Treating Mealtime Difficulties in Children

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Melanie H. Bachmeyer-Lee, Caitlin A. Kirkwood, and Connor M. Sheehan

Teaching Mealtime and Feeding Behavior

Eating is not only necessary for development and survival; it also plays a major role in human behavior and social interactions. Throughout history, mealtimes have occurred as meaningful social gatherings with friends and family, and most social events include the consumption of food. While most individuals often look forward to the next meal, some individuals face challenges that make eating less pleasurable.

Eating is a complex chain of behaviors and difficulties may arise at any step in the chain, leading to the potential risk of developing a feeding disorder. Eating begins with acceptance of food or liquid into the mouth and the formation of a bolus (i.e., amount of food or liquid) using the tongue. We move the tongue from side to side inside the mouth (tongue lateralization) to manipulate food to be chewed before we again form a bolus in the center of the mouth. We then propel the food or liquid to the back of the mouth, swallow it, and retain it (Arvedson & Brodsky, 2002). One may exhibit problems at different points in this chain. For example, a child may turn his or her head or cover his or her mouth when a caregiver presents a bite, preventing food from being accepted or deposited into the mouth. A child may accept bites into his or her mouth but expel (spit out) the food or have difficulty lateralizing and chewing the food and hold the food in his or her mouth (packing or pocketing bites). Persistent difficulties at any step in the behavior chain may lead to dysfunctional patterns of eating that without intervention may result in long-term eating problems.

Diagnosis

Many children exhibit problematic mealtime behavior that resolves naturally over time, such as picky eating during the toddler years (Cermak et al., 2010). However, some children exhibit persistent feeding difficulties that warrant intervention (Mascola et al., 2010). Feeding disorders are heterogenous and encompass a wide range of dysfunctional patterns of eating. Some children exhibit selective consumption by food type, texture, brand, color, presentation format, or a combination of these factors (Bandini et al., 2010). For example, some children may eat a limited number of foods within or across food groups, refuse entire food groups (e.g., vegetables), eat only smooth foods (e.g., baby food or yogurt) or crunchy dissolvable foods (e.g., crackers and chips), or eat only a specific brand of foods (e.g., chicken nuggets only from McDonald's™).

M. H. Bachmeyer-Lee (✉) · C. A. Kirkwood · C. M. Sheehan
Center for Pediatric Behavioral Health, Wilmington, NC, USA
e-mail: bachmeyerm@centerforpbh.com

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Whereas other children may consume only limited quantities or refuse all food or liquid. Additionally, some children may lack the skills that allow them to eat or drink independently during meals. It is not uncommon for a pediatric feeding disorder to result as the manifestation of some combination of these difficulties.

Children born prematurely, with developmental or genetic disorders, or complex medical conditions are at greater risk for developing feeding difficulties (Arvedson & Brodsky, 2002; Burklow et al., 2002; Manikam & Perman, 2000). It is estimated that feeding disorders occur in 2–35% of typically developing children and up to 80% of children with developmental disabilities (Bachmeyer, 2009; Williams et al., 2005). The range in reported prevalence rates is likely due to the wide range of difficulties and clinicians and researchers using different definitions for diagnosis (Piazza, 2008). A feeding disorder is often diagnosed when these difficulties result in inadequate nutrition, failure to maintain or gain weight, and/or dependence on supplemental means of nutrition, such as enteral feeds or high calorie formulas beyond an age that is appropriate (Bachmeyer, 2009; Piazza, 2008). However, several terms have evolved to describe feeding difficulties in children including failure to thrive, infantile anorexia nervosa, and posttraumatic feeding disorder, which each encompass a different range of dysfunctional feeding. Most recently, the category of "Feeding and Eating Disorders" in the DSM-V (American Psychiatric Association, 2013) contains diagnostic criteria for Avoidant/Restrictive Food Intake Disorder (ARFID) which is diagnosed when an individual exhibits a feeding disturbance that inhibits their ability to meet their nutritional needs. A feeding disturbance may manifest as a disinterest in food or eating, avoidance of certain foods based on characteristics of the food (e.g., texture, color), or concern for aversive consequences that may be associated with eating (e.g., dysphagia). Persistent failure to meet appropriate nutritional and/or energy needs is characterized by at least one of the following: significant weight loss, significant nutritional deficiency, dependence on enteral feedings or oral nutritional supplements, and/or psychosocial functioning interference.

Etiology

Feeding disorders are as heterogeneous in the factors leading to their development as they are in their presentation. Some combination of co-occurring medical, oral-motor, and behavioral concerns often contribute to the development and maintenance of feeding disorders (Rommel et al., 2003). Medical factors that may contribute to feeding difficulties include gastrointestinal problems (e.g., gastroesophageal reflux disease [GERD], eosinophilic esophagitis (EoE), constipation, motility disorders), anatomical anomalies (e.g., cleft palate), neurological conditions (e.g., cerebral palsy), and food allergies or intolerances (Field et al., 2003; Piazza, 2008). For instance, a child with untreated GERD may experience pain following meals when the gastric contents pass from the stomach into the esophagus (Rybak et al., 2017). This painful experience may lead to the child refusing some or all foods and/or liquids in the future to avoid the painful experience he or she has after eating (classical conditioning). The child may refuse to eat or drink by exhibiting inappropriate mealtime behaviors (e.g., covering the mouth, turning away from or pushing away food or drink presentations), expelling (spitting out food or liquid), or packing (holding food or liquid in the mouth).

Oral-motor factors, such as problems with lip closure or tongue movement, delayed chewing skills, difficulty swallowing (i.e., dysphagia), or structural impairments, may also contribute to feeding difficulties (Field et al., 2003). A child with dysphagia may experience pain when swallowing certain foods or liquids or may cough and gag excessively during meals (Arvedson, 2008). Similar to a child experiencing pain from reflux after eating, a child may also begin to refuse foods and/or liquids to avoid the discomfort associated with painful swallowing (classical conditioning). Additionally, if a child has delayed skills at any point in the chain of eating, the child may refuse certain foods or liquids or refuse eat-

ing all together. For example, children with immature patterns of chewing may exhibit inappropriate mealtime behavior or expel food that is not masticated if they are unable to efficiently chew their food. Children with delayed oral motor skills often refuse to eat toward the end of meals with higher textured foods due to fatigue because the effort associated with eating becomes too high. Furthermore, children who are dependent on liquids or enteral feeds for their nutrition may miss opportunities to develop more advanced oral-motor skills, such as chewing or lateralization.

Inappropriate mealtime behavior may be maintained or worsen as a result of the consequences provided after it occurs in the natural environment (operant conditioning). That is, caregivers often deliver consequences following inappropriate mealtime behavior that may be effective for children without feeding difficulties but reinforce the inappropriate mealtime behavior exhibited by children with feeding difficulties. Caregivers may deliver attention in the form of coaxing ("Peas are so yummy"), comforting ("You're okay"), or reprimanding ("Don't push the spoon away"); provide escape by removing the food or drink or ending the meal; and/or deliver highly preferred toys or foods to try to motivate the child or ensure that they consume something. For example, a child may exhibit inappropriate mealtime behavior when the child's caregiver tries to feed him or her a nonpreferred food. If the caregiver responds by removing the nonpreferred food and providing the child with a preferred food, the child may learn that exhibiting inappropriate mealtime behavior results in removal of a nonpreferred food (negative reinforcement) and delivery of a preferred food (positive reinforcement). Relief from the child's inappropriate mealtime behavior might lead the caregiver to terminate more meals or provide preferred foods again in the future. Thus, the caregiver's behavior may become maintained by negative reinforcement (in the form of escape from the child's inappropriate mealtime behavior). These repeated interactions between the child and caregiver may ultimately contribute to the long-term maintenance of the child's feeding difficulties.

Associated Problems

Children with feeding difficulties may be at risk for associated medical conditions (Cohen et al., 2006). Dysfunctional patterns of eating can lead to medical conditions, such as lethargy, recurrent infections, constipation, compromised immune systems, high cholesterol, and obesity (Cohen et al., 2006). For example, enteral feedings or consumption of a high-calorie formula can be a good temporary solution, but children may develop infections, vomit more frequently, and undergo multiple surgeries for tube placement or re-placement if they are dependent on enteral feeds for long periods of time. Children with feeding disorders may also be at risk for delayed cognitive and social development (Piazza, 2008; Volkert & Piazza, 2012). Severe malnourishment may impair adequate brain development and lead to learning difficulties and behavior disorders. Children with feeding difficulties may not be motivated or able to participate in social events or daily activities that involve eating (e.g., school lunches or birthday parties) because the child exhibits problem behavior when food is present or requires an atypical mealtime structure. Children who receive tube-feedings may be subject to social stigma resulting in social isolation from their peers. Spending less time with peers because of these situations may lead to delayed social development.

Caregivers of children with feeding disorders are at risk for increased mental health difficulties and have often reported mental health problems associated with increased stress, depression, and anxiety (Garro et al., 2005; Greer et al., 2008). Caregivers of children who receive tube feedings may be at risk for additional stress related to tube maintenance and frequent visits with specialists (Garro et al., 2005). Feeding disorders may also create a financial burden on families if the child is dependent on tube-feedings, drinking nutritional supplements, or receiving specialized services (Franklin & Rodger, 2003; Greer et al., 2008).

Interdisciplinary Approach

Given the complex etiology, prevalence of co-occurring medical conditions, and range of feeding difficulties, an interdisciplinary approach to the assessment and treatment of feeding disorders is necessary. An interdisciplinary team should include a medical provider (physician or nurse practitioner) with expertise in pediatric gastroenterology, an oral-motor specialist (speech-language pathologist or occupational therapist) with expertise in feeding, a pediatric dietician, and a behavior analyst. All members of the interdisciplinary team play a critical role during assessment and treatment.

The medical provider's role is to rule out or identify and treat any medical conditions that might be contributing to the child's feeding difficulties. The medical provider completes a physical examination of the child and reviews the child's medical history and any test results to determine if medical treatment or additional testing/evaluation is needed. They clear the child to begin feeding therapy, monitor and treat any previously identified or new medical concerns, and coordinate care with the child's other medical providers. For example, if a child is constipated, the medical provider might order an abdominal X-ray, provide caregivers with clean out instructions, and follow-up with the child's pediatrician to provide a medication and care update. Another medical condition seen in children with feeding difficulties is eosinophilic esophagitis (EoE), which is caused by an abnormal immunologic response to specific food antigens that results in irritation of the esophagus and tissue damage (DeZoeten & Markowitz, 2008). Children with EoE often present with symptoms of GERD and dysphagia, but additional medication and dietary restrictions are needed to improve symptoms (Liacouras et al., 2005). Without ongoing medical oversight, serious conditions such as EoE can be overlooked, and when medical problems are not effectively treated, they may decrease the effectiveness of the behavioral treatments and/or worsen the feeding difficulties.

The oral-motor specialist assesses the child's oral-motor skills and safety while eating. They are trained to identify potential risks (e.g., aspiration, difficulty swallowing) and might refer for additional testing prior to treatment (e.g., modified barium swallowing study) to gather more information about the child's specific needs. They provide recommendations for appropriate food texture, liquid consistency, bolus size, and feeding apparatus based on a child's oral motor structure and skills to keep a child safe during intervention. They also identify demands of appropriate effort to ensure the effectiveness of behavioral intervention and create a plan in which oral-motor skills are developed in a systematic way. For example, if a child demonstrates aspiration, the specialist might recommend thickening foods or liquids. If a child who exhibits food selectivity has an immature pattern of chewing, the specialist may recommend an altered food texture based on the child's specific oral-motor skills. It is a common misconception that children who are selective eaters have adequate chewing skills because they consume some table texture foods. However, often, the food selective eaters consume foods that do not require mature oral motor skills, such as soft or smooth foods, starches/carbohydrates that dissolve in saliva, and even processed meats. In fact, Williams et al. (2005) showed that children with special needs had significantly more oral-motor difficulties than other children. It is important that the expertise of an oral-motor specialist also be incorporated throughout behavioral intervention to: (a) inform necessary modifications when oral motor concerns arise during intervention or current treatment plans are not effective, (b) reevaluate the child's oral motor skills when new treatment goals are developed (e.g., increasing food texture), and (c) provide guidance on teaching new oral motor skills (e.g., chewing).

The dietician assesses the child's nutritional status and growth parameters. This is often done through daily logs of the child's diet, medication, and elimination (urination and bowel movement) to help determine the child's nutritional excesses and deficits. The dietician reassesses the child's nutritional status based on their oral consumption and growth parameters

throughout treatment and makes quality and quantity recommendations for food and drink items and supplements for each child's growth and health needs.

The behavior analyst conducts assessments to identify environmental variables that contribute to the child's feeding difficulties and uses empirically supported antecedent- and consequence-based treatments to increase appropriate mealtime behaviors (e.g., accepting, swallowing, chewing, self-feeding) and decrease maladaptive behaviors (e.g., inappropriate mealtime behavior, expulsion, packing).

Assessment

Indirect Assessment Methods

The interdisciplinary team gathers information regarding the child's medical, developmental, and feeding histories from the caregiver(s) via questionnaires, interviews, and the child's medical records. The medical history might include the child's medical diagnoses, current medications, growth curves, current heigh and weight, results of medical tests (e.g., swallow study, endoscopy), gastrointestinal symptoms, bowel history, allergies and intolerances, and a review of bodily systems (e.g., ear, nose, and throat; cardiovascular; endocrine; respiratory). The developmental history might include the child's birth history, developmental delays or diagnoses, developmental milestones, and general behavior concerns. The feeding history might include tube-feeding placements and schedule, oral feed schedule, typical mealtime structure (e.g., seating arrangement, average length of meals), feeding milestones (e.g., advancement through textures), current feeding skills (e.g., use of various utensils, self-feeding skills), current oral motor behaviors (e.g., biting off pieces of food, tongue control, swallowing, chewing, coughing, gagging), the variety of food types and textures and liquids consumed, the typical quantity of food and liquid consumed, and goals and results of other therapies.

Descriptive Analysis

A descriptive analysis provides an opportunity for the behavior analyst to observe a natural, unstructured meal to identify antecedent variables (e.g., food type and texture, bite size), appropriate and inappropriate child behavior, and caregiver-delivered consequences (Borrero et al., 2010; Piazza et al., 2003a). For example, Borrero et al. (2010) conducted descriptive analyses of 25 parent–child dyads with histories of feeding difficulties and calculated the conditional probability (i.e., the likelihood of one event given some other event) of the caregiver delivering escape, attention, or preferred foods or drinks and toys following inappropriate mealtime behavior. Results showed that common caregiver responses to inappropriate mealtime behavior include delivering escape from bite presentations, access to attention (in the form of coaxing, comforting, and/or reprimanding), and/or access to preferred foods or drinks and toys. A descriptive analysis also provides an opportunity for the oral-motor specialist to observe the child's oral motor skills and function.

Functional Analysis of Inappropriate Mealtime Behavior

A functional analysis of inappropriate mealtime behavior involves systematically manipulating antecedents and consequences to determine caregiver-delivered consequences that reinforce inappropriate mealtime behavior (e.g., Bachmeyer et al., 2009; Girolami & Scotti, 2001; Najdowski et al., 2008; Piazza et al., 2003a). For example, Piazza et al. (2003a) used procedures similar to those described by Iwata et al. (1982/1994) to conduct functional analyses of 15 children with feeding problems. Conditions included: escape, attention, and tangible test conditions and a control condition. The feeder delivered continuous access to preferred items and attention and did not provide differential consequences following inappropriate mealtime behavior in the control condition. The feeder removed the bite or drink following inappropriate

mealtime behavior in the escape condition; provided attention following inappropriate mealtime behavior in the attention condition; and provided either preferred toys or foods following inappropriate mealtime behavior in the tangible condition. Results showed that negative reinforcement was the most common variable maintaining inappropriate mealtime behavior (i.e., 90% of the 10 children who exhibited differential responding showed a sensitivity to escape). Results also showed that the inappropriate mealtime behavior of 80% of children who exhibited differential responding was maintained by multiple functions. Not every child's behavior was maintained by the same or all functions.

The procedures described by Piazza et al. (2003a) involved prompting bites across all conditions. An alternative method involves prompting bites only in the escape condition (e.g., Najdowski et al., 2008). Bachmeyer et al. (2019) assessed the inappropriate mealtime behavior of three children with an identified feeding disorder by comparing the two procedural variations. The two methods resulted in different outcomes for two of three children. The method that prompted bites only in the escape condition identified only an escape function, and the method that prompted bites across all conditions identified multiple functions (escape from bites and attention). The researchers examined the relative effects of extinction procedures matched to both functions (individually and in combination) to determine the validity of each functional analysis method. Results suggested that the procedural variation that failed to identify an attention function for two of three children produced false negative findings. Presenting bites and prompts to eat only in the escape condition may omit the relevant discriminative stimuli or motivating operations for inappropriate mealtime behavior in the other test conditions and result in false negative findings for some children. Therefore, sources of reinforcement for inappropriate mealtime behavior are contextual. That is, an event such as attention functions as reinforcement in the presence of prompts to eat, but not in other contexts, such as when a child is left alone with a plate of food on the table or outside of the mealtime context. However, presenting bites across all conditions may result in a lack of discrimination, particularly during an alternating treatment design involving rapid alternation of more than two conditions. Therefore, functional analyses of inappropriate mealtime behavior are often conducted in a reversal design (Piazza et al., 2003a) or pairwise design (Bachmeyer et al., 2009). A pairwise design involves rapid alteration of only one test condition and the control condition and may more efficiently identify functions than a reversal design in which phases are repeated to demonstrate a functional relationship.

Researchers have shown that failure to identify all functions of inappropriate mealtime behavior could lead to an ineffective intervention (Bachmeyer et al., 2009; Kirkwood et al., 2020). For example, Bachmeyer et al. (2009) showed that a treatment that combined escape extinction and attention extinction was necessary to increase acceptance to high and stable levels and decrease inappropriate mealtime behavior maintained by escape and attention to near-zero levels for all children. Alternatively, implementing a package that addresses all potential functions could lead to a less specific intervention. For example, Kirkwood et al. (2021) observed that although caregivers of three children with feeding disorders provided escape from bites and drinks and attention following inappropriate mealtime behavior, results of functional analyses showed that inappropriate mealtime behavior was only maintained by escape from bites or drinks for all three children. They examined the effects of escape extinction when the feeder either provided or withheld attention following inappropriate mealtime behavior and found that inappropriate mealtime behavior decreased and acceptance increased when the feeder implemented escape extinction independent of whether they provided or withheld attention.

It is not uncommon for practitioners to question the utility of a functional analysis to treat pediatric feeding disorders because research has shown that escape plays a major role in the maintenance of inappropriate mealtime behavior and escape extinction is often necessary. Further, escape extinction is commonly described in the

literature as being structurally similar to escape extinction combined with attention and/or tangible extinction. That is, the feeder withholds both escape and other potential reinforcers (attention or tangible items) following inappropriate mealtime behavior regardless of the procedure. In addition, practitioners often teach caregivers to implement escape and attention extinction as a treatment package. However, identifying the specific reinforcers that maintain inappropriate mealtime behavior can be important. For example, although a clinician would not typically teach a caregiver to provide attention following instances of inappropriate mealtime behavior, teaching a caregiver to withhold escape and attention for inappropriate mealtime behavior (i.e., escape and attention extinction) when only escape is identified as a reinforcer, may be unnecessary. Training a caregiver to refrain from providing reprimands for a child's problem behavior may eliminate a strategy that the caregiver has previously used to manage the child's behavior or create an additional procedure for the caregiver to follow. Clinicians might also avoid unnecessary conflict with caregivers who are adamant about not ignoring their child's behavior when their child's inappropriate mealtime behavior is not maintained by attention (Kirkwood et al., 2020). Finally, training caregivers to implement treatment packages that include unnecessary components may increase treatment complexity and could negatively impact procedural integrity (Vollmer et al., 2008).

Antecedent Assessments

Analyses of motivating operations may provide useful information about specific stimuli that can alter the efficacy of the reinforcers identified during the functional analysis, thus increasing or decreasing the likelihood of appropriate or inappropriate mealtime behavior (Michael, 1993). Within the feeding context, this may include the feeding utensil (e.g., spoon versus Nuk® brush or cup versus bottle), bolus (bite) size, food texture (e.g., puree versus wet ground), and bite placement (e.g., Munk & Repp, 1994; Patel et al., 2002; Sharp & Jaquess, 2009; Sharp et al., 2012). For example, Munk and Repp (1994) evaluated the effects of different food types at various textures (e.g., junior [50% puree and 50% wet ground], ground, and chopped texture) on bite acceptance, inappropriate mealtime behavior, and expulsion with five individuals with intellectual disabilities. Specific food types and textures were associated with different levels of appropriate or inappropriate mealtime behavior. Sharp and Jaquess (2009) compared the effects of bite size (ranging from 1 to 5 cc) and food texture (pureed, wet ground, ground, and chopped) on the inappropriate mealtime behavior, gagging, and packing exhibited by a child who presented with food selectivity. Results showed increased inappropriate mealtime behavior with larger bite sizes and increased gagging and packing with higher textures. Sharp et al. (2012) compared the effects of presentation method with a flipped versus upright spoon on expulsion and mouth clean (a product measure of swallowing). Lower levels of expulsion and higher levels of mouth clean occurred during the flipped spoon presentation for all participants.

Identification of antecedent variables (e.g., food type and texture, bite size, feeding utensils) that may influence the likelihood of appropriate and inappropriate mealtime behaviors allows the behavior analyst to individualize the child's behavioral intervention.

Intervention

Behavioral interventions have proven effective and currently have the most scientific support to decrease maladaptive mealtime behaviors and increase appropriate mealtime behaviors (e.g., Addison et al., 2012; Kerwin, 1999; Peterson et al., 2016; Volkert & Piazza, 2012). Kerwin (1999) and Volkert and Piazza (2012) conducted systematic searches of peer-reviewed studies on psychosocial or behavioral interventions for children with a feeding disorder. They identified studies with rigorous methodologies and classified the treatments as well-established, probably efficacious, or promising according to specific

criteria and guidelines described by the Task Force on Promotion and Dissemination of Psychological Procedure (1995) and Society for Pediatric Psychology. Results indicated that some behavioral treatments are empirically supported and are well-established treatments for pediatric feeding disorders. Addison et al. (2012) and Peterson et al. (2016) directly compared the relative effectiveness of behavior-analytic and sensory integration therapies to treat feeding disorders. Results showed that the behavior-analytic therapy reduced inappropriate mealtime behavior and increased acceptance to stable and acceptable levels for all children, whereas inappropriate mealtime behavior remained above clinically acceptable levels and acceptance remained low or variable with the sensory integration therapy.

Consequence-Based Procedures

The most frequently researched behavioral intervention is a multi-component treatment package that combines two consequence-based procedures, escape extinction and differential reinforcement of alternative behavior (DRA) (e.g., Ahearn et al., 1996; Anderson & McMillan, 2001; Babbitt et al., 1994; Cooper et al., 1995; Hoch et al., 1994; Kerwin et al., 1995; Patel et al., 2002; Piazza et al., 2003b). In fact, Kerwin (1999) and Volkert and Piazza (2012) found that escape extinction and differential reinforcement of alternative behavior are both empirically supported and the well-established treatments for pediatric feeding disorders.

Escape Extinction

Escape extinction, which is implemented when a child's feeding behavior is presumed to be maintained by negative reinforcement (escape from food or drink), is a procedure in which escape from the demand of eating or drinking is no longer permitted. That is, the feeder no longer removes the bite or drink following inappropriate mealtime behavior. Two common escape extinction procedures are nonremoval of the spoon and physical guidance. Nonremoval of the spoon involves positioning the spoon or cup at the child's lips until he or she accepts the bite or drink, thus preventing escape from the bite presentation (e.g., Ahearn et al., 1996; Babbitt et al., 1994; Cooper et al., 1995; Piazza et al., 2003b; Reed et al., 2004). An alternative escape extinction procedure, physical guidance, consists of applying gentle pressure to the child's mandibular joint to guide the mouth open, so that the bite may then be deposited in the child's mouth (e.g., Ahearn et al., 1996). Ahearn et al. (1996) compared the relative effects of nonremoval of the spoon and physical guidance on appropriate and inappropriate mealtime behavior for three children with an identified feeding disorder. Results showed that both treatments were effective at increasing bite acceptance for all three children. Re-presentation, a procedure in which the feeder scoops up expelled food or liquid and re-deposits it in the child's mouth until it is consumed, is commonly used in combination with nonremoval and physical guidance (e.g., Piazza et al., 2003b; Reed et al., 2004).

Differential Reinforcement of Alternative Behavior

Differential reinforcement of alternative behavior (DRA) involves providing the child with access to preferred stimuli (e.g., foods/drinks, toys, activities) contingent on appropriate behaviors, such as accepting or swallowing bites of food or drinks (e.g., Brown et al., 2002; Cooper et al., 1999; Levin & Carr, 2001; Piazza et al., 2003b; Riordan et al., 1980; Riordan et al., 1984). For example, Riordan et al. (1980) treated the feeding problems of four children who exhibited limited and selective food intake. The primary treatment procedures involved delivering preferred foods contingent on acceptance of non-preferred foods, which resulted in increased food intake for all four children.

It may be possible to increase the quantity or variety of foods some children consume using DRA in the absence of escape extinction when it is possible to identify highly preferred foods or drinks (e.g., Brown et al., 2002; Cooper et al., 1999; Levin & Carr, 2001; Riordan et al., 1980; Riordan et al., 1984). However, there are factors that may influence whether preferred foods or

drinks may function as positive reinforcers in the treatment of feeding difficulties, including the magnitude of the reinforcer and reinforcer deprivation. For example, Cooper et al. (1999) manipulated the quantity and/or the quality of positive reinforcement (i.e., contingent access to preferred foods or drinks) paired with acceptance of bites of nonpreferred foods in the treatment of four children who exhibited either low overall intake or highly selective food intake. Increasing the quantity of reinforcers (i.e., number of sips of Pepsi™ or bites of potato chips) provided contingent on acceptance of bites of nonpreferred foods resulted in an overall increase in food acceptance (in the absence of escape extinction) for one of four children. These results suggest that it may be necessary to increase the number of reinforcers offered for each bite of nonpreferred food consumed if treatment effects are not achieved with the initial quantity of reinforcers selected. After consumption of nonpreferred foods has been established utilizing contingent access to preferred foods, the proportion of bites of preferred and nonpreferred foods may be altered by either gradually decreasing the schedule of reinforcement or gradually increasing the demand requirement to access reinforcement. For example, Riordan et al. (1980) utilized demand fading (i.e., gradually increasing the demand requirement to access reinforcement) combined with contingent positive reinforcement to increase the proportion of nonpreferred foods to preferred foods consumed by two children who exhibited low and selective food intake.

Another factor that may influence the effectiveness of potential reinforcers, particularly preferred foods or drinks, is the relative states of deprivation associated with the preferred stimuli. For example, Levin and Carr (2001) examined the differential effects of having or not having access to preferred food items prior to meals that involved the presence versus absence of contingent positive reinforcement for acceptance of bites of nonpreferred food with four children exhibiting food selectivity by type. All four children consumed nonpreferred foods only when the positive reinforcement contingency was implemented and access to the preferred foods prior to meals was restricted.

Although DRA may not be effective without escape extinction for all children, it has been associated with beneficial effects for some children when added to escape extinction. For example, Piazza et al. (2003b) examined the effects of DRA (contingent access to preferred toys) and escape extinction, individually and in combination, to treat the feeding disorders of four children. Results showed that DRA alone did not increase food consumption, whereas escape extinction increased food consumption independent of whether DRA was present or absent. However, DRA combined with escape extinction produced lower levels of inappropriate behavior and negative vocalizations for some children.

Noncontingent Reinforcement

Noncontingent reinforcement (NCR) typically involves continuous access to preferred adult attention and/or preferred toys or leisure activities in the treatment of pediatric feeding disorders (e.g., Berth et al., 2019; Reed et al., 2004; Wilder et al., 2005). For example, Wilder et al. (2005) examined the use of NCR to decrease self-injury and increase food acceptance in a child who exhibited limited and selective food intake. Treatment involved continuous access to a video during meals without the use of escape extinction, which resulted in decreased self-injury and increased food acceptance.

Noncontingent reinforcement has also been associated with beneficial effects when added to escape extinction for some children. For example, Reed et al. (2004) examined the effects of NCR (continuous access to preferred toys) and escape extinction, individually and in combination, to treat the feeding disorders of four children. Noncontingent reinforcement alone did not increase food consumption, whereas escape extinction increased food consumption independent of whether NCR was present or absent. However, NCR combined with escape extinction produced lower levels of inappropriate behavior for some children.

Berth et al. (2019) compared the effects of DRA and NCR and the relative effects of escape

extinction with and without DRA or NCR when escape extinction was necessary. Both reinforcement procedures were effective without escape extinction to treat the food refusal of one child, but only DRA was effective without escape extinction to treat the child's liquid refusal. Escape extinction was necessary for four of five children, and similar to the results of Piazza et al. (2003b) and Reed et al. (2004), the addition of positive reinforcement resulted in beneficial effects for three of four children (i.e., more stable acceptance, decreased inappropriate mealtime behavior or negative vocalizations). With escape extinction, DRA was more effective to treat food refusal for two children and NCR was more effective for one child. Thus, the results of Berth et al. suggest that the addition of positive reinforcement to escape extinction may have beneficial effects for some children, but the relative effects of DRA and NCR are idiosyncratic.

Antecedent-Based Procedures

The earliest behavioral literature on the treatment of pediatric feeding disorders focused primarily on consequence-based treatment procedures (i.e., reinforcement, extinction). A second wave of studies introduced antecedent-based treatment procedures (e.g., utensil manipulation, simultaneous presentation, stimulus fading, demand fading). Researchers have demonstrated that some of these procedures may result in desired treatment outcomes without the need for other treatment components, increase the effectiveness of other treatments, or attenuate the side effects of escape extinction for some children with feeding difficulties. It may be that these antecedent treatments enhance treatment outcomes because they decrease the aversiveness of the mealtime context and/or reduce the response effort for appropriate mealtime behavior, which may alter the value of reinforcers maintaining inappropriate mealtime behavior (motivating operations), accommodate or support oral-motor skill deficits, or a combination of both.

Utensil Manipulation

For some children, re-presenting bites does not effectively decrease expulsions and increase mouth clean. A few researchers have shown that flipping the spoon over (open bowl on the top of the tongue) when depositing the food may decrease expulsion and increase mouth clean (e.g., Dempsey et al., 2011; Rivas et al., 2011; Sharp et al., 2012; Sharp et al., 2010). For example, Sharp et al. (2012) examined the effects of bite placement with a flipped versus upright spoon on expulsion and mouth clean for three children with a feeding disorder and identified oral motor deficits. For all three children, nonremoval of the spoon resulted in decreased inappropriate mealtime behavior and increased bite acceptance; however, re-presentation did not reduce expulsion or increase mouth clean. Flipped spoon presentations and re-presentations decreased expulsions and increased mouth clean for all children. Similarly, Dempsey et al. (2011) treated the liquid refusal of a child with a feeding disorder using a flipped spoon presentation combined with a chin prompt. Mouth clean did not increase with the chin prompt alone and increased only modestly with the flipped spoon alone. The greatest increases in mouth clean resulted from the combination of two antecedent manipulations (flipped spoon and chin prompt).

Using a Nuk® brush to present bites may be an alternative option to decrease expulsion and increase mouth clean (e.g., Sharp et al., 2010; Wilkins et al., 2014). For example, Wilkins et al. (2014) compared presenting bites on a spoon or on a Nuk® brush using nonremoval and re-presentation for 12 children with feeding difficulties. Feeding behavior improved for eight children. Of those eight children, five showed lower levels of expulsions and four showed higher levels of mouth clean with presentations on the Nuk® brush than with the spoon. Similarly, Sharp et al. (2010) compared the effects of presentations on an upright spoon, flipped spoon, or Nuk® brush in the treatment of a feeding disorder for one child. The child expelled all bites presented on an upright spoon but showed decreased expulsions and increased mouth cleans with the flipped spoon and Nuk® brush presentations.

Simultaneous Presentation

Simultaneous presentation involves presenting a more preferred with a less preferred food at the same time (e.g., Ahearn, 2003; Buckley & Newchok, 2005; Piazza et al., 2002). The foods may be presented together on the same utensil in an observable format, blended together in a pureed format, or the nonpreferred food may be inside or covered by the preferred food. This strategy has been effective at increasing consumption of nonpreferred foods in the absence of escape extinction and increasing the effectiveness of escape extinction for some children. For example, Piazza et al. (2002) showed that simultaneous presentation of a more preferred food with a less preferred food may actually be a more effective method than contingent access to preferred foods to increase acceptance of less preferred foods. Piazza and colleagues compared the effects of these two methods of food presentation (simultaneous versus contingent) to increase the acceptance of less preferred foods by three children with feeding difficulties. The simultaneous presentation involved presenting preferred foods at the same time as a nonpreferred food (e.g., a piece of broccoli on a chip, salad dressing on a piece of broccoli). The contingent presentation involved presentation of a preferred food following acceptance of a nonpreferred food. Acceptance of nonpreferred foods immediately increased (without escape extinction) for two of the three children with the simultaneous presentation relative to the contingent presentation. For one child, acceptance of nonpreferred food increased with the simultaneous presentation but not the contingent presentation with the addition of escape extinction (physical guidance and re-presentation).

Results of these studies suggest that simultaneous presentation may be an effective treatment option when preferred foods can be identified. This strategy may momentarily decrease the aversive properties of the nonpreferred food and thus decrease the child's motivation to refuse the nonpreferred food. An alternative explanation is that flavor–flavor conditioning occurs (i.e., a preference for the nonpreferred is acquired as a result of pairing it with a preferred flavor; Piazza et al., 2002). However, it is possible that preference for the preferred food may be altered as a result of pairing it with nonpreferred foods; thus, this strategy may be more appropriate when a child demonstrates a strong preference for food(s) other than those that comprise the majority of the child's current nutrition.

Stimulus and Demand Fading

Food Type Researchers have shown that gradually changing the ratio or concentration of preferred and nonpreferred foods or liquids (stimulus fading) may increase acceptance of nonpreferred foods or liquids in the absence of escape extinction (e.g., Luiselli et al., 2005; Tiger & Hanley, 2006) or increase the effectiveness of escape extinction (e.g., Mueller et al., 2004; Patel & Piazza 2001). For example, Luiselli et al. (2005) gradually faded the concentration of liquid in the absence of escape extinction to establish milk consumption with a child with identified feeding difficulties. Treatment consisted of gradually increasing the concentration of milk in a beverage the child consistently consumed (Pediasure®, a supplemental nutritional beverage). After nonremoval and DRA or NCR, increased consumption of only one or two of 16 foods for two children with feeding difficulties, Mueller et al. (2004) added stimulus fading in which they blended a small portion of nonpreferred pureed foods into the pureed foods the children consistently consumed (e.g., 10% nonpreferred/90% preferred) and gradually altered the ratio until the children were consuming the nonpreferred foods alone during probes.

It may also be necessary to gradually change the ratio or concentration of paired preferred and nonpreferred foods or liquids after successfully using simultaneous presentation in order to maintain appropriate feeding behavior with nonpreferred foods or liquids alone. For example, Luiselli et al. (2005) gradually faded the concentration of liquid (without escape extinction) to establish milk consumption with a child who drank Pediasure® at full strength and at a blend of 50% Pediasure® and 50% whole milk but refused whole milk at full strength or when it was blended

with Pediasure® at a concentration of less than 50% Pediasure®.

Gradually introducing the proportion of nonpreferred foods paired with preferred foods may also reduce the risk associated with pairing nonpreferred and preferred foods. Initially presenting the nonpreferred food with the preferred food at a minimal concentration or proportion may reduce the likelihood that the preferred food does not acquire the aversive properties of the nonpreferred food. A limitation to this procedure may be the length of time required for fading; however, periodic probes (of the full-strength substance) can be conducted to determine whether continuing to fade the concentration is necessary, as in the Mueller et al. (2004) study.

Food texture or liquid consistency Children with feeding disorders often display food selectivity by texture. For many of these children, consuming higher textured foods may be aversive or potentially dangerous due to delayed oral motor skills. For example, Shore et al. (1998) used texture fading in combination with nonremoval and DRA to treat the food selectivity exhibited by four children with feeding difficulties. Fading involved gradually increasing texture using various proportions of puree, junior, ground, and finely chopped food, based on results of periodic probes. Similarly, Bachmeyer et al. (2013) examined the effects of gradually altering the concentration of liquid by adding baby food to the liquid with two children who consistently consumed liquids, but not baby food, after treatment using physical guidance with re-presentation and DRA. High levels of mouth clean maintained throughout fading for both children. Mouth clean and gram intake increased and negative vocalizations decreased with 100% baby food after the fading treatment.

Utensil or feeding apparatus A few researchers have gradually altered the feeding apparatus from a utensil from which a child consistently accepts to an age-typical utensil (e.g., Babbitt et al., 2001; Groff et al., 2014; Johnson & Babbitt, 1993). For example, Babbitt et al. (2001) faded from a spoon with thickened liquids to a cup with thin liquids using nonremoval and DRA to establish cup drinking skills with two children who consistently consumed solid food but refused all liquids. Similarly, Groff et al. (2014) conducted syringe to cup and syringe to spoon fading after they established acceptance of liquids and solids with a syringe when nonremoval failed to be effective with a spoon or cup. The treatment involved using a syringe to deposit liquids and solids, increasing the volume of liquids and solids in the syringe, and conducting syringe-to-cup and syringe-to-spoon fading.

Bite size or quantity It may be beneficial to decrease the bite size and/or bite requirement at the beginning of treatment to reduce the aversive properties of the meal or response effort, and then gradually increase the bite size and/or number of bites to maintain low levels of problematic mealtime behavior and high levels of appropriate mealtime behavior (Kahng et al., 2003; Kerwin et al., 1995; Najdowski et al., 2003; Penrod et al., 2010; Sharp & Jaquess, 2009). For example, Kerwin et al. (1995) examined the role of bite amount (i.e., empty, dipped, quarter, half, and level spoon), differential reinforcement of incompatible behavior, and physical guidance or nonremoval of the spoon on feeding behaviors with three children with food refusal. Differential reinforcement of incompatible behavior and physical guidance or nonremoval of the spoon were introduced at the smallest bite amount and later introduced at the larger bite amounts with moderate to high levels of acceptance. Kahng et al. (2003) used contingent access to escape (termination of the meal) and token-based DRA to establish acceptance and consumption of food with a child with feeding difficulties, and then gradually increased the number of bites required to access reinforcement using a changing criterion design.

High-Probability Instructional Sequence

High-probability (high-*p*) instructional sequence involves presenting a series of instructions for

which compliance is highly probable followed by a request for which compliance is not probable (i.e., a low-probability [low-*p*] instruction). For example, Patel et al. (2007) evaluated the effects of a high-*p* instructional sequence on food acceptance with a child who inconsistently consumed a limited variety of foods. The high-*p* sequence consisted of three presentations of an empty spoon, and the low-*p* instruction was the presentation of a spoon with food. Acceptance of food increased in the presence and not the absence of the high-*p* instructional sequence. The high-*p* instructional sequence has been effective at increasing food consumption in the absence of escape extinction (Patel et al., 2007) and associated with beneficial effects when combined with escape extinction for some children (Dawson et al., 2003; Patel et al., 2006). If a child demonstrates high levels of compliance with a request similar to eating, such as acceptance of an empty spoon, then a high-*p* instructional sequence may be effective at increasing compliance (e.g., acceptance, mouth clean) with target foods.

Advanced Skill Development

In addition to learning to consume a sufficient variety and quantity of foods and liquids to meet their nutritional needs, some children with feeding difficulties need to explicitly learn to chew because of oral motor delays or dysfunction and/or lack of opportunities to naturally develop chewing skills during critical periods. Volkert et al. (2013, 2014) described the first treatment protocols to increase chewing using least-to-most prompting combined with either a descriptive verbal prompt (of the number of times to chew) or stimulus and demand fading (i.e., the child was required to chew on an empty chew tube, a bite of food in a chew tube, a strip of food on half of a chew tube, a strip of food, a bite of food, and increased bite sizes of food). In 2013, Volkert and colleagues also developed a product measure of chewing (i.e., if the food is broken down enough to safely swallow after chewing), termed mastication, to evaluate the effects of the treatment protocols.

Even after successful intervention to increase acceptance of solids and/or liquids, children with feeding difficulties may not demonstrate the skills or motivation to begin feeding themselves (Volkert et al., 2016). Therefore, additional intervention may be necessary to teach self-feeding/drinking skills to promote independence during mealtimes. For example, Peterson et al. (2015) demonstrated that differential positive reinforcement alone (descriptive praise and preferred toys/leisure items) was effective at increasing self-drinking for two children with feeding difficulties. Collins et al. (1991) used physical guidance with a constant-time delay procedure and descriptive praise to teach self-feeding to two children with feeding difficulties. After the children mastered self-feeding with physical guidance and a 0-s time delay, a 3-s time delay was implemented, and independent self-feeding increased for both children. Alternatively, Volkert et al. (2016) examined the effects of manipulating response effort and/or food preference to increase self-feeding by three children with feeding difficulties after descriptive praise alone was not effective. That is, researchers biased the children's responding to feed themselves instead of being fed by a therapist by increasing the number of bites and/or decreasing the relative preference of the foods they had to consume if a therapist fed them.

Ethical Considerations

No behavior analyst would knowingly or intentionally harm a client. However, practicing outside of one's competency without adequate supervision (Bailey & Burch, 2016), practicing outside of an interdisciplinary approach, and failing to select and implement safe and effective treatments can result in unintentional harm.

Training and Supervision

The Professional and Ethical Compliance Code for Behavior Analysts (Behavior Analyst Certification Board, 2014), herein referred to as the "Code," specifies providing services,

conducting research, and teaching only within the boundaries of one's *competence*, defined as being commensurate with education, training, and supervised experiences (Code 1.02). As Bailey and Burch (2016) discuss:

> …beyond that, practitioners will have to determine whether they are indeed competent in certain subspecialities of ABA. Examples of such subspecialties include treating feeding disorders, self-injurious behavior, aggression, and destructive behaviors. Attending a workshop or seminar on one of these specialties is not sufficient to describe oneself as competent in a subspecialty area. (p. 58)

Behavior analysts might take on a client or attempt to treat problem behaviors that are outside of their scope of competence because they want to help the child and caregiver. However, the long-term effects of behavior analysts working within the subspecialty without adequate training or supervision can be detrimental to a child's health and future success with eating and drinking.

Practitioners whose background did not involve extensive training in assessment and treatment of pediatric feeding disorders should seek comprehensive training and supervised experiences from a behavior analyst competent in this subspecialty prior to practicing or conducting research within this area. Alternatively, practitioners may be able to provide safe and effective services with ongoing consultation from a behavior analyst who is competent in this subspecialty prior to receiving additional training experiences. When behavior analysts have received some training within the subspecialty (e.g., practicum, internship, research experiences), their experience may have been limited in the number of clients and range of feeding difficulties treated, working within an interdisciplinary team, and/or the extent to which they learned to safely and effectively select, implement, and evaluate a limited variety of procedures. These behavior analysts should evaluate their competence with their supervisors or mentors to determine whether they will require additional supervision or consultation to provide safe and effective treatment. Behavior analysts practicing in this subspecialty must maintain their competence through professional development by staying current in the literature, attending conferences and workshops, and even completing additional coursework or supervised experiences (Code 1.03).

Interdisciplinary Approach

Behavior analysts protect their clients and themselves by making sure that they do not treat the behavioral manifestations of undiagnosed or unrecognized medical conditions (Copeland & Buch, 2020). Code 3.02 states that behavior analysts recommend seeking medical consultation if there is any reasonable possibility that a referred behavior is influenced by medical or biological variables. Given that approximately 86% of children diagnosed with a feeding disorder are diagnosed with a medical condition (Rommel et al., 2003), behavior analysts should assume that the child's feeding difficulties have a medical or biological component. The best way for the behavior analyst to protect his or her client and him or herself is to work within an interdisciplinary approach.

In addition, Code 2.03 states that it is always indicated and professionally appropriate to cooperate with other professionals in a manner that is consistent with the philosophical assumptions and principles of behavior analysis to effectively and appropriately serve clients. Medical providers, speech and language pathologists, and occupational therapists often have different philosophical views, but it is the behavior analyst's responsibility to collaborate with other interdisciplinary team members to ensure the best outcomes for the client.

Treatment Selection and Implementation

Code 2.09 specifies that every client has a right to an effective treatment. Many practitioners may be aware that escape extinction and reinforcement are the most commonly used evidence-based treatments for feeding difficulties, but they may not be familiar with all of the factors that

should be considered to safely and effectively program and implement treatment.

For example, researchers have shown that escape extinction is highly effective to treat feeding difficulties and is often a necessary treatment component. However, extinction has been associated with numerous side effects, such as extinction bursts, emotional responding, and extinction-induced aggression (Lerman et al., 1999). Caregivers of young children with feeding disorders and often complicated medical histories may find these potential side effects unacceptable. Further, it can be discouraging for caregivers if appropriate mealtime behavior (e.g., bite acceptance) does not occur relatively quickly or if additional topographies of inappropriate mealtime behavior emerge (e.g., expulsion, packing). Consistent with Code 4.08, including a positive reinforcement component with escape extinction or other aversive procedures may attenuate the potential side effects of escape extinction for some children (e.g., Berth et al., 2019; Piazza et al., 2003b; Reed et al., 2004). Further, manipulating antecedent variables when programing escape extinction may reduce the potential side effects of extinction and increase its effectiveness, resulting in quicker acquisition of appropriate mealtime behaviors (e.g., Munk & Repp, 1994; Patel et al., 2006; Sharp & Jaquess, 2009). In addition, when developing an intervention utilizing contingent access to preferred foods or drinks, consideration needs to be given to completely restricting access to preferred foods as this could result in a decrease in overall food intake for some children. Likewise, caution should be used when simultaneously presenting preferred and nonpreferred foods because the preferred food may become aversive and result in a decrease in their overall consumption for some children. Code 4.03 requires that the behavior analyst tailor behavior-change programs to the unique behaviors, environmental variables, assessment results, and goals of each client. "One of the most difficult tasks the behavior analyst faces is extrapolating from published research methods to procedures that will work with an individual client" (Bailey & Burch, 2016). Knowing how to develop individualized antecedent assessments and interpret the results to develop the most safe and effective individualized treatment for a child with feeding difficulties requires sufficient training and experience with numerous clients with a wide range of feeding difficulties and with a variety of assessment and treatment procedures.

Considerations when implementing escape extinction should include procedural fidelity and safety of the client. Consistent with Code 4.08, escape extinction should only be implemented to treat feeding difficulties by individuals who are well-trained and receiving appropriate supervision and oversight. Forced feeding, although structurally and theoretically different than escape extinction, has been identified as a contributing factor in the development of feeding problems (Palmer et al., 1975; Riordan et al., 1980) and aspiration pneumonia (Perske et al., 1977). Escape extinction implemented by a behavior analyst without proper training and supervision can pose the same safety risks as forced feeding. Further, treatment fidelity can be greatly influenced by the child's size and strength and history with escape extinction procedures. The risks and benefits of using escape extinction with older and stronger children must be considered in terms of how likely a trained feeder can accurately and safely keep the utensil at the child's lips during high rates of intense inappropriate mealtime behavior, extinction-induced emotional responding, and aggression and/or self-injurious behavior. Further, escape extinction should only be implemented in a setting, where additional trained therapists are available to block inappropriate mealtime behavior (to ensure the feeder can keep the utensil at the child's lips to prevent escape) and where additional materials are available (e.g., appropriate adaptable seating, padding for the table and seating, protective equipment for the feeder). There are additional safety issues to consider when structuring the mealtime, particularly when implementing escape extinction, such as keeping the child in a safe, upright position; not depositing bites or drinks when the child is coughing or gagging or when the head is tilted back; appropriate bite size, food texture, and liquid consistency;

appropriate placement or deposit of the food or liquid; and appropriate pacing between bite or drink presentations. Fortunately, this knowledge and skills can be acquired with appropriate training and supervision or consultation with a behavior analyst who is competent in this specialized area of behavior analysis.

Summary

Failure to consume sufficient calories or meet nutritional needs can place a child at risk for significant delays to their growth and overall development. Children with feeding difficulties, such as ARFID, may exhibit a wide range of presenting problems, including refusal of all food or liquid, dependence on liquids, highly selective patterns of eating, and skill deficits. Behavioral interventions are effective at decreasing maladaptive behaviors (e.g., inappropriate mealtime behavior, expulsions), increasing appropriate mealtime behaviors (e.g., bite acceptance, swallowing), and teaching new skills (e.g., chewing, self-feeding). However, given the variance in presenting problems and complex etiology of feeding difficulties, an interdisciplinary approach to assessment and treatment is necessary. Further, it is important that the behavior analyst be adequately trained or receive sufficient supervision or consultation to provide an effective intervention and keep the child safe as indicated by the Professional and Ethical Compliance Code for Behavior Analysts.

Over the past two decades, behavior analysis has made great strides in the subspecialty of feeding disorders. Investigators developed new assessment methods to prescribe individualized treatments. Numerous researchers also developed a range of antecedent-based treatments that provide additional treatment options, and in some cases, may enhance existing treatments by altering motivating operations or supporting skill deficits. Further, some researchers improved our knowledge on methods to teach new skills. Although replication of some of these methods is necessary to establish additional behavioral treatments as efficacious, as we move into the next decade, there remains several other areas for investigation to further advance the effectiveness, efficiency, and specificity of our therapeutic approach. Given the complexity and heterogeneity of feeding difficulties, it is likely that multiple antecedent variables may interact to influence the value of reinforcers that maintain problem behavior in the mealtime context and/or influence feeding behavior based on response effort and acquired skills or deficits. Therefore, more comprehensive assessments evaluating potential interactions between multiple antecedent variables and research examining interactions between various antecedent manipulations and different consequence-based procedures may allow practitioners to more efficiently and specifically prescribe treatment. Further, research examining interactions between biological and behavioral variables in the treatment of feeding difficulties may also provide more effective treatments. Finally, long-term effectiveness of our treatments in the natural setting is essential to resolve feeding difficulties and achieve typical eating patterns. Therefore, future research should explore methods to program for generalization and maintenance of treatment success and prevent treatment relapse.

References

Addison, L. R., Piazza, C. C., Patel, M. R., Bachmeyer, M. H., Rivas, K. M., Milnes, S. M., & Oddo, J. (2012). A comparison of sensory integrative and behavioral therapies as treatment for pediatric feeding disorders. *Journal of Applied Behavior Analysis, 45*, 455–471. https://doi.org/10.1901/jaba.2012.45-455

Ahearn, W. H. (2003). Using simultaneous presentation to increase vegetable consumption in a mildly selective child with autism. *Journal of Applied Behavior Analysis, 36*, 361–365. https://doi.org/10.1901/jaba.2003.36-361

Ahearn, W. H., Kerwin, M. L., Eicher, P. S., Shantz, J., & Swearingin, W. (1996). An alternating treatments comparison of two intensive interventions for food refusal. *Journal of Applied Behavior Analysis, 29*, 321–332. https://doi.org/10.1901/jaba.1996.29-321

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890435596

Anderson, C. M., & McMillan, K. (2001). Parental use of escape extinction and differential reinforcement

to treat food selectivity. *Journal of Applied Behavior Analysis, 34*, 511–515. https://doi.org/10.1901/jaba.2001.34-511

Arvedson, J. C. (2008). Assessment of pediatric dysphagia and feeding disorders: Clinical and instrumental approaches. *Developmental Disabilities Research Reviews, 14*, 118–127. https://doi.org/10.1002/ddrr.17

Arvedson, J. C., & Brodsky, L. (2002). *Pediatric swallowing and feeding: Assessment and management* (2nd ed.). Singular Publishing Group. https://doi.org/10.1016/S0165-5876(02)00205-7

Babbitt, R. L., Hoch, T. A., & Coe, D. A. (1994). Behavioral feeding disorders. In D. N. Tuchman & R. S. Walter (Eds.), *Disorders of feeding and swallowing in infants and children: Physiology, diagnosis, and treatment* (pp. 77–95). Singular Publishing Group.

Babbitt, R. L., Shore, B. A., Smith, M., Williams, K. E., & Coe, D. A. (2001). Stimulus fading in the treatment of adipsia. *Behavioral Interventions, 16*, 197–207. https://doi.org/10.1002/bin.94

Bachmeyer, M. H. (2009). Treatment of selective and inadequate food intake in children: A review and practical guide. *Behavior Analysis in Practice, 2*, 43–50. https://doi.org/10.1007/BF03391736

Bachmeyer, M. H., Piazza, C. C., Fredrick, L. D., Reed, G. K., Rivas, K. D., & Kadey, H. J. (2009). Functional analysis and treatment of multiply controlled inappropriate mealtime behavior. *Journal of Applied Behavior Analysis, 42*, 641–658. https://doi.org/10.1901/jaba.2009.42-641

Bachmeyer, M. H., Gulotta, C. S., & Piazza, C. C. (2013). Liquid to baby food fading in the treatment of food refusal. *Behavioral Interventions, 28*, 281–298. https://doi.org/10.1002/bin.1367

Bachmeyer, M. H., Kirkwood, C. A., Criscito, A. B., Mauzy, C. R., IV, & Berth, D. P. (2019). A comparison of functional analysis methods of inappropriate mealtime behavior. *Journal of Applied Behavior Analysis, 52*, 603–621. https://doi.org/10.1002/jaba.556

Bailey, J. S., & Burch, M. R. (2016). *Ethics for behavior analysts* (3rd ed.). Routledge. https://doi.org/10.4324/9781315669212

Bandini, L. G., Anderson, S. E., Curtin, C., Cermak, S., Evans, E. W., Scampini, R., Maslin, M., & Must, A. (2010). Food selectivity in children with autism spectrum disorder and typically developing children. *The Journal of Pediatrics, 157*, 259–264. https://doi.org/10.1016/j.jpeds.2012.02.013

Behavior Analyst Certification Board. (2014). *Professional and ethical compliance code for behavior analysts.* Retrieved from http://bacb.com/ethics-code/

Berth, D. P., Bachmeyer, M. B., Kirkwood, C. A., Mauzy, C. R., IV, Retzlaff, B. J., & Gibson, A. L. (2019). Noncontingent and differential reinforcement in the treatment of pediatric feeding problems. *Journal of Applied Behavior Analysis, 52*, 622–641. https://doi.org/10.1002/jaba.562

Borrero, C. S. W., Woods, J. N., Borrero, J. C., Masler, E. A., & Lesser, A. D. (2010). Descriptive analyses of pediatric food refusal and acceptance. *Journal of Applied Behavior Analysis, 43*, 71–88. https://doi.org/10.1901/jaba.2010.43-71

Brown, J. F., Spencer, K., & Swift, S. (2002). A parent training programme for chronic food refusal: A case study. *British Journal of Learning Disabilities, 30*, 118–121. https://doi.org/10.1046/j.1468-3156.2002.00128.x

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*, 405–409. https://doi.org/10.1901/jaba.2005.71-04

Burklow, K. A., McGrath, A. M., & Kaul, A. (2002). Management and prevention of feeding problems in young children with prematurity and very low birth weight. *Infants and Young Children, 14*, 19–30. https://doi.org/10.1097/00001163-200204000-00004

Cermak, S. A., Curtin, C., & Bandini, L. G. (2010). Food selectivity and sensory sensitivity in children with autism spectrum disorders. *Journal of the American Dietetic Association, 110*, 238–246. https://doi.org/10.1016/j.jada.2009.10.032

Cohen, S. A., Piazza, C. C., & Navathe, A. (2006). Feeding and nutrition. In I. L. Rubin & A. C. Crocker (Eds.), *Medical care for children and adults with developmental disabilities* (pp. 295–307). Paul H. Brooks Publishing Co.

Collins, B. C., Gast, D. L., Wolery, M., Holcome, A., & Leatherby, J. G. (1991). Using constant time delay to teach self-feeding to young students with severe/profound handicaps: Evidence of limited effectiveness. *Journal of Developmental and Physical Disabilities, 3*, 157–179. https://doi.org/10.1007/bf01045931

Cooper, L. J., Wacker, D. P., McComas, J. J., Brown, K., Peck, S. M., Richman, D., Drew, J., Frischmeyer, P., & Millard, T. (1995). Use of a component analyses to identify active variables in treatment packages for children with feeding disorders. *Journal of Applied Behavior Analysis, 28*, 139–153. https://doi.org/10.1901/jaba.1995.28-139

Cooper, L. J., Wacker, D. P., Brown, K., McComas, J. J., Peck, S. M., Drew, J., Asmus, J., & Kayser, K. (1999). Use of a concurrent operants paradigm to evaluate positive reinforcers during treatment of food refusal. *Behavior Modification, 23*, 3–40. https://doi.org/10.1177/0145445599231001

Copeland, L., & Buch, G. (2020). Addressing medical issues in behavior analytic treatment. *Behavior Analysis in Practice, 13*, 240–246. https://doi.org/10.1007/s40617-019-00342-9

Dawson, J. E., Piazza, C. C., Sevin, B. M., Gulotta, C. S., Lerman, D., & Kelley, M. L. (2003). Use of the high-probability instructional sequence and escape extinction in a child with food refusal. *Journal of Applied Behavior Analysis, 36*, 105–108. https://doi.org/10.1901/jaba.2003.36-105

Dempsey, J., Piazza, C. C., Groff, R. A., & Kozisek, J. M. (2011). A flipped spoon and chin prompt to increase mouth clean. *Journal of Applied Behavior Analysis, 44*, 961–965. https://doi.org/10.1901/jaba.2011.44-961

DeZoeten, E., & Markowitz, J. E. (2008). Eosinophilic esophagitis. In C. A. Liacouras, D. A. Piccoli, & L. M. Bell (Eds.), *The requisites in pediatrics: Pediatric gastroenterology*. Mosby. https://doi.org/10.1016/B978-0-323-3.50012-0

Field, D., Garland, M., & Williams, K. (2003). Correlates of specific childhood feeding problems. *Journal of Pediatric Health, 39*, 299–304. https://doi.org/10.1046/j.1440-1754.2003.00151.x

Franklin, L., & Rodger, S. (2003). Parents' perspectives on feeding medically compromised children: Implications for occupational therapy. *Australian Occupational Therapy Journal, 50*, 137–147. https://doi.org/10.1046/j.1440-1630.2003.00375.x

Garro, A., Thurman, S. K., Kerwin, M. E., & Ducette, J. P. (2005). Parent/caregiver stress during pediatric hospitalization for chronic feeding problems. *Journal of Pediatric Nursing, 20*, 268–275. https://doi.org/10.1016/jpedn.2005.02.015

Girolami, P. A., & Scotti, J. R. (2001). Use of analog functional analysis in assessing the function of mealtime behavior problems. *Education & Training in Mental Retardation & Developmental Disabilities, 36*, 207–223.

Greer, A. A., Gulotta, C. S., Masler, E. A., & Laud, R. B. (2008). Caregiver stress and outcomes of children with pediatric feeding disorders treated in an intensive interdisciplinary program. *Journal of Pediatric Psychology, 33*, 612–620. https://doi.org/10.1093/jpepsy/jsm116

Groff, R. A., Piazza, C. C., Volkert, V. M., & Josted, C. M. (2014). Syringe fading as treatment for feeding refusal. *Journal of Applied Behavior Analysis, 47*, 834–839. https://doi.org/10.1002/jaba.162

Hoch, T. A., Babbitt, R. L., Coe, D. A., Krell, D. M., & Hackbert, L. (1994). Contingency contracting: Combining positive reinforcement and escape extinction procedures to treat persistent food refusal. *Behavior Modification, 18*, 106–128. https://doi.org/10.1177/01454455940181007

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*, 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities, 2*, 3–20, 1982). https://doi.org/10.1901/jaba.1994.27-197

Johnson, C. R., & Babbitt, R. L. (1993). Antecedent manipulation in the treatment of primary solid food refusal. *Behavior Modification, 17*, 510–521. https://doi.org/10.1177/01454455930174006

Kahng, S. W., Boscoe, J. H., & Byrne, S. (2003). The use of an escape contingency and a token economy to increase food acceptance. *Journal of Applied Behavior Analysis, 36*, 349–353. https://doi.org/10.1901/jaba.2003.36-349

Kerwin, M. E. (1999). Empirically supported treatments in pediatric psychology: Severe feeding problems. *Journal of Pediatric Psychology, 24*, 193–214. https://doi.org/10.1093/jpepsy/24.3.193

Kerwin, M. E., Ahearn, W. H., Eicher, P. S., & Burd, D. M. (1995). The costs of eating: A behavioral economic food analysis of food refusal. *Journal of Applied Behavior Analysis, 28*, 245–260. https://doi.org/10.1901/jaba.1995.28-245

Kirkwood, C. A., Bachmeyer-Lee, M. H., Sheehan, C. M., Mauzy, C. R., IV, & Gibson, L. A. (2020). Further examination of the treatment of multiply controlled inappropriate mealtime behavior. *Journal of Applied Behavior Analysis*, 1–22. https://doi.org/10.1002/jaba.738

Kirkwood, C. A., Piazza, C. C., & Peterson, K. M. (2021). A comparison of function- and nonfunction-based extinction treatments for inappropriate mealtime behavior. *Journal of Applied Behavior Analysis., 54*(3), 928–945.

Lerman, D. C., Iwata, B. A., & Wallace, M. D. (1999). Side effects of extinction: Prevalence of bursting and aggression during the treatment of self-injurious behavior. *Journal of Applied Behavior Analysis, 32*, 1–8. https://doi.org/10.1901/jaba.1999.32-1

Levin, L., & Carr, E. G. (2001). Food selectivity and problem behavior in children with developmental disabilities: Analysis and intervention. *Behavior Modification, 25*, 443–470. https://doi.org/10.1177/0145445501253004

Liacouras, C. A., Spergel, J. M., Ruchelli, E., Verma, R., Mascarenhas, M., Semeao, E., Flick, J., Kelly, J., Brown-Whitehorn, T., Mamula, P., & Markowitz, J. E. (2005). Eosinophilic esophagitis: A 10-year experience in 381 children. *Clinical Gastroenterology and Hepatology, 3*, 1198–1206. https://doi.org/10.1016/S1542-3565(05)00885-2

Luiselli, J. K., Ricciardi, J. N., & Gilligan, K. (2005). Liquid fading to establish milk consumption by a child with autism. *Behavioral Interventions, 20*, 155–163. https://doi.org/10.1002/bin.187

Manikam, S. M., & Perman, J. A. (2000). Pediatric feeding disorders. *Journal of Clinical Gastroenterology, 30*, 34–46. https://doi.org/10.1097/00004836-200001000-00007

Mascola, A. J., Bryson, S. W., & Agras, W. S. (2010). Picky eating during childhood: A longitudinal study to age 11 years. *Eating Behaviors, 11*, 253–257. https://doi.org/10.1016/j.eatbeh.2010.05.006

Michael, J. (1993). Establishing operations. *The Behavior Analyst, 16*, 191–206. https://doi.org/10.1007/BF03392623

Mueller, M. M., Piazza, C. C., Patel, M. R., Kelley, M. E., & Pruett, A. (2004). Increasing variety of foods consumed by blending nonpreferred foods into preferred foods. *Journal of Applied Behavior Analysis, 37*, 159–170. https://doi.org/10.1901/jaba.2004.37-159

Munk, D. D., & Repp, A. C. (1994). Behavioral assessment of feeding problems of individuals with severe disabilities. *Journal of Applied Behavior Analysis, 27*, 241–250. https://doi.org/10.1901/jaba.1994.27-241

Najdowski, A. C., Wallace, M. D., Doney, J. K., & Ghezzi, P. M. (2003). Parental assessment and treat-

ment of food selectivity in natural settings. *Journal of Applied Behavior Analysis, 36*, 383–386. https://doi.org/10.1901/jaba.2003.36-383

Najdowski, A. C., Wallace, M. D., Penrod, B., Tarbox, J., Reagon, K., & Higbee, T. S. (2008). Caregiver-conducted experimental functional analyses of inappropriate mealtime behavior. *Journal of Applied Behavior Analysis, 41*, 459–465. https://doi.org/10.1901/jaba.2008.41-459

Palmer, S., Thompson, R. J., & Linscheid, T. R. (1975). Applied behavior analysis in the treatment of childhood feeding problems. *Developmental Medicine and Child Neurology, 17*, 333–339. https://doi.org/10.1111/j.1469-8749.1975.tb04671.x

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

Patel, M. R., Piazza, C. C., Santana, C. M., & Volkert, V. M. (2002). An evaluation of food type and texture in the treatment of a feeding problem. *Journal of Applied Behavior Analysis, 35*, 363–374. https://doi.org/10.1901/jaba.2002.35-183

Patel, M. R., Reed, G. K., Piazza, C. C., Muller, M., Bachmeyer, M. H., Layer, S. A., & Pabico, R. S. (2006). An evaluation of a high-probability instructional sequences to increase acceptance of food and decrease inappropriate behavior in children with pediatric feeding disorders. *Research in Developmental Disabilities, 24*, 430–442. https://doi.org/10.1016/j.ridd.205.05.005

Patel, M. R., Reed, G. K., Piazza, C. C., Mueller, M., Bachmeyer, M. H., & Layer, S. A. (2007). Use of a high-probability instructional sequence to increase compliance to feeding demands in the absence of escape extinction. *Behavioral Interventions, 22*, 305–310. https://doi.org/10.1002/bin.251

Penrod, B., Wallace, M. D., Reagon, K., Betz, A., & Higbee, T. S. (2010). A component analysis of a parent-conducted multi-component treatment for food selectivity. *Behavioral Interventions, 25*, 207–228. https://doi.org/10.1002/bin.307

Perske, R., Clifton, A., McClean, B. M., & Stein, J. I. (Eds.). (1977). *Mealtimes for severely and profoundly handicapped persons: New concepts and attitudes*. University Park Press.

Peterson, K. M., Volkert, V. M., & Zeleny, J. R. (2015). Increasing self-drinking for children with feeding disorders. *Journal of Applied Behavior Analysis, 28*, 436–441. https://doi.org/10.1002/jaba.210

Peterson, K. M., Piazza, C. C., & Volkert, V. M. (2016). A comparison of a modified sequential oral sensory approach to an applied behavior-analytic approach in the treatment of food selectivity in children with autism spectrum disorders. *Journal of Applied Behavior Analysis, 49*, 1–27. https://doi.org/10.1002/jaba.332

Piazza, C. C. (2008). Feeding disorders and behavior: What have we learned? *Developmental Disabilities Research Reviews, 14*, 174–181. https://doi.org/10.1002/ddrr.22

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

Piazza, C. C., Fisher, W. W., Brown, K. A., Shore, B. A., Patel, M. R., Katz, R. M., Sevin, B. M., Gulotta, C. S., & Blakely-Smith, A. (2003a). Functional analysis of inappropriate mealtime behaviors. *Journal of Applied Behavior Analysis, 36*, 187–204. https://doi.org/10.1901/jaba.2003.36-187

Piazza, C. C., Patel, M. R., Gulotta, C. S., Sevin, B. M., & Layer, S. A. (2003b). On the relative contributions of positive reinforcement and escape extinction in the treatment of food refusal. *Journal of Applied Behavior Analysis, 36*, 309–324. https://doi.org/10.1901/jaba.2003.36-309

Reed, G. K., Piazza, C. C., Patel, M. R., Layer, S. A., Bachmeyer, M. H., Bethke, S. D., & Gutshall, K. A. (2004). On the relative contributions of noncontingent reinforcement and escape extinction in the treatment of food refusal. *Journal of Applied Behavior Analysis, 37*, 27–42. https://doi.org/10.1901/jaba.2004.37-27

Riordan, M. M., Iwata, B. A., Wohl, M. K., & Finney, J. W. (1980). Behavioral treatment of food refusal and selectivity in developmentally disabled children. *Applied Research in Mental Retardation, 1*, 95–112. https://doi.org/10.1016/0270-3092(80)90019-3

Riordan, M. M., Iwata, B. A., Finney, J. W., Wohl, M. K., & Stanley, A. E. (1984). Behavioral assessment and treatment of chronic food refusal in handicapped children. *Journal of Applied Behavior Analysis, 17*, 327–341. https://doi.org/10.1901/jaba.1984.17-327

Rivas, K. D., Piazza, C. C., Kadey, H. J., Volkert, V. M., & Stewart, V. (2011). Sequential treatment of a feeding problem using a pacifier and flipped spoon. *Journal of Applied Behavior Analysis, 44*, 387–391. https://doi.org/10.1901/jaba.2011.44-387

Rommel, N., De Meyer, A. M., Feenstra, L., & Veereman-Wauters, G. (2003). The complexity of feeding problems in 700 infants and young children presenting to a tertiary care institution. *Journal of Pediatric Gastroenterology and Nutrition, 37*, 75–84. https://doi.org/10.1097/00005176-200307000-00014

Rybak, A., Pesce, M., Thapar, N., & Borreli, O. (2017). Gastro-esophageal reflux in children. *International Journal of Molecular Sciences, 18*, 1–17. https://doi.org/10.3390/ijms18081671

Sharp, W. G., & Jaquess, D. L. (2009). Bite size and texture assessments to prescribe treatment for severe food selectivity in autism. *Behavioral Interventions, 24*, 157–170. https://doi.org/10.1002/bin.282

Sharp, W. G., Harker, S., & Jaquess, D. L. (2010). Comparison of bite-presentation methods in the treatment of food refusal. *Journal of Applied Behavior Analysis, 43*, 739–743. https://doi.org/10.1901/jaba.2010.43-739

Sharp, W. G., Odom, A., & Jaquess, D. L. (2012). Comparison of upright and flipped spoon presentations to guide treatment of food refusal. *Journal of Applied Behavior Analysis, 45*, 83–96. https://doi.org/10.1901/jaba.2012.45-83

Shore, B. A., Babbitt, R. L., Williams, K. E., Coe, D. A., & Snyder, A. (1998). Use of texture fading in the treatment of food selectivity. *Journal of Applied Behavior Analysis, 31*, 621–633. https://doi.org/10.1901/jaba.1998.31-621

Task Force on Promotion and Dissemination of Psychological Procedures. (1995). Training in and dissemination of empirically-validated psychological treatments: Report and recommendations. *Clinical Psychologist, 48*, 3–23.

Tiger, J. H., & Hanley, G. P. (2006). Using reinforcer pairing and fading to increase the milk consumption of a preschool child. *Journal of Applied Behavior Analysis, 39*, 399–403. https://doi.org/10.1901/jaba.2006.6-06

Volkert, V. M., & Piazza, C. C. (2012). Pediatric feeding disorders. In P. Sturmey & M. Hersen (Eds.), *Handbook of evidence-based practice in clinical psychology* (pp. 323–337). John Wiley & Sons. https://doi.org/10.1002/9781118156391.ebcp001013

Volkert, V. M., Piazza, C. C., Vaz, P. C. M., & Frese, J. (2013). A pilot study to increase chewing in children with feeding disorders. *Behavior Modification, 37*, 391–408. https://doi.org/10.1177/0145445512474295

Volkert, V. M., Peterson, K. M., Zeleny, J. R., & Piazza, C. C. (2014). A clinical protocol to increase chewing and assess mastication in children with feeding disorders. *Behavior Modification, 38*, 705–709. https://doi.org/10.1177/0145445514536575

Volkert, V. M., Piazza, C. C., & Ray-Price, R. (2016). Further manipulations in response effort or magnitude of an aversive consequence to increase self-feeding in children with feeding disorders. *Behavior Analysis in Practice, 29*, 573–575. https://doi.org/10.1007/s40617-016-0124-1

Vollmer, T. R., Sloman, K. N., & St Peter Pipkin, C. (2008). Practical implications of data reliability and treatment integrity monitoring. *Behavior Analysis in Practice, 1*, 4–11. https://doi.org/10.1007/BF03391722

Wilder, D. A., Normand, M., & Atwell, J. (2005). Noncontingent reinforcement as treatment for food refusal and associated self-injury. *Journal of Applied Behavior Analysis, 38*, 549–553. https://doi.org/10.1901/jaba.2005.132-04

Wilkins, J. W., Piazza, C. C., Groff, R. A., Volkert, V. M., Kozisek, J. M., & Milnes, S. M. (2014). Utensil manipulation during initial treatment of pediatric feeding problems. *Journal of Applied Behavior Analysis, 47*, 1–16. https://doi.org/10.1002/jaba.169

Williams, K. E., Gibbons, B. G., & Schreck, K. A. (2005). Comparing selective eaters with and without developmental disabilities. *Journal of Developmental and Physical Disabilities, 17*, 299–309. https://doi.org/10.1007/s10882-005-4387-7