Assessment of Pediatric Feeding Disorders

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Diagnosis and Prevalence

Most individuals eat multiple meals daily as part of their normal routine. Eating is an enjoyable activity for many, not just because food is an unconditioned primary reinforcer (Cooper, Heron, & Heward, 2007) and humans need it to survive, but also because eating often represents a meaningful social opportunity for friends and family to come together and interact (e.g., at restaurants or birthday parties, sitting around the dinner table). In fact, most typically eating individuals look forward to eating and demonstrate preferences for a large variety of foods. Given that food is often a potent reinforcer, many may assume that eating is a simple, instinctual process that would not be disrupted easily. In reality, feeding is a complex and dynamic operant behavior chain, consisting of many stages involving both nutritive and protective skills. Eating begins with accepting food or liquid into the mouth; forming that food or liquid into a bolus,; chewing (if necessary),; elevating the tongue and propelling food or liquid backward through the oral cavity; swallowing; and finally, retaining the food or liquid (Arvedson & Brodsky, 2002). A child's growth in height and weight is dependent on consistent daily intake of sufficient calories and nutrients (Kerwin, 1999). Thus, when there is a persistent disruption in the feeding process, caregivers should be concerned that the child might be at risk for the development of a feeding disorder.

Healthcare providers (e.g., pediatricians, licensed psychologists) diagnose a feeding disorder when a child is unable or unwilling to consume enough calories or a sufficient variety of solids and liquids to maintain adequate nutrition, hydration, and growth (Volkert & Piazza, 2012). Many children experience minor feeding difficulties during their toddler years, usually in the form of mild food selectivity (e.g., picky eating, refusing to eat presented foods). Often, these problems are typical and transient and will resolve over time in the absence of intervention. For some children, however, feeding problems are more severe and unlikely to resolve in the absence of intervention. For example, some children exhibit total food refusal and eat little to nothing by mouth, resulting in the need for support from tube feedings (e.g., nasogastric- or gastrostomy-tube feedings). Other children exhibit liquid dependency and rely exclusively on one calorically dense liquid (e.g., PediaSure) as the main source of daily nutrition. Some children exhibit more severe and persistent food selectivity and

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only eat certain foods of a specific type (e.g., starches), brand (e.g., McDonald's), color (e.g., white foods), texture (e.g., crunchy foods), temperature (e.g., warm milk), or presentation format (e.g., foods served on a specific plate). Estimates suggest that 25–45% of typically developing children and 80% of children with developmental disabilities have a feeding difficulty at some point in their lifetime (Manikam & Perman, 2000). In fact, certain subsets of the population are at greater risk for persistent feeding difficulties. These at-risk populations include children born prematurely (Arvedson & Brodsky, 2002) children with developmental disabilities (Babbitt, Hoch, & Coe, 1994); and children with certain genetic disorders such as autism spectrum disorder, Down syndrome, and cerebral palsy (Bandini et al., 2010). Children with complex medical conditions such as gastroesophageal reflux, bronchopulmonary dysplasia, short-gut syndrome, aspiration, and childhood cancer also may be at greater risk for developing a feeding disorder (Linscheid, Budd, & Rasnake, 1995).

Failing to eat or drink sufficient calories or nutrients to grow and maintain nutritional status can have devastating physical, psychological, and financial consequences for the child, the child's family, and society. Inadequate calories and nutrition are associated not only with poor growth but also long-term health, learning, and behavior problems (Freedman, Dietz, Srinivasan, & Berenson, 1999). For example, children who routinely refuse solids and liquids by mouth can experience poor weight gain; failure to thrive (i.e., deceleration of weight); malnutrition; dehydration; imbalances in electrolytes; impairments related to cognitive, emotional, or academic functioning; hospitalization; recurrent infections; a compromised immune system; dependency on tube feedings; and in severe cases if left untreated, death (Christophersen & Hall, 1978; Cohen, Piazza, & Navathe, 2006; Schwartz, 2000; Volkert & Piazza, 2012).

For these children, tube feedings can serve as a critical, life-saving solution. With recent advances in technology, surgeons can place the tube using minimally invasive procedures including laparoscopic techniques (Akay et al.,

2010). However, there are several drawbacks to tube dependence. Even though tube placement is generally a relatively safe procedure, researchers have reported several major complications, including, but not limited to, skin infections, colonic fistulas, excessive bleeding, and esophageal tears (El-Matary, 2008). There also are minor complications associated with long-term dependency on tube feedings, such as superficial skin infections, vomiting, recurrent surgeries to resize the tube, and tube leakage or fallout, which occur in up to 50% of patients (El-Matary, 2008; Volkert, Patel, & Peterson, 2016). Another drawback includes the strain on caregivers given the response effort required to (a) maintain cleanliness of the tube and site, (b) conduct daily tube feedings, and (c) bring the child back to the hospital to address potential complications. Finally, another challenge is that tube feedings do not promote typical oral feeding or allow for feeding practice. As a result, the child may have even less motivation to eat or drink by mouth. In some cases, tube dependency might result in delayed oral-motor skills (e.g., chewing, tongue lateralization) due to inadequate opportunities to develop the skills needed for oral feeding (Piazza, 2008).

Liquid dependency on low-calorie liquids could place a child at risk for health problems if the caloric density is not sufficient to meet daily needs (Volkert, Patel, & Peterson, 2016). Alternatively, exclusive consumption of high-calorie liquids might result in deficiencies or excesses in vitamins and minerals if the liquid is not balanced in terms of macro- and micronutrients (Volkert, Patel, & Peterson, 2016). Children who consume nutrient-deficient diets consisting of foods that are high in fat (e.g., fast foods) or sugar (e.g., candy, soda) are likely at greater risk for acquiring severe health problems such as obesity, type 2 diabetes, chronic constipation, and hypertension (Freedman, Dietz, Srinivasan, & Berenson, 1999; Ludwig et al., 1999).

These types of feeding difficulties also may result in substantial distress for the family. Caregivers of children with feeding disorders have reported feelings of rejection, anger, anxiety, lack of self-confidence, stress, and depression

(Franklin & Rodger, 2003). Caregiver stress could likely be the result of a lifestyle that requires frequent contact with medical personnel (e.g., gastroenterologist) and unconventional feeding routines, as the caregivers are required to manage the child's medical and nutritional needs constantly (Franklin & Rodger, 2003; Winters, 2003). Most major social, cultural, and religious events (e.g., birthdays, holidays, weddings) involve consumption of food; therefore, this lifestyle often prevents families from engaging in typical activities due to the child's eating habits. For example, when a child only eats food from a specific restaurant, the family must alter vacation plans by only traveling to places near the specific restaurant. Children with total food and liquid refusal might not attend birthday parties because the child will not eat with the other children.

In addition to these physical and emotional health concerns, feeding disorders can be costly in terms of finances for the family and for society in general. Nicholls, Lynn, and Viner (2011) reported that feeding disorders are financially burdensome to healthcare systems, as 50% of the surveyed children from the study were hospitalized for their feeding disorder for a mean length of 32 days each. An independent analysis by the Nebraska Legislature's fiscal office showed that the state would save close to 1 million dollars over a 3-year period if 50 children received intervention to increase oral feeding and prevent gastrostomy-tube placement. In addition, the impact of feeding disorders on families who live in rural areas of the Midwest like Nebraska is magnified because the specialized services needed to treat pediatric feeding disorders are often nonexistent locally; thus, the emotional and financial costs of intervention are increased by the travel required to access intervention.

Etiology

Childhood feeding problems may occur in isolation or as the result of a complex interaction between physiological, medical, oral-motor, and environmental factors (Rommel, De Meyer, Feenstra, & Veereman-Wauters, 2003). Rommel

et al. (2003) characterized the feeding disorders of 700 children referred for assessment and treatment of severe feeding difficulties as medical (86%), oral-motor (61%), behavioral (18%), or combined (e.g., medical, behavioral, and oral-motor; 60%). For example, a child who suffers from chronic gastroesophageal reflux disease may learn that eating and drinking often result in pain and discomfort. If the pain is significant enough, the child may begin refusing foods and liquids to avoid those feelings of discomfort in the future. In another situation, a child may develop feeding problems due to aversive experiences such as choking, gagging, or vomiting during or immediately after eating. The child may start avoiding the specific foods that were present during the aversive experience by engaging in excessive problem behavior whenever those or similar foods are presented. Over time, the parent attempts to avoid child problem behavior and begins only presenting the foods the child will eat willingly.

Many children with feeding disorders display oral-motor skill deficits, which could contribute to or serve as a causative factor for the feeding disorder. Children might display oral-motor skill deficits if they missed out on building critical prerequisite skills during early childhood, perhaps because they had not engaged in sufficient practice or gone through the appropriate milestones during development (e.g., due to medical conditions, tube dependence). In these situations, the child may refuse to eat because he or she does not possess the necessary skills or because he or she fatigues quickly when the eating response becomes too effortful. For example, children with oral-motor deficits may lack the necessary skills to efficiently chew or swallow solids and liquids safely. Anatomical abnormalities (e.g., cleft lip or palate) also can lead to feeding disorders in children (Palmer & Horn, 1978). If a child was not born with the necessary structures to eat, the child may not have the ability to consume solids or liquids orally without surgical intervention. Other children may develop "oral aversions" and refuse to let food or liquid near the mouth if they were exposed to invasive medical procedures involving tools in or near the mouth (e.g.,

laryngoscopy) or if they were exposed to noxious-tasting medications. Oral aversions may even affect other daily self-care routines, such as toothbrushing.

These conditions are often worsened by antecedent and consequent events in the natural environment. Children who experience chronic pain following oral feeds due to medical conditions or children who fatigue quickly during meals or do not have the necessary skills due to oral-motor delays often engage in problem behavior at mealtimes to escape or avoid the meal. If caregivers then provide escape from the meal or excessive attention following problem behavior in the form of coaxing (e.g., "please just take a little bite, you'll make mommy so happy") or reprimands (e.g., "You need to take your bites"), it is likely that child problem behavior will persist (Borrero, Woods, Borrero, Masler, & Lesser, 2010). Thus, it could be that problematic mealtime behavior occurs in isolation or as the result of an interaction of multiple factors (e.g., environmental events such as caregiver attention along with medical conditions). In our clinical practice, we have seen that even long after physicians treat symptoms of the medical condition (e.g., prescription medication for reflux), children with feeding disorders continue to engage in problem behavior at mealtimes. In these cases and others, persistence of problem behavior at mealtimes is likely due to the environmental events that now serve to strengthen and maintain the behavior over time (Piazza et al., 2003).

Assessment: Typical Versus Atypical Feeding

One approach to understanding the severity of a feeding problem is to compare the child's feeding behavior with typical developmental feeding patterns (Piazza, 2008). Because it is relatively common for children to demonstrate transient difficulties during feeding, professionals and caregivers might find it challenging to know when feeding problems warrant greater concern. Part of the challenge of answering this question is that feeding disorders are a heterogeneous group

of problems (as described above). Many health-care professionals will advise parents to wait before seeking treatment, given that the child will likely "grow out of" his or her feeding problem. This will be true for some children. That is, the feeding problems displayed by most children are often mild and many times resolve in the absence of intervention (Kerwin, 1999). By contrast, the feeding problems of children with atypical feeding patterns often persist and worsen over time (Lindberg, Bohlin, & Hagekull, 1991). In fact, Peterson, Piazza, and Ibañez (in press) recently compared an applied behavior-analysis intervention to a wait-list control with six participants diagnosed with autism spectrum disorder and food selectivity to determine whether waiting (up to 6 months) would result in the feeding problems resolving independent of treatment. After initial baseline assessments for both groups, children in the intervention group received applied behavior-analysis treatment for their food selectivity and children in the wait-list control group were asked to return home. Children in the intervention group demonstrated increases in independent acceptance across the 16 targeted novel or nonpreferred foods following applied behavior-analysis intervention. Children in the wait-list control group continued to refuse the 16 targeted novel or nonpreferred foods. Moreover, children in the wait-list control group did not demonstrate independent acceptance until they were exposed to the intervention. Overall, these results suggested that feeding problems might not resolve over time for children with atypical feeding patterns (e.g., food selectivity).

An objective way to compare typical to atypical feeding patterns often begins with an evaluation of the child's growth parameters. During wellness visits, a child's pediatrician will conduct physical exams that include taking the child's height and weight and plotting them on a growth chart to determine the child's growth curve (i.e., change in height and weight over time relative to other children of the same age and gender). The general expectation is that children consistently grow along their own curves. When the child's growth plateaus (i.e., weight or height stays the same across multiple months) or decelerates (i.e.,

the child fails to gain weight or grow taller, thereby failing to track continuously along his or her curve), there should be concern for a more serious feeding problem.

In addition to growth, practitioners must consider other factors relative to behavior and development and determine whether the child is engaging in feeding behavior that is generally age appropriate. For example, typically eating infants will accept breastmilk or formula readily after birth. Some infants have difficulty latching or may have problems initially coordinating the suck, swallow, breathe response. However, these difficulties typically resolve relatively quickly. Healthcare providers should become concerned about a possible feeding disorder when the infant consistently rejects or is unable to manage breast or bottle feedings, particularly if this lack of improvement is accompanied with slow or no weight gain (Piazza, 2008). According to typical developmental patterns, infants should begin to transition from breastmilk or formula to solid (pureed) baby foods around 4–6 months. It is typical for some tongue thrusting to occur, which might result in the infant temporarily pushing the food or liquid out of his or her mouth. However, for typically eating infants, replacing the food back into the infant's mouth provides sufficient practice to eliminate tongue thrusting over time. Healthcare providers might become concerned about a possible feeding disorder if they observe persistent tongue thrust that does not resolve with practice, as this behavior could result in low oral intake and lengthy meals (e.g., Gibbons, Williams, & Riegel, 2007). Most typically eating children transition to mashed table foods by 12 months of age and if they have teeth, demonstrate the ability to safely manage small bites of table-textured foods. By contrast, children with feeding disorders may display difficulties transitioning to baby, mashed, or table foods. These children might continue to depend on textures that are not age appropriate (e.g., purees) or show preference for one texture to the exclusion of others.

As children progress from a liquid to solid diet, most typically eating toddlers display preference for certain foods relative to others, with preferences sometimes rapidly shifting across foods. For this reason, picky eating might be tolerated for periods or go by unnoticed. Due to these circumstances, more chronic forms of picky eating are often misunderstood or underestimated and are associated with masked health risks given that most children who are selective eaters continue to grow well (Peterson, Piazza, &Ibañez, in press). Picky eating becomes a feeding disorder (i.e., food selectivity) when the child's selectivity results in severe nutrient deficiencies. For example, some children who consume a diet that is low in protein, fruit, and vegetables are likely deficient in iron, zinc, and vitamin C (Sullivan et al., 2002). Children with severe food selectivity often engage in more intense refusal (e.g., self-injury) with the introduction of novel or nonpreferred foods than do typically eating children. It also may be common for toddlers and preschoolers to vary their intake from day to day, consuming more calories on some days over others but generally obtaining enough calories to meet their needs, continue growing, and remain healthy. By contrast, children with feeding disorders often do not respond to hunger cues as typically eating children and can go multiple days without eating. This creates a potentially dangerous, life-threatening situation in which the child is likely failing to consume sufficient calories and nutrients to maintain adequate health and growth (Piazza, 2008).

Throughout childhood and even beyond the toddler years, caregivers should expect to see fairly consistent growth over time, in terms of weight and height. Thus, if the child experiences up to three consecutive months of weight loss, practitioners should be suspicious of a feeding disorder and recommend the child for services immediately.

Assessment: Interdisciplinary Team

The Pediatric Feeding Disorders Program in Omaha, Nebraska, provides a comprehensive, behavior-analytic approach to the treatment of pediatric feeding disorders through our assessment and intervention services. Children in our program range in age from birth to 18 years and

often have comorbid medical conditions. Due to the complex etiology of pediatric feeding disorders, we use an interdisciplinary approach to assessment and intervention. An interdisciplinary team is often necessary to identify all possible contributing and maintaining factors before recommending treatment.

Our interdisciplinary team consists of a physician, speech-language pathologist, registered dietician, feeding therapists, behavior analysts, and licensed psychologists. We assemble members of this team to conduct initial intake evaluations before a child is admitted to our program and rely on input or recommendations from team members throughout the child's admission. For the intake evaluation specifically, we begin the process after we first receive a referral, usually from the child's pediatrician or medical specialist. At this point, we instruct caregivers to complete an intake packet and submit the necessary paperwork to schedule an evaluation in the clinic.

The *physician's* role on the interdisciplinary team is first to review the child's medical records for (a) significant and chronic medical conditions or illnesses (e.g., gastroesophageal reflux disease, intestinal failure), (b) history of frequent visits to the emergency room for dehydration or weight loss, (c) growth concerns (e.g., failure to thrive), or (d) dietary intolerances and severe food allergies. The physician also determines whether any additional medical workups or tests (e.g., endoscopy) are necessary. Overall, the physician must clear the child as medically fit to participate in feeding services before admission to our program. Following the intake evaluation, the physician continues to monitor the child's medical status throughout his or her admission by reviewing progress weekly. If the treatment team or physician identifies new concerns during the child's admission, the physician typically returns to the clinic to observe the child during mealtimes, schedules an examination relative to the child's medical needs, meets with the family to discuss the next course of action, and makes recommendations for treatment or additional testing as needed. The physician also manages acute or chronic medical problems and maintains contact with the child's physician or specialist as needed. Given that many children with feeding difficulties have medical comorbidities, this is a critical component of the child's assessment and admission.

During the intake evaluation, the *speech-language pathologist* assesses the child's oral-motor status and safety as an oral feeder and identifies delays or deficits. The speech-language pathologist first observes the child during an oral meal to assess the child's safety (e.g., chewing or swallowing concerns). The speech-language pathologist also schedules an interview with the child's caregivers to review the child's history relative to feeding in general (e.g., known history of choking or aspiration, child's ability to safely swallow, chew, and manage a variety of textures). If the speech-language pathologist identifies any potential risks (e.g., history of pneumonia, dysphagia, frequent coughing) during this assessment, he or she will likely refer the child for a modified-barium swallow study (Eicher et al., 2000). Based on the assessment and results of the swallow study (if necessary), the speech-language pathologist makes recommendations regarding solid and liquid textures (e.g., smooth, thickened), bolus (amount per bite or drink) sizes, and rates of presentation and provides recommendations regarding procedures to address any oral-motor deficits during the child's admission. Before admission, the speech-language pathologist must clear the child as a safe oral feeder who is not at risk for choking or aspiration. If the speech-language pathologist or the team identifies concerns along the way, the speech-language pathologist conducts observations of the child's meal and provides recommendations for safety precautions.

The *registered dietician* assesses the child's nutritional status and growth. Our registered dietician lives in another state but can attend intake evaluations virtually using a secure web-based platform. Before the intake evaluation, we ask caregivers to complete and submit a 3-day food log. The dietician analyzes the content of the food log to determine how many calories, on average, the child consumes daily and whether there are any nutrient deficiencies. During the

intake evaluation, we measure the child's height and weight and plot the information on a growth chart. One of our feeding therapists takes a full-body picture of the child to send to the dietician, so she can assess the child's size and stature. The dietician then meets briefly with the caregivers to review the child's feeding and nutrition history. Throughout the child's admission, the dietician continues monitoring the child's growth, dietary intake, hydration, and elimination (e.g., urination, bowel movements, vomiting). The dietician also provides recommendations for formula and foods, based on the child's deficiencies and estimated caloric needs.

Feeding therapists are members of our program's staff who hold bachelor's or master's degrees in psychology, behavior analysis, education, or a related field (e.g., counseling). Given that we are a highly sought-after training site, feeding therapists also include trainees from across the country, including masters- or doctoral-level students, predoctoral interns, and postdoctoral fellows. Feeding therapists assist with the intake evaluation by preparing the foods and other session materials needed to conduct the meal observation. Feeding therapists also (a) observe and collect data on both child and caregiver behavior during the meal, (b) interview caregivers to complete any missing information from the intake packet, and (c) update the doctoral-level behavior analyst or licensed psychologist on the findings of the meal observation. Throughout the child's admission, feeding therapists implement the intervention, collect and graph data, and teach caregivers how to implement the procedures. Outside of the child's meals, feeding therapists prepare foods for the sessions and check in with supervisors for assessment or intervention decisions. At the beginning of the admission, we assign each child a team of feeding therapists who oversee the child's daily care.

Doctoral-level behavior analysts and *licensed psychologists* comprise two other critical members of the interdisciplinary team who use systematic assessment methods to identify the effects of environmental variables on feeding behavior (i.e., the conditions under which the child will and will not eat or drink). During the

intake evaluation, the doctoral-level behavior analyst and licensed psychologist observe the caregiver conducting a meal as he or she typically would at home. These observations allow the behavior analyst and psychologist to identify some of the specific problems that may contribute to the child's feeding disorder. For example, caregivers might be more likely to terminate the meal early or provide attention in the form of reprimands and coaxing if the child is engaging in excessive problem behavior (e.g., head-turning, crying, pushing food away). At the end of the intake evaluation, the behavior analyst or psychologist meets with the family to provide diagnosis (discussed below) and treatment recommendations (i.e., outpatient versus intensive day treatment). Throughout the child's admission, the doctoral-level behavior analyst and licensed psychologist oversee the child's care, using empirically supported assessment tools (e.g., functional analysis) to guide intervention planning and decision-making. The doctoral-level behavior analyst and licensed psychologist oversee the therapeutic team who works directly with the child and oversee all aspects of intervention, including long-term maintenance and generalization of appropriate feeding behavior.

Assessment: Direct Observation

During the child's intake evaluation, we conduct direct observation assessments to gather information about the child's feeding difficulties. First, we conduct a *home baseline* assessment to observe the natural mealtime conditions (e.g., child and caregiver behavior) in the absence of treatment recommendations, structure, or intervention. The home baseline assessment provides an opportunity for direct observation of antecedent conditions, appropriate and inappropriate child behavior, and consequences provided by caregivers. For this assessment, we conduct one 5-min session with a few of the child's preferred foods (i.e., foods the child consistently eats) and one 5-min session with a few of the child's non-preferred foods (i.e., novel foods or foods the child refuses). We instruct caregivers to feed and

interact with the child as they normally would at home.

After the home baseline assessment, we conduct a *standard outcome baseline* assessment to observe how the child responds when presented with solids and liquids with structure added to the meal. That is, we instruct caregivers to present a specific bolus (amount) of food or liquid during bite or drink presentations according to a fixed-time presentation schedule (e.g., fixed-time 30 s). We evaluate child responding during the standard outcome baseline assessment to gather initial data for which to compare later, after the child has been admitted to the program and is exposed to intervention. First, the therapist teaches the caregiver how to prepare an appropriate bolus on the utensil and models specific prompts he or she will use throughout the assessment (e.g., "Take a bite"). The therapist instructs the caregiver to present four different target foods (i.e., potato, green bean, pear, and chicken) prepared at pureed and table texture (e.g., small pieces at 1/4 in. by 1/4 in. by 1/4 in. in size) and a calorically dense, nutritionally complete liquid (e.g., milk mixed with Carnation Instant Breakfast). Depending on the child's age, we instruct caregivers to present the foods and liquids using both a self-feeder and nonself-feeder format in separate sessions, to assess the child's current skills and observe whether there are differences in caregiver-provided consequences. During each session of the standardized outcome baseline assessment, the therapist prompts the caregiver to present five bites or drinks approximately every 30 s and instructs the caregiver to otherwise respond as he or she would at home. If the parent misses a prompt or prepares an incorrect bolus, the therapist provides immediate corrective feedback.

Following the standard outcome baseline assessment, the therapist conducts a brief *interview* with the caregivers to fill any gaps that might be missing in the child's paperwork and review details or remaining questions regarding the child's feeding and medical history. The caregiver interview provides the therapist with an opportunity to gather additional information on the child's past and current medical diagnoses, prior services (e.g., occupational therapy, nutri-

tion), typical meal format, and past and current food intake.

After members of the interdisciplinary team have completed their evaluations and met with other team members to review the child's history and current medical status, the licensed psychologist pulls together the relevant information to determine a diagnosis. The licensed psychologist gives a diagnosis of *avoidant/restrictive food intake disorder* when the presence of a feeding difficulty results in significant weight loss or nutritional deficiency, dependence on tube feedings or oral nutritional supplements, marked impairment with psychosocial functioning, or any combination of these conditions (American Psychiatric Association, 2013). The licensed psychologist provides a diagnosis of *feeding difficulties and mismanagement* when developmental delays in feeding, oral aversion, or feeding problems in infancy are present (World Health Organization, 1992). Based on the diagnosis and severity of the feeding disorder, the feeding team makes recommendations for the most appropriate level of service. The licensed psychologist or doctoral-level behavior analyst reviews the findings of the intake evaluation, diagnosis, and recommendations for treatment with the caregivers.

The feeding team recommends services at different levels based on clinical observations, past and current medical concerns, past and current food and liquid intake, current skill, and current growth. We typically recommend *intensive day-treatment* services when the child exhibits total food or liquid refusal; is liquid-, bottle-, or tube-dependent; has a diagnosis of failure to thrive or has recently lost a significant amount of weight; is currently eating fewer than 20 foods; engages in extreme problem behavior during the meal (e.g., self-injury, aggression, disruption, throwing food off the table); or a combination. We typically recommend weekly *outpatient* services, which we most often conduct via telehealth due to recent advances in technology, when the child exhibits food, texture, or brand selectivity, is not at risk for tube placement or a diagnosis of failure to thrive, has prerequisite feeding skills (e.g., eating pureed food but needs to advance to age-appropriate chewing), does not engage in

high rates of problem behavior during the mealtime, or a combination. We recommend admission to the feeding and early intervention hybrid program called *SEEDS (Starting Early: Eating and Developmental Skills)* if the child is appropriate for outpatient services and has a diagnosis of autism spectrum disorder or developmental delays. The SEEDS program provides early intervention (e.g., skill acquisition, toilet training) and feeding services simultaneously. Currently, our program does not accept patients without insurance, but we work with other service providers, apply for grants or other coverage options, or refer to other providers as appropriate for patients without insurance.

Assessment: Initial Admission

Kerwin (1999) and Volkert and Piazza (2012) demonstrated in their reviews of the literature that interventions based on applied behavior analysis were the only ones with empirical support as treatment for pediatric feeding disorders. Given these findings, our pediatric feeding disorders program uses empirically supported assessment tools during the assessment of a child's feeding difficulties to indicate which empirically supported behavior-analytic interventions will be most effective.

At the beginning of every child's admission, regardless of the program (day treatment, outpatient, or SEEDS), we conduct additional assessments and evaluations. We always collect new growth information by obtaining a new height and weight for the child. After we take caregivers through basic paperwork and the consent process, we often initiate another series of more complex assessments. Given that several months may have elapsed between the intake evaluation and the first week of the child's admission, we first instruct caregivers to again implement the standard outcome baseline assessment, as outlined above. This time, we conduct multiple sessions of each condition (e.g., multiple sessions with purees, multiple sessions with table-textured bites) to obtain a more thorough assessment of how the child responds during structured,

baseline contingences. During the assessment, the feeding team (e.g., licensed psychologist or doctoral-level behavior analyst, feeding therapists) monitors the rate of inappropriate mealtime behavior and levels of acceptance, mouth clean (i.e., no food or liquid larger than a pea inside the mouth 30 s after acceptance; product measure for swallowing), and negative vocalizations to determine the next steps for assessment.

Preference Assessments

The purpose of a preference assessment is to identify stimuli that may serve as reinforcers for child behavior. Our program uses a variety of preference assessments, including the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD; Fisher, Piazza, Bowman, & Amari, 1996), paired-choice preference assessment (Fisher et al., 1992), and a free-operant preference assessment (Roane, Vollmer, Ringdahl, & Marcus, 1998). In structured interviews, we ask caregivers to first identify stimuli (e.g., edibles, games, toys) their children are more likely to engage with or complete a task for using the RAISD. Based on the caregiver interview and the RAISD, we assess the child's preference for a few items using the paired-choice preference assessment to identify which items might function as reinforcers. During the assessment, the therapist presents each item in a pair with every other item across multiple trials. Observers collect data on how often the child *approaches* the items, defined as the child moving toward the object or event with his or her hand or body within 5 s of the presentation. Data collectors also measure *consumption*, defined as interaction with the item for longer than 5 s after the child approaches the item. If the child does not approach either item, data collectors score *no response*. After no response during a trial, the therapist removes both items, models interaction with the items, and presents the pair of items one additional time. If the child does not approach either item after the second presentation, the data collector once again scores no response, and the therapist removes the items from the child's reach and field of vision. Data collectors score *avoid* if the child

pushes the item away. After the therapist has paired each item with every other item, the feeding team compares how often the child approached and consumed each item and ranks the items in terms of high, medium, or low preference. We use the top five highly preferred items during the functional analysis and intervention evaluations (see below).

We use the free-operant preference assessment arrangement to assess preference if the child engages in high rates of problem behavior in a chair, high rates of problem behavior whenever the therapist removes an item, is unable to indicate choice, or does not respond to any items during a paired-choice preference assessment. In a free-operant assessment, we present stimuli in a circle or semicircle around the child in an open space. We provide the child with noncontingent continuous access to the presented items. Observers record *item manipulation* during the 10-min assessment and use the total duration of time engaged with each item to rank preference.

Functional Analysis

After the standardd outcome baseline and preference assessments, the feeding therapists conduct a functional analysis of inappropriate mealtime behavior. Functional analyses (Iwata, Dorsey, Slifer, Bauman, & Richamn, 1994) involve the systematic manipulation of environmental events that may maintain problem behavior. In a functional analysis of inappropriate mealtime behavior, we arrange various antecedents (e.g., presenting a bite of nonpreferred food) and consequences (e.g., reprimands when the child does not take the bite) from the child's natural environment into different analogue conditions, so we can evaluate their separate effects on inappropriate mealtime behavior (Bachmeyer et al., 2009; Piazza et al., 2003). We evaluate child responding in the functional analysis using a pairwise design and use information from caregiver reports and direct observation of caregiver-fed meals to inform the conditions of each child's functional analysis. For example, we conduct escape, attention, and tangible conditions if we observed

the caregiver delivering escape, attention, and access to tangible items following inappropriate mealtime behavior during the home baseline and standard outcome baseline assessments.

Before each five-bite session of the functional analysis, the feeder randomly selects one food from each of the food groups (i.e., fruit, protein, starch, and vegetable) from the child's list of target foods, resulting in the presentation of three foods once and one food twice. The feeder randomly selects the order to present the foods before each session and presents bites approximately every 30 s by touching the child's lips with the utensil and saying, "Take a bite." The feeder provides brief verbal praise for acceptance (e.g., "Good job taking your bite") and activates a timer for 30 s. The feeder conducts a mouth check when 30 s elapse (e.g., "Show me, ahh") while modeling an open mouth. The feeder provides brief verbal praise (e.g., "Good job swallowing your bite!") for mouth clean or delivers a verbal prompt to "Swallow your bite" and presents the next bite regardless of whether any food remains in the child's mouth at the check. If the child has food greater than the size of a pea inside the mouth after five bites, the feeder conducts a mouth check every 30 s until no food (larger than a pea) remains in the mouth or until 10 min elapse from the start of the session. The feeder provides no differential consequence for coughing, gagging, negative vocalizations, or vomiting. If the child does not accept the bite and does not engage in inappropriate mealtime behavior (e.g., head turns), the feeder holds the spoon stationary for 30 s across all conditions of the functional analysis. The feeder does not re-present expelled bites.

During the *control* condition, the feeder presents highly preferred stimuli, identified during the paired-choice preference assessment, on the tray at the beginning of the session and interacts with the child in the form of singing, playing, and telling stories throughout the session. The feeder provides no differential consequences if the child engages in inappropriate mealtime behavior. The purpose of this condition is to assess the frequency of inappropriate mealtime behavior when the child has free access to attention and preferred items. In the *escape* condition, the feeder removes

the bite for 30 s immediately following the first instance of inappropriate mealtime behavior and presents the next bite at the end of the 30-s interval. The feeder does not provide attention or toys during this condition. The purpose of this condition is to assess the effects of negative reinforcement in the form of escape from bite presentations following inappropriate mealtime behavior. In the *attention* condition, the feeder delivers 30 s of continuous attention matched to the form that the caregiver delivered during the caregiver-fed meals described above (e.g., coaxing, reprimands, statements of concern) immediately following the first instance of inappropriate mealtime behavior and presents the next bite after the 30-s attention interval. No toys are available. The purpose of this condition is to assess the effects of social positive reinforcement in the form of caregiver attention. In the *tangible* condition, the feeder delivers a highly preferred item (identified in the preference assessment) for 30 s following the first instance of inappropriate mealtime behavior. After 30 s elapse, the feeder removes the item and presents the next bite. The purpose of this condition is to assess the effects of social positive reinforcement in the form of tangible items. We only conduct tangible conditions if we observe the caregiver deliver tangible items following inappropriate mealtime behavior during the home or standardized outcome baseline assessments.

Reinforcement Assessment

Often, we conduct a reinforcement assessment as the next step of the assessment process. Results of previous research have shown that positive-reinforcement-based interventions are ineffective for reducing inappropriate mealtime behavior for children with feeding disorders in the absence of escape extinction (Bachmeyer et al., 2009; Patel, Piazza, Martinez, Volkert, & Santana, 2002; Piazza, Patel, Gulotta, Sevin, & Layer, 2003; Reed et al., 2004). Even though functional analyses often reveal that inappropriate mealtime behavior is maintained by negative reinforcement in the form of escape from bites (Piazza et al.,

2003), we conduct reinforcement assessments as a method to evaluate the least-restrictive procedures first. In addition, there may be some benefit to adding positive reinforcers to the meal for some children in that positive reinforcement may mitigate the undesirable side effects of escape extinction (e.g., crying, other forms of problem behavior). Therefore, we conduct an assessment to evaluate the effects of differential and noncontingent positive reinforcement in the absence of escape extinction for some children. We compare the effects of these positive-reinforcement based procedures using a multielement design, rapidly alternating between differential reinforcement, noncontingent reinforcement, and a control or no-reinforcement condition. We use the procedure described for the functional analysis (e.g., five-bite sessions, 30-s mouth checks, feeder rotates across target foods for each child). During the *differential reinforcement* condition, the feeder presents a preferred stimulus immediately following acceptance of the bite of target food. In the *noncontingent reinforcement* condition, the feeder provides continuous, noncontingent access to various preferred items (e.g., attention in the form of talking and singing, toys) regardless of acceptance or inappropriate mealtime behavior. In the *control* or no-reinforcement condition, the feeder presents the bite and provides no differential consequences following acceptance or inappropriate mealtime behavior. Escape from bites is available across all conditions. The feeder immediately removes the spoon if the child engages in inappropriate mealtime behavior.

The reinforcement assessment has yielded mixed results thus far. For most children, we have demonstrated that positive-reinforcement-based interventions alone are not sufficient to increase bite or drink acceptance and reduce inappropriate mealtime behavior to clinically acceptable levels. For some children, we have observed beneficial effects of positive reinforcement, such as lower levels of negative vocalizations or inappropriate mealtime behavior, but with no increases in levels of acceptance. Some caregivers, however, request the addition of positive reinforcement to the treatment package, reporting that the mealtime is more enjoyable. We will continue evaluating

the effects of positive reinforcement for children with severe feeding disorders to determine whether there are any merits or challenges with adding positive reinforcers to the meal context. For example, even if including differential reinforcement with arbitrary tangible items (e.g., toys) results in slightly lower levels of negative vocalizations initially, it may make the meal appear less typical and require more effort on caregivers if they must include highly preferred items during every meal.

Baseline Evaluation

Consistent with the field of applied behavior analysis, we use single-case designs to evaluate interventions aimed at reducing inappropriate mealtime behavior and increasing alternative, appropriate feeding behavior (e.g., acceptance, swallowing). To do this, we begin by conducting baseline to determine patterns of responding before implementing the intervention. The baseline condition serves as a control for which to measure and compare the effects of intervention, and we use the results of the functional analysis to inform the baseline. For example, if the functional analysis reveals both social positive (e.g., attention) and negative reinforcement functions, we arrange the baseline condition so that the feeder delivers escape and attention immediately after instances of inappropriate mealtime behavior. Once we observe stable responding during baseline at a level or trend that would indicate the need for intervention, we proceed with our intervention evaluation, using any number of empirically supported design strategies (e.g., reversal, multielement, multiple baseline) and interventions.

Intervention Evaluation

Results of the functional analysis guide our intervention decisions because we use that information to design individualized, function-based treatments to achieve the most effective outcomes. Recall that most often, we observe that the child's inappropriate mealtime behavior is maintained by negative reinforcement in the form of escape from bites and drinks. When we identify escape as the function for inappropriate mealtime behavior, we most often select escape extinction as the first line of treatment. Research demonstrates that escape extinction is the most efficacious and well-supported intervention for pediatric feeding disorders (Kerwin, 1999; Volkert & Piazza, 2012) and that inappropriate mealtime behavior is likely to persist in the absence of escape extinction (Addison et al., 2003). In a feeding context, therapists implement escape extinction using non-removal of the spoon with or without physical guidance. That is, during structured sessions and across a time-based presentation schedule, the feeder presents the spoon to the child's lips and follows the child's lips until the child opens to accept the bite or drink, regardless of inappropriate mealtime behavior (e.g., head turns, batting at the spoon).

We typically evaluate the effectiveness of escape extinction using a reversal design. Once we observe high stable levels of acceptance and mouth clean and low, stable levels of inappropriate mealtime behavior during the intervention, we then remove the intervention to demonstrate functional control to determine whether escape extinction produced the change in responding. After a reduction in acceptance and mouth clean and an increase in inappropriate mealtime behavior during the return-to-baseline condition, we return to the intervention (i.e., escape extinction).

Occasionally, we include positive-reinforcement-based interventions in our treatment package, even if results of the reinforcement assessment demonstrate little to no effects with positive reinforcement alone. We include positive reinforcement if caregivers indicate a preference for the additional component. In addition, if escape extinction results in consistently high levels of negative vocalizations, inappropriate mealtime behavior, or other problem behavior, we may evaluate alternative strategies such as antecedent interventions instead of or in addition to the escape-extinction procedure (e.g., stimulus fading). If we observe an increase in corollary problem behavior (e.g., packing or pocketing food inside the mouth for extended periods of

time, expulsion or spitting food or liquid) following acceptance during the intervention evaluation, we evaluate specific interventions to address these challenges. For example, research has demonstrated that a flipped-spoon procedure is effective at reducing packing for children with pediatric feeding disorders (Volkert, Vaz, Piazza, Frese, & Barnett, 2011).

Caregiver Training Evaluation

After we evaluate and determine which treatment is most effective, we teach caregivers to implement the treatment protocol using competency-based training as well as instructions, modeling, and feedback. We first train caregivers in the clinic where the child has demonstrated success with feeding. Before training, caregivers observe meals with the therapists feeding. We then collect data on the caregiver's integrity and provide in vivo feedback to praise correct implementation or give corrective guidance after implementation errors. We measure caregiver accuracy with the intervention protocols by assessing whether the caregiver holds the utensil in the correct location during a meal (i.e., ensuring that the utensil follows the child's lips during non-removal of the spoon) and whether the caregiver follows other critical components of the intervention (e.g., refraining from providing attention following inappropriate mealtime behavior during attention extinction). We systematically fade therapists from the meal as caregivers demonstrate high levels of treatment integrity and the child's behavior remains stable. After caregivers implement the procedures with high integrity in the clinic setting, we observe the caregivers conducting meals in the home and any other natural environments where the child eats (e.g., school, daycare) to ensure generalization. In addition, we observe all meals the caregivers conduct throughout the day as there are different variables at each meal that could interfere with correct protocol implementation.

Goal Evaluation

At the beginning of a child's admission, we set observable and measurable goals. We evaluate progress toward goal attainment at intermittent points throughout the child's admission. Often, our first goal is to increase the child's acceptance and mouth clean of a variety of solids, up to 16 target foods across all 4 major food groups and liquids (e.g., calorically dense and nutritionally complete formula) to 80% across all opportunities. That is, we expect that the child will begin (a) accepting the bite or drink within 5 s of the presentation and (b) swallowing the bite or drink within 30 s of the bite entering the mouth (i.e., mouth clean) during treatment. Another goal is to reduce inappropriate mealtime behavior to low levels (e.g., rate of <5 per min). After the child meets these initial goals, we teach caregivers (e.g., parents, grandparents, siblings) to implement the intervention procedures with high integrity (see above).

Throughout the child's admission, we also set goals to (a) increase variety of foods in the diet, (b) increase volume of oral intake while making simultaneous deductions to tube feedings, (c) increase meal efficiency by increasing the rate of bite and drink presentations and gradually increasing the bolus size (e.g., 2 cc, 4 cc, 6 cc, 10 cc), (d) maintain success as we work toward creating a more typical meal by removing structured components of the procedure (e.g., removal of prompts and mouth checks), and (e) teach other caregivers to implement the procedures with high integrity in other environments (i.e., generalization to daycare, school, home).

During follow-up outpatient services, we set other goals geared toward the child becoming an age-typical feeder. Before setting goals for building more advanced feeding skills, we conduct new assessments to determine the child's safety and readiness (e.g., whether the child chews and masticates the bites or attempts to swallow the bites whole). After we determine the child is ready, we set goals to (a) increase self-feeding and self-drinking, (b) increase chewing and other

skills required to consume table-textured foods (e.g., lateralization), (c) increase consumption of age-appropriate portion-based meals involving both solids and liquids to ensure the child becomes more independent during meals, and (d) increase the child's acceptance and tolerance of foods presented in their natural forms (e.g., presenting a whole hot dog inside a hot dog bun).

During SEEDS (Starting Early: Eating and Developmental Skills) admissions, we set similar goals to increase appropriate feeding behavior (e.g., increase acceptance of a wider variety of nutritional foods) and reduce inappropriate mealtime behavior; however, we expand the service to include a variety of critical goals toward improving adaptive functioning for the child. We use the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008) or the Assessment of Basic Language and Learning Skills (Revised) (ABLLS-R; Partington, 2008) tools to determine each child's most critical areas of need. We then set individualized, observable, and measurable goals to target skill acquisition across a variety of domains, including self-help (e.g., appropriate toileting, handwashing, tooth brushing), social (e.g., greetings, sharing), academic (e.g., receptive and expressive identification of letters), and communication (e.g., mands and tacts). We also set behavior-reduction goals, when necessary, to decrease severe problem behavior (e.g., aggression, self-injury), noncompliance, resistance to change (e.g., difficulty with transitions), or elopement.

Conclusions

Pediatric feeding disorders are serious conditions that have a significant impact on the child's health, learning, and behavior. Failing to eat or drink sufficient calories or nutrients to grow and maintain nutritional status can have devastating physical, psychological, and financial consequences for the child, the child's family, and society. The difficulty lies in the many factors that contribute to these disorders. An interdisciplinary approach enables the feeding team to assess all relevant factors. Behavior analysts and

behavioral psychologists play a critical role on this interdisciplinary team, given that they are uniquely equipped to assess and address specific environmental variables that likely affect feeding behavior. We use structured, systematic and empirically supported assessment tools to determine the environmental factors maintaining a child's inappropriate mealtime behavior and then use the results of these assessments to guide intervention decisions, set appropriate goals for the child, evaluate whether the intervention is effective, and teach caregivers to implement the effective interventions with high integrity across a variety of settings. These rigorous assessment strategies are part of the reason why researchers identified applied behavior analysis as the only empirically supported interventions for pediatric feeding disorders.

For many children, we have a good understanding of why feeding disorders develop (e.g., complex medical histories, environmental variables). For children with autism spectrum disorders, conclusions are less clear regarding the specific establishing operations or antecedent conditions that contribute to food selectivity and rigid eating patterns. Recent studies show that up to 80% of children with autism spectrum disorders display food selectivity. Researchers report that children with autism spectrum disorders often refuse healthy foods and replace them with a limited variety of calorie-dense, nutritionally deficient alternatives (e.g., cookies, chips) that are often high in fat, sugar, and sodium (Hubbard, Anderson, Curtin, Must, & Bandini, 2014; Schreck, Williams, & Smith, 2004). This type of food selectivity occurs in seemingly healthy children who may not have a significant medical history or obvious skill deficits to explain how the problem developed. Instead, children with autism spectrum disorder and food selectivity often insist upon sameness of mealtime routines (e.g., will only eat pizza from Pizza Hut if served from the box); display rigidity with the type, texture, or other stimulus properties of the foods (e.g., only eats white foods, only eats pureed foods); and engage in excessive problem behavior in the presence of novel foods. Given these behavior patterns, we often conceptualize food selectivity

in this population as a manifestation of one of the characteristic symptoms of autism spectrum disorder (i.e., rigid or repetitive behavior patterns, behavior that is highly resistant to change; Turner, 1999). However, we still do not possess effective tools for which to fully assess this prevalent problem. Thus, future researchers should consider evaluating the conditions under which food selectivity emerges for children with autism spectrum disorder as well as the conditions under which the child is willing to eat. Hubbard, Anderson, Curtin, Must, and Bandini (2014) found that children with ASD refused more foods based on texture (77% versus 36%), taste or smell (49% versus 5%), and brand (15% versus 1%) than typically developing children. We could benefit from a more comprehensive assessment tool to identify the precise stimulus properties of foods most commonly consumed by children with autism spectrum disorder or other relevant antecedent conditions that result in food selectivity. An empirically supported assessment of this type could capture a comprehensive list of the stimulus conditions under which a child may or may not eat a variety of foods. This empirical assessment could then be used to guide strategies and prescribe intervention. For example, if an assessment indicates that a child will only consume foods that are white and crunchy (e.g., Club crackers), a clinician could arrange the stimulus conditions to match those that result in appropriate mealtime behavior (i.e., consumption) by first presenting a Club cracker to the child. After observing child acceptance and consumption of the Club cracker across sessions, the clinician could alter the stimulus properties of the Club cracker systematically to approximate a novel food (i.e., stimulus fading). This approach increases the likelihood that the child's behavior will either contact reinforcement following success after the initial demand or come under instructional control of the context and therapist. More refined and comprehensive assessment tools would allow us to systematically, rather than arbitrarily, select a "starting point" for the child. Smith, Iwata, Han-Leong, and Shore (1995) highlighted the importance of a more

detailed analysis of establishing operations, and food selectivity appears to be a behavior that would greatly benefit from this approach.

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