Feeding Disorders

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Pediatric Feeding Disorders: Clinical Presentation and Diagnosis

Feeding problems are prevalent within the pediatric population, occurring in up to 45% of typically developing children and as many as 80% of children with disabilities (Ahearn, Castine, Nault, & Green, 2001; Linscheid, 2006; Williams, Gibbons, & Schreck, 2005). A wide-ranging spectrum of issues exist among reported feeding difficulties, from mild problems like picky eating to more severe problems like total food refusal and liquid or tube dependence. Although some difficulties fall within the scope of typical child development, often resolving in the absence of formal treatment, pediatric feeding disorders occur when such difficulties result in impairments in social functioning, irrespective of nutritional deficiencies or loss of weight (Murphy & Zlomke, 2016). Common feeding problems encountered in children include problems related to *feeding skill delay and deficits* such as lack of self-feeding, failure to advance texture, oral motor dysfunction, swallowing problems, and respondent choking, gagging, and vomiting, as well as *maladaptive and disruptive mealtime behavior* including aggression, throwing food, tantrums, food refusal and food selectivity, packing or pocketing food, and eating too much or too little in addition to eating too fast or too slow (Berlin, Davies, Lobato, & Silverman, 2009).

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In the current *Diagnostic and Statistical Manual of Mental Disorders*, feeding disorders have been classified under a new category referred to as Avoidant/Restrictive Food Intake Disorder (ARFID). Diagnostic criteria include restricted feeding and lack of interest or avoidance of food based on sensory properties of the food or fear of consequences that may result from eating (American Psychiatric Association, 2013). Although some of the aforementioned feeding problems might not necessarily be captured under the ARFID diagnostic category, all of them are likely to cause functional impairment to some extent, thereby warranting intervention.

Some common feeding disorders, discussed in more detail below, include food selectivity, food refusal, and lack of developmentally appropriate feeding skills.

Food Selectivity

Food selectivity is a common feeding difficulty typically characterized as the chronic failure to meet recommended nutritional needs due to the consumption of a limited variety of foods (Shore & Piazza, 1997). Food selectivity can be further delineated as selectivity by type (e.g., refusal to consume vegetables), texture (e.g., refusal of tabletop textures such as apple slices in favor of pureed textures such as apple sauce), or even brand (e.g., only eating fries from one restaurant and refusing store-bought fries or fries from other restaurants). Though selective eaters might sustain normal weight and growth, they lack requisite nutrition for healthy development as a result of prolonged dietary restrictions.

Food Refusal

The term "food refusal," when used to describe a type of feeding disorder, typically refers to children who reject consuming most if not all foods when presented (Field, Garland, & Williams, 2003) and can also be used to describe children who consume some foods yet at inadequate volumes (Williams, Field, & Seiverling, 2010). Total food refusal and liquid dependence are two severe forms of food refusal where the child either refuses oral consumption altogether or only consumes fluids while refusing to consume solid food, respectively. Enteral feedings are a common medical intervention aimed at addressing the nutritional deficits associated with severe cases of food refusal where a nutritionally insignificant amount of food is consumed orally. Enteral tube feedings (ETF) can be used alone or in conjunction with oral and intravenous nutritional supplementation and require that a nutritionally complete food be pumped directly into the stomach, duodenum, or jejunum on a set schedule to provide requisite nutrition. Although ETF is often medically necessary to stabilize children whose health has been compromised by severe weight loss or nutritional deficiencies (e.g., iron deficient anemia), there are a number of potential physical and developmental concerns that can result from the procedure. For example, children can experience local wound infections, tube dislodgement, and tube blockage or fracture (Holmes, 2012); furthermore, children may become tube dependent even when ETF is no longer medically necessary which might inhibit the development of oral feeding (Morris, 1989).

Feeding Skill Deficits

Skill deficits related to feeding are often multifactorial in etiology. Examples of potential contributing factors include structural abnormalities (e.g., cleft lip/palate, mandibular hypoplasia), medical complications such as food allergies and gastroesophageal reflux disease (GERD), genetic disorders (e.g., cerebral palsy, Down syndrome), neuromuscular and developmental delays (e.g., hypotonia, lack of communication), and environmental factors. These organic and nonorganic determinants might produce a variety of skill deficits including swallowing disorders, packing, chewing deficits, and a lack of self-feeding.

Swallowing dysfunction (i.e., dysphagia) is characterized by difficulties or pain when swallowing. There are several voluntary and reflexive behaviors that contribute to swallowing, including

bolus formation, bolus transfer, initiation of the swallow, and passage of the bolus through the esophageal sphincter. Difficulty in completing any one of these behaviors can put a child at risk for aspiration, pneumonia, gagging, choking, and vomiting (Arvedson, 2008). Packing occurs when an accepted bite of food is held or "pocketed" in the mouth in the absence of swallowing. Much like dysphagia, there is also a risk of aspiration. Chewing deficits constitute a variety of problems and, like dysphagia and packing, can result from a range of organic factors. Treatment of chewing and swallowing deficits should be based on the specific type of deficit(s) exhibited (Kadey, Roane, Diaz, & Merrow, 2013). In some cases, chewing deficits might not have any identifiable organic origin. For example, deficits with chewing can develop from a lack of learning opportunities resulting from prolonged use of tube feedings in which oral consumption is infrequent or does not occur (Morris, 1989). Self-feeding or independence with feeding, similar to chewing deficits, can be delayed as a result of environmental factors (e.g., lack of opportunities to practice due to prolonged bottle dependence). However, these delays can also result from some of the genetic and developmental etiologies mentioned previously, especially when motor movements to reach for, pick up, bite, and chew are effortful. In general, difficulty eating might reduce the motivation to eat, and this lack of motivation should be considered when developing a comprehensive intervention plan, by teaching appropriate feeding skills, and thereby decreasing response effort (Kadey et al.). Prior to intervention, each of these deficits should be evaluated for potential organic causes, and medical clearance must be obtained.

Medical, Developmental, and Social Outcomes

The aforementioned feeding disorders usually require some form of intervention to address a variety of negative biomedical, developmental, and social outcomes. Untreated feeding disorders that result in malnutrition and weight loss can lead to impairments in intellectual, emotional, and academic development, (Hoch et al., 2001) in addition to familial stress (Greer, Gulotta, Masler, & Laud, 2008), while children who engage in food selectivity and consume a large volume of their preferred foods may experience unhealthy weight gain when those foods are rich in calories and fat. Obesity in childhood has been linked to an increased prevalence of type II diabetes, high cholesterol, hypertension, and a number of social consequences (e.g., ostracism, bullying, weight preoccupation; Dietz, 1998). Although this subpopulation does not experience the immediate biomedical concerns associated with marked weight loss, developmental delays, or need for enteral feedings, they are likely to experience drastic long-term outcomes as a result of their feeding problem and would likely benefit from interventions targeting improved nutrition.

Malnutrition that results from feeding disorders can often lead to delays with young children, including cognitive impairment, in particular during the sensitive period of development between birth and 5 years of age. Children can also display delays in speech, social responses, motor development, and might fail to reach other major developmental milestones within an appropriate window of time. These symptoms, in conjunction with weight loss or stagnation, are sometimes referred to as "failure-to-thrive," a condition that describes the child's decelerated or arrested development (Heffer & Kelley, 1994).

As eating is typically a social activity, feeding difficulties can also limit the number of social opportunities for children as they no longer participate in mealtimes (e.g., family dinner, school lunch). In fact, the child's participation in such settings might be an unpleasant experience for everyone involved. For example, a child who engages in total food refusal, and as a result receives feedings via a gastrostomy tube, might miss important learning opportunities to engage in social behaviors most common at mealtimes. Attempts to include the child might lead to inappropriate mealtime behaviors (e.g., gagging, vomiting, crying, aggression, self-injury), behaviors commonly exhibited by children with feeding difficulties. These experiences likely make

mealtimes difficult for families if the caregivers' attention is consumed with managing such behaviors, preventing them from enjoying their own meal and interacting with other members of the family (Greer et al., 2008).

Multidisciplinary Assessment: The Role of Applied Behavior Analysis

As previously mentioned, feeding disorders have been categorized as *feeding skill delays and deficits* and *maladaptive feeding behaviors and disruptive mealtime behaviors* (Berlin et al., 2009). It is important to note that the feeding problems within these broad categories are not always distinct from one another and generally occur within a relational context. Thus, Berlin et al. proposed a third grouping of feeding problems characterized as *relational or family difficulties and unpleasant mealtime environments*, in which feeding problems are identified in the context of family difficulties such as an antagonistic environment, parents' own aversions surrounding mealtimes, and mealtime interactions that are coercive in nature. In other words, parental mismanagement may be responsible for the development and/or maintenance of feeding problems. Given the complexity of pediatric feeding disorders in clinical presentation and diagnosis, biological, behavioral, and psychosocial factors must all be considered and addressed (Berlin et al.). As such, a multidisciplinary approach is the suggested model of care for the assessment and treatment of severe feeding disorders (Cornwell, Kelly, & Austin, 2010), including speech and/or occupational therapy, medical and dietary interventions, psychosocial support provided by a social worker or psychologist, and a strong emphasis on behavioral interventions.

Though the etiology of feeding problems varies widely and can include medical complications such as GERD allergies, and structural abnormalities that impact chewing and swallowing, maladaptive feeding behaviors exhibited by children, regardless of initial precipitating events, can all be attributed to environment-behavior relations. In other words, maladaptive feeding behaviors are learned behaviors often maintained by negative reinforcement contingencies (Clawson & Elliott, 2014), and regardless of underlying structural, neurological, cardiorespiratory, and/or metabolic features of feeding disorders, there is often a significant behavioral component. In fact, a study by Burklow, Phelps, Schultz, McConnell, and Colin (1998) identified significant behavioral contributions to feeding disorders in as many as 80% of children referred to a multidisciplinary feeding clinic.

Consequently, applied behavior analysis is uniquely important in multidisciplinary assessment and treatment because even after underlying medical, developmental, sensory, or psychosocial challenges have been addressed, maladaptive feeding behaviors are likely to persist if the reinforcement contingencies that maintain such behavior are not identified and disrupted. Further, treatments that include behavioral interventions may also act to increase the child's compliance with treatments focused on oral-motor skill development used by speech pathologists or occupational therapy (Clawson & Elliott, 2014). In order to develop a comprehensive treatment that addresses the function of maladaptive mealtime behavior, a functional behavioral assessment, as described below, is critical.

Assessment

Various types of questionnaires, observations, and other assessment methodologies can be used to gather information on the severity of feeding problems and other qualitative aspects regarding mealtimes, as well as types of inappropriate mealtime behavior the child exhibits and events that might influence their persistence.

Indirect Assessment

Studies evaluating indirect methods as a means to obtain information regarding the function of problem behavior have been largely unsuccessful

in identifying behavioral functions as compared to functional analysis methodology (Smith, Smith, Dracobly, & Peterson Pace, 2012; Zarcone, Rodgers, Iwata, Rourke, & Dorsey, 1991). However, use of initial surveys for obtaining crucial information pertaining to medical concerns (e.g., physical abnormalities, allergies), past interventions, and food preferences can not only be useful in ensuring the safety of the child but helpful in guiding potential intervention approaches as well.

Questionnaires such as the Brief Autism Mealtime Behaviors Inventory (BAMBI; Lukens & Linscheid, 2008), Children's Eating Behavior Inventory (CEBI; Archer, Rosenbaum, & Streiner, 1991), and Screening Tool of Feeding Problems (STEP; Matson & Kuhn, 2001) can be used as assessment tools to identify whether a child has a feeding problem or as the dependent measure in determining efficacy of interventions. For example, the BAMBI has been shortened to a 15-item survey in which parental report on questions pertaining to food selectivity, disruptive mealtime behavior, food refusal, and mealtime rigidity is obtained (DeMand, Johnson, & Foldes, 2015; Lukens & Linscheid). These types of assessments are useful for specific purposes such as identifying whether intervention is warranted for an individual but will likely fall short when used as the sole method for obtaining accurate information regarding the function of inappropriate mealtime behavior. Nonetheless, indirect assessments such as interviews are valuable in a number of ways. For example, assessing the types of foods a child currently consumes via questionnaire could inform their inclusion in a direct assessment (e.g., preference assessment), examining dietary patterns via food logs might inform the types of foods necessary to include in an intervention to better nutritional outcomes, and obtaining information regarding problems related to cross-discipline expertise might inform the need for including alternate professionals (e.g., dental problems warranting a dentist, oral motor deficits warranting a speech and language pathologist) in cases where behavior analysts are providing treatment outside of a multidisciplinary team.

Descriptive Assessment

In general, studies have shown descriptive assessments to be insufficient for obtaining accurate information regarding the function of problem behavior when comparing the outcomes obtained from descriptive assessments with functional analysis (see description below; e.g., Pence, Roscoe, Bourret, & Ahearn, 2009). However, the initial process for identifying environment-behavior relationships for subsequent manipulation in functional analysis might hinge on the careful observation of these relationships by clinicians. For example, in a seminal functional analysis study conducted by Piazza, Fisher, et al. (2003), the experimenters utilized contingencies in the functional analysis that were informed by the prior descriptive observations of caregiver-conducted meals. Despite the lack of research comparing the obtained function of inappropriate mealtime behavior from descriptive and functional analysis methods, the outcomes from descriptive assessment studies have been crucial in showing that a number of environmental events such as caregiver attention (e.g., coaxing, reprimands), delivery of preferred items (e.g., toys, preferred foods), and escape from bite presentations are events that likely take place during meals (Borrero, Woods, Borrero, Masler, & Lesser, 2010; Piazza, Fisher, et al.). Thus, descriptive methods could be useful in conveying to caregivers and other professionals how these events might be playing a role in the maintenance of a feeding problem.

Preference Assessments

Generally, preference assessments are often used in research and clinical practice to identify potential reinforcing stimuli, both leisure and edible. With respect to assessing foods for individuals with feeding problems, the process or outcome of conducting a preference assessment can serve several additional purposes such as confirming caregiver report of the topographies of problem behavior their child exhibits and which foods are consistently refused. For the sake of assessment

of feeding problems prior to a treatment evaluation, preference assessments are typically used to identify foods that are not consumed altogether. Although, it is possible preference assessments could be utilized to identify foods that are inconsistently accepted or consumed relative to foods that are not accepted at all. It is possible those foods that are consumed more frequently, albeit not to a sufficient level, might be more easily incorporated into the child's diet with less intrusive interventions than foods the child completely refuses. Although more research needs to be conducted using such an assessment, it is likely that these procedures would only be applicable for cases of picky eating rather than children who exhibit more severe forms of feeding problems.

The utility of different preference assessments might depend on what function they are being used for. For example, a paired stimulus preference assessment (PSPA; Fisher et al., 1992) is typically used to obtain a relative hierarchy of preference across foods. However, given that children with feeding problems often refuse to consume foods when presented, the typical outcome of a PSPA is that the majority of foods are not consumed even when preferred foods are used in combination with non-preferred foods during the assessment. The result of the PSPA being that consumption occurs for a few of the preferred foods whereas consumption does not occur for any other foods. Further, consumption is not likely to occur during the PSPA if the child engages in total food refusal or preferred foods are not incorporated into the preference assessment. Thus, a hierarchy of preference cannot be obtained, defeating the original purpose of using the PSPA. Alternatively, a single stimulus preference assessment (SSPA; Pace, Ivancic, Edwards, Iwata, & Page, 1985) might be the most practical preference assessment and yield the resulting information if the goal is to corroborate caregiver report of foods their child likely refuses and identify what foods the child will or will not consume.

Other preference assessments such as the multiple stimulus without replacement (MSWO; DeLeon & Iwata, 1996) have not been employed as frequently as the PSPA when assessing preferences for this population; however, there might be practical utility in using different preference assessment arrangements dependent on various types of feeding problems. For example, as noted above, the SSPA is likely most useful when wanting to obtain information about whether a child will or will not consume a specific food. In contrast, the MSWO arrangement might be most similar to a typical meal in that multiple foods are presented at the same time. Thus, this arrangement would make it possible to examine the sequencing of bites within a meal. Likewise, assessment of bite sequencing could occur if bites are replaced as in the multiple stimulus with replacement preference assessment (Windsor, Piché, & Loche, 1994), if free access is provided similar to that of the free operant preference assessment (Roane, Vollmer, Ringdahl, & Marcus, 1998) or if foods are restricted as exclusive consumption occurs, as in the response-restriction preference assessment (Hanley, Iwata, Lindberg, & Conners, 2003). In addition, if several foods (with a range of preference) are available to the child to consume in any order, one would be able to measure at what point problem behavior occurs. For example, the SSPA and MSWO presentation methods might be useful to distinguish whether the child will engage in inappropriate mealtime behavior when non-preferred foods are presented in isolation (SSPA) or when presented simultaneously with preferred foods (MSWO). In addition, both might be important assessments if the recommendation is to provide exposure to a variety of foods as a possible least intrusive intervention where caregivers or therapists might present non-preferred foods on a time-based schedule. However, applying preference assessments in this way has yet to be empirically validated and, like any direct assessment, will only prove to be useful if they provide valuable information in guiding the design of subsequent treatments and predicting successful applications or outcomes.

As an example, Munk and Repp (1994) utilized an assessment procedure in which 10–12 types of food (e.g., pears, chicken) were presented at up to four possible textures (e.g., ground, chopped) for five individuals with feeding problems. The experimenters recorded acceptance, refusal, expulsion, and inappropriate mealtime

behavior in an effort to categorize each child's feeding problem as total food refusal, selectivity by type, selectivity by texture, or selectivity by both type and texture. The pattern of behavior that would be expected for each category would be refusal to consume all foods when presented across all textures, only consuming a few foods regardless of texture but refusing other types of foods, consuming foods at one texture but not another, and only consuming some foods at some textures but refusing other foods, respectively. Subsequent research has demonstrated that the assessment procedures proposed by Munk and Repp can identify functional relationships between dimensions of foods and behavior such as accepting, consuming, or expelling as well as predict successful intervention strategies (e.g., Patel, Piazza, Santana, & Volkert, 2002).

In addition to the possibility of preference assessments being used to inform treatment development, preference assessments might also be used in a pre- and posttreatment format to measure both generalization and maintenance. As we noted previously, the PSPA can be limited in assessing the hierarchy of preference between foods for this population; however, researchers have begun utilizing pre- and posttreatment PSPAs to measure changes in preferences following intervention (e.g., Fernand, Penrod, Brice Fu, Whelan, & Medved, 2015; Penrod & VanDalen, 2010). The pre- and posttreatment PSPA allows for measurement of both generalization and maintenance. Generalization is measured if foods are included in the PSPA that the child was not exposed to during intervention, and consumption occurs with those foods during the posttreatment PSPA. Finally, the posttreatment PSPA allows for an assessment of the possibility for fading treatment in that the PSPA is typically implemented under baseline contingencies (i.e., escape is available and no programmed consequences are delivered). Thus, treatment components are removed during the PSPA, and one possible variable maintaining consumption is the change in preference that occurred during treatment, indicating that consumption might be likely to occur in the future (i.e., maintain) without formal intervention components as a result of the shift in preference.

Functional Analysis

Functional analysis methodology (e.g., Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) has been used as a means to identify variables that influence the occurrence of problem behavior and are considered the only assessment method that reliably identifies a functional relationship between two variables, typically between environmental events and a response class. Girolami and Scotti (2001) were one of the first to extend functional analysis procedures to the assessment of inappropriate mealtime behavior in an effort to identify the circumstances under which those behaviors are likely to occur; however, since then a number of studies have utilized similar methodology by arranging variations of attention, escape, tangible (toy and edible), and control conditions (e.g., Bachmeyer et al., 2009; Piazza, Fisher, et al., 2003). Typically in the attention condition of a functional analysis, a bite of food is presented for a predetermined amount of time and remains fixed in position until that interval lapses, regardless of problem behavior. However, inappropriate mealtime behavior results in the delivery of attention (e.g., consoling, coaxing, reprimands). Increased problem behavior in this condition would suggest the child's inappropriate mealtime behavior is sensitive to social-positive reinforcement in the form of attention. In the escape condition, a bite of food is presented for the same interval of time as decided upon in the attention condition. However, the bite of food is removed, and the demand to eat the bite is terminated for a brief amount of time (e.g., 20 s) contingent upon inappropriate mealtime behavior, and no other programmed consequences are provided for problem behavior, that is, attention is not provided in the escape condition. Elevated problem behavior in this condition would suggest that the child's inappropriate mealtime behavior is sensitive to social-negative reinforcement in the form of escape from eating or bite presentations. During the tangible condition, the arrangement is the same as the previous conditions; however, attention and escape are not provided. Instead, a preferred item (either a toy or food) is presented contingent upon the occurrence of

problem behavior. Increased problem behavior in this condition would suggest the child's inappropriate mealtime behavior is sensitive to social-positive reinforcement in the form of access to preferred items. Lastly, during the control condition, either the bite of food used in the other conditions is presented (e.g., Piazza, Fisher, et al.) or a preferred food is presented (e.g., Najdowski et al., 2008). Typically in this condition, noncontingent access to attention is provided, and in some cases noncontingent access to toys is provided (if assessing a tangible function), and no programmed consequences are provided if inappropriate mealtime behavior occurs. A number of studies have presented variants of the aforementioned conditions using a variety of designs including reversal (e.g., Piazza, Fisher, et al.) and multielement designs (e.g., Najdowski et al.), as well as pairwise (LaRue et al., 2011) and brief analyses (e.g., Wilder, Normand, & Atwell, 2005). Together, previous research has identified inappropriate mealtime behavior is likely to serve an escape function (e.g., Piazza, Fisher, et al.) pointing to the importance of interventions focused on decreasing the aversive properties of foods, feeding apparatus, or mealtime context as well as those which terminate the relationship between the escape contingency for engaging in inappropriate mealtime behavior.

Intervention

Although there is a range of medical conditions that can influence the development of feeding disorders, the previous section has highlighted how behavioral factors can often play a large role in both the development and maintenance of feeding problems. Indeed, the functional analysis literature has highlighted how both negative reinforcement (i.e., the removal or avoidance of non-preferred foods) and positive reinforcement (e.g., Bachmeyer et al., 2009; Najdowski et al., 2008; Piazza, Fisher, et al., 2003) can participate in the development and maintenance of inappropriate mealtime behavior. There are several other factors to consider when pursuing a broad functional analysis of feeding disorders, though. For example, Babbitt et al. (1994) suggested that there are two general issues, which might overlap, that often contribute to the presence of a feeding disorder: (1) motivational problems and (2) skills deficits. Along these lines there are a number of interventions that might be pursued to target both motivation and skill deficits.

The effectiveness of behavioral interventions in the treatment of pediatric feeding disorders has been well documented. Specifically, behavioral interventions have been used to address inappropriate mealtime behaviors (Bachmeyer et al., 2009), food selectivity (Najdowski, Wallace, Doney, & Ghezzi, 2003; Piazza et al., 2002), packing (Gulotta, Piazza, Patel, & Layer, 2005; Patel, Piazza, Layer, Coleman, & Swartzwelder, 2005), total food refusal (Gulotta et al., 2005; Mueller, Piazza, Patel, Kelley, & Pruett, 2004; Shore, Babbitt, Williams, Coe, & Snyder, 1998), swallowing problems (Greer, Dorow, Williams, McCorkle, & Asnes, 1991; Lamm & Greer, 1988), and self-feeding (Collins, Gast, Wolery, Holcombe, & Leatherby, 1991; Luiselli, 2000). This section considers less intrusive interventions, namely, those that involve positive reinforcement and antecedent interventions and those that strengthen skills involved in feeding.

Importantly, in our clinical experience the extent to which less intrusive interventions are successful in the absence of extinction is often related to the severity of inappropriate mealtime behavior, and this is consistent with patterns in the research literature as well (Seubert, Fryling, Wallace, Jiminez, & Meier, 2014). That is to say, less intrusive interventions, those that don't involve extinction, seem more likely to be successful for less severe feeding problems. To be sure, there are a great variety of interventions that might be characterized as less intrusive. Given this, our aim is to provide an overview of some of the strategies that have been evaluated within the research literature, but at the same time we acknowledge that our review is selective and that more thorough reviews might be pursued. We begin by reviewing perhaps one of the most straightforward behavioral interventions, differential reinforcement of alternative behavior.

Differential Reinforcement of Alternative Behavior (DRA)

DRA consists of providing access to a reinforcer contingent upon a target behavior and not providing access to this reinforcer in the absence of the target behavior. Within the context of a feeding intervention, DRA consists of providing reinforcers contingent upon acceptance and consumption of non-preferred foods and withholding those reinforcers in the absence of acceptance or consumption. Interestingly, while this intervention may seem to be the most straightforward behavioral intervention, only a handful of studies have demonstrated its effectiveness in isolation. A study by Riordan, Iwata, Finney, Wohl, and Stanley (1984) demonstrated how positive reinforcement in the form of access to preferred items and social praise could be used to improve the number of bites accepted with three children admitted to an inpatient feeding disorders program. Brown, Spencer, and Swift (2002) described the successful use of DRA with a 7-year old who was a picky eater. In this study, parents were instructed to give their child a rule (e.g., "if you eat X you can have some Y"), and this contingency was successful at increasing consumption across three foods. Other researchers have examined DRA in combination with other interventions, suggesting that it may be a useful, though not necessarily critical, component of behavioral treatment packages (e.g., Najdowski et al., 2010). However, other research has shown that DRA is not successful at improving feeding behavior in isolation (e.g., Najdowski et al., 2003; Patel, Piazza, Martinez, Volkert, & Santana, 2002; Penrod, Wallace, Reagon, Betz, & Higbee, 2010), but that it may be helpful toward reducing challenging behavior associated with mealtimes (Piazza, Patel, Gulotta, Sevin, & Layer, 2003).

Non-contingent Reinforcement

Non-contingent reinforcement has also been studied within the feeding disorders research. Reed et al. (2004) assessed the relative effectiveness of non-contingent reinforcement and escape extinction in the treatment of four children with food refusal. Results showed that non-contingent reinforcement (access to toys and attention throughout meals) did not increase consumption of foods, but that it did reduce inappropriate mealtime behavior for some of the participants. Wilder et al. (2005) studied the effects of non-contingent reinforcement on the self-injurious behavior and food refusal of a 3-year-old child with autism and feeding difficulties. A pretreatment functional analysis confirmed that the child's self-injury was maintained by escape from food. Results showed that non-contingent reinforcement (access to a video throughout meals) resulted in a reduction in self-injury and an increase in bites accepted. Thus, there are somewhat mixed results related to the effectiveness of NCR in the treatment of feeding problems. Future researchers should continue to try to understand the contexts in which NCR is effective.

Antecedent Interventions

A number of interventions target the motivation to engage in negatively reinforced inappropriate mealtime behavior by specifically altering some aspect of the stimulus properties of non-preferred foods. These interventions generally a) target the stimulus properties of the avoided food itself or b) attempt to change the context in which the non-preferred food is presented and experienced. We will first review those interventions that have focused on changing the stimulus functions of non-preferred foods directly.

Fading and Texture Manipulations Stimulus fading and texture manipulations consist of changing the characteristics of the non-preferred foods directly. In a stimulus fading intervention, target foods (i.e., non-preferred foods) are blended with preferred foods (e.g., 70% preferred food and 30% non-preferred food). Mueller et al. (2004) improved the variety of foods two children with food refusal consumed by using a blending intervention that involved blending preferred and non-preferred foods at various ratios.

After the blending treatment, probes were conducted with both treated and untreated target foods. Results showed that consumption improved for all foods, but that consumption of foods that had not been exposed to the blending treatment only improved after several foods had been treated. Patel, Piazza, Kelley, Ochsner, and Santana (2001) evaluated a fading procedure with a child who would only consume water. Initially, the intervention involved systematically increasing the amount of Carnation Instant Breakfast ® (CIB) added to the water. When consumption was high with all of the CIB in the water, the amount of milk added to the water and packet of CIB was also systematically increased. Ultimately, the child consumed glasses of milk with a packet of CIB. Tiger and Hanley (2006) pursued a similar intervention with a child who would not drink milk. Chocolate syrup was added to the milk and systematically faded, as consumption remained high. At the end of the treatment, the child drank glasses of milk with no syrup added. These studies demonstrate that stimulus fading can be used to systematically transfer stimulus control to initially non-preferred foods and liquids.

Texture manipulations are similar to fading interventions in that the non-preferred food is directly altered in some way. Patel, Piazza, Santana, et al. (2002) evaluated a texture manipulation on the number of expulsions and grams consumed with a child who consumed foods at low textures (e.g., puree) but expelled foods at higher textures. The authors specifically reduced the textures of meats in this study, with results showing that expulsions decreased and grams consumed increased. This evaluation demonstrates that the texture of foods may be a variable to consider in the treatment of feeding problems and that texture manipulations may be pursued to improve consumption. Importantly, food texture is related to chewing and swallowing skills, and efforts to systematically increase texture after it is decreased may need to be combined with interventions aimed at developing and strengthening chewing and swallowing behavior (see below).

Simultaneous Presentation Another antecedent strategy involves providing non-preferred foods *with* preferred foods, a strategy called simultaneous presentation in the research literature. Piazza et al. (2002) conducted an evaluation of the effects of simultaneous presentation of non-preferred and preferred foods relative to the sequential presentation of non-preferred and preferred foods (i.e., only providing preferred foods after consuming non-preferred foods). Results of this study showed that two third of the participants consumed more food when non-preferred and preferred foods were provided simultaneously relative to sequentially. A final participant also consumed more in the simultaneous condition, but only when it was combined with escape extinction procedures. Ahearn (2003) also evaluated the simultaneous presentation condition with a 14-year old, mildly selective child, to improve the acceptance of three vegetables. Acceptance of all three vegetables improved when condiments (preferred food) were added to the vegetables (non-preferred foods). While these studies suggest that simultaneous presentation may be effective, other research has been less supportive. VanDalen and Penrod (2010) found that neither simultaneous nor sequential presentation methods were effective at increasing the consumption of bites with two children with autism spectrum disorder and that both methods were equally effective when combined with escape extinction. Given these mixed findings, more research is needed which identifies the circumstances in which the simultaneous presentation method is likely to be effective in the absence of escape extinction.

High-P Sequence Other interventions aim to improve consumption by altering some feature of the feeding context. One of these interventions involves the high-probability instructional sequence. Generally, the high-*p* sequence involves providing a series of instructions that the individual has a very high probability (i.e., history) of complying with prior to providing an instruction that they have a low probability of complying with. The high-*p* sequence has also had mixed effects within the feeding literature. For example, Dawson et al. (2003) found that the high-*p* sequence did not improve consumption or

inappropriate mealtime behavior and that it also did not add to the effectiveness of escape extinction. Patel et al. (2006) also found that the high-*p* sequence did not improve acceptance or consumption, but that it did reduce inappropriate mealtime behavior when combined with extinction interventions relative to extinction alone. Others have found the high-*p* sequence to be effective in the absence of escape extinction (Ewry & Fryling, 2016; Meier, Fryling, & Wallace, 2012; Patel et al., 2007). It is noteworthy that these studies employed a variation of the high-p sequence wherein the high-*p* instruction was topographically similar to the low-*p* instruction (both involved taking bites from spoons) and involved participants that were generally compliant. Finally, Penrod, Gardella, and Fernand (2012) combined the high-*p* sequence with demand fading (i.e., progressively increasing the demand requirement) to improve consumption with children with food selectivity. The results of Penrod et al. demonstrate that the high-*p* sequence may be successful when combined with other interventions.

As we have mentioned before, a great number of interventions might fall within the purview of *antecedent* interventions for feeding problems. Interested readers are encouraged to consult reviews on the topic (e.g., Bachmeyer, 2009; Seubert et al., 2014). Interestingly, although appetite has been mentioned in some of the behavioral feeding literature (Linscheid, 2006), the role of appetite manipulation has not been systematically evaluated in the behavior analytic feeding literature. However, interventions such as developing a structured feeding schedule and reducing the extent to which individuals eat small amounts of food (or "snack") throughout the day seem to be part of standard behavioral recommendations for feeding intervention (e.g., Williams & Foxx, 2007).

Developing Related Skills

Chewing Relatively fewer published behavioral interventions have focused specifically on strengthening target skills related to eating. Volkert, Piazza, Vaz, and Frese (2013) examined two relatively straightforward behavioral interventions to improve chewing skills. Their first study involved examining the effects of a least-to-most prompting procedure and praise on the number of chews per bite with a typically developing 4-year-old child. Results showed that the intervention was successful at increasing the number of chews per bite across various foods (green beans, apricots, peaches, carrots, potatoes, fish sticks, and chicken). In a refinement of the first experiment, the researchers evaluated the effects of a descriptive verbal prompt (i.e., "Chew 10 times") and praise on chewing with a 14-year-old child with a developmental disability. Results showed that both chews per bite and mastication improved as a result of the intervention. These initial evaluations suggest that simple behavioral interventions might be used to improve skills associated with chewing and swallowing.

More recently, Volkert, Peterson, Zeleny, and Piazza (2014) evaluated a protocol involving a chew tube to improve chews per bite, mastication, and to decrease early swallows with three young children with feeding problems (aged 2, 3, and 4 years). Specifically, using mothers as therapists, participants were taught to first bite a chew tube, then, using least-to-most prompting, to chew the tube with a bite in it, then to chew a half tube with a bite, and finally least-to-most prompting with a bite was used alone. Target behaviors improved for each of the three participants involved in the study. These studies suggest that behavioral interventions may be used to improve chewing skills with children with feeding problems. Given the importance of skills such as chewing, it is hoped that more research focuses on this area.

Self-Feeding An additional skill related to feeding is that of self-feeding. As we have described throughout the chapter thus far, children with feeding difficulties often have histories of avoiding foods for various reasons, and, as a consequence, having caregivers feed them. This history may result in a lack of self-feeding skills in children with a history of feeding difficulties. Behavioral researchers have examined a number

of procedures that may be used to improve self-feeding. Like all skills, self-feeding skills may be deficient due to skill deficits or motivational problems. Luiselli (1991, 1993, 2000) reported a number of case studies where individuals with various disabilities were taught self-feeding skills using prompting and prompt fading, differential reinforcement, and demand fading. These studies demonstrated that when self-feeding skills are weak or absent, they can be taught using common behavioral acquisition procedures.

Self-feeding can also be deficient with individuals who have a self-feeding repertoire. Recently, behavioral researchers have evaluated the use of negative reinforcement contingencies (i.e., avoidance) to increase self-feeding with individuals who have self-feeding skills. Specifically, participants were given choices between self-feeding a bite of a target food and having someone else feed them a bite of the target food, multiple bites of the target food, or multiple bites of less preferred foods (Rivas et al., 2014; Vaz, Volkert, & Piazza, 2011). Results demonstrated that self-feeding increased when children could avoid having someone feed them multiple bites of the target food or multiple bites of less preferred foods. Given this, it seems possible that once self-feeding skills are established, motivation to self-feed, perhaps especially with children, who have a history of feeding difficulties, can be improved with avoidance contingencies. Given the importance of self-feeding, much research remains to be done in this area.

Implications

As we have described, there are many interventions that have been evaluated to improve feeding behavior. While having options is often considered a good thing, perhaps the largest problem with having so many interventions is determining *when* a particular intervention should or should not be used. Clearly, for practitioners, simply having a very large menu of possible interventions is not all that is needed. Future research should focus on identifying the specific contexts where less intrusive interventions are more or less likely to be effective in the absence of extinction. In the meantime, we recommend that clinicians consider a pretreatment assessment of various treatments rather than pursue what may become a rather lengthy trial and error process. Consistent with the functional analysis logic described earlier in the chapter, this involves testing out the effects of various interventions on important target behaviors, most often acceptance, consumption, and inappropriate mealtime behavior. Such an assessment may be relatively brief; there are often notable differences that can be seen very quickly.

For example, after verifying that a child is ready and able to participate in a feeding intervention (i.e., ruling out medical causes, assessing for prerequisite skills), a therapist might discuss several intervention options with a caregiver. Collaboratively, it may be decided that two to three interventions are of interest and fit within the context of the child's situation. Then, using an alternating treatment design, therapists can "probe" the effects of different interventions (e.g., DRA and non-contingent reinforcement) on consumption and inappropriate behavior (see Fig. 1). This way, potential differences between the two interventions will be identified rather quickly, and if not, a parent could choose which intervention they find to be more preferable, and this can be pursued while planning for generalization and maintenance (more on generalization and maintenance below). While careful pretreatment assessments might be pursued in future research, we also recommend them as good clinical practice given the likely idiosyncratic responses different children will have to various feeding treatments.

Of course, as we have described above, there are situations in which less intrusive interventions are not effective in isolation, when something more intrusive is required. Again, it is our experience that these situations are closely related to the severity of the inappropriate mealtime behavior (e.g., yelling, pushing the spoon away, attempting to leave the feeding context) that children engage in. It is also possible that individuals with more lengthy histories of reinforcement for challenging behavior could require more intrusive interventions, at least initially. Much more research is

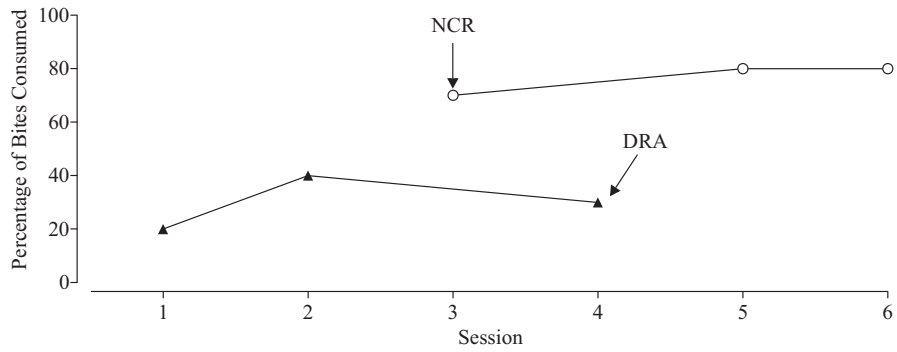

Fig. 1 Example of a brief pretreatment assessment of the effects of two interventions

needed to explore these possibilities. The following section provides a detailed overview of what we know about extinction procedures.

Escape Extinction and Procedural Variations

As noted, the use of antecedent and some consequence-based environmental manipulations to address feeding difficulties can often prove to be inefficient when dealing with more persistent problem behavior (e.g., noncompliance, continual expulsions), warranting a more intensive treatment model. In such cases, the incorporation of escape extinction within the existing intervention should be considered. At times, feeding disorders are so severe that extinction procedures can be immediately warranted as part of an initial treatment package in an effort to resolve imminent threats to health or well-being (e.g., prevention of further declines in weight and surgical placement of a gastrostomy tube). In any case, it is crucial that extinction procedures be implemented with integrity and only by individuals who have been trained to implement the procedure and recognize potential safety risks or under close supervision of someone with extensive experience in the provision of this type of treatment.

Placing any behavior on extinction will reduce the future frequency of the behavior or may stop the occurrence of the targeted behavior altogether. Extinction-based procedures involve withholding functional reinforcers when the target behavior is emitted (Cooper, Heron, & Heward, 2007). When applied to feeding difficulties, such as food refusal or food selectivity, extinction procedures typically include preventing escape from non-preferred foods or from the mealtime situation. It is speculated that escape extinction procedures are the most efficient means of addressing food refusal behavior because the negative reinforcement contingency maintaining such behavior (often escape or avoidance of non-preferred foods) is disrupted (Riordan, Iwata, Wohl, & Finney, 1980). Although the efficacy of escape extinction procedures for feeding difficulties has been demonstrated repeatedly in the literature (Ahearn, Kerwin, Eicher, & Lukens, 2001; Cooper et al., 1995; Piazza, Patel, et al., 2003), there are numerous clinical considerations to make regarding *whether* and *how* to incorporate them into a comprehensive intervention plan. With careful consideration of these variables, escape extinction procedures can be both an efficient and effective treatment component for remediating feeding difficulties when other treatment methods prove ineffective or inefficient.

Escape extinction procedures for feeding problems typically involve repeated exposure to, and continued presentation of, non-preferred or novel foods, as well as escape prevention, and shaping consumption of target foods through differential

reinforcement. Application of the escape extinction procedure occurs repeatedly (i.e., across several sessions) until the child meets a termination criterion (e.g., is independently consuming the target food). The most common application of escape extinction involves what is referred to as nonremoval of the spoon (NRS). A variation of escape extinction that has received relatively little attention in the literature (yet may seem more acceptable to parents) is nonremoval of the meal (NRM; Tarbox, Schiff, & Najdowski, 2010).

Nonremoval of the Spoon (NRS) NRS is the most experimentally evaluated escape extinction procedure in the treatment of pediatric feeding disorders. Implementation of NRS may be likened to feeding an infant as the therapist holds the feeding apparatus (e.g., spoon) directly in front of the child's mouth and deposits each bite upon the child opening their mouth. Escape from the bite presentation is prevented and no longer provided for inappropriate mealtime behavior. However, escape *is* provided in the form of brief breaks from bite presentations or termination of the meal/treatment session, contingent on the emission of a previously identified alternative behavior or behavior product (e.g., acceptance, swallowing, mouth-clean). Variables to consider before implementing NRS include the frequency and rate of bite presentations, the manner in which bites are deposited, and whether or not expelled bites will be re-presented.

Bite Presentation The number of bites presented (i.e., opportunities to accept/consume) in a single treatment session may vary with respect to both frequency and rate. The reported number of bites accepted per treatment session have ranged from 1 (Allison et al., 2012; Sharp, Jaquess, Bogard, & Morton, 2010) to 51 (Penrod et al., 2010) with a mode of 20 (Ahearn, Kerwin et al., 2001; Ahearn, Kerwin, Eicher, Shantz, & Swearingin, 1996; Kerwin, Ahearn, Eicher, & Burd, 1995). In general, bites are presented as discrete trials, and in addition to being presented for a fixed number of opportunities, bites are often presented on a set schedule, regardless of the behavior emitted by the child. Schedules that have been evaluated include FT-30s (Allison et al.; Patel, Piazza, Martinez et al., 2002) and FT-45s (Riordan et al., 1984). It may also be useful to employ quasi-fixed time schedules in which bites are presented every 30 s, unless the child engages in packing (Allison et al.; Patel, Piazza, Martinez et al., 2002), or the child's rate of acceptance changes in which case the rate of presentation can be modified accordingly (Cooper et al., 1995). A maximum number of bite presentations per session should be based on the average number of bites the child has been observed to consume consistently while eating their preferred foods (if relevant) so as to avoid presenting an excessive number of bites and ensure satiation is not affecting rates of acceptance or inappropriate mealtime behavior.

Bite Insertion The manner in which bites are deposited into the child's mouth varies across studies that have evaluated NRS. In some cases, bites have been inserted at any time the child's mouth was sufficiently open – including yawning, crying, and accepting the bite (Anderson & McMillan, 2001; Hoch, Babbitt, Coe, Krell, & Hackbert, 1994; LaRue et al., 2011). In other cases, the bite was held in close proximity to the child's mouth (e.g., within 1 in.), until the child opened to accept the bite independent of physical or partial physical prompting (Ahearn, 2002; Coe et al., 1997; Hoch et al., 1994). The frequency with which the child is exposed to the target food may depend on the manner in which bites are deposited during NRS. For example, if the bite is held in front of the child's lips until she/he accepts the bite, there could be fewer opportunities for the child to taste and subsequently consume the bite as compared to an NRS procedure in which bites are inserted at any opportune time. However, consideration should be given to any problem behaviors emitted by the child when making this selection. For example, children who engage in active inappropriate mealtime behavior (e.g., aggression, self-injury, operant vomiting) might be less likely to emit said behaviors when bites are deposited only when they independently open their mouth to accept.

Re-presentation of Expelled Bites Re-presentation is a treatment component requiring expelled bites to be scooped up and re-presented as a consequence for expulsion (Coe et al., 1997). Inclusion of this component might depend largely on the idiosyncrasies of the child's behaviors during the application of extinction-based feeding procedures. Prior to including this procedure, it is recommended that an assessment of the child's eating skills be conducted to ensure the presented texture can be consumed safely. This might include assessments conducted by a speech and language pathologist to rule out any physiological abnormalities or skill deficits, followed by the type versus texture assessment referred to earlier in this chapter (Munk & Repp, 1994) as previous research has reported texture can affect the rate of expulsion (Patel, Piazza, Santana, et al., 2002), in which case texture fading would also be required as part of the child's treatment package as opposed to re-presentation.

Nonremoval of the Meal (NRM) Some children will not require an intrusive trial-based procedure like NRS. Furthermore, caregivers might not feel comfortable consenting to NRS with their child. Older children, for example, who can feed themselves and who do not engage in persistent expulsion, might respond to less intrusive variations of escape extinction – specifically nonremoval of the meal (NRM). Much like NRS, NRM provides repeated exposure to and prevents escape from non-preferred food while reinforcing an alternative behavior. This procedure differs from NRS in regard to the frequency of food presentation; the food or bite is presented as a meal, and the entire mealtime situation is terminated following the emission of the alternative behavior (Tarbox et al., 2010). NRM closely resembles a common mealtime contingency enforced by parents who require their child to clear their plate before being excused from the table; however more research is needed to substantiate the effectiveness of this procedure. When selecting this method of escape extinction, special consideration should be given to the volume of food presented. Furthermore, NRM may be implemented in conjunction with bolus and volume fading (Hoch et al., 2001) to increase the likelihood that the child will contact reinforcement.

Considerations for the Use of Escape Extinction

The use of extinction-based procedures can often complement treatment packages including antecedent- and reinforcement-based interventions; however, not every child will respond favorably to escape extinction even when implemented as part of a treatment package. Moreover, caregivers must be comfortable with the procedure; otherwise, treatment integrity and generalization of treatment effects are likely to be compromised.

Extinction-based procedures have been documented to evoke what Ahearn (2002) describes as interfering corollary behaviors including negative vocalizations, disruption of the bite presentation, and self-injurious behavior. Whereas the occurrence of such behavior typically decreases in frequency and duration as compliance increases, it can be distressing for both the child and parent. The likelihood and range in severity of emotional responses, as well as the potential for extinction bursts, should be explained to caregivers prior to intervening so that their consent to implement such an intervention is fully informed. This is especially important, as the application of extinction must be consistent to avoid unintentional intermittent reinforcement. A single instance of reinforcement for a previously extinguished behavior may make it difficult for the child to discriminate whether reinforcement will continue to be available in the future, contributing to a resistance to extinction (i.e., strengthening the problem behavior against extinction in the future; Cooper et al., 2007, p. 463–465). If there are concerns about whether procedures would be implemented with fidelity, it might be more efficacious to postpone using extinction-based procedures, or exclude them altogether, until additional training produces the high treatment fidelity necessary for such treatments to be successful.

Parent Training

Parent training is a critical component in the success of a feeding intervention especially considering caregivers will ultimately be the ones presenting meals and feeding their child following the identification and, often, implementation of effective treatments. Although it is often the case that parents are not used as the initial behavior-change agents during intervention, their training is crucial in the continued success of their child's progress following treatment.

Some research has incorporated caregivers within the assessment process by having them serve as therapists when conducting functional analysis of inappropriate mealtime behavior (e.g., Najdowski et al., 2008). One advantage to having caregivers serve as therapists during the assessment process is that they are the primary individuals that serve as feeders within the home and have acquired the most history with respect to the feeding process relative to a novel therapist in the clinic. However, research has yet to be conducted on examining the differences in outcomes between caregiver-conducted and therapist-conducted functional analyses with respect to inappropriate mealtime behavior, so it remains tentative on whether starting with caregivers as feeders produces better outcomes. Given the published literature on functional analysis of inappropriate mealtime behavior producing clear outcomes across studies thus far, the presence of a caregiver or a therapist currently seems unsupported. In addition, given that most individuals engage in inappropriate mealtime behavior as a function to terminate the bite requirement, it is likely that it does not matter in terms of who is presenting the non-preferred food during sessions.

One of the most empirically researched procedures on improving parent-implemented interventions is behavioral skills training (BST; e.g., Marcus, Swanson, & Vollmer, 2001). BST is a treatment package in which instructions, modeling, rehearsal or role-play, as well as feedback are implemented to increase treatment integrity. Sometimes these components are implemented as a package (e.g., Seiverling, Williams, Sturmey, & Hart, 2012), whereas other times the components are implemented one at a time to determine the necessary resources for training caregivers to implement intervention (e.g., Mueller et al., 2004). However, parent and child behavior is not always measured and reported together regardless of method used to increase caregiver skills. For example, Mueller et al. measured parent implementation of differential reinforcement with nonremoval of the spoon or noncontingent reinforcement with nonremoval of the spoon procedures, yet to what extent the caregiver's level of implementation and treatment integrity impacted their child's behavior remains unknown because child behavior was not reported. Conversely, Anderson and McMillan (2001) measured and displayed child behavior (i.e., acceptance and inappropriate mealtime behavior) and demonstrated a therapeutic effect of differential reinforcement with nonremoval of the spoon on child behavior when caregivers implemented the intervention, yet the caregiver's implementation was not reported. Fluctuations on a session-by-session basis when both caregiver and child behaviors are measured and depicted can allow for careful scrutiny over what treatment variables are influencing child behavior and vice versa. For example, parents might not need to implement all of the treatment components for cases in which it is demonstrated that parents have poor treatment fidelity, yet consumption persists and inappropriate mealtime behavior remains low. However, additional components might be warranted even if a caregiver is implementing the protocol perfectly, yet their child's acceptance, consumption, problem behavior, or other targeted responses do not improve. Thus, measuring both parent and child behavior and analyzing their patterns together could serve as important stimuli in guiding the decision-making process when implementing behavioral interventions to address feeding problems.

Little work has been conducted examining caregiver or child preferences for treatments. One notable study conducted by Ahearn et al. (1996) compared physical guidance and a nonremoval of the spoon to treat food refusal in three children using an alternating treatments design. The experimenters showed both treatments resulted

in similar increases in acceptance and decreases in expulsion. However, the physical guidance treatment was correlated with slightly lower levels of problem behavior than the nonremoval of the spoon procedure. When caregivers viewed graphs and video of sessions and were provided with a session-by-session description of their child's progress, they reported a preference for the physical guidance over the nonremoval of the spoon procedure. Ahearn et al. provided self-report statements from caregivers that implied caregiver preference for treatment might be influenced by the efficiency and effectiveness of the preferred intervention. Future work in caregiver and child preferences for different types of feeding treatments remains imperative as behavioral feeding procedures are disseminated to other fields and become selected for based on their perceived acceptability.

Conducting sessions via telehealth (e.g., Barretto, Wacker, Harding, Lee, & Berg, 2006) seems to be a cost-effective method in which specialized behavioral services can be implemented in the child's natural environment and when families live in remote areas relative to where those services are housed. One advantage of this training option is that caregivers serve as feeders in their home, where the child's meals typically take place. However, safety precautions prior to conducting clinical treatments via telehealth should be taken into consideration. Thus, currently this method of conducting sessions might be most useful as follow-up after initial treatments have already been validated and caregivers have been thoroughly trained as little research has been conducted on the types of feeding problems that might be addressed in this manner. For example, Peterson, Volkert, and Zeleny (2015) conducted sessions via telehealth with caregivers as therapists with one participant's sessions to increase self-feeding following a previous intervention to increase consumption. In another study, Wilkins et al. (2014) taught a child to close her mouth around a spoon using a three-step prompting procedure via telehealth as a follow-up procedure after an inpatient clinical evaluation of those procedures. Thus, future research remains warranted in evaluating the components needed to assess for the prerequisite skills necessary to conduct protocols with high fidelity and increase those skills if they are not sufficient via telehealth while ensuring the safety of the children undergoing those protocols.

Programming for Generalization and Maintenance

Programming for generalization and maintenance is paramount to the success of any of the aforementioned interventions. Although measures of generalization and maintenance have not been commonly reported in the feeding literature, a number of study characteristics have been identified that are commensurate with strategies for promoting generalization and maintenance, including *reinforcing instances of generalization* (e.g., Anderson & McMillan, 2001; Cooper et al., 1995; Galensky, Miltenberger, Stricker, & Garlinghouse, 2001), *training skills that contact natural contingencies* (e.g., Galensky et al., 2001; Najdowski et al., 2003), *incorporating a variety of relevant stimulus situations in training* (e.g., Hoch et al., 2001; LaRue et al., 2011), and *incorporating common stimuli* (e.g., Najdowski et al.; Mueller et al., 2004).

In a notable study, Najdowski et al. (2010) specifically measured generalization and maintenance of participants' consumption following a treatment evaluation in which parents served as the primary behavior-change agents in their own homes. Results indicated that caregivers trained to implement a treatment package consisting of demand fading, differential reinforcement, and NRS successfully increased their child's consumption of both foods targeted during the intervention as well as untrained foods. Further, the schedule and magnitude of reinforcement were systematically thinned to mirror more natural contingencies of reinforcement, and behavior change was maintained over time. Some notable features of this study that map onto recommended strategies for the promotion of generalization and maintenance include *reinforcing instances of*

generalization (providing training in the target situation and teaching parenting skills in the home), *training skills that contact natural contingencies* (systematically thinning the magnitude and schedule of reinforcement), and *incorporating common stimuli* (using parents as the primary behavior-change agents and foods regularly prepared at home).

When the provision of treatment cannot be carried out in the child's home (e.g., inpatient treatment), generalization strategies must be specifically incorporated into the treatment plan. Such strategies may include selecting foods to target what the child is likely to encounter in their natural environment and training skills likely to contact natural contingencies of reinforcement such as targeting snacks commonly provided at the child's school or focusing on age-appropriate purees for children who are selective with respect to the texture of foods (e.g., transitioning from jarred baby food to age-appropriate purees [yogurt, applesauce, mashed potatoes, etc.]). Attention should be given to contingencies in the natural environment that may need to be modified; for example, family members may need to be trained to not make negative comments about food or provide attention for inappropriate mealtime behaviors.

Consideration should also be given to the number of foods (exemplars) targeted. The number of foods targeted during a single treatment session has varied widely in the literature from a single food (Bachmeyer et al., 2009; Freeman & Piazza, 1998) to as many as three to five different foods (Hoch et al., 1994, 2001; LaRue et al., 2011). The total number of foods targeted during the span of treatment may be directly related to the likelihood of generalization as well as caregiver independence with treatment implementation. Findings from Ahearn (2002) suggest that selecting a single target food to present during sessions may increase the speed with which independent consumption of the food occurs, whereas selecting and presenting multiple foods may lead to more efficient rates of generalization. The child's generalization of previously acquired skills should also be considered in terms of the number of exemplars needed for response generalization. The nature of the child's feeding disorder could also serve as a factor in the decision to target a single food versus multiple foods. For example, if a child is engaging in total food refusal, it might be beneficial to establish consumption of a single food as an initial treatment goal to increase oral intake, whereas a child with several foods already included in their diet (albeit within restricted food categories) might benefit from more effective generalization programming.

Incorporating stimuli from the natural environment into the treatment setting may also promote generalization. For example, asking parents to bring their child's favorite plate and utensils, targeting foods parents bring from home, and arranging the treatment setting to resemble the mealtime setting at home as closely as possible. Lastly, stimuli from the treatment setting might also be incorporated in the child's natural environment (e.g., visual timers, mealtime rules), and in some situations self-generated mediators may be incorporated into the child's natural environment; for instance, if a child learned to pace their eating using a vibrating pager, the vibrating pager can transition with the child back to the mealtime setting at home.

Treatment Considerations and Recommendations

This chapter has reviewed several treatment options to remediate feeding disorders, including reinforcement-based interventions, antecedent interventions, interventions to address skill deficits, and escape extinction. We have also described assessment methods that can be used to inform the selection of variations within each of these treatment categories as well as other contextual factors that should be considered when designing an intervention. Some additional considerations germane to each of the aforementioned treatments are discussed below, namely, identification of target foods, identification of target behaviors, and the frequency and duration of treatment sessions.

Identifying Target Foods

When designing an intervention, target foods should be selected in consultation with caregivers. Including caregivers in this decision could increase caregiver compliance with treatment, as well as increase the likelihood that foods included in treatment will continue to be presented in the child's home environment following termination of the intervention. It might also be beneficial to collect several days of data regarding the child's existing diet, as initial target foods that more closely resemble the existing diet could increase the likelihood of success. Further, assessing the child's preference for foods caregivers would like to target in treatment may reveal some foods to be more preferred than initially reported by caregivers. Data collection could reveal that high rates of acceptance are occurring with foods that also have a low rate of presentation. Therefore, training caregivers to increase the presentation of certain foods might benefit the child in the absence of direct intervention. Measures of preference (approach responses, interaction with the foods presented [smelling, licking, etc.]) may also be used to identify relative preferences of non-preferred foods, from most to least disliked. Selecting those non-preferred foods that are the least aversive may be advantageous, though this remains an empirical question as previously noted.

In addition to caregiver preference for target foods, the types and textures should vary with respect to the child's dietary needs, restrictions, and oral motor skill set. For example, a child who consumes several fruits but no vegetables would benefit from targeting vegetables specifically. Continuing, special diets and food allergies may in contrast preclude interventions with specific types of foods. Lastly, children with structural abnormalities or delayed oral motor skills, specifically immature chewing and swallowing patterns, require intervention with less advanced textures (e.g., pureed or ground) while learning to chew and swallow, with the ultimate goal being to advance to tabletop textures or the texture deemed appropriate, which will be specific to each child.

Identifying Target Behaviors to Strengthen Through Differential Reinforcement

Differential reinforcement is typically provided both for *acceptance* and the behavior product of consumption, *mouth-clean*. Consideration should be given to the child's existing skill set and history of inappropriate mealtime behavior when selecting appropriate alternatives to refusal. For example, a child with a long history, absent of oral acceptance, might benefit from reinforcement of acceptance initially as opposed to mouth-clean, so as to bring the child into contact with reinforcement more consistently and efficiently. Regardless of the behavior selected to replace inappropriate mealtime behavior, the operational definition should reference with clarity the required volume, latency, and level of independence necessary to occasion reinforcement.

A reinforcement contingency for acceptance has been cited most frequently in the literature; however, the way in which *acceptance* has been operationally defined varies across publications. The most frequently reported definition of acceptance appears to have initially been provided by Hoch et al. (1994), "...only those instances in which the [participant] opened his mouth such that the food was deposited within 5 seconds of instructing him to do so…" (p. 110). It should be noted that reinforcement based on this definition has been documented to increase the persistent expulsion of target foods (Coe et al., 1997). Observed increases are possibly related to the provision of reinforcement prior to the emission of the terminal link in the behavior chain of consumption. In some studies, researchers have reinforced both *acceptance and retention* (Riordan et al., 1984) or have transitioned from reinforcement of *acceptance* to *swallowing* (Coe et al.). Continuing, bite re-presentation has been demonstrated to be an effective treatment component for addressing persistent expulsions that have resulted from reinforcement of acceptance alone (Coe et al.). In contrast, several studies have documented that the reinforcement of acceptance alone produces consumption

(Ahearn, 2002; Ahearn, Kerwin, et al., 2001; Cooper et al., 1995; Vaz et al., 2011). Thus, the child's learning history with each of the required behaviors in the behavior chain (e.g., accepting, retaining, chewing, swallowing) should be considered when selecting an alternative response for reinforcement (Patel, Piazza, Santana, et al., 2002).

Treatment Sessions

Repeated exposure is an inherent component of all feeding interventions, but particularly extinction-based feeding procedures. Multiple sessions are required over a period of time so that a sufficient number of learning opportunities occur to disrupt the preexisting contingency of escape from the non-preferred or novel foods being presented and establish a history of reinforcement for acceptance and consumption. The number of treatment sessions required will vary across children based on individual characteristics and efficacy of treatment.

Frequency Sessions may be held several times each day or as little as two to three times each week. Attempting to implement procedures for feeding with a frequency less than two to three times a week will not only increase the duration of treatment considerably, but it may not be sufficient for maintaining progress. The frequency of sessions should reflect the child's age and skill set, levels of satiation (i.e., latency of most recent meal), as well as treatment model (e.g., inpatient treatment will be more intense with a more frequent schedule of sessions). Furthermore, frequency of sessions will depend on the duration of each session and should negatively correspond with increases in duration. It may be beneficial to determine a maximum duration of time for a 24-h period and then break that down into the desired number of sessions so that sufficient breaks are provided in between treatments.

Duration There are several options for defining session durations when implementing feeding procedures. Some successful interventions have terminated session regardless of progress, once a predetermined session duration was reached (Allison et al., 2012; Coe et al., 1997; McCartney, Anderson, & English, 2005). Others have used either/or criteria in which session termination was contingent on the participant either consuming a specified number of bites or the session was terminated after a maximum duration was reached (Ahearn, Kerwin, et al., 2001; Cooper et al., 1995; Freeman & Piazza, 1998), whichever occurred first. Still others required that the session continue until the bite presented just prior to the end of the session was consumed. For example, Cooper et al. (1995) had a maximum duration of 20 min per session for two participants. Refusal to consume the bite presented just prior to the culmination of the session duration resulted in the continued presentation of that bite, regardless of the effects on duration of treatment, until consumption occurred. Following consumption of that particular bite, the session was terminated. The shortest and longest durations identified in the literature range from 5 min (Allison et al., 2012; Patel et al., 2002) to 60 min (Coe et al.; Patel et al., 2006). It should be noted that while session duration is best predetermined, in practice these durations can be altered throughout the course of treatment to suit the particular child's needs and progression of treatment, and the same is true of session frequency.

Concluding Remarks

When designing interventions to address feeding difficulties, the initial use of antecedent interventions and less intrusive consequence-based interventions is recommended. This is due to the ease with which such interventions might be faded, the ethical preference for least intrusive means of remediation, as well as the decreased likelihood of corollary problem behavior. That said, escape extinction remains the most empirically supported intervention for feeding disorders and thus should not be ruled out in spite of a myriad of factors to consider when designing a treatment package that includes an escape extinction component.

As previously noted, it can be difficult to determine when and when not to use particular

interventions given the limited number of studies that have provided information on how contextual variables and participant characteristics may be correlated with positive (or negative) treatment outcomes (Silbaugh et al., 2016). However, using functional analysis logic, we can make informed treatment selections by conducting pretreatment assessments in which we quickly compare variations of treatment to determine differential effectiveness. Additionally, we should also consider parental preference and aptitude for implementing certain interventions. For example, a caregiver who has a long history of parental mismanagement (e.g., using bribery or threats as opposed to contingent reinforcement) may be more successful implementing noncontingent reinforcement as opposed to differential reinforcement. In short, practitioners should use all of the information at hand to determine the best treatment options, including relevant information from other disciplines that can be extremely informative when making decisions. This includes appropriate foods to target that are both safe for the child to consume and beneficial in terms of meeting nutritional requirements as well as the selection of the most appropriate utensils and cups to facilitate oral motor skill development. Provision of treatment in the context of a multidisciplinary team is ideal, and for those practitioners working outside of a multidisciplinary team, we recommend consultation with professionals from relevant disciplines to ensure the best possible care.

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