Behavior Analysis in Practice (2024) 17:176–188
https://doi.org/10.1007/s40617-023-00821-0

RESEARCH ARTICLE

Evaluating a Treatment Package for Avoidant/Restrictive Food Intake Disorder to Increase Food Variety

Ashley S. Andersen[1] · **Meeta R. Patel**[1,2]

Accepted: 6 June 2023 / Published online: 6 July 2023

Abstract

There is a dearth of published research evaluating behavior-analytic assessment and treatment of avoidant/restrictive food intake disorder (ARFID) given the recent revisions in the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition. In this study, therapists conducted periodic food preference assessments to help guide treatment for a typically developing child with ARFID and food selectivity. Further, therapists evaluated a treatment package including demand fading, escape prevention, and self-monitoring to increase food variety. Consumption increased during treatment with target foods; however, preference shifts were minor when compared to the pretreatment food preference assessment. Variety continued to increase overtime using the same treatment package and treatment effects were generalized to family meals and other locations.

Keywords avoidant/restrictive food intake disorder · food preferences · food selectivity · demand fading · self-monitoring

It is estimated that 20%–50% of typically developing children have feeding problems (Benjasuwantep et al., 2013). Avoidant/restrictive food intake disorder (ARFID) can be identified when a child fails to meet their nutritional needs, energy needs, or both. It can be associated with significant weight loss, significant nutritional deficiency, dependence on enteral feeding or supplements, or interference with psychosocial functioning (American Psychiatric Association [APA], 2013). Children diagnosed with ARFID may display poor appetite, food selectivity, or fear of eating (Milano et al., 2019). Because assessment and treatment data are limited in the AFRID literature and presenting problems are like those diagnosed with a pediatric feeding disorder (PFD; Goday et al., 2019), Sharp and Stubbs (2019) suggested using the PFD literature as a guide. Behavior-analytic treatment has the most empirical support for the treatment of PFD, and it is reasonable to believe these treatments would also be efficacious for those diagnosed with ARFID (Sharp et al., 2010; Taylor et al., 2019; Volkert & Piazza, 2012; Williams & Seiverling, 2022).

Clinicians and researchers often use functional analyses of inappropriate mealtime behavior to design an individualized and appropriate treatment (e.g., Penrod & Van Dalen, 2010; Saini et al., 2022). Although researchers have demonstrated that treatment based on the results of a functional analysis of inappropriate mealtime behavior may be no different than treatment that is not informed by a functional analysis of inappropriate mealtime behavior (Saini et al., 2019), there are a multitude of other decisions or assessments that go into designing an individualized treatment. For example, food preference assessments have been shown to inform treatment especially for children with food selectivity, with the paired-stimulus preference assessment being most common (Pichardo et al.; 2020). Penrod and Van Dalen (2010) demonstrated how the paired-stimulus preference assessment described by Fisher et al. (1992) can be used to select foods to target during treatment and as an outcome measure for three children with food selectivity and autism spectrum disorder (ASD) or sensory, visual-motor, and oral-motor delays.

- Assessing food preference can help determine which foods to introduce in treatment first.
- Treatment packages with the inclusion of fading can keep negative vocalizations, refusal, and gagging low during treatment.
- When designing treatments to increase food variety, clinicians should include components that will assist with generalizing to typical meals as components of the treatment are removed.

✉ Ashley S. Andersen
ashley_andersen@clinic4kidz.com

[1] Clinic 4 Kidz, PO Box 1711, Sausalito, CA 94966, USA

[2] Department of Pediatrics-Gastroenterology, Stanford University School of Medicine, Stanford, CA, USA

From the pretreatment preference assessment, Penrod and Van Dalen confirmed that caregiver-reported nonpreferred foods were indeed nonpreferred and they used them as targets during treatment. Penrod and Van Dalen found that some previously nonpreferred foods had increased preference after treatment, suggesting the likelihood of treatment effects maintaining over time. However, in the Penrod and Van Dalen (2010) study, the format of pre- and posttreatment preference assessments differed (single-stimulus compared to paired-stimulus, respectively) making it difficult to directly compare the results. Zeleny et al. (2020) assessed food preferences with three children with PFD and medical diagnoses using the same format (paired-stimulus preference assessment) before and during treatment to determine if preference developed for foods exposed to the child during treatment compared to foods that the child was not exposed to. Zeleny et al. did not observe increases in preference for exposure or nonexposure foods and only aimed to assess preference throughout treatment and therefore, did not use the information to inform or alter the treatment.

Although there are few studies using food preference assessments to guide treatment, behavior-analytic treatments have been extensively studied. Behavior-analytic treatments are well-established for targeting food refusal and food selectivity (Volkert & Piazza, 2012). Some efficacious treatments for food selectivity include: demand fading (gradual increases in bite number required or changes in response approximations [touch, taste, bite, eat] toward consumption; e.g., Penrod et al., 2012; Taylor et al., 2019; Turner et al., 2020), simultaneous presentation (high-preferred food or liquid presented with the target food or liquid; e.g., Piazza et al., 2002), stimulus fading (gradual changes in the food or liquid; e.g., Patel et al., 2001), and high-probability (high-p) instructional sequences (typically three highly preferred foods followed by the target food; e.g., Meier et al., 2012). However, much of the literature has evaluated treatments for young children (e.g., 2–5 years old), and modified treatments may be more appropriate for school-age children or adolescents. For example, for a child with rule-governed behavior and good receptive language, treatments that include antecedent strategies, choices, and opportunities to actively participate in their treatment may decrease treatment side effects (e.g., emotional responding, refusal behaviors) and may be viewed as more acceptable by the child and their caregivers. Self-monitoring is a treatment option that requires the individual to actively participate in the treatment and has been shown to decrease problem behaviors (Erhard et al., 2022), but self-monitoring has not been evaluated for addressing food refusal or selectivity among children. A treatment package that includes self-monitoring in combination with other empirically validated procedures that allow for choice and active participation may be a socially valid method for targeting food refusal or selectivity.

Penrod et al. (2012) implemented a treatment package for two school-age children with food selectivity and ASD. The treatment included high-p instructional sequences and demand fading in the absence of escape extinction. Compliance with demand fading target steps was high for the two participants for most steps and consumption increased once at the final step. Although the authors minimized undesirable behaviors during treatment, they noted that volume consumed was minimal given the number of sessions required to complete treatment. It is possible that additional treatment components, such as escape prevention, could increase overall consumption whereas other treatment components, such as choice or active participation, could keep undesirable behaviors low. In addition, Penrod et al. (2021) recommended that for an older child who self-feeds and engages in active refusal behaviors, nonremoval of the meal (or escape prevention) may be the most appropriate variation of escape extinction. This approach may be perceived by caregivers and clinicians as more socially acceptable and may minimize active refusal compared to nonremoval of the spoon.

Taylor et al. (2019) evaluated a treatment package including differential reinforcement, choice, and demand fading to increase consumption of novel foods for a typically developing 13-year-old child with ARFID and food selectivity. Taylor et al. conducted multiple stimulus without replacement (MSWO) food preference assessments to determine preference level and assign reinforcer amounts (e.g., more tokens for low-preference foods). The researchers presented one bite of each target food each session, and the child chose which foods they would consume. Each session had a bite criterion that the child had to meet before ending the session, and the criterion increased across sessions. The treatment package increased the variety of foods the child consumed and preference shifts were observed for some foods. Taylor et al. showed that behavior-analytic treatment for a child with ARFID and food selectivity can be efficacious, and the information gathered from assessing preference throughout treatment can be used to guide treatment decisions; however, research in this area is still limited.

The purpose of this study was to extend previous research on preference assessments during treatment for food selectivity by consistently assessing preference throughout treatment and utilizing the results to inform treatment. The study also aimed to evaluate a treatment package including demand fading, escape prevention, and self-monitoring to increase consumption of novel foods for a typically developing child with ARFID and food selectivity. By doing this, we assessed a novel treatment component, self-monitoring, which to our knowledge, has yet to be evaluated for addressing food selectivity.

Method

Participant

Sadie was a typically developing white female diagnosed with ARFID and a history of failure to thrive. She was admitted to an intensive hybrid (home-based and telehealth) interdisciplinary pediatric feeding disorders program to address her food selectivity. She also met the diagnostic criteria for PFD, but had not received a formal diagnosis. Sadie was 6 years old at the start of the study and turned 7 shortly after the study was initiated. She was in first grade in a general education classroom. She had a tongue tie released at 2 months of age, after which there was a mild improvement in breast feeding. After caregivers introduced solids, she had a limited diet, at times only consuming congee (rice porridge) before switching to only consuming yogurt. She was diagnosed with ARFID at 5 years of age. Caregivers reported that Sadie experienced medical complications due to her limited diet, including a history of anemia, which was resolved prior to the study due to supplements. Sadie's primary care physician cleared her for intensive treatment and determined she was medically stable. At the time of admission, Sadie met her caloric needs from her limited food repertoire and nutritional needs from a daily multivitamin gummy and protein supplement powder that was added to homemade muffins. Weight was not a concern at the time of admission, so therapists did not conduct regular weight checks. The family completed a 3-day food diary and it was analyzed by the program's dietitian. There were no immediate nutritional concerns at the onset of treatment due to the consumption of the multivitamin and muffins. Prior to treatment, Sadie was assessed by a speech language pathologist (SLP) who determined she did not have deficits with regards to oral motor skills and was a safe oral feeder.

Sadie received occupational and speech therapies to address feeding challenges for approximately 3 years prior to her admission to our program. Caregivers reported some improvements (i.e. smelled foods but no consumption) from prior therapies but did not observe an impactful change on consumption of a variety of foods and rigidity surrounding meals at home.

Prior to this study, caregivers reported Sadie consumed 12 foods consistently: 6 snack foods (shredded wheat crackers, Ritz crackers, pita chips, tortilla chips, fish crackers, and chia and rice flakes cereal), 1 fruit (Fuji apples), 1 vegetable (raw baby carrots), 2 grains (Hawaiian sweet bread rolls, honey nut O's cereal with whole milk), and 2 proteins (chocolate hazelnut spread, homemade chocolate protein supplement muffins). Sadie was rigid about the presentation of each of the foods she consumed consistently. For example, she would not consume chia and rice flakes cereal when mixed with milk, and she would not eat the muffins that had crispy edges. When presented novel foods or preferred foods in a different format, caregivers reported that Sadie made negative statements, stated she was scared, cried, turned her body away from the food, and attempted to leave the meal area. As a result, her family discontinued presenting novel foods to avoid these behaviors. Her limited diet and rigidity surrounding meals affected her performance at school (i.e., she fell asleep at school regularly because she would not eat outside the home) and ability to participate in social events (e.g., birthday parties, classroom celebrations, field trips).

Interdisciplinary Team

Sadie's treatment team consisted of two board-certified behavior analyst-doctoral-level (BCBA-D) therapists, a registered dietitian with experience working with children with feeding disorders, and her pediatrician. A SLP was available if the treatment team had questions or concerns regarding her chewing skills or swallowing. One BCBA-D served as Sadie's primary therapist, which involved conducting visits, implementing treatment protocols, and coordinating care among the treatment team. The second BCBA-D provided supervision for the therapist and attended visits monthly. The pediatrician was sent a monthly update to inform him of Sadie's progress in the program. The pediatrician would have been contacted if medical concerns arose during treatment, but this did not occur. The therapist collaborated with the dietitian to determine if multivitamin changes or additional supplements were necessary as the variety of food she consumed increased. In addition, the therapist and dietitian identified foods that would be important to introduce later in treatment, however, were not necessary immediately as nutritional needs were met in the short-term with the multivitamin and muffin. During treatment, the dietitian was sent periodic food diaries to analyze and determine if the multivitamin and supplements were still needed. After analyzing these food diaries, the dietitian eventually determined it was safe to discontinue protein supplements that were included in the muffins.

Setting and Materials

Sessions took place in Sadie's home at the family's dining room table. The therapist conducted paired-stimulus preference assessments, baseline sessions, demand fading treatment sessions, and continued exposure sessions with Sadie. Sessions took place during Sadie's treatment days (i.e., 3 consecutive days each month). On treatment days, the therapist conducted two to three sessions in a meal with 20 to 30 min breaks between meals. Therapists conducted an average of 8 meals per treatment day (range: 7–11). Therapists

trained caregivers to conduct continued exposure sessions for the remainder of the month when the therapist was not present (described below); caregivers conducted continued exposure sessions once per day (i.e., snack).

Therapists selected foods for inclusion in the paired-stimulus preference assessment based on caregiver report in three categories: Sadie often consumed, Sadie used to consume but had since removed from her diet, and Sadie had never consumed. Therapists selected apples, carrots, and strawberries as foods Sadie often consumed. Therapists selected waffle with syrup, strawberry breakfast bar, and snap pea crisps as foods Sadie used to consume but had since been removed from her diet, and these were targets for treatment. Therapists selected Triscuit with peanut butter spread, tater tots, and cheddar cheese as foods Sadie had never consumed, and these were also targets for treatment. These initial target foods were foods Sadie's brother often ate and caregivers wanted to target initially in treatment. After all foods from the paired-stimulus preference assessment were mastered, the therapist and Sadie's mother selected additional target foods based on foods the family regularly consumed. The therapist presented foods in their typical format cut into bites 0.6 cm x 1.3 cm x 1.3 cm. The therapist used toothpicks initially as a utensil for picking up bites during sessions because the family used toothpicks in the past to make it fun to try new foods for both Sadie and her brother. Sadie demonstrated that she could safely eat using a toothpick with her preferred foods. Later in treatment, the therapist made a transition from using toothpicks to using appropriate utensils (i.e., fork, spoon).

During demand fading with self-monitoring and escape prevention sessions (described below), Sadie had a self-monitoring sheet (see Fig. 1). The sheet included all steps in the demand fading progression and had five empty boxes to represent the five-trial sessions. The therapist laminated the sheet so it could be written on with dry erase marker and easily erased. Materials also included an iPhone with access to Sadie's highly preferred songs and headphones for Sadie to exchange her minutes earned. The iPhone with highly preferred songs was unavailable at other times and used only as a reinforcer for the demand fading treatment.

During continued exposure with escape prevention sessions (described below), the therapist placed foods on a special heart plate; this plate was only used for these sessions, and Sadie had not used the plate before treatment. During these sessions, Sadie also earned tokens. The tokens were 2.5 cm x 2.5 cm pieces of white paper with a hand-drawn image of the target food. The therapist laminated tokens and attached Velcro to the back of each token. In addition to the tokens, the therapist created a token board for the tokens to be placed after Sadie earned tokens. The therapist individualized the token board to Sadie's interests with a food rainbow for her to match with the color of the food on the token. Materials

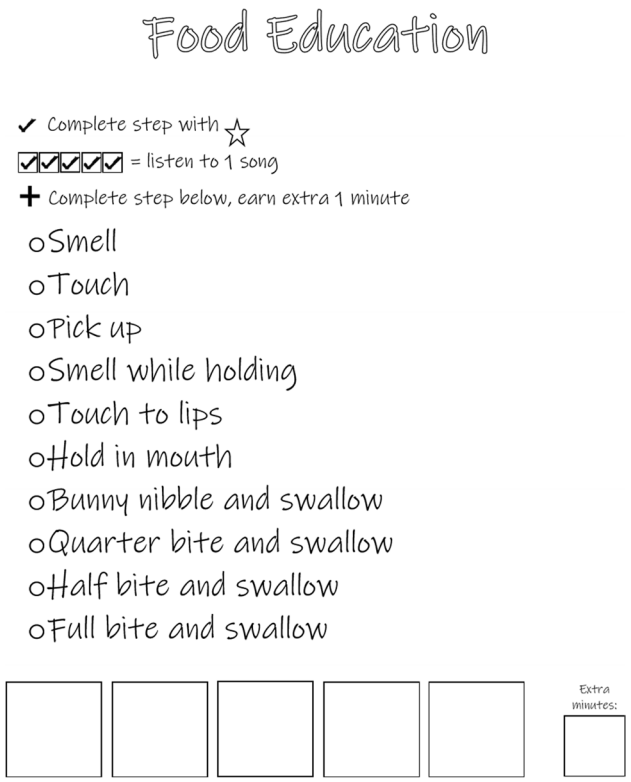

Fig. 1 Demand fading treatment self-monitoring checklist

also included the same iPhone with highly preferred games for Sadie to exchange her tokens earned. The iPhone with highly preferred games was unavailable at other times.

Dependent Variables and Interobserver Agreement

Dependent Variables

The primary dependent variable during the paired-stimulus preference assessments was consumption, and the primary dependent variable during the demand fading treatment was target-step completion. The therapist also recorded refusal, negative vocalizations, and gags during the demand fading treatment. Therapists recorded *consumption* when Sadie named or pointed to a food item, placed the food item into her mouth, and engaged in up and down movement of the jaw followed by movement of the throat indicating a swallow occurred. Therapists recorded *target step completion* when Sadie engaged in the target response within 15 s of the food item being placed on the table in front of her or completing a response higher in the response hierarchy within 15 s of the food item being placed on the table in front of her. Therapists recorded *refusal* when Sadie turned her torso 45 degrees past midline, pushed the food away from her body, or covered her mouth when the target food was presented on the table. Therapists recorded *negative vocalizations* when Sadie cried, screamed, whined, or made

negative statements about the food or therapist that occurred for a minimum of 3 s at any volume. Therapists recorded *gags* when Sadie made a retching sound with extension of the neck or opening of the mouth. Therapists did not record chewing and mouth cleans because Sadie did not have oral-motor skill deficits and had been observed appropriately chewing a variety of textures across her pretreatment foods.

Throughout treatment, therapists also recorded the total number of foods in Sadie's diet. A food was considered to be in Sadie's diet when she consumed the food without spitting the food out in continued exposure with escape prevention for three consecutive sessions. Foods that were removed due to low preference were not counted in the total number of foods after removal.

Interobserver Agreement

A master's-level BCBA was the second observer who independently recorded dependent variables for 40% of paired-stimulus preference assessments and 41% of sessions during the demand fading treatment. The first author calculated mean trial-by-trial agreement for consumption from the paired-stimulus preference assessments and for target step completion, refusal, negative vocalizations, and gags from the demand fading treatment. The number of trials with agreement from each assessment or session were divided by the total number of trials and multiplied by 100. Agreement was averaged across assessments or sessions. Interobserver agreement was 100% for consumption from the paired-stimulus preference assessments and 100% for target step completion, 100% for refusal, 99% for negative vocalizations, and 100% for gags from the demand fading treatment.

Experimental Sequence and Design

On the first treatment day each month, therapists conducted a paired-stimulus preference assessment. The data from the paired-stimulus preference assessment were used to select the order to introduce foods in demand fading with self-monitoring and escape prevention treatment. If Sadie selected and consumed foods during the paired-stimulus preference assessment or baseline, they were not introduced in demand fading with self-monitoring and escape prevention treatment but were practiced in continued exposure with escape prevention. Only one food was introduced in demand fading with self-monitoring and escape prevention treatment at a time; however, multiple foods were practiced in continued exposure with escape prevention after they were mastered in the demand fading treatment. The family continued to follow the treatment plan for mastered foods in continued exposure with escape prevention between treatment days but did not introduce new foods in demand fading treatment. The therapist conducted the demand fading treatment only. Preference continued to be assessed monthly.

Therapists used a nonconcurrent multiple baseline design across foods to evaluate the efficacy of demand fading with self-monitoring and escape prevention treatment. After completing the treatment evaluation, the therapist introduced additional foods using the same treatment but without a baseline phase. The therapist did not conduct additional baseline phases with subsequent foods to keep the treatment efficient because efficacy was already demonstrated with the initial target foods and the treatment occurred during Sadie's clinical admission. The therapist did not evaluate the efficacy of continued exposure with escape prevention using a single subject design because it was a continuation of the demand fading treatment. The purpose of continued exposure was to help facilitate generalization and maintenance and to be an interim step prior to including the food in regular family meals.

Procedures

Paired-Stimulus Preference Assessment

The therapist conducted paired-stimulus preference assessments using procedures similar to Zeleny et al. (2020). The therapist described the contingencies of the preference assessment to Sadie before beginning. For example, "I'm going to put two foods in front of you, and you can pick the one you like most and eat it if you want; you don't have to make a choice." Two foods were presented in front of Sadie approximately 15 cm apart in separate bowls. The therapist told Sadie the names of the foods and told her, "Pick one." The foods stayed in front of Sadie for 15 s or until she selected (i.e., pointed to or named) one of the foods. If Sadie selected a food, the other food was removed. If Sadie picked up the food and placed it into her mouth, she was given 15 s to chew and swallow before the therapist began the next trial. The therapist did not conduct a mouth clean check; instead, the therapist observed Sadie chew and waited to see movement of the throat before preparing the next trial. Traditional mouth clean checks (Buckley & Newchok, 2005) were not conducted because of Sadie's age and development and to avoid introducing an unnatural treatment component that would later need to be faded. Mouth clean or mastication checks would have been added if the therapist observed Sadie repeatedly chew very few times before swallowing or hold food in her mouth for extended periods of time without chewing, but this did not occur.

The therapist conducted the last preference assessment slightly different with the hopes of getting a more accurate assessment of preference after Sadie had consumed all foods. Therapists introduced escape prevention, so Sadie was required to choose one of the two foods to consume each trial. This differed from previous assessments where Sadie had the option not to select, which she often chose to do. The

therapist told Sadie, "I'm going to put two foods in front of you and you need to pick the one you like most to eat; we will wait until you make a choice." The foods stayed in front of Sadie until she selected one of the foods to feed herself. The next trial did not begin until Sadie chewed and swallowed the food she selected. Had Sadie not made a selection after 15 s, the therapist would have reminded her of the rule and continued to wait until she made a selection; however, this did not happen.

Baseline

All baseline sessions were five trials with one target food: waffle with syrup, strawberry bar, Triscuit with peanut butter, tater tot, or cheese. The therapist presented these target foods individually in separate baseline sessions. During baseline, the target step was consumption without spitting out the food. At the beginning of each meal block with baseline sessions, the therapist told Sadie the rules, "I'm going to put a food in front of you, and you can choose if you want to eat it." The therapist placed the food in a bowl in front of Sadie for 15 s. The therapist did not provide differential consequences for refusal, negative vocalizations, or gagging. If Sadie picked up the food and placed it into her mouth, the therapist provided praise and she was given 15 s to chew and swallow before the therapist began the next trial. The therapist did not conduct mouth clean checks; however, the therapist used the same procedures as the paired-stimulus preference assessment to ensure the bite was swallowed before presenting the next bite. After 15 s, the therapist removed the food and began the next trial.

Demand Fading with Self-Monitoring and Escape Prevention

Prior to starting the demand fading treatment package with a target food, Sadie and the therapist created tokens of the food item, because Sadie enjoyed drawing and coloring. While coloring the token, the target food was present on the table and Sadie and the therapist discussed what the food looked like and described what the food tasted like.

All demand fading sessions were five trials with one target food; Triscuit with peanut butter, tater tots, and cheese were introduced during separate sessions of the demand fading treatment. At the beginning of each meal block with demand fading sessions, the therapist told Sadie the rules, "We need to fill in our five boxes. When you do the 'must-do' step, you can give yourself a check. If you do a step below the 'must-do' step, you can give yourself a plus. Once our boxes are filled in, you will earn listening to one song and pluses will earn you extra minutes." Each box on the self-monitoring sheet represented one trial. The therapist then told Sadie the target (i.e., "must-do") step for the session and asked her to circle it on her self-monitoring sheet. The target steps were listed on the self-monitoring sheet from lowest to highest response effort as hypothesized by the therapist. The target steps included: smell (bite within 2.5 cm of Sadie's nose and audible sound of air intake), touch with fingers (finger contacted bite for any duration of time), pick up with toothpick (bite on toothpick while Sadie held toothpick), touch to lips (bite contacted lips for any duration of time), hold in mouth (hovering in mouth past plane of the lips using toothpick for a minimum of 1 s), nibble (any amount less than a quarter bite visibly missing from the bite), quarter bite (0.6 cm x 0.6 cm x 0.6 cm), half bite (0.6 cm x 0.6 cm x 1.3 cm), to full bite (i.e., consumption without spitting the food out). The treatment team predetermined target steps based on clinical expertise and the literature (e.g., Penrod et al., 2012), and the therapist progressed through the target steps sequentially.

The therapist placed the food in a bowl in front of Sadie and started a 15-s timer for data collection purposes (i.e., completion within 15 s). After 5 s, if Sadie completed a previous step, the therapist reminded Sadie of the target step and provided encouragement (e.g., "I know you can do this!"). If Sadie made an attempt but did not complete the target step, the therapist said, "Good try" and reminded her what the target step was in the absence of refusal, negative vocalizations, and gagging. If 2 min had passed and Sadie had not completed the target step or Sadie engaged in refusal, gagging, or negative vocalizations, the therapist waited until these behaviors ceased for 3 s, then reminded her that she could do a previous step first if she wanted to and provided more encouragement (e.g., "you're so brave; you've got this!"). When Sadie completed the target step, the therapist looked at the bite to determine that she had consumed the correct amount, and if so, the therapist provided praise. The therapist gave Sadie 15 s to chew and swallow before reminding Sadie to fill out her sheet. The therapist used the same procedures as the paired-stimulus preference assessment for target steps nibble, quarter bite, half bite, and full bite to ensure the bite was swallowed before presenting the next bite. There was one trial in session 14 of tater tot that Sadie swallowed a nibble without chewing, and the therapist told Sadie that she must chew before swallowing and premature swallowing was not observed again. If Sadie completed a step farther along in the progression than the target step (e.g., must do step was nibble but Sadie did quarter bite), the therapist provided high-quality praise (e.g., "Wow, that was amazing!") and Sadie marked a plus on her sheet indicating she earned an extra minute. After filling the five boxes, the therapist and Sadie totaled the number of minutes she earned during the session and added the total to the minutes accumulated or Sadie could choose to exchange the minutes right away to listen to her favorite songs. For example, Sadie earned a minimum of 3 min (i.e., one song) each session but could earn up to 8 min if all boxes were

filled with pluses. The session did not end until the target step was completed; there was no session time cap. Sadie did not attempt to leave the meal area before demand fading sessions ended.

The therapist progressed to the next demand fading step after one session with 80% or greater target step completion, except for quarter and half bite steps for Triscuit with peanut butter and tater tots because of challenges getting the correct sized bite. That is, Sadie took multiple bites to eat a quarter bite resulting in target step completion occurring after 15 s. Instead, the therapist progressed after observing an increasing trend in target step completion to keep the evaluation efficient. To prioritize treatment efficiency during Sadie's clinical admission, therapists chose not to require multiple sessions of 80% or greater target step completion for each step of the demand fading procedure to avoid prolonging the treatment evaluation. Target foods were considered mastered when Sadie had three consecutive sessions with 80% to 100% target step completion at the full bite step. Therapists would have gone back to a new intermediate target step if Sadie's completion was not on an increasing trend after five sessions; however, this did not happen. For example, therapists could have gone back to touch to teeth if completion for nibble did not increase after five sessions. Therapists were cautious about going back to previous steps because therapists did not want Sadie to learn that low target step completion would result in a potentially easier target step.

Continued Exposure with Escape Prevention

After target foods progressed through the demand fading treatment, they moved to continued exposure with escape prevention. Prior to continued exposure sessions, the therapist or caregiver placed three tokens on a menu to signal which foods were available to choose. During continued exposure sessions, the therapist or caregiver gave Sadie the menu with tokens. After Sadie selected the food to consume first, the therapist or caregiver prepared the food and placed it on the heart plate reserved for these sessions only. The therapist or caregiver told Sadie the rules, "empty plate, then all done." She was also told she needed to eat the food on the plate the way it was given, the food may be a different color or size but it is the same food, and after chewing and swallowing she can put the token on the token board. Sadie could ask for reminders of the rules if she wanted, which happened during the first month but decreased after she had become familiar with the rules. During these sessions, the therapist or caregiver conversed with Sadie when she was consuming the food, and if asked a question, told Sadie they could answer when she was eating; conversation was included so that these sessions started to resemble family mealtimes more closely. Similar to the demand fading treatment, the therapist or caregiver provided encouragement if Sadie brought the bite to her mouth but placed it back on the plate and reminded Sadie she could do small steps (e.g., smell, touch to lips, nibble) if she wanted. That is, the therapist or caregiver waited until refusal, negative vocalizations, or gagging ceased for 3 s, then provided encouragement. If Sadie attempted to leave the meal area before the plate was empty, she was told to return to her chair and reminded of the rules. If Sadie did not return to her chair on her own, the therapist counted down from five to signal they would soon guide her back to her chair. Sadie returned to her chair on her own before the therapist counted down to zero from five. Once she consumed the food on her plate and made the plate empty, she placed the corresponding token on the token board. These steps were repeated until all foods on the menu were selected, then the session ended. Therapists or caregivers provided opportunities approximately twice per week where Sadie could exchange the number of tokens she earned for minutes on the iPhone to play games.

The therapist trained one caregiver to implement continued exposure with escape prevention before the final treatment day during Month 1 with foods in Sadie's repertoire including Triscuit with peanut butter. Prior to caregiver training, the therapist conducted all continued exposure sessions with foods in Sadie's repertoire. Training included a verbal explanation of procedures, modeling the procedures with Sadie for the caregiver to observe, and providing feedback while the caregiver implemented procedures with the therapist present (Parsons et al., 2012). The therapist observed the caregiver implement sessions until the caregiver independently implemented sessions without requiring feedback for three consecutive sessions.

The caregiver was instructed to place recently mastered target foods on the menu at least once per day, so Sadie got regular practice between treatment days. Throughout the course of the month between treatment days, Sadie continued to practice consuming the mastered foods in larger volumes and in slightly differing presentations (e.g., cut into strips, cut into triangles, presented whole). The caregiver conducted these sessions once per day. The therapist gave her caregiver specific instructions on how to increase the volume of food on the plate and how to vary the presentation to target her rigidity with preferred or familiar foods. Each month, the therapist observed the caregiver implement continued exposure sessions and provided additional feedback if needed to ensure procedural drift did not occur.

Generalization

After completion of the demand fading and continued exposure treatments with the target foods, generalization to family meals was the focus, whereas additional novel foods continued to be introduced in demand fading with further

exposure of those foods during continued exposure treatment. Foods moved to the appropriate meal (e.g., tater tots at dinner) after consistent consumption in continued exposure treatment occurred for 1 month. Consistent consumption was determined based on caregiver report that they regularly presented the food item every 1 to 2 days, Sadie ate the food with minimal delay, and Sadie engaged in low to zero negative vocalizations after being presented the food. At regular family meals, the caregiver placed the tokens next to Sadie's dinner plate instead of having her pick tokens from the menu. The foods were placed on her dinner plate instead of the heart plate, and Sadie could choose the order to consume the foods. Sadie was told the same rules as during the continued exposure treatment. Reinforcement (i.e., exchanging tokens earned for minutes of iPhone games) was still available, but the format of these sessions was less structured as these sessions occurred during regular family meals with Sadie's preferred foods. Over the course of the month, the portion of each food was increased gradually. After consistent consumption during regular family meals, reinforcement was removed and the tokens transitioned to cards with the food name on a meal menu where Sadie picked the foods she wanted to consume from the menu. Foods on the meal menu were presented at age-typical portions recommended by the dietitian. Escape prevention remained in place. That is, caregivers ensured Sadie stayed at the table until the plate of food was consumed and reminded her to return to the table if she left the meal area; this was not problematic, but Sadie would occasionally get up from the table to get water for example and caregivers then reminded her to sit back down.

As part of the focus on generalization, therapists instructed caregivers to present the target foods that were prepared from a restaurant instead of made at home. For example, once quesadilla had progressed through demand fading, continued exposure, and regular family meals, caregivers varied quesadilla by occasionally presenting quesadillas from their local restaurant instead of making them at home. In addition, generalization included teaching Sadie's teachers to implement generalization sessions (initiated Month 2) and conducting meals at restaurants (initiated Month 8). Sadie's teachers checked her lunch box before she could leave the lunch area to ensure she consumed foods with associated tokens (i.e., escape prevention) and caregivers provided exchange opportunities for tokens earned at home.

Social Validity

After foods were mastered and generalized to typical meals, therapists gave Sadie's caregiver who was primarily involved in her feeding treatment a social validity questionnaire to complete. The questionnaire was a modified version of the Treatment Acceptability Rating Form–Revised (TARF; Reimers & Wacker, 1992). The questionnaire was modified to specify refusal instead of challenging/destructive behavior and included only relevant questions. The caregiver answered questions using a Likert scale, with 1 being strongly disagree and 5 being strongly agree. There were eight positively framed questions such that a 5 indicated highly satisfied and one negatively framed question such that a 1 indicated highly satisfied; for this reason, the first author summed positive questions and negative questions separately yielding two social validity scores. Questions asked about the perceived effectiveness of the treatment, the caregiver's reaction to the treatment, the perceived discomfort their child experienced during the treatment, and willingness to use the treatment again.

Results

During the paired-stimulus preference assessments, the percentage of trials consumed was consistently highest for the foods Sadie regularly consumed prior to treatment (an average of 98% for apple, 70% for carrot, and 88% for strawberry; see Fig. 2). Sadie consumed snap pea crisp during the first paired-stimulus preference assessment, so this food was practiced in continued exposure with escape prevention and demand fading was not necessary. Preference increased for waffle with syrup (0%–25%), strawberry bar (0%–13%), and snap pea crisps (25%–75%) after these foods had been in treatment for 1 month. Across assessments, waffle with syrup was consumed 13% of trials, strawberry bar was consumed 10% of trials, and snap pea crisp was consumed 53% of trials. Only in the last preference assessment where Sadie was required to pick one food to consume every trial was an increase in preference observed for Triscuit with peanut butter (13%) and cheese (25%); preference did not increase for tater tots (0%).

During baseline of the demand fading with self-monitoring and escape prevention treatment, Sadie consumed waffle with syrup and strawberry bar, so these foods were practiced in continued exposure with escape prevention and the demand fading treatment was not introduced. During baseline, Sadie did not engage in the target step (i.e., consumption without spitting the food out) with Triscuit with peanut butter, tater tot, or cheese (see Fig. 3). During baseline, refusal and gags occurred for 0% of sessions for all target foods. Negative vocalizations occurred for 33% (range: 0%–80%), 0%, and 4% (range: 0%–20%) of sessions on average for Triscuit with peanut butter, tater tots, and cheese, respectively. After introducing the demand fading treatment package for Triscuit with peanut butter, target step completion increased and the therapist progressed through steps quickly. At the quarter bite target step, target step completion was more variable because it was difficult for Sadie to bite

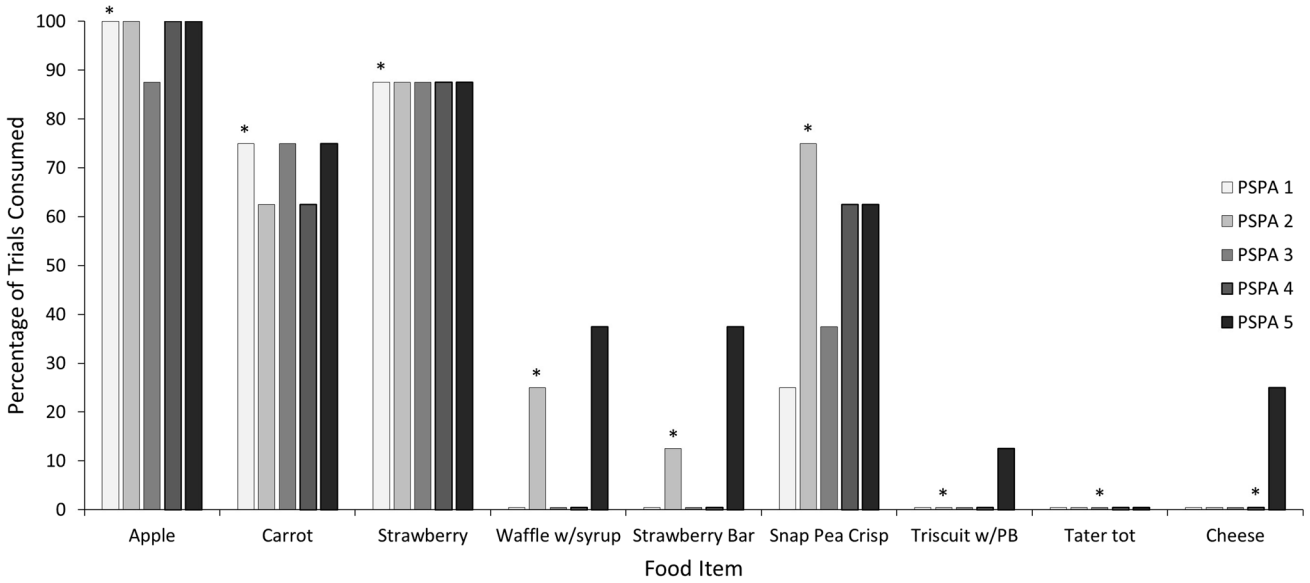

Fig. 2 Paired-stimulus preference sssessment results across treatment. *Note.* Asterisks indicate when the food item was regularly consumed or in treatment for a minimum of 1 month before the preference assessment

off the correct amount of cracker due to the texture of the cracker. After observing an increasing trend, the therapist progressed to the next target step, and target step completion increased and maintained once Sadie consumed the full bite. This pattern was replicated with tater tot, also observing challenges with biting off a quarter and half bite. Sadie required fewer sessions at each step for tater tot and cheese to progress to full bite. After three consecutive sessions with 80% to 100% target step completion at the terminal step (i.e., consumption without spitting the food out), these foods were moved to continued exposure with escape prevention so Sadie could get additional practice with these foods at larger volumes and varying presentations. Refusal, negative vocalizations, and gags did not occur during demand fading sessions.

Across the first 12 months of Sadie's treatment, the variety of foods she regularly consumed greatly increased (see Fig. 4). Before treatment, Sadie regularly consumed 12 foods (1 vegetable, 1 fruit, 2 grains, 2 proteins, 6 snack foods), and after 6 months of treatment, she regularly consumed 41 foods (2 vegetables, 4 fruits, 14 grains, 12 proteins, 9 snack foods). After 12 months of treatment, Sadie regularly consumed 76 foods (11 vegetables, 9 fruits, 27 grain, 19 proteins, 10 snack foods). An average of 5 foods were added each month (range: 2–11). It is important to note that 10 foods were removed from treatment due to a lack of preference after they were introduced for a minimum of 1 month (these foods are not counted as being in her repertoire once removed). Also, due to frequent practice consuming foods in varying formats during continued exposure sessions, Sadie willingly consumed mastered foods in a variety of presentations. For example, Sadie consumed mastered foods when cut into strips, triangles, squares, and in an age-typical format.

Social Validity

Sadie's caregiver rated the treatment to be acceptable, giving an average rating of 4.4 (range: 4–5) for positively framed questions and giving a 3 (neutral) for the negatively framed question.

Discussion

In the current study, the researchers aimed to increase the variety of foods consumed for a child with ARFID (A2 subtype) and food selectivity and used preference assessment data to inform treatment. The variety of foods consumed increased quickly during demand fading treatment package without an increase in refusal, negative vocalization, or gagging. Across months of treatment, Sadie displayed a rapid improvement in food variety; however minimal preference shifts were observed when choice to consume or not was available.

It is interesting that not all target foods from the paired-stimulus preference assessment required the demand fading treatment for consumption to increase. Sadie chose to consume waffle with syrup, strawberry bar, and snap pea crisp before the demand fading treatment was initiated with those foods. The therapist and caregiver selected these foods as targets because they were foods that Sadie used to consume but had since removed from her diet. Therapists anticipated that the *used to consume* foods would achieve consumption

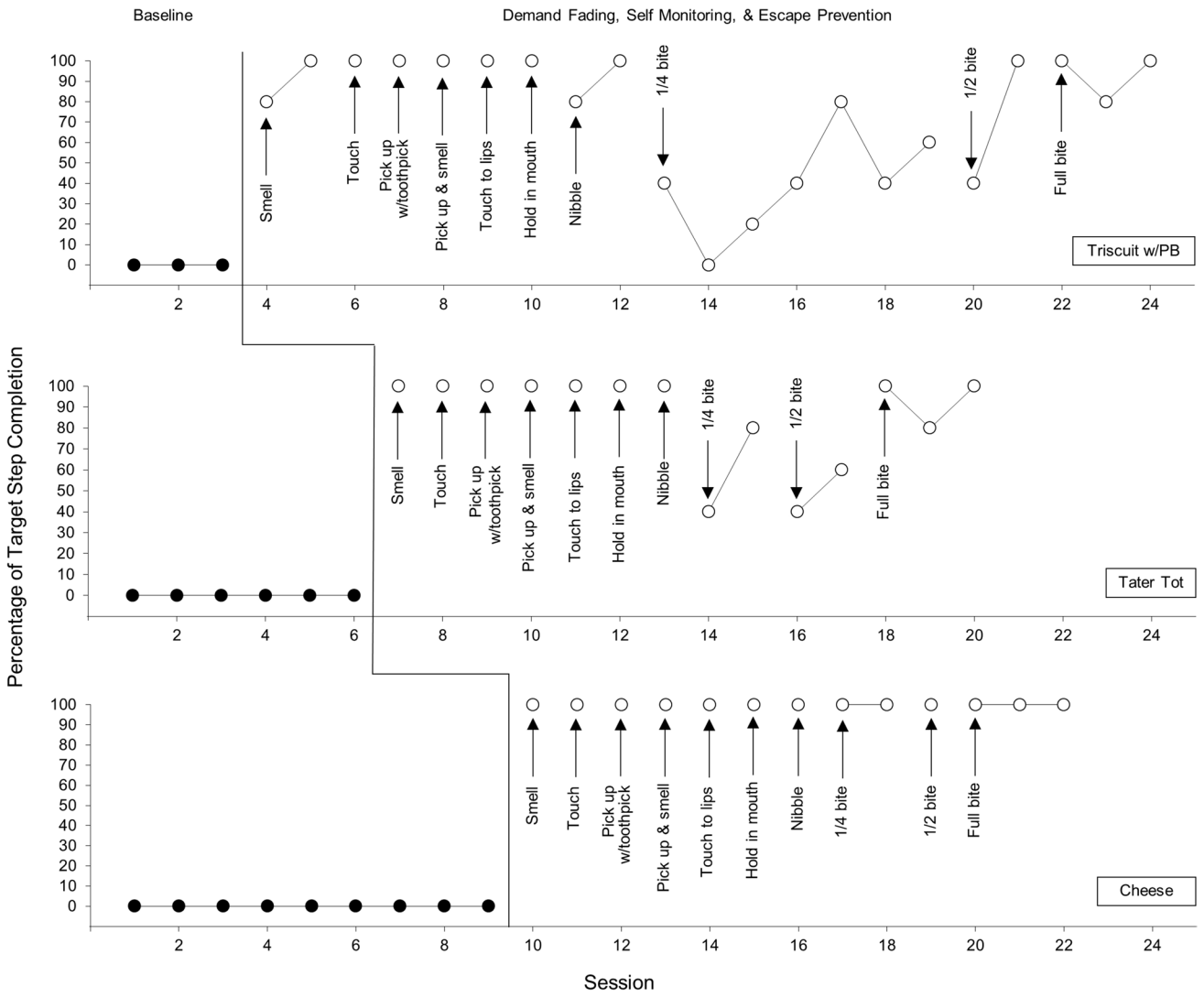

Fig. 3 Target step completion during demand fading treatment

in fewer sessions and with fewer undesirable behaviors if introduced in treatment first. However, therapists observed that these foods did not require the demand fading treatment at all, demonstrating one benefit of conducting preference assessments throughout treatment.

Upon study completion, Sadie was taking part in regular family meals in the home, at school, and in the community and was beginning to eat what her family was eating. At the end of this study, Sadie was still in the intensive home-based interdisciplinary pediatric feeding disorders program with goals focusing on continuing to consume foods the family eats regularly and trying novel foods independently without the added structure of the demand fading treatment package. Despite ongoing feeding goals, Sadie was able to participate in social events involving food and caregivers report their stress regarding Sadie's eating has greatly reduced.

Previous researchers have assessed food preference during treatment in various ways. Penrod and Van Dalen (2010) assessed preference of caregiver-reported high-preferred foods separate from target foods prior to treatment but in combination post treatment. Penrod and Van Dalen did observe apparent preference shifts, but the assessments were not conducted in the same way pre and posttreatment. In the current study, therapists assessed preference consistently at different points during treatment, but the inclusion of high-preferred foods may have affected preference for the target foods. Taylor et al. (2019) assessed preference of target foods only using a MSWO preference assessment, and observed preference shifts for some foods after exposure during treatment. Future researchers should consider including only target foods when assessing preference throughout treatment. In addition, therapists observed Sadie choose to not consume a food frequently when the option was available

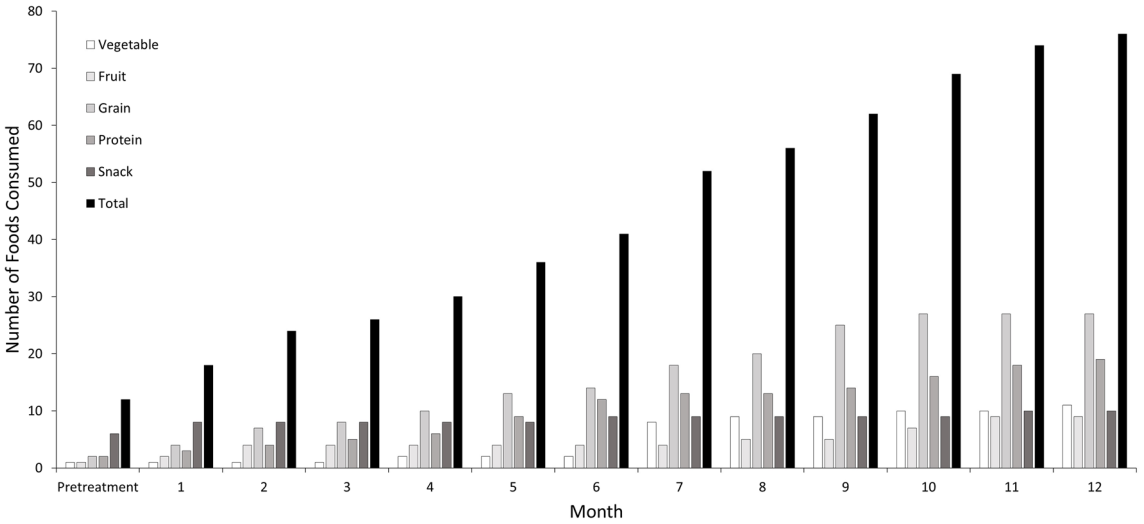

Fig. 4 Number of foods consumed throughout treatment

(i.e., assessments 1–4). Zeleny et al. (2020) included a random-choice paired-stimulus preference assessment in anticipation of children not selecting a food to consume. Future researchers could consider including escape prevention to get a more accurate assessment of preference between two target food options or explore other ways to shift preference during treatment while allowing escape in the preference assessment. The latter would be representative of choice in the absence of treatment components, which is the ultimate goal for long-term maintenance.

The therapist removed target foods for which preference did not develop and replaced those foods with other foods from the same food group. If the target food was a food the family regularly consumed, therapists reintroduced the food after a few months to see if preference would emerge after Sadie started consuming other foods. Future researchers should systematically evaluate modifications for low preference target foods to determine efficacious methods to increase preference. Strategies for increasing preference, such as adjusting reinforcer magnitude, selecting target foods that have similar properties to preferred foods, or simultaneous presentation with preferred foods, may be beneficial for planning for long-term maintenance in the absence of treatment.

Similar to previous research (Taylor et al., 2019), behavior-analytic treatment was efficacious at increasing consumption of novel foods for a child with ARFID and food selectivity who had years of previous therapies without success. Therapists used empirically supported treatment components (i.e., escape prevention, demand fading, differential reinforcement) and tailored the treatment to the child's specific interests. The information from this study in combination with other studies suggests that assessment and treatments for pediatric feeding disorders may be useful for children with ARFID as well. In addition, the self-monitoring component of the treatment in this study has not been fully explored in the PFD or ARFID literature.

When designing the demand fading treatment, therapists included components that may not have been the driving force of the treatment's efficacy but including them at the beginning allowed us to carry them through the progression of treatment. In particular, it is unlikely that the use of tokens or rules, without escape prevention, would have led to the increase in consumption of novel foods. But, including them at the beginning of treatment created consistency and predictability for Sadie as other components of the treatment were altered or removed to transition to age-typical eating within family meals. Further, the inclusion of demand fading likely was responsible for the absence of undesirable behaviors (refusal, negative vocalizations, gagging). It is possible that a treatment package without demand fading that included rules, tokens, escape prevention, and self-monitoring could have similarly resulted in increased consumption of novel foods; however, it is unlikely that the increase in consumption would have happened without undesirable behaviors or long session durations. In addition, it is difficult to determine if self-monitoring would be effective as a standalone treatment. Future researchers should consider a component analysis of the treatment while prioritizing treatment acceptability and keeping undesirable behaviors low.

Although this study does expand the literature on assessment and treatment for children with ARFID, there are some limitations that should be mentioned. The study did not include a measure of treatment integrity. A doctoral-level BCBA implemented these sessions, but it is still important to measure treatment integrity to demonstrate the treatment was implemented as described. Further, therapists did not include mouth checks to confirm consumption and

instead used indirect observation (i.e., without spitting out, movement of the throat to indicate a swallow response). Although this was clinically appropriate for Sadie, this may not be appropriate for other children with food selectivity. Some children with food selectivity may prematurely swallow as an escape response to get the food out of their mouth faster, but swallowing inadequately chewed food may increase the risk for choking. Clinicians should consider including mastication or mouth clean checks to be certain that children chew and swallow appropriately before removing checks. In addition, the authors evaluated the treatment with a single participant, so its replicability to other children is unknown. Yet, evaluating the treatment with one child allowed the treatment to be highly individualized. Last, the authors did not evaluate the generalization procedures using a single-subject design to demonstrate function control of the procedures on the increase in number of foods consumed. Future research should evaluate the generalization procedures because it is crucial for treatment to extend beyond structured sessions to everyday eating situations.

In conclusion, we demonstrated that a treatment package including empirically validated behavior-analytic components increased food variety for a child with ARFID and food selectivity. Treatment was not associated with an increase in undesirable behaviors, and there were minor shifts in food preferences. The variety of foods consumed continued to increase across months of treatment. Future researchers should continue evaluating treatments for typically developing children with ARFID and food selectivity who have the capacity to exercise autonomy and actively participate in treatments that are socially valid.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40617-023-00821-0.

Author Contributions All authors contributed to the design and execution of the study. In addition, authors contributed to the writing process.

Funding The authors did not receive any direct funding for this research project; however, these data were collected within the patient's clinical care.

Data Availability All data collected for this study are presented in the article. The Excel file where the data are stored can be available upon reasonable request.

Declarations

Consent to Participate Written informed consent was obtained by legal guardian to participate in research and publication.

Conflicts of Interest There are no financial interests to disclose for this study. The second author of this study is on the Editorial Board for the journal.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.) *(DSM-5).*

Benjasuwantep, B., Chaithirayanon, S., & Eiamudomkan, M. (2013). Feeding problems in healthy young children: Prevalence, related factors, and feeding practices. *Pediatric Reports, 5*(10), 38–42. https://doi.org/10.4081/pr.2013.e10

Buckley, S. D., & Newchok, D. K. (2005). An evaluation of simultaneous presentation and differential reinforcement with response cost to reduce packing. *Journal of Applied Behavior Analysis, 38*(3), 405–409. https://doi.org/10.1901/jaba.2005.71-04

Erhard, P., Wong, T., Barnett, M., Falcomata, T. S., & Lang, R. (2022). Self-management skills and applied behavior analysis. In J. L. Matson & P. Sturmey (Eds.), *Handbook of autism and pervasive developmental disorder: Assessment, diagnosis, and treatment* (pp. 957–973). Springer International. https://doi.org/10.1007/978-3-030-88538-0_41

Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25*(2), 491–498. https://doi.org/10.1901/jaba.1992.25-491

Goday, P. S., Huh, S. Y., Silverman, A., Lukens, C. T., Dodrill, P., Cohen, S. S., Delaney, A. L., Feuling, M. B., Noel, R. J., Gisel, E., Kenzer, A., Kessler, D. B., Kraus de Camargo, O., Browne, J., & Phalen, J. A. (2019). Pediatric feeding disorder: consensus definition and conceptual framework. *Journal of Pediatric Gastroenterology & Nutrition, 68*(1), 124. https://doi.org/10.1097/MPG.0000000000002188

Meier, A. E., Fryling, M. J., & Wallace, M. D. (2012). Using high-probability foods to increase the acceptance of low-probability foods. *Journal of Applied Behavior Analysis, 45*(1), 149–153. https://doi.org/10.1901/jaba.2012.45-149

Milano, K., Chatoor, I., & Kerzner, B. (2019). A functional approach to feeding difficulties in children. *Current Gastroenterology Reports, 21*(10), 1–8. https://doi.org/10.1007/s11894-019-0719-0

Parsons, M. B., Rollyson, J. H., & Reid, D. H. (2012). Evidence-based staff training: A guide for practitioners. *Behavior Analysis in Practice, 5*, 2–11. https://doi.org/10.1007/BF03391819

Patel, M. R., Piazza, C. C., Kelly, M. L., Ochsner, C. A., & Santana, C. M. (2001). Using a fading procedure to increase fluid consumption in a child with feeding problems. *Journal of Applied Behavior Analysis, 34*(3), 357–360. https://doi.org/10.1901/jaba.2001.34-357

Penrod, B., Gardella, L., & Fernand, J. (2012). An evaluation of a progressive high-probability instructional sequence combined with low-probability demand fading in the treatment of food selectivity. *Journal of Applied Behavior Analysis, 45*(3), 527–537. https://doi.org/10.1901/jaba.2012.45-527

Penrod, B., Silbaugh, B. C., Page, S. V., & Moseman, M. (2021). Interventions to support feeding in people with intellectual and developmental disabilities. In R. Lang & P. Sturmey (Eds.), *Adaptive behavior strategies for individuals with intellectual and developmental disabilities* (pp. 21–45). Springer.

Penrod, B., & Van Dalen, K. H. (2010). An evaluation of emerging preference for non-preferred foods targeted in the treatment of food selectivity. *Behavioral Interventions, 25*(3), 239–251. https://doi.org/10.1002/bin.306

Piazza, C. C., Patel, M. R., Santana, C. M., Goh, H. L., Delia, M. D., & Lancaster, B. M. (2002). An evaluation of simultaneous and sequential presentation of preferred and nonpreferred food to treat food selectivity. *Journal of Applied Behavior Analysis, 35*(3), 259–270. https://doi.org/10.1901/jaba.2002.35-259

Pichardo, D., Franke, K., Smith, H. M., Suarez, L. V., & Kozlowski, A. M. (2020). A systematic review of food preference assessments for children with pediatric feeding disorders: A need for modifications and technological descriptions. *Behavioral Development, 25*(2), 66. https://doi.org/10.1037/bdb0000097

Reimers, T. M., & Wacker, D. P. (1992). Acceptability of behavioral treatments for children: Analog and naturalistic evaluations by parents. *School Psychology Review, 21*(4), 628–643.

Saini, V., Andersen, A. S., Jessel, J., & Vance, H. (2022). On the role of operant contingencies in the maintenance of inappropriate mealtime behavior: An epidemiological analysis. *Journal of Applied Behavior Analysis, 55*(2), 513–528. https://doi.org/10.1002/jaba.901

Saini, V., Jessel, J., Iannaccone, J. A., & Agnew, C. (2019). Efficacy of functional analysis for informing behavioral treatment of inappropriate mealtime behavior: A systematic review and meta-analysis. *Behavioral Interventions, 34*(2), 231–247. https://doi.org/10.1002/bin.1664

Sharp, W. G., Jaquess, D. L., Morton, J. F., & Herzinger, C. V. (2010). Pediatric feeding disorders: A quantitative synthesis of treatment outcomes. *Clinical Child & Family Psychology Review, 13*(4), 348–365. https://doi.org/10.1007/s10567-010-0079-7

Sharp, W. G., & Stubbs, K. H. (2019). Avoidant/restrictive food intake disorder: A diagnosis at the intersection of feeding and eating disorders necessitating subtype differentiation. *International Journal of Eating Disorders, 52*(4), 398–401. https://doi.org/10.1002/eat.22987

Taylor, T., Haberlin, A., & Haberlin, J. (2019). Treatment of avoidant/restrictive food intake disorder for a teenager with typical development within the home setting. *Journal of Adolescence, 77*(1), 11–20. https://doi.org/10.1016/j.adolescence.2019.09.007

Turner, V. R., Ledford, J. R., Lord, A. K., & Harbin, E. R. (2020). Response shaping to improve food acceptance for children with autism: Effects of small and large food sets. *Research in Developmental Disabilities, 98*, 103574. https://doi.org/10.1016/j.ridd.2020.103574

Volkert, V. M., & Piazza, C. C. (2012). Pediatric feeding disorders. In P. Sturmey & M. Hersen (Eds.), *Handbook of evidence-based practice in clinical psychology* (Vol. 1, pp. 323–338). John Wiley & Sons.

Williams, K., & Seiverling, L. (2022). Behavior analytic feeding interventions: Current state of the literature. *Behavior Modification*, 1–29. https://doi.org/10.1177/01454455221098118

Zeleny, J. R., Volkert, V. M., Ibañez, V. F., Crowley, J. G., Kirkwood, C. A., & Piazza, C. C. (2020). Food preferences before and during treatment for a pediatric feeding disorder. *Journal of Applied Behavior Analysis, 53*(2), 875–888. https://doi.org/10.1002/jaba.625