 to 4 days when they had both previously participated in days, and weeks (for Bruce) of intensive intervention without successfully increasing acceptance. These results indicate that these prompts may produce positive outcomes rapidly for some children and suggest that prospective research in a clinical setting is feasible, as it may improve clinical outcomes and can be implemented efficiently. It may be helpful to ask supervising clinicians on the case how they felt about their patients and case therapists participating in the study (e.g., did it feel cumbersome or too long, did it prevent them from treating other presenting concerns they may otherwise have been treating). Their input could assist us in making any changes that could strengthen buy-in and clinician-researcher collaboration if indicated for future research conducted in the clinic.

Although the current intervention data are promising, follow-up data are unavailable to determine if participants have maintained outcomes or whether they sometimes need a physical guidance prompt during meals at home. For post-discharge follow-up, researchers should analyze the data on child and caregiver mealtime behavior collected during a scheduled follow-up appointment around 4 to 6 months post-discharge from the program.

Topographies of Refusal and Appropriate Prompts

This study extended previous research that discussed and indirectly measured passive refusal and was the first to define and directly measure passive refusal. We directly measured passive refusal by recording whether we observed the child engage in more than 5 seconds of lip pursing or teeth clenching while sitting still during a bite presentation. We observed passive refusal with both Willow and Bruce and not with Reese. For Willow, we observed high levels of passive refusal in baseline and then moderate to high levels following treatment that eventually decreased to consistently low levels. For Bruce, we observed low to moderate levels of passive refusal across baseline and treatment, though eventually decreasing to consistently low levels in

treatment. Rapid acceptance increased following the finger and spoon prompts for both children who engaged in some levels of passive refusal likely because the prompts facilitated an open mouth. The finger and spoon prompts were likely ineffective in increasing Reese's rapid acceptance because the prompts primarily function as an open-mouth prompt and do not promote lip closure to pull the food off of the spoon. The responders then likely began opening their mouths and accepting the bites more quickly to avoid the prompt (negative reinforcement), or the addition of the prompts could have decreased lip pursing and teeth clenching (positive punishment). Physical-guidance prompts have been deemed effective in increasing acceptance with children with more active refusal, like IMB, and we also observed that with Willow and Bruce. Further, we were also able to say that we saw increased acceptance with children demonstrating passive refusal as well. It is unclear to what extent passive refusal was observed in previous studies as it was described but never directly measured.

The finger and spoon prompts, as the other physical guidance prompts previously evaluated (e.g., jaw prompt, Nuk prompt, side deposit), may have differing utilities, as in they may not be interchangeable or functionally equivalent. Both prompts enter the child's closed mouth, but one remains in the side of the cheek and gums (finger prompt) and one actually attempts to shift the teeth apart (spoon prompt). Visually, the movement or attempting to open clenched teeth may seem more invasive, although, the therapists in this study appeared to disagree with that assertion. Future work should focus on delineating when each prompt would be most appropriate to use and order them from least to most invasive, so they can be attempted in that order. This type of work may result in clinical decision-making models for feeding interventions that are found in other areas of behavior analysis that focus on severe challenging behavior (e.g., preference assessment; Karsten et al., 2011; Lill et al., 2021).

As previously mentioned, the spoon prompt is also used for mouth-clean checks in routine clinical practice in the setting where data were collected. Due to this extra exposure, the children experiencing the spoon prompt may be primed and either are familiar with the expectation to open, or they may be desensitized as they experience it frequently. Researchers in other clinics should consider evaluating the spoon prompt to determine if children who have never experienced this prompt would respond similarly.

Social Validity

The majority of caregivers found the finger prompt more acceptable than the spoon prompt and found the spoon prompt to be more invasive. These perceptions remained constant before caregivers saw the prompts with their children and after, even though the spoon prompt resulted in similar levels of bite acceptance. In comparison, all three therapists perceived the finger prompt to be more invasive than the spoon prompt, which differs from caregivers' perception. One explanation is that therapists use spoon prompts much more frequently in daily clinical care, as the spoon prompt is often used as part of the prompting sequence for mouth clean checks (i.e., the spoon prompt is used during the physical prompt, following a verbal and model prompt, when the child has not shown the therapist if they have swallowed). The therapists could simply be more comfortable with the spoon prompt since they are using it more. To address any discomfort from the therapist (or caregiver), we could recommend the therapist receive more training (e.g., role play) with less familiar prompts. Future research should assess social validity of the prompts in clinics where both prompts are novel to the users.

For all three participants, we asked the caregiver to select the physical prompt they would like for their clinical team to continue with as part of their child's treatment package because all children performed similarly with each prompt. In the case of Bruce and Reese, therapists and

caregivers agreed, but Willow's caregiver and therapist disagreed. We asked caregivers to rate their perceptions on the prompts before and after seeing them used with their child; however, none of the caregivers actually implemented them. Caregivers' opinions and preferences could change after they implement each technique, and this is important to consider because they will be the interventionists at home. Future research should assess role playing each technique with caregivers as an additional measure of acceptability before caregivers select the final prompt to continue with in treatment. Further, it is interesting that while responders felt their child or patient performed better with one prompt over the other, the data did not indicate this. For example, although Willow responded similarly to both prompts, Willow's therapist reported she felt that Willow performed better with the spoon prompt, and her mother reported she performed better with the finger prompt. It may be interesting to explicitly ask what made respondents think their child performed better with one prompt then another. We left a free space and prompt for comments on the social validity questionnaire, but, it was presented as optional.

We measured some indices of participant distress (e.g., IMB, negative vocalizations), and there appeared to be no meaningful difference in responses across the two prompts. We did not, however, measure indices of happiness that could have impacted caregiver and therapist perception of efficacy and acceptability. For example, if an adult observes a child smiling or interacting more during one intervention, the intervention could be perceived as more effective and acceptable. In the future, researchers could attempt to measure indices of happiness among participants to determine if there is a difference across the two interventions and a correlation between participant happiness and stakeholder acceptability. Further, using indices of happiness during an intervention to assist in selecting an intervention could increase the social validity of the intervention among participants and stakeholders (e.g., Parsons et al., 2012).

It may be beneficial to ask caregivers and therapists additional questions regarding the prompts. Taylor (2020) reported that caregivers preferred one physical prompt over another because it did not require an extra utensil. Caregivers may have felt that way about the finger prompt. Caregivers may also have felt more comfortable with a finger prompt since it was being used with their own child, whereas, therapists may have felt less comfortable putting their finger inside a child's mouth against their teeth out of concern that they may be bit.

While we measured procedural integrity, some aspects of the procedure were not observable, like pressure of the spoon prompt on their child's teeth. This important for researchers to investigate in the future as the spoon prompt is viewed as more invasive by caregivers and the amount of pressure on teeth cannot be easily operationalized (e.g., how much pressure can you use safely if the teeth are clenched tightly), which could be problematic when training feeders. We scored whether therapists implemented each observable component of the prompts correctly. It may be interesting to investigate what aspects of the prompt and the protocol are the most important to yield a robust outcome (increased rapid acceptance, decreased IMB and passive refusal). For example, researchers could assess whether the finger prompt would still be as effective without the back-and-forth motion (e.g., finger prompt version 1; Borrero et al., 2013). Researchers could also conduct a component analysis to determine if all aspects of the treatment package were necessary to maintain results.

Future research should survey clinicians regarding their decision-making process regarding treatment approaches for non-acceptance when NRS and reinforcement are ineffective. Antecedent-based approaches like demand fading may increase rapid acceptance but could be very time-consuming, whereas physical guidance prompts may increase rapid acceptance more quickly but could lead to corollary behaviors like temporarily increased IMB and negative

vocalizations and could be seen as invasive by some caregivers and therapists. It would be interesting to know when clinicians would choose different interventions or even different prompts to treat this type of refusal. It would also be interesting to ask caregivers if they prefer a treatment with potentially higher emotional response from child but quicker results, or if they prefer a treatment with slower progress but potentially fewer corollary behaviors. It is likely that these decisions may be case-specific. For example, if a child is admitted for failure to maintain appropriate weight and/or moderate to severe malnutrition, it may be that an intervention like physical guidance yielding positive outcomes quickly is warranted. Conversely, if a child is well-nourished but refuses to eat a few vegetables, this level of intervention would not be warranted. Finally, the social validity measures used in this study, in addition to past studies, were surveys created by the first author. In the future, researchers should use previously validated measures used in behavioral research like the Treatment Evaluation Inventory–Short Form (TEI-SF; Kelley et al., 1989) or the Treatment Acceptability Rating Form–Revised (TARF-R; Reimers & Wacker, 1992; Wacker et al., 1998).

As stated in past physical guidance literature, proper oversight of these procedures is necessary. Within this study, all procedures were conducted by trained staff who were supervised by licensed psychologists with multiple years of experience in the treatment of pediatric feeding disorders. We also collected integrity data and ensured therapists implemented procedures with high integrity. No therapist or child sustained any injury related to study procedures during this study.

Conclusion

Overall, results from this study replicated a previously evaluated physical prompt, the finger prompt version 2 (Rubio et al., 2020), to increase rapid acceptance and compared it to a physical prompt that has never been evaluated, the spoon prompt. Results from this study suggest

that both prompts were effective at increasing rapid acceptance among two children who engaged in both active refusal, or IMB, and passive refusal. Both prompts were acceptable overall, with the finger prompt being more often preferred by caregivers. Future research is warranted to evaluate these prompts with more participants, to measure passive refusal, and to assess social validity among stakeholders. Researchers should also assess clinicians' decision making related to physical prompt selection or alternatives to physical prompts, collect additional social validity data, and create a hierarchy of least-to-most preferred and acceptable prompts, so that clinicians would have clearer guidelines when selecting from among these interventions.

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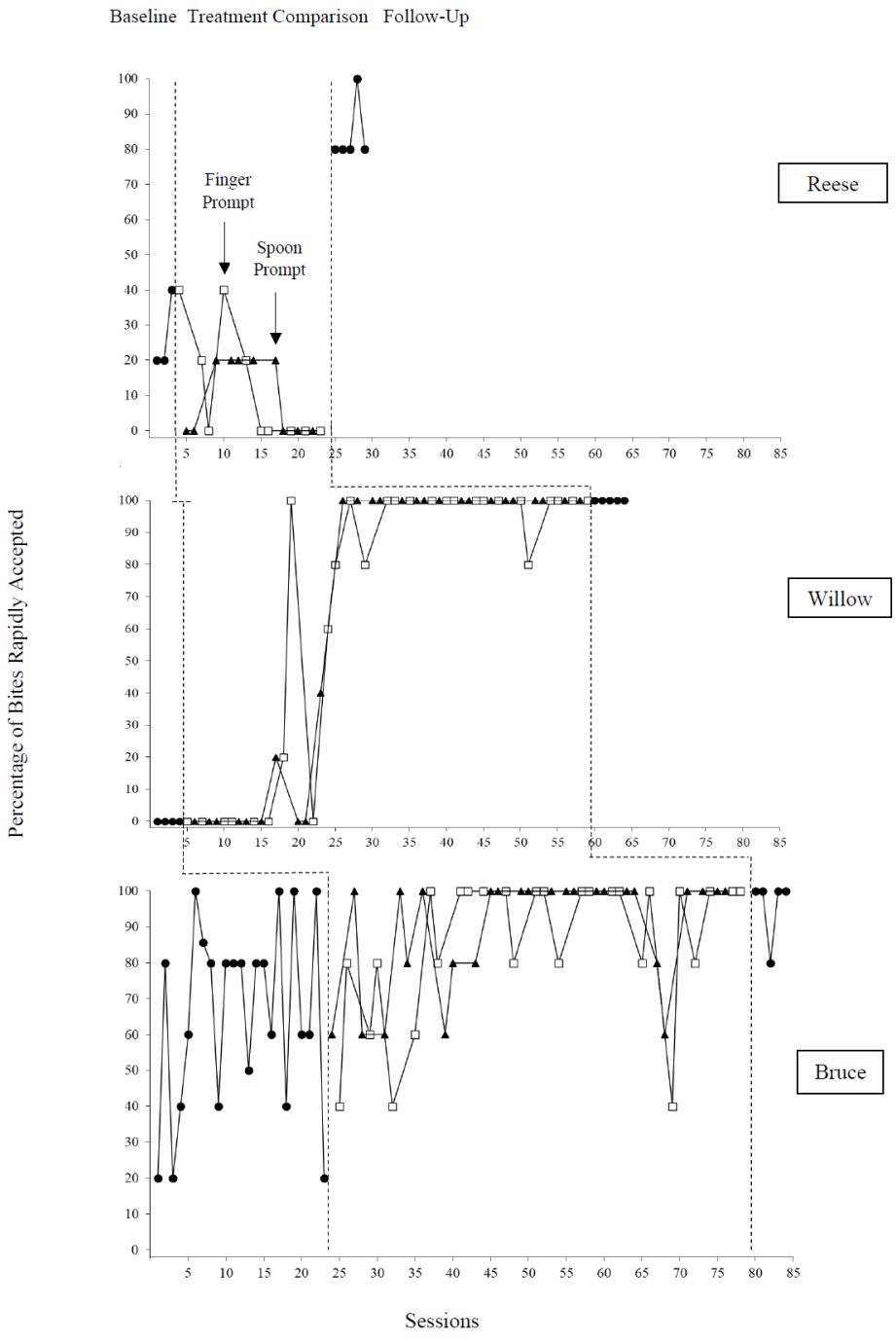

Figure 1. Percentage of bites with rapid acceptance during baseline (NRS with DRA or NCA), treatment (NRS with DRA or NCA plus finger or spoon prompt), and follow-up for Reese on the top panel, Willow on the middle panel, and Bruce on the bottom panel. NRS = nonremoval of the spoon, DRA = differential reinforcement of acceptance, NCA = noncontingent access.

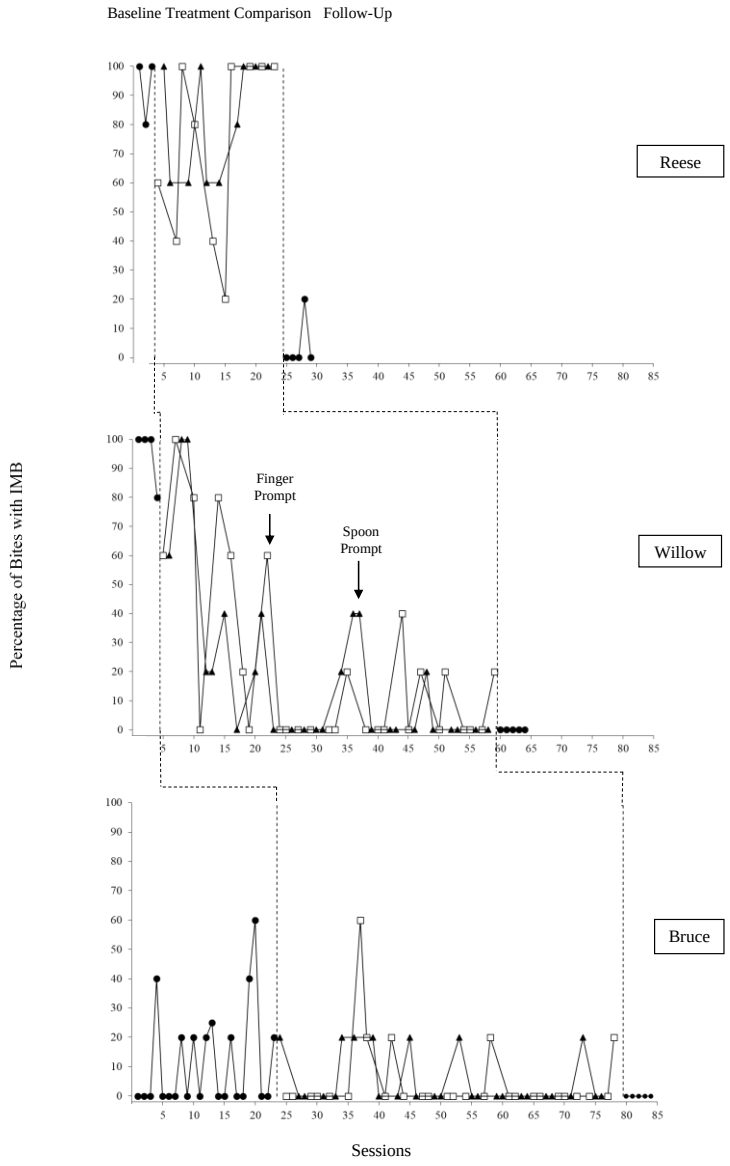

Figure 2. Percentage of bites with IMB during baseline (NRS with DRA or NCA), treatment (NRS with DRA or NCA plus finger or spoon prompt), and follow-up for Reese on the top panel, Willow on the middle panel, and Bruce on the bottom panel. NRS = nonremoval of the spoon, DRA = differential reinforcement of acceptance, NCA = noncontingent access.

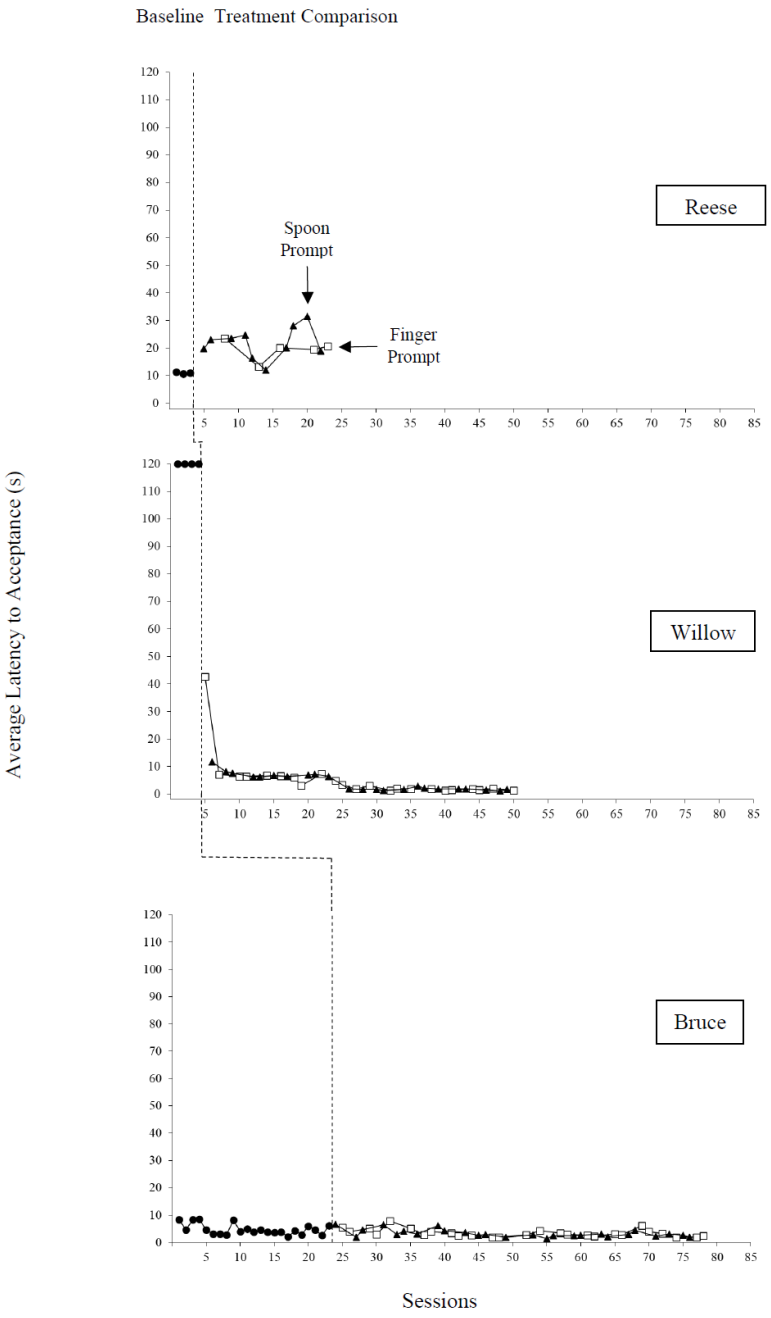

Figure 3. Average latency to acceptance during baseline (NRS with DRA or NCA) and treatment (NRS with DRA or NCA plus finger or spoon prompt) for Reese on the top panel, Willow on the middle panel, and Bruce on the bottom panel. NRS = nonremoval of the spoon, DRA = differential reinforcement of acceptance, NCA = noncontingent access.

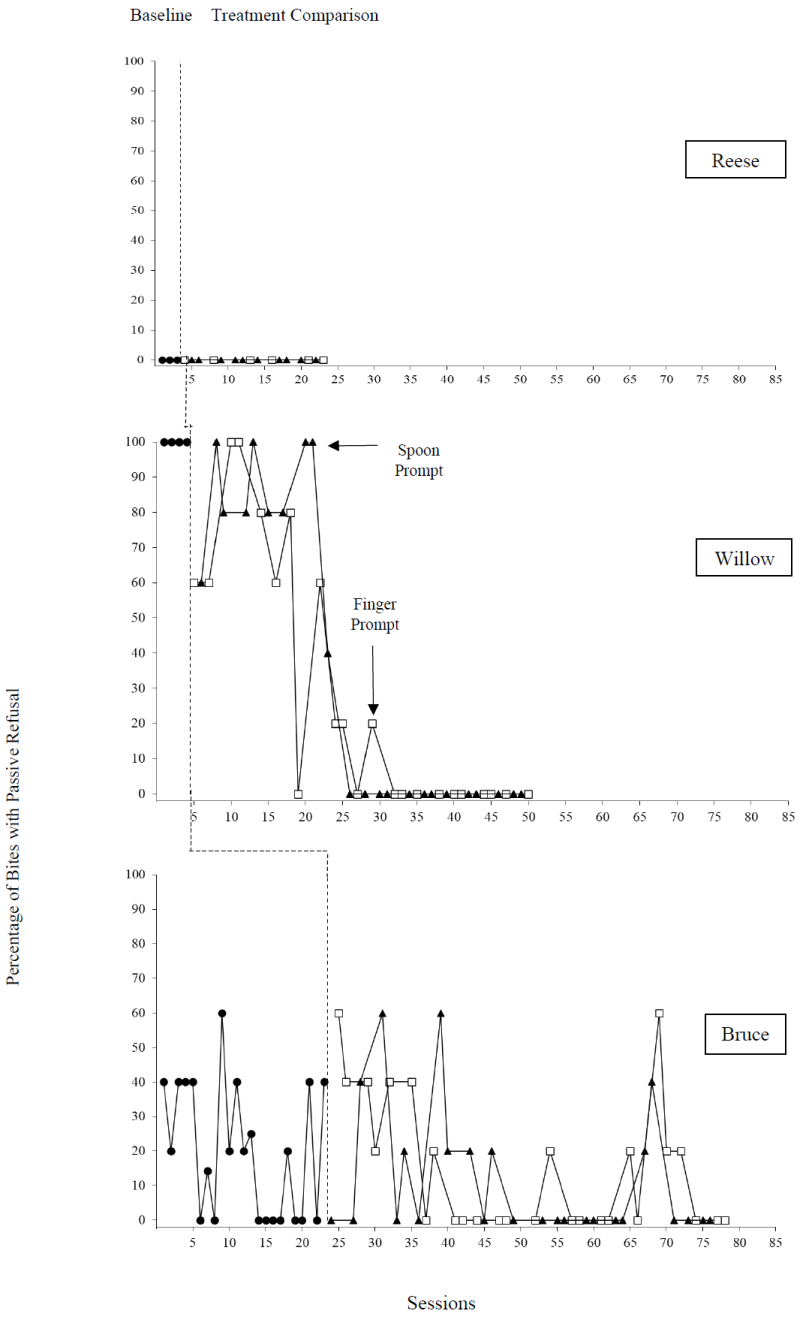

Figure 4. Percentage of bites with passive refusal during baseline (NRS with DRA or NCA) and treatment (NRS with DRA or NCA plus finger or spoon prompt) for Reese on the top panel, Willow on the middle panel, and Bruce on the bottom panel. NRS = nonremoval of the spoon, DRA = differential reinforcement of acceptance, NCA = noncontingent access.

Table 1

Caregiver Responses to Pre-Treatment Choice/Preference Social Validity Questionnaire

Statement	Reese	Willow	Bruce	Average
In which condition do you think your child would perform better?	NO	FP	SP	FP: 33.3% SP: 33.3%
Which treatment do you find more acceptable?	FP	FP	SP	FP: 66.7% SP: 33.3%
Which treatment do you find more invasive?	SP	SP	FP	FP: 33.3% SP: 66.7%
Which treatment do you think would be easier for you to implement?	FP	FP	SP	FP: 66.7% SP: 33.3%
Which treatment would you be more willing to implement when you feed your child at home?	FP	FP	SP	FP: 66.7% SP: 33.3%

*NO=No Opinion; FP=Finger Prompt; SP=Spoon Prompt

Table 2

Caregiver Responses to Post-Treatment Choice/Preference Social Validity Questionnaire

Statement	Reese	Willow	Bruce	Average %
In which condition do you think your child performed better?	FP	FP	SP	FP: 66.7% SP: 33.3%
Which treatment did you find more acceptable?	FP	FP	SP	FP: 66.7% SP: 33.3%
Which treatment did you find more invasive?	SP	SP	FP	FP: 33.3% SP: 66.7%
Which treatment do you think would be easier for you to implement?	FP	FP	SP	FP: 66.7% SP: 33.3%
Which treatment would you be more willing to implement when you feed your child at home?	FP	FP	SP	FP: 66.7% SP: 33.3%

*NO=No Opinion; FP=Finger Prompt; SP=Spoon Prompt

Table 3

Therapist Responses to Post-Treatment Choice/Preference Social Validity Questionnaire

Statement	Reese	Willow	Bruce	Average %
In which condition do you think your patient performed better?	FP	SP	SP	FP: 33.3% SP: 66.7%
Which treatment did you find more acceptable?	NO	NO	SP	FP: N/A SP: 33.3%
Which treatment did you find more invasive?	FP	FP	FP	FP: 100% SP: 0%
Which treatment was easier for you to implement?	FP	SP	FP	FP: 66.7% SP: 33.3%
Which treatment would you be more willing to recommend for future patients?	FP	NO	SP	FP: 33.3% SP: 33.3%

*NO=No Opinion; FP=Finger Prompt; SP=Spoon Prompt

Table 4

Caregiver Responses to Post-Treatment Social Validity Questionnaire: Finger Prompt (Scale 1 = Strongly Disagree to 5= Strongly Agree)

Statement	Reese	Willow	Bruce	Average
I was comfortable with this treatment for my child.	5	4	5	4.7
I feel like the procedures in this treatment will be easy for me to implement at home.	5	3	4	4.0
I feel my child is now accepting more food (amount and/or variety) during mealtimes than before this treatment.	3	4	4	3.7
I would recommend this treatment for other children who will not accept food when other treatment approaches have not worked.	3	4	5	4.0
I feel like the finger prompt procedure as a treatment to increase my child's food acceptance and decrease food refusal was invasive.	1	2	3	2.0

*Acceptability calculated by averaging the averages of the first four questions

Table 5

Caregiver Responses to Post-Treatment Social Validity Questionnaire: Spoon Prompt (Scale 1 = Strongly Disagree to 5= Strongly Agree)

Statement	Reese	Willow	Bruce	Average
I was comfortable with this treatment for my child.	1	2	5	2.7
I feel like the procedures in this treatment will be easy for me to implement at home.	3	1	5	3.0
I feel my child is now accepting more food (amount and/or variety) during mealtimes than before this treatment.	3	3	5	3.7
I would recommend this treatment for other children who will not accept food when other treatment approaches have not worked.	2	2	5	3.0
I feel like the finger prompt procedure as a treatment to increase my child's food acceptance and decrease food refusal was invasive.	5	5	1	3.7

*Acceptability calculated by averaging the averages of the first four questions

APPENDICES

Appendix A

Caregiver Questionnaire- Finger Prompt

We were evaluating a procedure (the finger prompt) to increase your child's food acceptance and decrease inappropriate mealtime behavior when other treatments were not effective. After observing these sessions, we would like you to answer the following questions regarding your impressions and preferences (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree). Please add any additional information in the space provided. Please let anyone on the team know if you have any questions.

Thank you!

Caregiver Questionnaire: Please circle your answer.

1. I was comfortable with this treatment for my child.

1 2 3 4 5

2. I feel like the procedures in this treatment will be easy for me to implement at home.

1 2 3 4 5

3. I feel my child is now accepting more food (amount and/or variety) during mealtimes than before this treatment.

1 2 3 4 5

4. I would recommend this treatment for other children who will not accept food when other treatment approaches have not worked.

1 2 3 4 5

5. I feel like the finger prompt procedure as a treatment to increase my child's food acceptance and decrease food refusal was invasive.

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Any comments?

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Appendix B

Caregiver Questionnaire- Spoon Prompt

We were evaluating a procedure (the spoon prompt) to increase your child's food acceptance and decrease inappropriate mealtime behavior when other treatments were not effective. After observing these sessions, we would like you to answer the following questions regarding your impressions and preferences (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree). Please add any additional information in the space provided. Please let anyone on the team know if you have any questions.

Thank you!

Caregiver Questionnaire: Please circle your answer.

1. I was comfortable with this treatment for my child.

1 2 3 4 5

2. I feel like the procedures in this treatment will be easy for me to implement at home.

1 2 3 4 5

3. I feel my child is now accepting more food (amount and/or variety) during mealtimes than before this treatment.

1 2 3 4 5

4. I would recommend this treatment for other children who will not accept food when other treatment approaches have not worked.

1 2 3 4 5

5. I feel like the spoon prompt procedure as a treatment to increase my child's food acceptance and decrease food refusal was invasive.

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Any comments?

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Appendix C

Caregiver Questionnaire- Pre-Treatment Choice/Preference

We are comparing two treatment conditions, one that involves a finger prompt and another that involves a spoon prompt. After observing these treatments, we would like you to answer the following questions regarding your impressions and preferences. Please let anyone on the team know if you have any questions. Thank you.

Caregiver Questionnaire: Please circle your answer.

1. In which condition do you think your child would perform better?

Finger Prompt Spoon Prompt No opinion

2. Which treatment do you find more acceptable?

Finger Prompt Spoon Prompt No opinion

3. Which treatment do you find more invasive?

Finger Prompt Spoon Prompt No opinion

4. Which treatment do you think would be easier for you to implement?

Finger Prompt Spoon Prompt No opinion

5. Which treatment would you be more willing to implement when you feed your child at home?

Finger Prompt Spoon Prompt No opinion

6. Any comments or concerns?

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Appendix D

Caregiver Questionnaire- Post-Treatment Choice/Preference

We were comparing two treatment conditions, one that involved a finger prompt and another that involved a spoon prompt. After observing these sessions, we would like you to answer the following questions regarding your impressions and preferences. Please let anyone on the team know if you have any questions. Thank you.

Caregiver Questionnaire: Please circle your answer.

1. In which condition do you think your child performed better?

Finger Prompt Spoon Prompt No opinion

2. Which treatment did you find more acceptable?

Finger Prompt Spoon Prompt No opinion

3. Which treatment did you find more invasive?

Finger Prompt Spoon Prompt No opinion

4. Which treatment do you think would be easier for you to implement?

Finger Prompt Spoon Prompt No opinion

5. Which treatment would you be more willing to implement when you feed your child at home?

Finger Prompt Spoon Prompt No opinion

6. Any comments or concerns?

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Appendix E

Therapist Questionnaire- Choice/Preference

We were comparing two treatment conditions, one that involved a finger prompt and another that involved a spoon prompt. After observing these sessions, we would like you to answer the following questions regarding your impressions and preferences. Please let anyone on the team know if you have any questions. Thank you.

Therapist Questionnaire: Please circle your answer.

1. In which condition do you think your patient performed better?

Finger Prompt Spoon Prompt No opinion

2. Which treatment did you find more acceptable?

Finger Prompt Spoon Prompt No opinion

3. Which treatment did you find more invasive?

Finger Prompt Spoon Prompt No opinion

4. Which treatment was easier for you to implement?

Finger Prompt Spoon Prompt No opinion

5. Which treatment would you be more willing to recommend for future p tients?

Finger Prompt Spoon Prompt No opinion

6. Any comments or concerns?

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