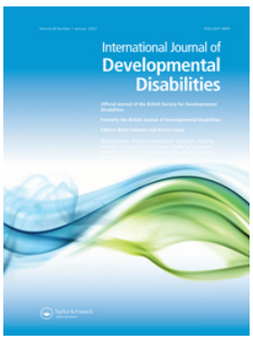

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# Prioritizing choice and assent in the assessment and treatment of food selectivity

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Food selectivity affects up to 72% and 45% of individuals with and without disabilities, respectively, and there is a need for interventions that rely on positive, unrestrictive strategies. We evaluated an assessment and treatment package for food selectivity for young children with developmental disabilities that prioritized caregiver collaboration, client autonomy, and did not rely on restrictive procedures (e.g. escape extinction). The process involved: (a) collaborating with caregivers on the selection of foods and design of the children's functional analyses; (b) indirectly and directly measuring food preferences prior to treatment; (c) evaluating the sensitivity of mealtime problem behavior to environmental variables through an interview-informed synthesized contingency analysis (IISCA); and (c) incorporating the assessment results into a progressive treatment process consisting of choice-making opportunities and differential reinforcement of successive approximations to consumption. Children also had the ability to opt in and out of treatment sessions. The treatment was effective in increasing consumption of nonpreferred foods and successfully extended to caregivers. Practical implications and directions for future research are discussed.

**Keywords:** choice; food selectivity; shaping; synthesized reinforcement

Problems related to eating are common among children, particularly so among children on the autism spectrum. Schreck *et al*. (2004) found that up to 72% of 472 children with autism ate a narrow variety of foods, eating significantly less foods in each food domain than their typically developing peers. Food selectivity is defined by eating a limited number of foods along dimensions such as type and texture. Selective diets may meet a child's caloric needs but are often low in nutritional value (Peterson *et al*. 2016). Food selectivity can lead to high levels of family stress as caregivers work around their child's selective eating behaviors (Cooper *et al*. 1995). The co-occurrence of mealtime problem behavior often exacerbates these issues. These issues can lead to negative consequences for highly selective eaters' health, development, and socialization (Kedesdy and Budd 1998). Presumably, highly selective eating patterns may prevent individuals from fully participating in common activities surrounding food, such as family dinners, birthdays, and holiday traditions.

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There has been considerable research evaluating treatments for food selectivity. In a review of such treatments, Silbaugh *et al*. (2016) found that differential reinforcement and escape extinction were most commonly implemented. Differential reinforcement procedures include access to preferred items (e.g. Riordan *et al*. 1980, 1984) contingent on desired target behaviors such as acceptance or swallowing target foods. Escape extinction procedures include nonremoval of the spoon (Hoch *et al*. 1994, Peterson *et al*. 2016) and physical guidance (Borrero *et al*. 2013, Ives *et al*. 1978), which may require the child to remain seated. These procedures are often combined with re-presentation of expelled bites (Bachmeyer *et al*. 2009, Coe *et al*. 1997). Other interventions have included simultaneous presentation (Ahearn 2003), rules (Tarbox *et al*. 2010), and demand fading (Penrod *et al*. 2012). Of the thirty reviewed studies, only two described procedures that included choice-making opportunities as part of the intervention. Koegel *et al*. (2012) and McDowell *et al*. (2007) provided their participants with their choice of reinforcer and choice of targeted food each trial, respectively.


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A core principle of the behavior analytic ethical code is to treat others with compassion, dignity, and respect by actively promoting self-determination (i.e. the ability to make choices and manage one's life) (BACB 2020b, Holburn 1997, Wehmeyer *et al*. 2004). Thus, the paucity of research incorporating choice into food selectivity interventions is concerning given the importance of promoting autonomy and independence for clients within human services, especially when working with vulnerable populations. One evidence-based approach that prioritizes choice and autonomy within therapeutic interventions is Positive Behavior Support (PBS). The key tenets of PBS include: (a) operating from a person-centered value base, (b) recognizing the individuality of each person, and (c) working towards meaningful outcomes through comprehensive assessment and interventions (Carr and Sidener 2002). PBS approaches have been applied to food selectivity interventions (Binnendyk and Lucyshyn 2009, Chu 2012, Curtiss and Ebata 2019). Binnendyk and Lucyshyn (2009) for example, assessed and treated the food selectivity of a child while incorporating PBS strategies such as collaborating with caregivers, conducting functional behavioral assessments, and measuring multiple outcomes. The treatment package included multiple components such as a daily eating schedule; visual strategies, positive contingency statements, prompting with prompt fading, contingent access to preferred toys and activities, and escape extinction procedures. Other applications (e.g. Chu 2012) employed similar treatment packages, including some component of escape extinction for challenging behavior. It is worth noting that escape extinction has commonly been included in PBS interventions for food selectivity.

Escape extinction, through numerous replications, has proven to be efficacious and one of the only effective interventions for children with life threatening feeding challenges. For caregivers with and practitioners working with children with less severe feeding challenges, there may be practical concerns when considering the use of escape extinction (Bachmeyer 2009). First, escape extinction can be associated with an increase in the frequency and intensity of problem behavior and emotional responding (Lerman *et al*. 1999), and when these procedures are not implemented with integrity, it can lead to adverse treatment effects (Pipkin *et al*. 2010, Wilder *et al*. 2006). Second, practitioners and caregivers may not be able to contain a child to a chair to implement escape extinction in certain situations (e.g. in a school setting, with larger individuals). If practitioners cannot contain a child in chair, attempting to use physical guidance or nonremoval of the spoon while a child is resisting or eloping may be dangerous or prohibited under some conditions (LaVigna and Donnellan 1986). Intensive procedures such as escape extinction may be medically necessary for cases, and it is critical that research examines the conditions under which procedures like escape extinction are selected. When restrictive approaches are used as the first approach, this sequencing is in direct conflict with the human rights of people with disabilities (Bailey *et al*. 2010), especially if no other less restrictive procedures were attempted first and if their use is not reasonable or justified (French *et al*. 2010).

In order to minimize the use of restrictive procedures whenever possible, effective and alternative interventions need to be available. Behavior analysts are encouraged to first exhausted reinforcement-based strategies before moving on to more restrictive practices (Behavior Analytic Certification Board 2020a). Although there are limited examples of such alternatives (e.g. Koegel *et al*. 2012, Penrod *et al*. 2012, Tanner and Andreone 2015), more research is needed on the assessment and treatment of feeding problems that incorporates features such as family-centred planning, child preference and choice, and generalization to caregivers.

The current study extends the food selectivity literature by combining previously researched and novel methods into a single assessment and treatment package applied to children with developmental disabilities, with the aim to increase treatments for food selectivity that prioritize stakeholder collaboration, client autonomy, and minimize restrictive procedures. The assessment portion of the package included collaboration with caregivers on the selection of foods to further analyze and target and caregiver input on the design of the functional analyses of their children's mealtime problem behavior. The children's food preferences were directly measured (Levin and Carr 2001, Patel *et al*. 2002) and the practical functional assessment process (Hanley *et al*. 2014, Jessel *et al*. 2016) was employed to evaluate the qualitatively rich contingencies contributing to mealtime problem behavior. Treatment involved a skill-building approach through shaping across response topographies and choice-making opportunities. Perhaps most notably, the choice to leave and rejoin the treatment sessions at any time was provided to all children, and data were collected on participation in treatment sessions. Treatment was extended to increase the amount of target foods the children were eating as well as transferring treatment effects to caregivers. Mealtime problem behavior was measured throughout the treatment process, including the measurement of any emotional responding.

## Method

### *Participants, settings, and materials*

The study included three children reported to be selective eaters by their caregivers. The children's pediatricians cleared them to participate in the study, citing no medical or physiological reasons for their food

**Table 1. Response topography descriptions.**

| Step | Description | Definition |
|---|---|---|
| 1 | Look at food 5 ft away (covered) | Gaze is directed towards food |
| 2 | Look at food 5 ft away (uncovered) | Gaze is directed towards food |
| 3 | Look at food 1 feet away | Gaze is directed towards food |
| 4 | Look at food .5 feet away | Gaze is directed towards food |
| 5 | Touch plate | Hand makes contact with plate |
| 6 | Touch food with utensil or hand | Hand or utensil makes contact with food > 1 s |
| 7 | Hold food in spoon or hand | Food held for > 3 s |
| 8 | Bring to nose for 1 s | Food held within 1 inch under nose |
| 9 | Smell food | Audible inhale heard with food 1 inch under nose |
| 10 | Touch food to lips | Food makes contact with either lip for > 1 s |
| 11 | Touch food to tongue | Food makes contact with tongue for > 1 s |
| 12 | Deposit food on tongue, hold for 3 s | Food is held on tongue for > 3 s |
| 13 | Chew 3x, spit out | Opening and closing of jaw 3x around food |
| | a Touch to front teeth[a] | Food makes contact with any teeth |
| | b Bite with front teeth[a] | Front teeth make contact with food, leave mark |
| | c Bite into 2 pieces[a] | Food is bit into 2 pieces with front teeth |
| | d Chew 1x, spit out[a] | Opening and closing jaw 1x |
| 14 | Chew 5x, spit out | Opening and closing jaw 5x around food |
| 15 | Swallow 1 bite of food | Ingest entire bite of food |
| 16 | Chew 10x, spit out[a] | Opening and closing jaw 10x around food |
| | a Chew 15x, spit out[a] | Opening and closing jaw 15x around food |
| | b Chew 20x, spit out[a] | Opening and closing jaw 20x around food |
| | c Chew 25% for 20x, spit out[a] | Opening and closing jaw 20x around 1/4 bite of food |
| | d Chew 50% for 20x, spit out[a] | Opening and closing jaw 20x around 1/2 bite of food |
| | e Chew 75% for 20x, spit out[a] | Opening and closing jaw 20x around 3/4 bite of food |
| | f Swallow 25%[a] | Ingest 1/4 bite of food |
| | g Swallow 50%[a] | Ingest 1/2 bite of food |
| | h Swallow 75%[a] | Ingest 3/4 bite of food |
| 17-24 | Swallow 2 – 10 bites of food | Ingest |

[a]Levels added for Ali only.

selectivity. Caregivers reported their children had no issues consuming the table-textured foods they did eat. A university institutional review board approved the study, the participants were not expected to be exposed to more than minimal risk, and caregivers provided consent for their children to participate after reviewing assessment and treatment details. In addition, all behavior analysts were CPR and First Aid certified and a nurse was on-site should any medical issues arise.

Liam was a six-year-old boy whose family was in the process of obtaining an autism diagnosis. Liam primarily ate peanut butter sandwiches, grilled cheese, and pizza, but would only eat these foods if his mother prepared them a specific way. When instructed to try new foods, Liam typically pushed the food away or threw the food in the trash. If parents persisted, Liam would flop to the ground, cry, or vomit. As a result, Liam's mother refrained from cooking typical meals at home (e.g. one dinner for the whole family).

Ali was a four-year-old girl diagnosed with autism. Her mother reported that Ali was a healthy eater until 18 mo of age when the mother observed regression in social skills and in the variety of foods Ali ate. Ali ate chicken nuggets, pizza, strawberries, bananas, peanuts, and common junk foods (e.g. candy, chips). When Ali's mother instructed her to try novel or nonpreferred foods, she would engage in tantrums, which included aggression and throwing herself on the floor.

Luke was a six-year-old boy diagnosed with autism and attention-deficit hyperactivity disorder. Luke ate a variety of foods; however, when his mother instructed him to eat or to be in the presence of foods that contained sauces or pasta (e.g. spaghetti, chicken noodle soup) he engaged in severe problem behavior such as throwing food and aggression. As a result, he was often removed from the school cafeteria during lunch due to problem behavior, and his family avoided preparing these foods at home.

We conducted sessions in therapy and classrooms in the psychology department of a university. Rooms contained tables, chairs, a microwave, and materials related to observations. Each child used age-appropriate seating arrangements (e.g. smalls chairs in which their feet touched the floor) and utensils. Children were served food on a plate with a spoon or fork. Foods were cut into approximately 1 cm x 1 cm.

## *Measurement, interobserver agreement, and design*

Trained observers took data using software on laptops and paper data sheets in-vivo or via video recordings. Data were collected on problem behavior, preconsumption behaviors, and consumption (See Tables 1 and 2 for operational definitions). In addition, during treatment, the duration of time each client chose to spend away from the treatment table per visit was recorded.

A second independent observer collected data for a minimum of 20% of sessions (Hausman *et al*. 2022) across each assessment and treatment phase and a computer program (InstantData) calculated interobserver agreement. Data were compared on an item-by-item agreement per trial for the preference analysis, baseline,

**Table 2. Operational definitions of problem behavior variables.**

| Inappropriate Mealtime Behavior | |
|---|---|
| Negative vocalizations | Verbal protests (e.g. 'yucky, gross'), whining, |
| Covering mouth | Hands over lips |
| Spitting out food | Expulsion of food from mouth greater than the size of a pea |
| Pushing plate or food away | Forceful contact with the plate, utensil, or food that resulted in movement, an audible sound, or damage to the utensil |
| Severe Problem Behavior | |
| Aggression | Any instance of making forceful physical contact with another person using body or object |
| Self-injury | Any instance of self-hitting, self-pinching, self-biting, or banging head on surfaces |
| Property destruction | Damaging objects or furniture via breaking, throwing, or ripping |
| Screaming | Any vocalizations louder than communication volume |

and treatment. The number of agreements were divided by the total number of agreements and disagreements and multiplied by 100. An agreement was scored if both observers recorded the same event(s) on a given trial. Mean interobserver agreement across participants for the preference analysis was 98% (range, 93%-100%) and for baseline and treatment averaged 99% (range, 93–100%). Data were compared on a 10-s interval-by-interval basis for the mealtime observation, functional analysis, and posttest with caregivers. Agreement was calculated by dividing the smaller number of responses by the larger number and multiplying the quotient by 100. Mean interobserver agreement across participants for the mealtime observations was 87% (range, 80%-93%), for the functional analyses was 94% (range 80% −100%), and for posttests with caregivers 95% (range, 80%-100%).

A multi-element design was used to demonstrate control in the functional analysis. A changing criterion design was used to evaluate the effects of the intervention on the dependent variables. Functional control is demonstrated in a changing criterion design when behavior changes to meet a criterion when introduced, remains steady insofar as the criterion remains stable, and three or more criterion changes are replicated. Other requirements to demonstrate control include noncompulsory and unrestricted responding; that is, the participant is not physically prompted to complete responses and the participant may behave above or below the criterion, all of which were present in the current study. Although less common, there are examples of the use of changing criterion designs used across response topographies (Bloomfield *et al*. 2021, Dowrick and Dove 1980, Bourret *et al*. 2004, Rose and Beaulieu 2019, Gorski and Westbrook 2002, Cavalari *et al*. 2013). Bloomfield *et al*. 2021, for example, systematically increased the criteria for reinforcement across adult demands, with those adult demands consisting of increasing expectations of engagement with target foods.

## Indirect assessments

A number of indirect assessments were conducted with caregivers to assist in the design of subsequent analyses and to improve the ecology validity of those analyses. Caregivers first filled out a food preference survey, which contained a list of 10–20 foods per food group (e.g. dairy, vegetables, and grains). Caregivers were asked to record if their child never, sometimes, or always ate that food and to indicate if their family ate that food. Caregivers were then to nominate three foods from each food group they wished their child would eat. The behavior analyst then conducted an open-ended functional assessment interview (modified from Hanley 2012) with caregivers to learn more about the contexts under which mealtime problem behavior occurred in the home. It was during this interview that caregivers elaborated on their goals for their child's eating habits. By the end of the interview, the behavior analyst and caregivers collaborated to identify the foods to targets in subsequent assessments and identify the specific events that evoked and abated mealtime problem behavior.

## Preference analysis and direct observation

Up to six reportedly preferred and nine reportedly nonpreferred foods were selected based upon the results of the food preference survey and conversations with caregivers; these were (a) reported as always or never eaten by the child, (b) foods the family would eat, and (c) easy to prepare and store in our clinic. Participants' preference for foods was analyzed in a single-stimulus preference analysis[1]. Before the preference analysis, the behavior analyst told the child that she would be presenting different foods, and the child could eat the food or not. The behavior analyst presented the reported preferred and nonpreferred foods to the child one at a time in a random order until each was presented twice. The food was placed on a plate with a spoon, consumption was child-directed, and no additional prompts to eat were delivered, beyond the above noted instruction.

Following each presentation, the bite was removed if the child engaged in inappropriate mealtime behavior (IMB), severe problem behavior (SPB) (which never occurred), or indicated in any way that they did not want to consume the bite (e.g. 'I don't eat that kind of food'). If the child did not engage in any problem

behavior or did not approach the food within 30 s, the behavior analyst removed the food and presented the next bite. After reviewing the results with the behavior analyst, caregivers selected up to six nonpreferred and six preferred foods to target for consumption and use as reinforcers, respectively, during treatment.

The caregivers then finalized the foods to target for consumption and the behavior analyst observed caregivers presenting a meal consisting of those foods to their child. The purpose of the mealtime observation was to establish a baseline of consumption and problem behavior with caregivers from which to evaluate the eventual treatment extension. The nonpreferred foods the caregivers selected from the preference analysis were arranged into a 15–18 bite meal. Caregivers were asked to engage in behavior they typically would when presenting novel or nonpreferred foods to their child and were told they could terminate the session for any reason (e.g. if severe problem behavior or emotional responding occurred). Sessions lasted 10 min unless the caregiver terminated the session early.

### *Functional analysis*

Next, the behavior analyst conducted a functional analysis of the child's mealtime problem behavior, specifically an interview-informed synthesized contingency analysis (IISCA, Hanley *et al*. 2014). Peer-reviewed research has demonstrated this functional analysis method to be an efficient, safe, and reliable means to understanding the individualized variables influencing problem behavior and has led to efficacious, function-based treatments capable of eliminated problem behavior (Jessel *et al*. 2016, Slaton *et al*. 2017).

The goals of the functional analysis were to (a) confirm information collected from the open-ended interview, (b) safely demonstrate functional control over mealtime problem behavior, (c) establish a baseline of problem behavior, and (d) identify a motivating and child-specific context in which to increase consumption during treatment. Information from the interview and the mealtime observation informed the design of individualized test and control conditions for each child. In the control condition, the behavior analyst provided noncontingent access to all relevant reinforcers reported or observed during the observation including preferred toys, attention, and a preferred food selected by the child. No demands were presented to consume nonpreferred foods. During the test condition, every 30 s, the behavior analyst removed the preferred items and forms of attention and presented a nonpreferred food and instructed the child to take a bite. Contingent on problem behavior, the analyst removed the bite and provided each child with their reported reinforcers.

### *Treatment overview*

Treatment consisted of gradually shaping approximations to consumption across a series of response topographies (see Table 1) for each target food. Treatment rooms consisted of a treatment table, a space on the floor with child-selected toys, and the hang-out space (described below). During each trial, the child was asked to come to the treatment table from the reinforcement space, and they were presented with two choices: (a) choosing a nonpreferred food and (b) choosing what to do with it. They were presented with a board that visually depicted the various response topographies (e.g. touch, smell, taste) on notecards, each backed by a color associated with a particular set of reinforcement contingencies. The three types of reinforcement contingencies were full, partial, or no access to positive reinforcers. Full reinforcement included access to all reinforcers identified in the functional analyses; this may look like the child leaving the treatment table, receiving a piece of a preferred snack, and playing with the behavior analyst on the floor with preferred toys. Partial reinforcement included access to some of the reinforcers; this may look like the children remaining at the table and talking with the behavior analyst about preferred topics. No access to positive reinforcers involved no access to preferred forms of attention, toys, or edibles; if a child engaged in a response associated with no access to positive reinforcers, the behavior analyst simply removed the food and moved on to the next trial. Once the child selected both a food and what to do with it, a bite of the selected food was presented on a plate with a spoon or fork. The child's engagement with the food was scored, the corresponding consequences were delivered, and that trial was complete. The selected food was then removed from the selection for all remaining trials within that session. The session concluded once all the types of food had been selected, and a new session with all targeted foods began again.

If problem behavior occurred, the behavior analyst provided a statement of concern (e.g. 'I know, this is hard'), addressed any needs (e.g. providing a napkin), and reminded the child of the option to leave the table (procedures described below). In other words, the behavior analyst always responded to problem behavior in an overtly empathetic manner. The behavior analyst conducted 1-hr sessions 3 days per week.

### Assent procedures

On-going assent to participate in the shaping portion of the treatment was provided to all participants in the form of allowing them to leave and return to the treatment table at any time. There was a designated space, called the 'hang out' space (Rajaraman *et al*. 2022), populated with moderately preferred toys that the child could go to any time and spend however long they

wished. The behavior analyst provided minimal attention but did not join the child in the hang-out space. The shaping portion of the treatment resumed when the child voluntarily returned to the table.

This option was explained to the child before each session, and they were sometimes reminded of this option during treatment sessions. In this regard, assent was not taken at the start of the study but instead ongoing assent to participate in the shaping portion of the research project was provided. Data were taken on the duration of time the participants spent in the hang-out context.

### Baseline

Data from the functional analysis served as an initial baseline when problem behavior was being reinforced in the presence of the target foods. Next, a baseline using the board visually depicting the various response topographies was conducted in which engagement with the food was reinforced.

During this second baseline, the board and the rules were introduced to the child. Any notecard selection and corresponding behavior resulted in the delivery of the full reinforcement contingency for 60 – 120 s. That is, any response resulted in the behavior analyst removing nonpreferred food and providing access to a preferred food, toys, and attention. The purpose of this baseline was to get a measure of the children's voluntary engagement with the target foods, that is, where they were most comfortable engaging with the foods. Shaping began once stable responding was observed during baseline across several sessions.

### Shaping

Following the baseline in which any response was reinforced with the full reinforcement contingency, differential reinforcement was then introduced with the addition of the partial and no access to positive reinforcers contingencies. The initial full reinforcement level was determined by calculating the modal performance during the second baseline plus one to two levels. For example, if a child most commonly chose to touch a food during baseline, all topographies at or above holding the food were eligible for the full reinforcement during the first session of shaping. The two response topographies below were eligible for partial reinforcement. Partial reinforcement consisted of access to preferred forms of attention from the behavior analyst at the table for approximately 30 s. All lower response topographies were set to no access to positive reinforcement; that is, if a child chose to engage in a lower response (e.g. looking at a covered plate), the selected nonpreferred food was removed and the next trial was presented. Thus, extinction was in effect with respect to positive reinforcers, but escape extinction was never in effect. The child always had the opportunity to respond below or above the reinforcement criteria and the child always had the choice to leave the treatment table. The full and partial reinforcement criteria were increased following one to three sessions with performance at or above the current full reinforcement criterion on at least 75% of trials, with zero or near-zero problem behavior. This was indicated to the child visually; the behavior analyst rotated the colored notecards to reflect the new reinforcement contingencies.

Foods were considered mastered and removed from treatment following three to five sessions in which the child consumed the entire bite of food in the absence of any problem behavior. This phase was concluded once the child had consumed each of the targeted foods across a minimum of three sessions.

### Meal building and extension to caregivers

In this treatment phase, the full reinforcement contingency was placed on the number of bites the child consumed rather than response topographies. The opportunity to select a response topography was no longer available nor was partial reinforcement. The child continued to have a choice to participate (i.e. the hang out space was still available). At the beginning of each session, they were told how many bites they needed to consume to access full reinforcement. The session was capped at 10 min, and this phase was complete once the child consumed the entire meal within 10 min.

Treatment effects were then transferred to caregivers in a posttreatment meal observation, which was identical to the pretreatment meal observation with the addition of some parent coaching. The behavior analyst trained caregivers to implement the same procedures the analyst did during meal building in-vivo with their child across one 1-hr session. The caregiver was instructed to make the expectation clear (e.g. 'You have to eat 15 bites of food'), withhold tangible reinforcers until the criterion was met, and respond empathetically to problem behavior and neutrally to their child leaving and returning from the hang out space.

## Results

### *Assessment*

During the preference analysis, Liam (Figure 1, top panel) consumed all his reportedly preferred foods and never consumed his reportedly nonpreferred foods. Liam engaged in IMB, such as gently pushing away the plate or verbally refusing the food (e.g. 'Yucky!'), on 100% of trials that he did not consume the food. Results were similar for Ali and Luke (Figure 1, second and third panel, respectively); both consumed a variety of reportedly preferred foods and did not consume most of the reportedly nonpreferred foods. Ali and Luke consumed one and four

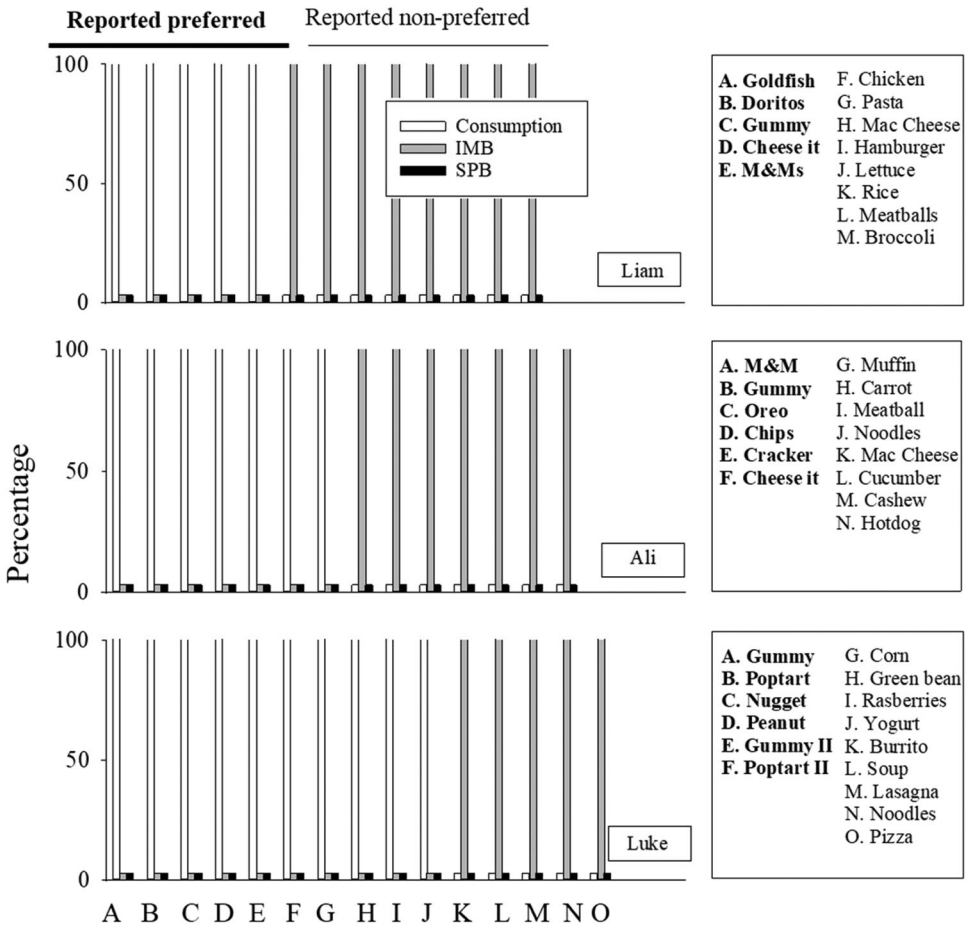


**Figure 1. Preference analysis results for Liam, Ali, and Luke.**
Note: IMB: inappropriate mealtime behavior, SPB: severe problem behavior.

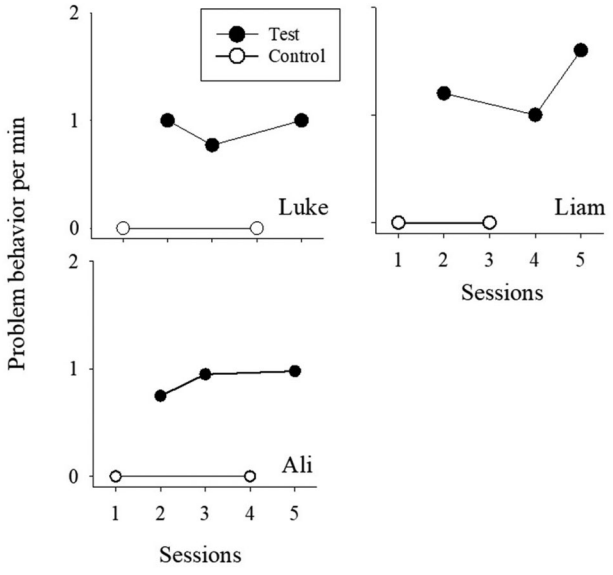


**Figure 2. Results from the functional analyses.**
IMB: inappropriate mealtime behavior, SPB: severe problem behavior.

reportedly nonpreferred foods, respectively, highlighting the importance of analyzing preference before treatment. Both engaged in IMB on the trials they did not consume the foods.

During the open-ended interview, Luke's caregivers reported that following problem behavior, nonpreferred food was removed and Luke was allowed to pick what he wanted to eat and/or leave the room and access preferred toys. During the mealtime observations (left panel of Figure 6), Luke engaged in a mean of 2.7 instances of IMB per min across two sessions, and ate the three pieces of pizza across both sessions. Pizza was thus not targeted for treatment. During the functional analysis (Figure 2), problem behavior reliably occurred in the test condition and was absent in the control condition, demonstrating a sensitivity to a synthesized reinforcement contingency of escape to preferred forms of attention and tangibles.

Results for Liam and Ali were similar in that the interview with caregivers led to a hypothesis that the child's mealtime problem behavior was sensitive to a synthesized contingency of reinforcement, the observation consisted of low levels of consumption and moderate levels of IMB, and the functional analysis demonstrated control of IMB with a synthesized contingency of reinforcement. Liam ate three bites of food with his mother; these foods were retained for treatment, however, because Liam did not consume these bites independently and only accepted them after many prompts and when spoon-fed by his mother.

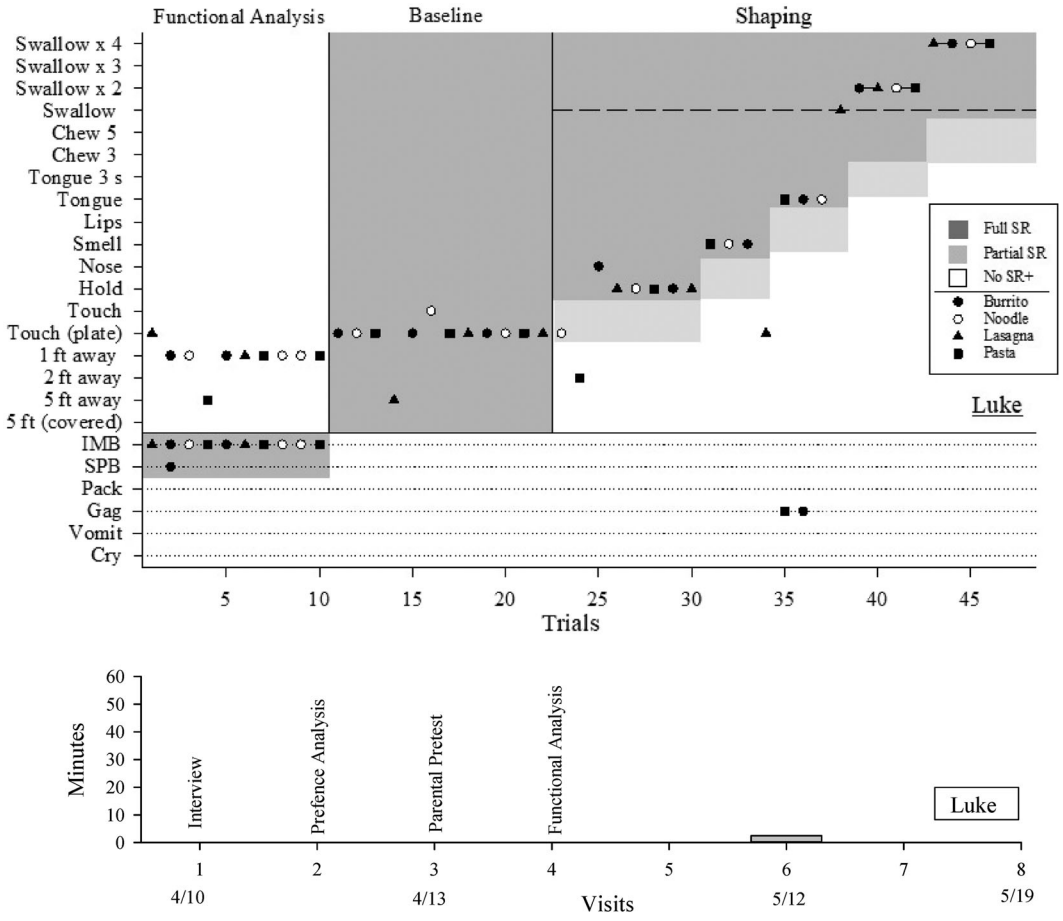


**Figure 3. Treatment results for Luke.**
Note: Lines connecting data points in top graph denote when Luke consumed multiple foods in one trial. Horizontal dotted line represents terminal criterion of consumption. SR = reinforcement.

### *Treatment*

Luke's treatment results are depicted in Figure 3. The bottom panel depicts time spent in hang out. During the functional analysis, Luke engaged in IMB each trial and SPB on one trial. During baseline, Luke primarily touched the plate of foods. The first full reinforcement criterion was set to holding the food. Throughout the process, Luke met or exceeded the full reinforcement criteria on each trial except for three. He gagged during two trials when the reinforcement criterion was set to touching the food to his tongue for the first time. When the criterion was set to chewing the food 5 times and spitting it out, Luke began consuming the foods (eating two bites of different foods per trial). When the criterion was set to swallow, Luke consumed all four bites of the food in one trial. Across five criterion levels, Luke's responding conformed to or exceeded the target criterion. Luke completed this initial treatment phase in eight visits across 3 weeks. He only left the treatment context for the hang out area once during his sixth visit for approximately 2.5 min. Following meal building with the analyst, Luke consumed all his targeted foods (15 total bites) with his mother in the absence of problem behavior (Figure 6).

Liam's results are depicted in Figure 4. During the functional analysis, Liam engaged in IMB each trial. During baseline, Liam primarily touched the plate; thus, the first full reinforcement criterion for treatment was set to touching the food. Liam performed at or above the criterion during the first six reinforcement criteria phases with several exceptions. There were several instances of IMB and gagging. Liam's performance deteriorated when the reinforcement criterion was increased to swallowing the food. Therefore, we decreased the reinforcement criterion back to chewing the food five times and remained at this level for 12 sessions due to inconsistent gagging. We again increased the criterion to swallowing the foods. By the fifth meal at this level, Liam consumed all the targeted foods across three meals.

Liam's responding was variable across the next several meals. Foods were removed from treatment once Liam had consumed the bites across three nonconsecutive meals. Across nine criterion phases, responding conformed to the target criterion in seven out of nine (78%) instances. Liam completed this initial treatment phase in 28 visits across 2 months. He left the treatment context during five visits for a range of 30 s to 25 min.

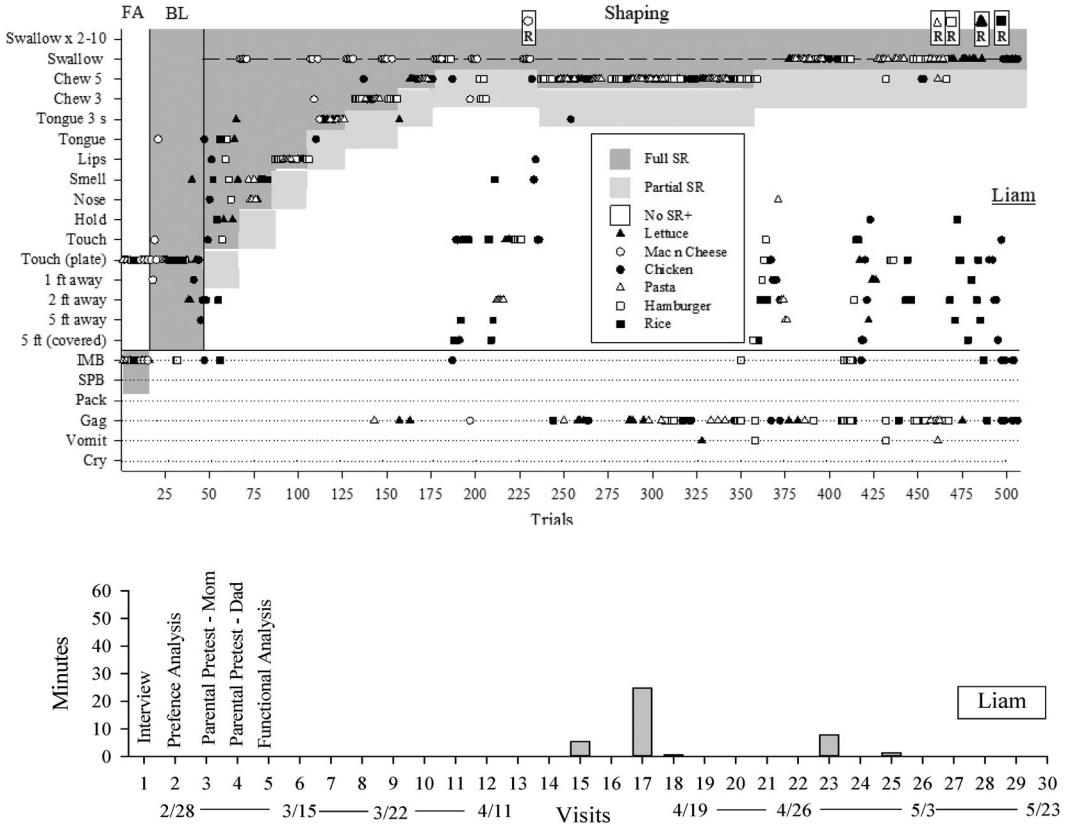


**Figure 4. Treatment results for Liam.**
Note: 'R' and corresponding data point denote when that food was removed from the bite shaping phase of treatment. Horizontal dotted line represents terminal criterion of consumption. SR = reinforcement.

Following meal building with the analyst, Liam consumed all his targeted foods (15 bites total) with his mother and father in the absence of problem behavior (Figure 6).

Ali's results are depicted in Figure 5. Her behavior conformed to the criterion in place for the 12 reinforcement phases. Once the criterion was increased to swallow, however, her performance deteriorated. Instead of returning to the previous level as we did with Liam, we task analyzed the steps further. The bites of food were cut into quarters and three additional levels were added (swallow 25%, 50%, and 75% of a bite). Ali's responding did not meet the new criteria. Thus, three additional criteria were added (chew 25%, 50%, and 75% of the bite 20 times). Ali began swallowing the smaller pieces of macaroni and cheese and noodle when the criterion was set to chewing 25% of the bite 20 times, and she began swallowing the entire bite when the criterion was increased to swallow 25% of the bite. Foods were removed once Ali had consumed the full bite across five sessions. This initial treatment phase was completed in 33 visits across four months. She left the treatment context during 12 visits, with a duration range of 30 s to 22 min. Following meal building with the analyst, Ali consumed all her targeted foods (18 bites total) with her mother in the absence of problem behavior (Figure 6).

## Discussion

We evaluated a comprehensive assessment and treatment package for addressing food selectivity without escape extinction that resulted in all participants consuming their target foods in the absence of problem behavior. During treatment, the terminal response of consuming multiple nonpreferred foods was gradually shaped using synthesized reinforcers, multiple choice-making opportunities, and treatment effects were generalized to caregivers. These effects were achieved within a model in which the children were given the opportunity to opt in and out of treatment sessions at any time.

Problem behavior remained at low frequencies and of low intensity throughout the entire assessment and treatment process, although IMB and gagging did persist for some participants. Liam engaged in IMB in 18 trials (3%), Ali engaged in IMB in 33 trials (12%), and Luke engaged in IMB in 0 trials (0%) across treatment sessions. IMB did persist throughout treatment for Liam and Ali. This may be the case because the responses the children engaged in presumably became more difficult across the initial phase of the treatment as the criteria for reinforcement was increased. These instances of IMB were primarily negative vocalizations (e.g. 'Ew I don't like chicken') and problem behavior was reduced to zero when they were eating a full meal with their

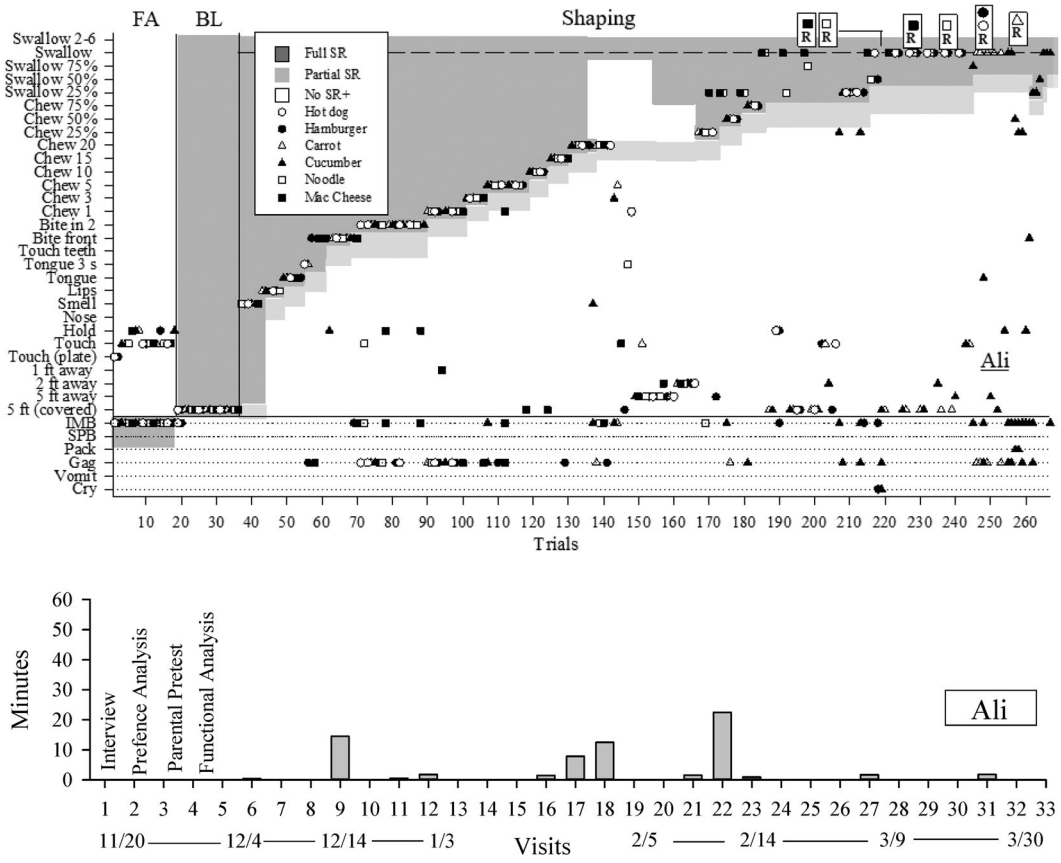


**Figure 5. Treatment results for Ali.**
Note: 'R' and corresponding data point denote when that food was removed from the bite shaping phase of treatment. Horizontal dotted line represents terminal criterion of consumption. SR = reinforcement.

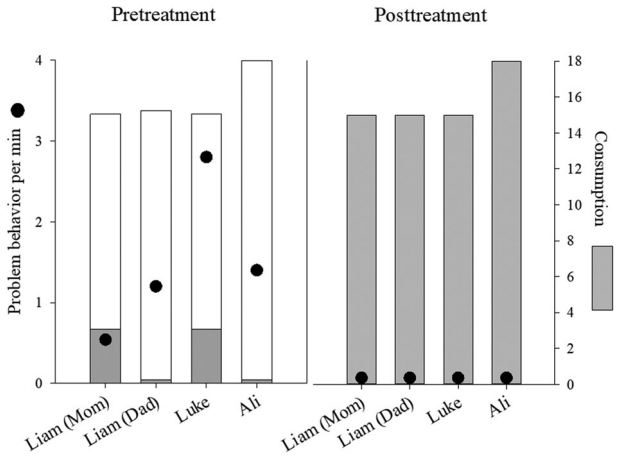


**Figure 6. Results from the mealtime observation pretreatment and posttreatment.**
Note: Bars represent the total number of bites available for consumption; gray represents the number of bites that were consumed.

caregivers. Future applications should consider removing foods from treatment if problem behavior persists, especially if progress is being made with other foods. This data pattern may exemplify the child's unique food preferences.

Assent procedures are rarely described or implemented in behavior analytic research (Morris *et al.* 2021), a field working largely with individuals with disabilities. This is likely because federal guidelines allow researchers to waive assent for populations with autism and other developmental disabilities if it is determined they are incapable of providing assent. The discussion of capability is a nuanced one; but having a disability should not restrict one of being an active participant in their own treatment. In the current study, although we did not obtain assent from the participants on the front end of the program (parental consent was obtained), we allowed participants to leave and return to the treatment context at any point, thereby allowing assent-gaining opportunities throughout the entirety of treatment.

The use of individualized, synthesized reinforcers without the use of escape extinction was efficacious in increasing consumption of the targeted foods for all three participants. This finding adds nuance to previous research that found escape extinction was necessary (Hoch *et al.* 1994, LaRue *et al.* 2011, Piazza *et al.* 2003, Reed *et al.* 2004) to increase consumption in that a partial extinction procedure was found effective in this case. We may have achieved different results for several reasons. First, our process relied on the use of a synthesized reinforcement contingency individualized for each child. The previous studies relied on single

reinforcers to be delivered following acceptance (e.g. LaRue *et al*. 2011). The potential relevance of synthesized reinforcers to our treatment outcomes is consistent with Slaton and Hanley (2018) findings that 89% of treatments with synthesized reinforcement contingencies achieved a mean baseline reduction of problem behavior of 80% or higher and over half achieved a reduction of 95% or higher, in contrast to 11% and 7% of treatments with isolated reinforcement contingencies, respectively. In other words, it is possible that synthesized reinforcement contingencies increase the probability of treatment efficacy in the absence of escape extinction.

However, it is possible that even isolated reinforcers could be efficacious when used in combination with gradual shaping across preconsumption and consumption behaviors. Indeed, shaping has proven effective in promoting consumption of novel or nonpreferred foods in the absence of escape extinction (Hodges *et al*. 2017, Koegel *et al*. 2012, Penrod *et al*. 2012, Tanner and Andreone 2015). The leap from nonconsumption to consumption may be too challenging for most food-selective children and, in the absence of escape extinction, shaping approximations may be necessary. In addition, shaping allows practitioners to meet a child where they are at, skill wise, and build from there. Promoting success through gradual increases of challenging events may facilitate client participation.

Some limitations of the study should be addressed in future research. First, although one participant only took 8 therapeutic hours to complete this treatment (Luke), two participants took 3–4 months to complete treatment. Methods for increasing the efficiency should be evaluated. Procedural integrity and social validity measures were not taken in the current study and should be included in future research. In addition, the methods as described in the current study require that the children can learn through instructions; thus, procedural modifications ought to be evaluated in order for these results to be relevant to children without strong communication skills. Relatedly, future research should examine the extent to which intensive procedures, like escape extinction, are necessary. It has been suggested that less severe cases of food selectivity may not require escape extinction, thus a kind of response to intervention model is needed for pediatric feeding disorders to help minimize escape extinction being used as a first line of defense, if possible.

This study also demonstrates the utility of a treatment model that provides frequent choice-making opportunities within a therapeutic process. This is especially noteworthy given the probable relevance of negative reinforcement. Several other studies have incorporated choice-making opportunities into treatments to address food refusal and selectivity (Cooper *et al*. 1995, Koegel *et al*. 2012, McDowell *et al*. 2007), but not the choice to leave treatment sessions at any point. Although the efficacy of these procedures in isolation has not been demonstrated, there are potential benefits to embedding choices into treatments. For example, people tend to prefer contexts in which they are allotted choices, and they may be more likely to participate in activities that contain choices-making opportunities (Bannerman *et al*. 1990, Geiger *et al*. 2010, Hanley 2010). Further, client choice and therapeutic intervention need not be in conflict (Bannerman *et al*. 1990). Although one might assume that children who eat selectively would continue doing so given a choice, our evaluation shows that gradual progression of food-related expectations foster opportunities to eat a wider array of foods even when given the option to not participate. Additional research on the conditions under which children will choose therapeutic contexts addressing food selectivity and refusal is needed.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Note

1. Regarding the term *preference analysis*, it is not our intention to indicate that we are doing something functionally distinct from others terming their activities *preference assessments*; rather, we use the term analysis in the same way that a functional analysis is often part of a functional behavior assessment. An analysis consists of direct observation, manipulation of relevant variables, and replication. Therefore, a survey is part of a preference assessment, but directly observing a child's behavior when foods are systematically and repeatedly presented may be better referred to as a preference analysis.

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