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Empirically Supported Treatments in Pediatric Psychology: Severe Feeding Problems

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Objective: **To identify treatment studies for severe pediatric feeding problems that meet the modified methodological criteria of the Task Force on Promotion and Dissemination of Psychological Procedures (1995).**
Methods: **Articles in peer-reviewed medical and psychological journals (1970–1997) reporting psychosocial or behavioral intervention studies targeting an identified oral feeding problem in children were selected. Methodologically rigorous studies were identified and treatments were classified as well established, probably efficacious, or promising interventions according to specified criteria.**
Results: **Effective interventions for children with severe feeding problems are contingency management treatments that include positive reinforcement of appropriate feeding responses and ignoring or guiding inappropriate responses. Promising interventions include positive reinforcement for acceptance and not removing the spoon for refusal and swallow induction training.**
Conclusions: **Because only studies of behavioral interventions met methodological criteria, well-controlled intervention studies are needed across a variety of theoretical perspectives. Empirically supported treatments for feeding problems exist; it is now time to turn to questions about for whom they are appropriate, and when, and why.**

Key words: *feeding; treatment; parent training; behavioral; psychosocial.*

Feeding is a complex, dynamic process requiring not only well-integrated movement and coordination among muscles but also effective interaction with caregivers and the environment, globally defined (Rudolph, 1994; Satter, 1990; Stevenson & Allaire, 1991). The mechanics of feeding include a continuous sequence of hierarchical steps consisting of preparing (e.g., scooping) and accepting a wide variety of foods of appropriate developmental texture as well as effectively, efficiently, and safely chewing, propelling, and swallowing the food; this process results in adequate growth in weight, height, and head circumference. Despite the seemingly "instinctive" ease with which most children feed, feeding problems do occur.

A nonexhaustive list of feeding problems includes (a) inappropriate mealtime behaviors (e.g., throwing food, having temper tantrums, and eating sloppily); (b) lack of self-feeding; (c) food selectivity (eating a few foods); (d) failure to advance texture from puree to table food texture; (e) food refusal (not accepting any or only small quantities of food); (f) oral-motor immaturity or dysfunction (oral-motor skills consistent with those of younger children or an inability to efficiently or effectively prepare and propel the food bolus); (g) aspiration or swallowing problems (food entering the trachea or

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abnormal pharyngeal functioning); and (h) frequent vomiting (Babbitt et al., 1994; Luiselli, 1989; Wolf & Glass, 1992).

In the literature, feeding problems are distinguished from growth deficiency or failure to thrive (FTT) (Breunlin, Desai, Stone, & Swilley, 1983). Often FTT is defined as either not maintaining expected rate of weight gain over time, with weight <5th percentile for age and sex on National Center for Health Statistics growth charts for two or more points of time, or downward deviation in weight of two major percentiles for at least one month duration (Benoit, 1993; Ramsay, 1995). Not a diagnosis, FTT is a description of an outcome that may result from numerous etiologies, singularly or in combination. Because of the vast array of possible etiologies, it is unlikely that a single treatment would be effective across all children experiencing growth deficiency (for treatment studies, see Black, Dubowitz, Hutcheson, Berenson-Howard, & Starr, 1995; Casey et al., 1994; Drotar, Nowak, Malone, Eckerle, & Negray, 1985; Meyer et al., 1994). As a result, this review of the literature will focus on specific feeding problems, not FTT or growth deficiencies.

Feeding problems are relatively common in infants and young children, with 25% to 40% of toddlers and early school-age children having feeding problems (Mayes & Volkmar, 1993). Parents report that 33% of infants and 52% of toddlers are "not always hungry at mealtime," 42% of toddlers "try to end meal after a few bites," 35% of toddlers are picky eaters, and 33% have strong food preferences; 62% of parents of toddlers reported more than one feeding concern (Reau, Senturia, Lebailly, & Christoffel, 1996).

Although feeding problems are relatively common among healthy infants and children, these difficulties are usually transitory and easily addressed by pediatricians and pediatric psychologists (Finney, 1986). Treatment of these mild feeding problems may include parent training, nutrition education, interaction coaching, and suggestions for presenting and preparing food. These interventions prevent more serious feeding problems in most children; however, some feeding problems may become serious enough to prompt parents and health care providers to seek more intensive interventions.

In contrast to mild feeding problems not associated with serious consequences for a child's health, some children experience severe feeding problems that may place the child at risk for aspiration, malnutrition, invasive medical procedures (i.e., placement of a nasogastric or gastrostomy tube), admission to an inpatient unit for treatment of the feeding problem, and/or limitations in social, emotional, and educational functioning and development (Skuse, 1993; Whitten, Pettit, & Fischhoff, 1969). Severe and persistent feeding problems, which are experienced by 3%–10% of children (Dahl & Sundelin, 1992; Jenkins, Owen, Bax, & Hart, 1984; Lindberg, Bohlin, & Hagekull, 1991; Reau et al., 1996), tend to persist and worsen over time (Lindberg et al., 1991). Severe feeding problems are more prevalent in children with physical disabilities (26%–90%); mental retardation (23%–43%); and medical illness, prematurity, and low birthweight (10%–49%) (Crist et al., 1994; Douglas & Bryon, 1996; Palmer, Thompson, & Linscheid, 1975; Reilly, Skuse, & Poblete, 1996; Thommessen, Heiberg, Kase, Larsen, & Riis, 1991). This review of the treatment literature will focus on interventions for severe and persistent feeding problems that are of concern to health professionals and parents.

In the biopsychosocial model, physiological, behavioral and social factors all contribute to the development of severe feeding problems (Casey, 1987; Chatoor et al., 1992; Heffer & Kelley, 1994; Ramsay, 1995; Skuse, 1993; Woolston, 1983). Physiological factors hypothesized to affect children's feeding and diet include, but are not limited to, anatomical abnormalities, sensory-perceptual abnormalities, motor dysfunction, oral-motor dysfunction, and respiratory, cardiac, and gastrointestinal problems (Stevenson, 1995). In addition to physiological factors, the child's behavior during mealtime as well as the parent-child relationship may occasion feeding problems (Iwata, Riordan, Wohl, & Finney, 1982; Satter, 1990). Feeding problems may manifest themselves as indicators of an emotional difficulty between parent and child (Chatoor, 1989; Chatoor, Schaefer, Dickson, & Egan, 1984). Caregivers who are overcontrolling, undercontrolling, chaotic, disorganized, excessively anxious, and insensitive to the cues of their children may disrupt the dynamic of the parent-child relationship, thereby causing a feeding problem (Chatoor, 1989; Satter, 1995). The child's health status, physical problems, dietary restrictions, temperament, or experience of a trauma related to feeding may indirectly affect the caregiver-child relationship by influencing both the parental responses to the child and parental anxiety about the feeding process (Chatoor, Conley, & Dick-

son, 1988; Satter, 1995). As a result, children with physical, medical, or developmental problems are most at risk for severe and persistent feeding problems.

Treatment for severe feeding problems have included behavioral interventions (for reviews, see Babbitt et al., 1994; Luiselli, 1989; O'Brien, Repp, Williams, & Christophersen, 1991), individual child psychotherapy (Palmer & Thompson, 1976), hypnosis (Culbert, Kajander, Kohen, & Reaney, 1996), cognitive-behavioral intervention for food phobia (Singer, Ambuel, Wade, & Jaffe, 1992), interactional therapy (Chatoor, 1989; Chatoor et al., 1984), and family-oriented interventions (Drotar et al., 1985; Koon, 1983). As a result of increased consensus for the biopsychosocial model of feeding (Chatoor et al., 1985; Ramsay, 1995), many of these interventions have been combined into treatment packages. For example, behavioral techniques are often embedded within psychosocial or interactional interventions (Dunbar, Jarvis, & Breyer, 1991; Iwaniec, Herbert, & McNeish, 1985; Ramsay & Zelazo, 1988). Furthermore, comprehensive assessment of feeding problems by interdisciplinary feeding programs results in multicomponent treatment packages that may address physiology, oral-motor functioning, parent-child interaction, and parental and family functioning (Bithoney et al., 1991; Casey, Wortham, & Nelson, 1984; Chamberlin, Henry, Roberts, Sapsford, & Courtney, 1991).

Evaluating the effectiveness of these interventions is hampered by methodological problems, including inconsistent definitions of feeding problems; inferior experimental designs; small sample size; inadequate or missing control groups or conditions; absence of standardized outcome measures; and incomplete descriptions of intervention (Sturm & Drotar, 1989; Whitten, 1976). However, the number of well-controlled treatment studies is burgeoning. The purpose of this review of the literature is to survey those studies meeting criteria of methodological rigor to identify those interventions with demonstrated effectiveness for the treatment of severe feeding problems. Although the biopsychosocial model of feeding is endorsed, this review of the literature will be restricted to interventions that are primarily psychosocial and behavioral. Psychosocial interventions are defined as psychotherapy or counseling for parent, child, or family; cognitive-behavioral interventions; hypnosis; or interactional coaching. Behavioral interventions are defined as use of procedures based on operant and respondent conditioning.

Method

Literature Search

I performed a systematic search of the medical and psychological literature using two computerized databases, Medline and Psychlit. The search parameters included feeding, nutrition, food refusal, and feeding problems paired with treatment and intervention. In addition, the key words behavioral and psychosocial intervention were used. In an attempt to ensure a complete search, citations within articles were obtained.

Eligibility Criteria

Using title and abstracts, I reviewed each article in the computer searches. To be eligible for inclusion in this study, articles had to meet the following criteria:

1. The article was published in a peer-reviewed journal between 1970 and 1997.
2. The participant sample consisted of children (birth to 18 years of age) with an identified oral feeding problem that is not oral-motor (e.g., drooling, tongue protrusion). Children with failure to thrive or growth deficiencies were included only if the focus of intervention was a specified oral feeding problem. The search excluded participants with rumination, pica, vomiting, rapid eating, sloppy eating, poor table manners, or those children meeting the Diagnostic and Statistical Manual-IV (DSM-IV, American Psychiatric Association, 1994) criteria for anorexia nervosa, bulimia nervosa, binge-eating disorder, and eating disorder not otherwise specified.
3. The study evaluated a psychosocial or behavioral intervention. Studies investigating the effects of medications, positioning, surgery, oral-motor treatment, oral/tactile stimulation, tube feedings, equipment, or social programs, such as Women, Infants, and Children (WIC), were excluded from the review. Nutritional interventions were included only when used with or in comparison to a psychosocial or behavioral intervention.
4. The dependent variable(s) was a measure of eating or caloric ingestion.
5. The article was published in English.

Methodological Criteria

The eligible articles were then reviewed for methodological rigor. The proposed criteria from the Task Force on Promotion and Dissemination of Psychological Procedure (1995) has been modified by the Society for Pediatric Psychology as:

1. *Well-established* interventions have at least two good between-group design experiments or at least nine single-subject experiments demonstrating (a) the superiority of an intervention to pill, psychological placebo, or alternative treatment or (b) equivalence to an already established treatment. Experiments are conducted with treatment manuals or with a specified treatment protocol; characteristics of the client samples are clearly specified; and effects are demonstrated by at least two different investigative groups.
2. *Probably efficacious* treatments have two experiments showing the treatment is more effective than a waiting-list control, or one or more experiments meeting the criteria for a well-established treatment conducted by the same investigative group.
3. *Promising* interventions have at least one well-controlled study and another less rigorously controlled study by a separate investigator, or two or more well-controlled studies with either small sample size or conducted by the same investigative group.

Good between-group design experiments were operationalized as those with random assignment of subjects to condition or a specified matching strategy. Reversal, multiple baseline, and multielement or simultaneous treatment single-subject designs are considered true experiments (Kazdin, 1982). A no treatment control condition used as baseline within a single-subject design was acceptable for the establishment of treatment effectiveness. Finally, those studies with obvious confounding variables were excluded (e.g., changing both treatment and experimenter from baseline to treatment).

Results

The computer searches yielded 79 studies meeting the eligibility criteria of time, population, intervention, dependent variable, and language. (A complete list of articles is available from the author.) Of these 79 articles, 29 met the modified criteria of the Task Force for Dissemination and Promotion of Psychological Practice (1995). The 50 studies not meeting methodological criteria evaluated a variety of interventions: behavioral (31), interactional (8), multimodal, interdisciplinary treatment (8), family intervention (1), and hypnosis (2).

Three studies met the methodological criteria, but could not be conveniently grouped together by type of intervention: overcorrection (Duker, 1981), peer-mediated swallowing training (Greer, Dorow, Williams, McCorkle, & Asnes, 1991), and contingency training with nutritional supplementation (Ramey, Starr, Pallas, Whitten, & Reed, 1975). The remaining 29 studies included 32 treatment packages. (Ahearn, Kerwin, Eicher, Shantz, & Swearingin, 1996; Kerwin, Ahearn, Eicher, & Burd, 1995; Riordan, Iwata, Finney, Wohl, & Stanley, 1984, reported multiple techniques). All of the articles meeting eligibility and methodological criteria employed primarily behavioral procedures; however, the articles reported treatment packages consisting of multiple treatment components. For the purpose of this review, the most salient aspect of each treatment package was used to classify the interventions.

Differential Attention

The 14 studies listed in Appendix 1 have in common the use of differential attention. Differential attention is defined as positive attention for appropriate feeding behavior and ignoring inappropriate behavior. Ten studies reported treatment packages in which differential attention was combined with other treatment components such as reward/tokens or time-out contingent upon eating or not eating, respectively, the specified amount or type of food during the feeding session or during a discrete time period (Linscheid, Oliver, Blyler, & Palmer, 1978; Linscheid, Tarnowski, Rasnake, & Brams, 1987; Madsen, Madsen, & Thompson, 1974; Stark, Bowen, Tyc, Evans, & Passero, 1990; Stark et al., 1993; Stark et al., 1996; Stark, Powers, Jelalian, Rape, & Miller, 1994; Thompson, Palmer, & Linscheid, 1977; Turner, Sanders, & Wall, 1994), and returning the child to the table or time-out for continued disruptive behavior (Stark et al., 1996; Werle, Murphy, & Budd, 1993).

These studies occurred with diverse populations of children across many settings. Participants were children with mental retardation (6–11 years old)

in inpatient or residential school settings; inpatient children with complex medical problems (23 months–6 years); children with cystic fibrosis (4–12 years) in outpatient settings; children in Head Start (mean = 6 years, 2 months); and outpatient children with no significant problems but feeding (21 months–5 years). Feeding problems were food selectivity, food refusal, growth deficiencies, and unspecified feeding problems. Five studies excluded children with underlying medical and organic causes of feeding (Luiselli, 1994; Riordan, Iwata, Wohl, & Finney, 1980, Riordan et al., 1984; Turner et al., 1994; Werle et al., 1993).

Randomized group designs were used to compare parent training of contingency management with nutritional education to wait-list control group (Stark et al., 1996) and parent training of contingency management to nutritional education (Turner et al., 1994). The remaining studies employed single-subject designs, in which baseline was a no treatment condition consisting of presenting food in the typical manner and providing no consequences for any response during a structured feeding session, or collecting calorie intake. In three studies, children were either returned to their chair or required to remain seated for the baseline assessment (Linscheid et al., 1987; Riordan et al., 1980, 1984).

All 14 studies evaluated an intervention consisting of contingent reinforcement (praise, preferred events, or food) for the target response (acceptance, swallowing, self-initiated bites, or eating specified quantity or type of food within time allotment) and ignoring of all other responses during the treatment session (see Turner et al., 1984; Werle et al., 1993, for use of time-out during meals). Reinforcement was often delivered for target responses within the meal, meeting meal termination criteria, and meeting criteria for responses across meals. Four studies reported fading the reinforcement schedule during the study (Luiselli et al., 1985; Luiselli, 1994; Riordan et al., 1980; Thompson et al., 1977). In addition, shaping within the differential attention procedure was used; for example, targeting only a few foods, or varying the quantity of food per bite. While the components of treatment were well described, only three studies specified the training methods and content of each session (Stark et al., 1994; Stark et al., 1996; Turner et al., 1994).

Although the components of differential attention are consistent across all studies, eight interventions included other components that might affect treatment effectiveness (Linscheid et al., 1978, 1987; Stark et al., 1993, 1994, 1996; Thompson et al., 1977; Turner et al., 1994). In addition to ignoring most inappropriate feeding responses, some treatment packages included no access to other food, loss of privileges for up to 2 hours, or a time-out for 30 minutes contingent on not eating the specified quantity of food during the session. Continued disruptive behavior during the meal resulted in a time-out in two treatments (Turner et al., 1994; Werle et al., 1993). Stark et al. (1994, 1996) taught participant children to use progressive muscle relaxation during meals. Six studies explicitly mentioned attempts to manipulate or control appetite by limiting access to food or prescribing nocturnal tube feedings.

Of these 14 treatment packages, six studies employed parent training of contingency management from the initiation of treatment (Stark et al., 1990, 1993, 1994, 1994, 1996; Turner et al., 1994; Werle et al., 1983), and six reported parent training procedures during or after treatment (Linscheid et al., 1978, 1987; Luiselli, 1994; Riordan et al., 1980, 1984; Thompson et al., 1977). Parent training methodology was similar across studies and included instruction, viewing videotaped sessions, and in vivo coaching. Five parent training studies combined instruction in contingency management with nutrition education (Stark et al., 1990, 1993, 1994, 1996; Werle et al., 1993). Nutritional education provided calorie information, alternative cooking methods, introduction of new or novel foods, and boosting calories.

Differential attention increased the grams and calories consumed, number of bites, and amount of nonpreferred food when compared to a no-treatment baseline, when combined with nutritional education and/or relaxation training, and compared to wait-list control group or no-treatment baseline. Weight gain was variable across children (Linscheid et al., 1987; Stark et al., 1990, 1993, 1996). Children increased appropriate and decreased inappropriate behavior after either parent behavioral training or nutritional education (Turner et al., 1994). Parents increased appropriate positive attention (Stark et al., 1994; Thompson et al., 1977; Tuner et al., 1994; Werle et al., 1993), decreased criticisms (Thompson et al., 1977), increased specific prompts (Werle et al., 1993), and decreased attention to disruption (Stark et al., 1994). In the studies reporting follow-up data on maintenance of differ-

ential attention intervention, the effects maintained for 38 of 39 children for 1 month to 2 years. Generalization to more advanced food textures (table foods) was difficult for one subject.

Treatment duration clustered into three groups: relatively brief interventions (4–17 sessions), moderately long interventions (27–62 sessions), and long intervention (88 sessions). The two studies with moderate treatment duration included components of fading the reinforcement schedule, changing the target response, or systematically fading in another utensil (Luiselli, 1994; Riordan et al., 1980). The lengthy intervention (Linscheid et al., 1987) seemed to result from the relative failure of the child to eat spaghetti, an identified nonpreferred food. This participant continued to have problems with foods needing chewing, suggesting a possible oral-motor skill deficit (Ramsay, Gisel, & Boutry, 1993).

In summary, differential attention is a *well-established* intervention for severe and persistent feeding problems, demonstrated to be effective when compared to either a no-treatment baseline or a wait-list control group for a diverse population of children with a variety of feeding problems across multiple settings, training formats, and target feeding responses. Although differential attention is often just one component of unique multicomponent treatment packages, it is the only common component across these 14 studies. The four studies that used differential attention as a sole component provide some support for its efficacy as a treatment component (Luiselli et al., 1985; Luiselli, 1994; Riordan et al., 1980, 1984). Because parents were trained successfully in these procedures, and treatment gains maintained for relatively long periods of time, additional studies should replicate the effectiveness of differential attention as a single intervention using treatment manuals (e.g., Stark et al., 1996; Turner et al., 1994).

Physical Guidance of the Appropriate Feeding Response

Appendix 2 lists the 13 studies investigating the effectiveness of manual guidance of the appropriate feeding response in combination with positive reinforcement. Participants were children and adolescents with severe to profound mental retardation (3.5–19 years) across inpatient settings, residential and nonresidential schools, and institutions; Rett syndrome (3–23 years) in an inpatient setting; and inpatients with complex medical problems (26 months–5 years). Feeding problems were either failure to self-feed independently or total food refusal necessitating an inpatient admission for treatment. Exclusion criteria were poor motor control (Nelson, Cone, & Hanson, 1975; Stimbert, Minor, & McCoy, 1977), structural or organic problem underlying the feeding problem (Riordan et al., 1984), and noncompliance with verbal requests (Luiselli, 1988b).

All studies employed a single-subject design. In the nine studies using a no-treatment baseline condition, participants were presented with food or utensils without verbal instructions (Luiselli, 1988a; Nelson et al., 1975; Reidy, 1979; Riordan et al., 1984; Stimbert et al., 1977), with a verbal or tactical prompt to take bites (Luiselli, 1993; Piazza, Andersen, & Fisher, 1993), or provided with manual assistance when necessary (Luiselli, 1988b; O'Brien, Bugle, & Azrin, 1972). The remaining four studies used treatment as baseline. Sisson and Dixon (1986a, 1986b) required the children to sample a bite to get dessert or to finish the baseline meal. In addition, behavior management techniques were used for aggressive and self-stimulatory behavior. Two studies conducted by the same investigative group used differential attention as a baseline condition (Ahearn et al., 1996; Kerwin et al., 1995).

A treatment component common to all studies was positive reinforcement (praise, access to toys or preferred events) after an appropriate feeding response (i.e., self-feeding, food acceptance), whether it occurred independently, after a verbal prompt, or after a modeled response. A second treatment component common to all studies was the manual guidance of the appropriate feeding response(s) after the occurrence of an incorrect response or after 40–60 seconds of no response, except Luiselli (1993). Luiselli employed backward chaining by physically guiding all steps prior to the step identified in baseline as a low frequency response (e.g., inserting spoon into mouth) and then gradually fading physical guidance. Two studies employed a hierarchy of instruction and prompting, commonly known as three-step guided compliance: (a) providing a verbal instruction, (b) if no response after a specified period of time, modeling with the verbal instruction, and (c) if still no response, manual guidance (Piazza et al., 1993; Sisson & Dixon, 1986a). Manual guidance was systematically faded in three studies (Luiselli, 1993; O'Brien et al., 1972; Stimbert et al., 1977).

In addition to positive reinforcement and manual guidance, five studies targeted the inappropriate

behavior of individuals with mental retardation with interruption of the behavior (Luiselli, 1988b; O'Brien et al., 1972; Reidy, 1979), restitution of the environment and positive practice of the appropriate response (Stimbert et al., 1977), or time-out and modeling of the appropriate response (Sisson & Dixon, 1986b).

Manual guidance was effective in increasing independent responses, correct utensil use, acceptance, grams consumed, and decreasing rate of eating. These effects maintained for 1 week to 1 year. There were variable effects for appropriate napkin use and chewing with mouth closed (Sisson & Dixon, 1986a, 1986b). Treatment duration was relatively brief (5–70 sessions) in ten studies. The remaining two studies report treatment duration of 5–8 weeks (Piazza et al., 1993; Stimbert et al., 1977). Although these two studies were effective, they are the only two studies in which gains did not maintain across all subjects.

In summary, positive reinforcement of independent and appropriate feeding responses combined with manual guidance of appropriate feeding response contingent on an incorrect response meets the criteria for a well-established intervention for self-feeding and food refusal, but not for napkin use or chewing with mouth closed. This conclusion is strengthened by the use of differential attention, an established treatment, as a baseline condition in two studies (Ahearn et al., 1996; Kerwin et al., 1995). Furthermore, the use of verbal and tactile prompts or manual assistance during baseline in four studies suggests a need for this intervention, at least for these individuals. There are not enough studies to establish the effectiveness of either the three-step guided compliance procedure (verbal prompt, model, manual guide) (Piazza et al., 1993; Sisson & Dixon, 1986a) or backward chaining using physical prompting and prompt fading (Luiselli, 1993). In addition, the need for consequences for inappropriate behavior has yet to be demonstrated.

Extinction

For some children with severe feeding problems, food refusal may have been negatively reinforced by removing the spoon after refusal, thereby increasing the probability of food refusal in the future (Iwata et al., 1982). Extinction by definition is removing the reinforcer of a response. If it can be demonstrated that escape from eating is reinforcing (i.e., increases) the probability of food refusal, then extinction may be an appropriate treatment. Therefore, an extinction procedure would require that the spoon remain at the child's lips until it is accepted into the mouth. Appendix 3 contains three studies using extinction of refusal by not removing the spoon after the child refuses a bite of food (Ahearn et al., 1996; Hoch, Babbitt, Coe, Krell, & Hackbert, 1994; Kerwin et al., 1995).

Participants were children 2 to 3.5 years old with mental retardation, complex medical problems, or autism admitted to a hospital for treatment of either total food refusal or food selectivity. Baseline was a structured assessment in which a verbal prompt to eat was given every 30 seconds with either differential attention for acceptance and refusal (Ahearn et al., 1996; Kerwin et al., 1995) or no consequences for appropriate or inappropriate behavior (Hoch et al., 1994).

Extinction increased independent acceptance (accepting the spoon within 5 or 30 seconds after the verbal prompt) and grams consumed in 10 to 130 sessions. However, all but one parent either did not choose to be trained in the procedure or discontinued its use after discharge. Because nonremoval of the spoon is an extinction procedure, the behavior is likely to worsen before it improves. Parental dissatisfaction resulted from increased meal duration and increased negative corollary behaviors (e.g., crying). Therefore, procedural safeguards might include decreasing the amount of food on the spoon, specifying a time limit for the session or the number of bites required to terminate the meal. For example, the shortest treatment duration occurred when the spoon was only coated with food (Kerwin et al., 1995). Using a dry or slightly coated spoon allows acceptance without requiring the child to swallow any appreciable food. The shortened treatment duration and decreased negative responses may have contributed to this parent's decision to use the procedure resulting in positive gains at 6 months postdischarge.

Nonremoval of the spoon for refusal and positive reinforcement for acceptance in a discrete trial meal structure (i.e., verbal prompts beginning each trial) may be a *promising* intervention for food refusal and selectivity for children exhibiting severe feeding problems whose problems do not respond to differential attention. However, implementation of this intervention appears to be problematic because most parents did not continue to implement the procedure after the child was discharged from the hospital.

Swallowing Induction

Appendix 4 lists two studies investigating swallow induction treatment in an inpatient setting (Hagopian, Farrell, & Amari, 1996; Lamm & Greer, 1988). In swallowing induction treatment, the swallowing reflex is elicited with either the little finger or a feeding implement as the first or last step in a sequence of backward or forward chaining. Praise and toys are delivered contingent on swallowing. Initially, the child is expected to swallow a small volume of liquid; task demands are then increased gradually. Participants included infants with complex medical problems (10–13 months) and a 12-year-old child with autism. Eligible participants had no known neurological dysfunction; however, they did not swallow food. Baseline sessions consisted of presenting liquid with a verbal prompt to swallow for 10 trials in a structured feeding session or placing a small quantity of food or liquid on the anterior tongue. Frequency of swallows and amount consumed increased within 6 to 23 days or 12 to 125 sessions. These gains maintained for as long as two years. Because there are only two well-controlled studies using different variations of the same treatment components, this is a promising intervention for swallowing problems.

Discussion

Severe feeding problems can have serious consequences for a child's growth and development. Although severe feeding problems are relatively rare in the general pediatric population, children at risk for severe feeding problems are those with physical disabilities, medical problems, chronic illnesses, mental retardation, and developmental delays. Fortunately, for these children, a sufficient body of literature exists that establishes some empirically supported treatments for these feeding problems.

In particular, differential attention (positive reinforcement for appropriate specified eating behavior and ignoring refusal and other inappropriate behavior) has been demonstrated to be a common component of effective treatment packages for a variety of feeding problems, across diverse populations (children with mental retardation, complex medical problems and chronic illnesses, and children with no other identified problems), settings (home, inpatient, outpatient, residential and nonresidential schools), and change agents (trained staff, school caregivers, and parents).

Whereas differential attention is an effective treatment for most feeding problems, some exceptionally severe feeding problems do not always respond to differential attention. Physical guidance after refusal and positive reinforcement of independent acceptance is effective for total food refusal that has not responded to differential attention. Furthermore, an effective intervention for children with mental retardation who do not feed themselves independently is manual guidance of self-feeding combined with positive reinforcement for independent feeding. Interventions that are promising, but require more research, are extinction (nonremoval of the spoon) and swallow induction training (forward or backward chaining with elicitation of the swallowing reflex).

Treatments that are well established or promising have several components in common. Each effective intervention emanates from an explicitly behavioral perspective. Behavioral interventions typically feature repeated assessment of relevant target responses with graphic display of these data (cf., Stark et al., 1996; Turner et al., 1994). Frequent and systematic review of the data may result in treatment changes that ultimately ensure success for the individual child and parent. Each intervention provides positive reinforcement for specific feeding responses combined with an explicit procedure for consequating inappropriate feeding behavior (i.e., ignoring, guidance, extinction, or eliciting swallowing). Ignoring inappropriate behavior was effective across broader samples of children, settings, and change agents. The other procedures (guidance, extinction, and swallowing induction) were used primarily in inpatient or residential settings for individuals with either complex medical problems or mental retardation. Across all interventions, except extinction (not removing the spoon), gains were maintained and parents were willing to implement these interventions. Anecdotal evidence suggests parents are dissatisfied with the negative side effects of extinction (e.g., crying). Some studies reported interventions that attempted to decrease these possible negative side effects and maximize the child's success by beginning with easier task demands (i.e., smaller amount of food on spoon or plate) and then systematically increasing the difficulty of the task demands (Kerwin et al., 1995; Linscheid et al., 1978, 1987; Luiselli, 1994).

Although there are procedural commonalties across studies, each study described a unique treatment package composed of different components. For example, some studies investigating differential attention used within-meal consequences, meal termination criteria for access to or loss of privileges, token economies for performance across meals, or controlled access to food and liquid. Determining which component(s) is critical for treatment effectiveness is currently not possible. Component analyses of these established treatment packages are a necessary area for the advancement of intervention research in feeding (see Cooper et al., 1995).

Behavioral interventions comprise the largest proportion of eligible studies reviewed (76%); however, their use for feeding problems is controversial (Satter, 1990). Specifically, there is concern that their use will result in control and countercontrol in the parent-child interaction as well as undermine the child's natural motivation to eat (Birch & Fisher, 1996; Satter, 1990, but see also Cameron & Pierce, 1994, Eisenberger & Cameron, 1996). In a study of typically developing 3- to 5-year-old children, Johnson and Birch (1994) report a negative correlation between mother's self-report of "controlling" practices during mealtimes and their children's one session sensitivity to caloric density loading and subsequent caloric intake. This negative correlation is interpreted as "parents who exerted more control over their children's food intake had children who showed less responsiveness to the caloric density of the diet" (Johnson & Birch, 1994, p. 659). It is equally plausible that the children had a history of demonstrating some mild feeding difficulties affecting parental management style (Ramsay, 1995). In addition, the extent to which these correlational relationships extend to children with severe feeding problems is unknown. In contrast, data from well-controlled studies of children with severe feeding problems demonstrate that treatment gains with differential attention and manual guidance are maintained with additional improvements for up to two years (Appendix 1 and Appendix 2).

The use of any intervention, especially some of these intensive behavioral interventions, requires ethical considerations in implementation. Aspiration is a potential risk in any feeding situation; therefore, all interventions should receive medical approval prior to implementation. In addition, the targeted feeding responses and possible side effects should be assessed continuously and monitored closely. Inability to increase appropriate feeding responses within a reasonable time period, regression of progress, and significant negative side effects (prolonged crying, tantrums, expelling food) should result in a thorough review of the intervention plan and implementation with feeding experts and medical staff.

Manual guidance, extinction, and swallow induction training are considered intrusive and restrictive procedures and are not appropriate for the majority of children experiencing severe feeding problems. The decision to use these procedures requires a cost/benefit analysis. The children in these studies exhibited *severe* feeding problems necessitating an admission to an inpatient unit for treatment of the feeding problem. These children were at risk for or had received relatively restrictive medical procedures (i.e., placement of a nasogastric or gastrostomy tube), experienced social and emotional difficulties, or were denied access to appropriate educational placements.

Implementation of these procedures requires safeguards to maintain a least restrictive environment and to minimize possible negative side effects. Manual guidance, extinction, or swallow induction should be implemented only after the documented failure of either an established, less intensive treatment (Ahearn et al., 1996; Hoch et al., 1995; Kerwin et al., 1995) or after failure of frequent use of manual assistance and instruction in the case of self-feeding. These interventions should always be combined with rich schedules of positive reinforcement and implemented initially by trained staff in structured, supervised settings. Easier task demands (e.g., using an empty spoon initially) may minimize the number of times these intensive interventions are used or their negative side effects. When implemented appropriately, the data indicate that these more intrusive contingencies are rarely used after the first few sessions, and independent feeding responses increase quickly and remain at high and stable levels. Prolonged use of these procedures would be cause for concern. Despite these safeguards, more research is needed to examine the efficacy and effectiveness of other less aversive techniques.

Objective, methodological criteria afford some confidence in these conclusions; however, several problems limit interpretation. These conclusions cannot, and should not, be generalized to all children with feeding problems. More studies are

needed to replicate and extend the treatment packages across different populations. To the naïve observer, these behavioral interventions may appear mechanistic and cold. Presumably, these techniques are faded as the child begins to enjoy the natural consequences of eating. The majority of studies reviewed provide little detail regarding when parents were introduced into the feeding sessions, how parents were trained, how (or if) they were instructed to fade the use of procedures, and their perspectives on these procedures. Future research should investigate how best to incorporate parents or caregivers into treatment implementation, and what training procedures or techniques are best for ensuring continued utilization techniques after treatment has ended.

Conclusions from this review of the treatment literature should be tempered by the methodological limitations of these studies. Although no treatment control groups are standard in behavioral research, treatment is inseparable from, and confounded with, providing attention. Therefore, additional research is needed using either psychological placebo, or established treatments as control conditions. Given the biopsychosocial model of feeding, inclusion and exclusion criteria need to be more clearly delineated. For example, the one child for whom differential attention was not effective struggled to eat spaghetti, suggesting the possibility of an undetected oral-motor problem (Linscheid et al., 1987). More recent studies have excluded individuals with organic or oral-motor problems. Finally, as multidisciplinary treatment teams for feeding become more common (Heffer & Kelley, 1994), well-controlled studies investigating the effectiveness of multidimensional interventions across multiple measures of success should be conducted. In addition, the use of treatment manuals is needed across research groups to allow for more controlled and replicable research.

While the practical implications of this review are clear and compelling, the theoretical implications, although not as pronounced, are also important. When evaluated against stringent methodological criteria, behavioral interventions are the only documented effective or promising treatments for severe pediatric feeding problems. Although these results might be interpreted as rejecting the efficacy of psychosocial interventions for severe feeding problems, a more accurate conclusion is that only studies of behavioral interventions met methodological criteria. Well-controlled intervention studies are needed across a variety of theoretical perspectives. We now know that empirically supported treatments for feeding problems exist; it is now time to turn to questions about for whom they are effective, and when, and why.

Appendix 1: Summary of Differential Attention Interventions

Madsen, C. H., Madsen, C. K., & Thompson, F. (1974). Increasing rural Head Start children's consumption of middle-class meals. *Journal of Applied Behavior Analysis, 7,* 257–262.

Sample. $N = 46$. Rural black children in Head Start below poverty standard. Mean age = 6 years, 2 months.

Inclusion/exclusion criteria. Weight was 4–6 lbs. under indicated minimum for height and age.

Baseline and procedures. Four meals; food presented typically with minimal interaction.

Experimental design. Reversal.

Assessment measure. Food into mouth and percentage of meal consumed.

Treatment protocol. Four meals; praise and sugar cereal contingent on food into mouth and candy for completion of entire meal.

Outcome. Number of children eating increased from 20%–30% and larger proportion of meal consumed (76%–93%).

Follow-up. None.

Thompson, R. J., Palmer, S., & Linscheid, T. R. (1977). Single-subject design and interaction analysis in the behavioral treatment of a child with a feeding problem. *Child Psychiatry and Human Development, 8,* 43–53.

Sample. $N = 1$ (white male, 30 months old; otherwise normal; outpatient clinic).

Inclusion/exclusion criteria. Food selectivity.

Baseline and procedures. Three sessions; parent fed as typically would.

Experimental design. Reversal.

Assessment measure. Grams consumed; parent behaviors.

Treatment protocol. Nine sessions; parent trained in differential attention with established meal termination criteria; access to foods after meal dependent on performance.

Outcome. Total intake initially dropped; overall increase in nonpreferred foods with less maternal criticism and increase in appropriate positive attention.

Follow-up. At 6 months diet varied; intake = 127% of RDA; maternal behaviors maintained.

Linscheid, T. R., Oliver, J., Blyler, E., & Palmer, S. (1978). Brief hospitalization for the behavioral treatment of feeding problems in the developmentally disabled. *Journal of Pediatric Psychology, 3,* 72–76.

Sample. *N* = 1 (female, 4 years, 6 months old, with spina bifada; inpatient).

Inclusion/exclusion criteria. Food selectivity and partial food refusal, growth deficit.

Baseline and procedures. Three meals; free access to all foods; spoon of nonpreferred food presented with verbal prompt.

Experimental design. Reversal.

Assessment measure. Percentage of nonpreferred food eaten and bites accepted.

Treatment protocol. Twelve meals (4 days); differential attention; small amount of nonpreferred food needed to be eaten in 30 minutes; if not, 30-minute time-out in bed.

Outcome. By eighth session, subject ate all nonpreferred food presented.

Follow-up. At 3 months; subject continued to eat nonpreferred foods.

Riordan, M. M., Iwata, B. A., Wohl, M. K., & Finney, J. W. (1980). Behavioral treatment of food refusal and selectivity in developmentally disabled children. *Applied Research in Mental Retardation, 1,* 95–112.

Sample. *N* = 2 (females, 6 and 9 years old; inpatients; mental retardation).

Inclusion/exclusion criteria. Food refusal and selectivity; <5th percentile weight and height; no digestive or oral-motor problems.

Baseline and procedures. Eight sessions (2.5 days); no consequences except to return child to meal.

Experimental design. Multiple baseline across food group.

Assessment measure. Bites taken; grams consumed; expel; disruption.

Treatment protocol. Twenty-seven to sixty-two sessions; praise and preferred foods for acceptance initially on CRF then faded schedule; modified to include swallowing.

Outcome. Means of 25.8 to 66.8 bites; 82.3 to 116 grams/session; 9.1 to 12.5 bites taken and 57.2 to 157.6 grams/meal.

Follow-up. Two months, limited to 1 child; continued increase in bites and grams.

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

Sample. *N* = 3 (1 male, 2 females; age = 23–40 months; inpatients with complex medical problems).

Inclusion/exclusion criteria. Food refusal or selectivity; at risk for FTT; no structural or organic problems; not self-feeding.

Baseline and procedures. Five to eleven sessions; no consequences except to return child to meal.

Experimental design. Multiple baseline across food group.

Assessment measure. Acceptance; expulsion; disruptive behavior.

Treatment protocol. Nine to fifteen sessions; preferred food for acceptance of targeted food for children with selectivity; toys for acceptance.

Outcome. All subjects accepted >90% of bites; expulsion varied between 17.4% and 50% of intervals; grams consumed increased by a mean of 19.4.

Follow-up. At 7 months to 2 years across children; grams consumed-increased for 1; maintained for 1; decreased for 1.

Luiselli, J. K., Evans, T. P., & Boyle, D. A. (1985). Contingency management of food selectivity and oppositional eating in a multiply handicapped child. *Journal of Clinical Child Psychology, 14,* 153–156.

Sample. $N = 1$ (male, 11 years old; premature and sensory impairments; residential school).

Inclusion/exclusion criteria. Food selectivity; oppositional eating.

Baseline and procedures. One day; meal presented for 25 minutes without staff intervention.

Experimental design. Reversal.

Assessment measure. Percentage of meal estimated by staff.

Treatment protocol. Fifteen days; contingent reinforcement and planned ignoring for "undesirable" behaviors.

Outcome. Mean of 33.3%–75% of meal consumed; reversal 45%; final treatment 87.8%

Follow-up. At 1 month; 97.7% of meal consumed by subject.

Linscheid, T. R., Tarnowski, K. J., Rasnake, L. K., & Brams, J. S. (1987). Behavioral treatment of food refusal in a child with short-gut syndrome. *Journal of Pediatric Psychology, 12,* 451–459.

Sample. $N = 1$ (6-year-old male with short-gut syndrome; inpatient).

Inclusion/exclusion criteria. Total food refusal.

Baseline and procedures. Four meals at minutes; remained seated for 25 minutes in environment free of distraction.

Experimental design. Multiple baseline across food.

Assessment measure. Type and amount of fluids, liquids, and semi-solids eaten.

Treatment protocol. Eighty-eight meals; contingent attention/planned ignore; "hero" badge for consuming required amount; token system across multiple meals.

Outcome. Eighty-three percent of the meals met criterion; good progress until spaghetti and "resistance to texture."

Follow-up. At 1 month; new foods but lost weight. At 2 months; weight gain and all oral. At 6 months: problems with chewing.

Stark, L. J., Bowen, A. M., Tyc, V. L., Evans, S., & Passero, M. A. (1990). A behavioral approach to increasing calorie consumption in children with cystic fibrosis. *Journal of Pediatric Psychology, 15,* 309–326.

Sample. $N = 5$ (5–12 years old; two boys; varied SES; outpatients).

Inclusion/exclusion criteria. Cystic fibrosis with pancreatic involvement; weight <5th to 35th percentile.

Baseline and procedures. Calorie diaries for 2 weeks; weight and height for 3–5 months prior to intervention.

Experimental design. Multiple baseline across meals.

Assessment measure. Calories; growth; pulmonary function.

Treatment protocol. Six 90-minute group sessions of parents and children separately; nutrition education and contingent attention with star chart.

Outcome. Mean of 298 to 810 cal/day; increase in weight (24.7 to 26.2 kg); rate of gain = .0434 to .2314 kg/wk.

Follow-up. At 1, 3, 6, and 9 months; gains maintained.

Stark, L. J., Knapp, L. G., Bowen, A. M., Powers, S. W., Jelalian, E., Evans, S. Passero, M. A., Mulvihill, M. M., & Hovell, M. (1993). Increasing calorie consumption of children with cystic fibrosis: Replication with 2-year follow-up. *Journal of Applied Behavior Analysis, 26,* 435–450.

Sample. $N = 3$ (2 females, 1 male; 4–8.5 yrs old; middle class; outpatients).

Inclusion/exclusion criteria. Cystic fibrosis with pancreatic involvement; feeding problems.

Baseline and procedures. Calorie diaries for 2 weeks; weight and height for 3–5 months; videotaped dinner meal.

Experimental design. Multiple baseline across meals.

Assessment measure. Calories; growth; pulmonary function.

Treatment protocol. Six 90-minute group sessions of parents and children separately; nutrition education and child behavior management; relaxation for children.

Outcome. Significant increases in calories (1,585–2,368) and fat. Two children gained weight (1–1.2 kg); 1 child lost 2 kg.

Follow-up. At 4, 12, 24, 48, and 96 weeks; gains maintained.

Werle, M. A., Murphy, T. B., & Budd, K. S. (1993). Treating chronic food refusal in young children: Home-based parent training. *Journal of Applied Behavior Analysis, 26,* 421–433.

Sample. $N = 3$ (3 males; 21–53 months old; middle class).

Inclusion/exclusion criteria. Food selectivity without FTT; no medical problems; self-feeding; follow simple directions; no siblings with feeding problems; 2 parents.

Baseline and procedures. Four to ten sessions; parents asked to feed child as they normally would.

Experimental design. Multiple baseline across child.

Assessment measure. Twelve parent and seven child responses from videotape of meal.

Treatment protocol. Four to fourteen sessions at home; nutrition education and introducing foods; differential attention; blocking attempts to leave table; time-out for continued disruptive behavior.

Outcome. Parents increased specific prompts (.18–1.33 per min); 2 increased positive attention (.08–1.45 per min); children increased acceptance of targeted foods (1.3–24).

Follow-up. None.

Luiselli, J. K. (1994). Oral feeding treatment of children with chronic food refusal and multiple developmental disabilities. *American Journal of Mental Retardation, 98,* 646–655.

Sample. $N = 2$ (1 male, 7 years old; 1 female, 10 years old; mental retardation; cerebral palsy; sensory impairments).

Inclusion/exclusion criteria. Food refusal or food selectivity.

Baseline and procedures. Eight sessions; 30 or 10 minutes across subjects; no trainer intervention.

Experimental design. Multiple baseline across meals.

Assessment measure. Acceptance or rate of self-initiated versus train-presented bites.

Treatment protocol. Twenty-eight to thirty-eight meals; exposure to rocking before meal; differential attention; rocking contingent on swallowing; pairing new utensil with old systematically.

Outcome. Increase of acceptance to >90% for subject 1; 0–2.2 self initiated self-feeding responses/min for subject 2.

Follow-up. At 4 months to 1 year; effects maintained.

Stark, L. J., Powers, S. W., Jelalian, E., Rape, R. N., & Miller, D. L. (1994). Modifying problematic mealtime interactions of children with cystic fibrosis and their parents via behavioral parent training. *Journal of Pediatric Psychology, 19,* 751–768.

Sample. $N = 2$ (2 white, middle-class males, 3 and 5 years old).

Inclusion/exclusion criteria. Same as Stark et al. (1993).

Baseline and procedures. Two and 7 weeks; diet diaries; videotaped evening meals at home for 2 weeks.

Experimental design. Multiple baseline across children.

Assessment measure. Rating scale of feeding; calories; weight.

Treatment protocol. Six and nine weekly sessions (90 minutes); differential attention; contingent privileges; setting expectations; introducing new foods; training methods outlined.

Outcome. Decrease in attention to disruption (2.8–1.2); increase in reinforcement of eating (.7–4.8); increase in parent control (3–4.5); variable increase in eating (1.75–3.75).

Follow-up. At 1 month and 1 year; gains maintained.

Turner, K. M., Sanders, M. R., & Wall, C. R. (1994). Behavioural parent training versus dietary education in the treatment of children with persistent feeding difficulties. *Behaviour Change, 11,* 242–258.

Sample. $N = 20$. Age = 18–60 months. Seventeen children with GI problems.

Inclusion/exclusion criteria. One to five years; parents sought help for feeding problems lasting longer than 3 months; no organic or psychiatric causes.

Baseline and procedures. Intake diary for 7 days; videotape of mealtime observation in home and at clinic; parental report of mealtime behaviors.

Experimental design. Randomized group comparison of 2 treatments.

Assessment measure. Growth; parental satisfaction; calories; mealtime behaviors.

Treatment protocol. Behavioral parent training; 6 weekly behavioral management sessions.

Outcome. Significant increase in appropriate behavior and decrease in disruptive behavior over time, not by group; mothers getting behavior training increased positive attention.

Follow-up. At 3–4 months; effects maintained.

Stark, L. J., Mulvihill, M. M., Powers, S. W., Jelalian, E., Keating, K., Creveling, S., Byrnes-Collins, B., Harwood, I., Passero, M. A., Light, M., Miller, D. L., & Hovell, M. F. (1996). Behavioral intervention to improve caloric intake of children with cystic fibrosis: Treatment versus wait list control. *Journal of Pediatric Gastroenterology and Nutrition, 22,* 240–253.

Sample. $N = 9$. Age = 3 years, 8 months to 10 years, 1 month. Subjects diagnosed cystic fibrosis.

Inclusion/exclusion criteria. Children with cystic fibrosis.

Baseline and procedures. One group session; parents instructed how to record food intake; children told would receive stars for assisting parents in data collection.

Experimental design. Random assignment to group.

Assessment measure. Calories; growth; pulmonary function; resting energy expenditure.

Treatment protocol. Training methods outlined in detail for each session; 6 weekly sessions focused on nutritional education and child behavior management for parents; childlren were taught relaxation.

Outcome. Treatment resulted in increased calories (~1,000 cal/day) and weight gain (average 1.7 kg).

Follow-up. At 3 and 6 months; all maintained calorie intakes; 5 subjects showed continued weight gain.

Appendix 2: Summary of Studies on Physical Guidance of the Appropriate Feeding Response

O'Brien, F., Bugle, C., & Azrin, N. H. (1972). Training and maintaining a retarded child's proper eating. *Journal of Applied Behavior Analysis, 5,* 67–72.

Sample. $N = 1$ (6-year-old female with mental retardation in day care).

Inclusion/exclusion criteria. No self-feeding.

Baseline and procedures. Six meals; child returned to eating posture when face near bowl; session ended after 4 minutes or food consumed.

Experimental design. Reversal.

Assessment measure. Correct feeding response (food to mouth without spilling).

Treatment protocol. Fourteen sessions; subject 1 = interruption/extinction of correct feeding; subject 2 = manual guidance; teacher guided hand through 6 steps with criteria for fading use of guidance.

Outcome. Independent responses occurred when both manual guidance and interruption/extinction used.

Follow-up. None.

Nelson, G. L., Cone, J. D., & Hanson, C. R. (1975). Training correct utensil use in retarded children: Modeling vs. Physical guidance. *American Journal of Mental Deficiency, 80,* 114–122.

Sample. $N = 24$ (all males; 9–19 years old; institutionalized; with mental retardation).

Inclusion/exclusion criteria. Excluded poor hand coordination; special diets; when utensil use unsafe; poor self-feeding.

Baseline and procedures. Nine days; given utensils with the meal and no additional instructions.

Experimental design. Multi-element; group comparison.

Assessment measure. Mean percentage of correct utensil use, incorrect utensil use, and other behaviors.

Treatment protocol. Six meals; part 1: modeled or guided correct utensil use prior to meal; part 2: praise for correct use in any group; modeling group = modeled two times during each trial; guidance group trainer guided when correct; third group = guidance for incorrect and praise after self-correction.

Outcome. No difference among groups in part 1; in part 2, guidance (M = 27.75%) and guidance plus praise (M = 33.14%) statistically better than modeling (M = 8.14%).

Follow-up. At 7 days; gains generalized to large cafeteria.

Stimbert, V. E., Minor, J. W., & McCoy, J. F. (1977). Intensive feeding training with retarded children. *Behavior Modification, 1,* 517–530.

Sample. N = 6 (3 males, 3 females; 3.5–13 years old; mental retardation; inpatient setting).

Inclusion/exclusion criteria. Limited self-feeding skill; sufficient motor skill to grasp spoon and transport food.

Baseline and procedures. Eight to twenty-six sessions; feed self for 15 minutes without constraint.

Experimental design. Multiple baseline across subjects.

Assessment measure. Frequency of correct, incorrect, and inappropriate eating.

Treatment protocol. Five to eight weeks; praise for correct response; guidance faded systemically from wrist to shoulder; restitution and positive practice for errors; tray time-out for inappropriate behaviors.

Outcome. Increase in correct responses (8–27) and decrease in incorrect responses (31.4 to less than 5).

Follow-up. At 4–12 months; 3 subjects maintained; 2 worsened.

Reidy, T. J. (1979). Training appropriate eating behavior in a pediatric rehabilitation setting: Case study. *Archives of Physical Medicine and Rehabilitation, 60,* 226–230.

Sample. N = 1 (7-year-old male with head injury, mental retardation, and triplegia; inpatient).

Inclusion/exclusion criteria. Eating with fingers and gulping food without chewing.

Baseline and procedures. Two meals; eat without assistance or verbal command in nondistracting environment.

Experimental design. Reversal.

Assessment measure. Percentage of correct feeding response; chewing thoroughly; inappropriate behaviors.

Treatment protocol. Four days (10 meals); encouragement, praise, and physical contact for correct eating; interruption/extinction and manual guidance for incorrect response.

Outcome. Increase in correct eating responses from 20% to more than 85%.

Follow-up. At 15 weeks; gains maintained.

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

Sample. N = 1 (26-month-old female, inpatient with hydrocephalus and failure to thrive).

Inclusion/exclusion criteria. Food refusal; no structural or organic problems; not self-feeding.

Baseline and procedures. Twenty sessions; no consequences except to return child to meal.

Experimental design. Multiple baseline across food group.

Assessment measure. Acceptance; expulsion; disruptive behavior.

Treatment protocol. Eleven to seventeen sessions; preferred food for acceptance of targeted food for children with selectivity; toys for acceptance and guidance of mouth open for refusal.

Outcome. Greater than 90% of bites accepted; expels decreased to 50% of intervals; grams increased from mean of .4 to 11.

Follow-up. At 12 months: increase in grams; slight decrease in acceptance.

Sisson, L. A., & Dixon, M. J. (1986a). A behavioral approach to the training and assessment of feeding skills in multihandicapped children. *Applied Research in Mental Retardation, 7,* 149–163.

Sample. *N* = 4. Age = 4–15 years. Diagnosis of mental retardation with severe behavior problems; inpatient.

Inclusion/exclusion criteria. Failure to display age-appropriate mealtime behaviors.

Baseline and procedures. Six to thirty-six sessions; food served family style; required to sample a bite before dessert; ongoing behavior management for inappropriate behavior.

Experimental design. Multiple baseline across behaviors.

Assessment measure. Percentage of intervals of napkin use, utensil use, and chewing with mouth closed.

Treatment protocol. Eleven to forty sessions; token reinforcement; verbal prompts, modeling, and manual guidance (incorrect utensil use only) for absence of target responses; praise if target response followed prompt; other inappropriate behavior ignored.

Outcome. One hundred percent across all 3 target behaviors in 1–16 sessions; independent checks of trainer compliance were 93%–97%.

Follow-up. Generalization to hospital dining room.

Sisson, L. A., & Dixon, M. J. (1986b). Improving mealtime behaviors through token reinforcement. *Behavior Modification, 10,* 333–354.

Sample. N = 6. Age = 3–13 years. Mental retardation with severe behavior problems; inpatient.

Inclusion/exclusion criteria. Failure to display age-appropriate mealtime behaviors.

Baseline and procedures. Four to twenty-one sessions; food cut into bite-sized pieces; required to finish all food; behavior management for inappropriate behavior ongoing.

Experimental design. Multiple baseline across behaviors.

Assessment measure. Percentage of intervals of napkin use, utensil use, and chewing with mouth closed.

Treatment protocol. Five sessions for napkin use, 10 for utensil use, and 18 for chewing with mouth closed; verbal instruction with praise for target response; for inappropriate response: time-out, modeling, and manual guidance with behavioral rehearsal.

Outcome. Chewing improved to 65%–90% for all but 1 subject; utensil use improved 60%–95%; napkin use improved 30%–50%.

Follow-up. At 1–4 weeks; less than treatment; better than baseline.

Luiselli, J. K. (1988a). Improvement of feeding skills in multihandicapped students through paced-prompting interventions. *Journal of the Multihandicapped Person, 1,* 17–30.

Sample. *N* = 3 (females, 8–18 years old; mental retardation with sensory impairments; residential school).

Inclusion/exclusion criteria. Slow rate of consumption; limited self-feeding.

Baseline and procedures. Three to four meals; allowed to eat without trainer interventions.

Experimental design. Reversal.

Assessment measure. Placing a portion of food into mouth; inappropriate use of hands; physical guidance for feeding.

Treatment protocol. Five sessions; paced-prompting procedure (left hand guided to return to lap, right hand guided to table directly above plate after each bite) or physically guiding the completion of a response every 40 secs without independent feeding response.

Outcome. Decrease in bites/min; increase in number of bites and self-feeding responses (37.9%–88.5%).

Follow-up. None.

Luiselli, J. K. (1988b). Behavioral feeding intervention with deaf-blind, multihandicapped children. *Child and Family Behavior Therapy, 10,* 49–62.

Sample. $N = 2$ (males, 6 and 10 years old; mental retardation and sensory impairments; residential school).

Inclusion/exclusion criteria. No self-feeding; complies with verbal requests.

Baseline and procedures. Six to eight sessions; 15 mins with no intervention; some manual assistance in locating and scooping food.

Experimental design. Reversal.

Assessment measure. Rate of independent self-feeding.

Treatment protocol. Thirteen to seventeen sessions; physical guidance when no self-feeding for 1 minute; reinforcer after prompted or independent response; interruption of stereotypy; 1 bite on plate at a time.

Outcome. Guidance, reinforcement, and interruption required for independent feeding (0–1.5 per min).

Follow-up. None.

Piazza, C. C., Andersen, C., & Fisher, W. (1993). Teaching self-feeding skills to patients with Rett syndrome. *Developmental Medicine and Child Neurology, 35,* 991–996.

Sample. $N = 5$ (females, 3–23 years old; Rett syndrome; inpatients).

Inclusion/exclusion criteria. Not self-feeding.

Baseline and procedures. Two weeks; nondistracting environment; asked to eat every 30 seconds for 10 minutes; fed remainder of meal.

Experimental design. Multiple baseline across subjects.

Assessment measure. Average score for self-feeding.

Treatment protocol. Seven weeks; 3-step guided compliance; verbal prompt, model, guidance; praise following completion of step as verbal or model.

Outcome. Improvement in self-feeding skills (1–30); however, still requires some assistance.

Follow-up. At 1 year and 2.5 years; supervision for scooping.

Luiselli, J. K. (1993). Training self-feeding skills in children who are deaf and blind. *Behavior Modification, 17,* 457–473.

Sample. $N = 1$ (7-year-old female; mental retardation and sensory impairment; special education class).

Inclusion/exclusion criteria. Unable to feed independently.

Baseline and procedures. Three meals; trainer used tactual sign; if feeding not initiated in 10 seconds, then manual guidance; fed remainder of meal after 10 trials.

Experimental design. Multiple probe across behaviors with reversal.

Assessment measure. Independent performance of 6 self-feeding steps.

Treatment protocol. Fifteen sessions; backward chaining using physical prompting; prompt fading and contingent reinforcement applied across the behaviors of inserting and scooping.

Outcome. Training increased insertion and scooping (96%–100%); generalization to transport and grasping.

Follow-up. At 1, 6, and 8 months; all steps completed over 97.3% accurate.

Kerwin, M. L., Ahearn, W. H., Eicher, P. S., & Burd, D. M. (1995). The costs of eating: A behavioral economic analysis of food refusal. *Journal of Applied Behavior Analysis, 28,* 245–260.

Sample. $N = 2$ (2.5-year-old male and 5-year-old female; complex medical problems; inpatient).

Inclusion/exclusion criteria. Total food refusal; medical treatment of organic problems.

Baseline and procedures. Twenty-five sessions; differential attention in nondistracting environment; 30-second intertrial interval; varying spoon volumes.

Experimental design. Multiple baseline across spoon volume and reversal.

Assessment measure. Acceptance; refusal; expulsion; mouth clean.

Treatment protocol. Eleven to twenty-seven sessions; positive reinforcement for acceptance; physical guidance for refusal.

Outcome. Acceptance >90% at session 1 (dipped spoon) for 1 subject and session 16 (empty spoon) for other subject.

Follow-up. At 6 months; gains maintained; amount increased; limited need for procedure.

Ahearn, W. H., Kerwin, M. L. E., Eicher, P. S., Shantz, J., & Swearingin, W. (1996). An alternating treatments comparison of two intensive interventions for food refusal. *Journal of Applied Behavior Analysis, 29,* 321–332.

Sample. *N* = 3 (1 male, 2 females; age = 2 years, 9 months to 3.5 years; complex medical problems; inpatients).

Inclusion/exclusion criteria. Total food refusal.

Baseline and procedures. Eight to twenty-five sessions; differential attention with intertrial interval of 30 seconds; disruptions blocked.

Experimental design. Multi-element and multiple baseline across subjects.

Assessment measure. Acceptance; expels; negative vocalization; disruption.

Treatment protocol. Eighteen to twenty-six meals; premeal instruction; toys for acceptance; guidance for refusal; expels replaced.

Outcome. Guidance effective (acceptance >90%); decrease in expels (65.2%–6.75%) for 2 subjects.

Follow-up. At 2–10 months; 1 did not return; 2 maintained gains with advances.

Appendix 3: Extinction Interventions

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

Sample. *N* = 2 (25 and 41 months; mental retardation; hearing impairment; Dubowitz syndrome; inpatient).

Inclusion/exclusion criteria. Total food refusal.

Baseline and procedures. Eight to nine sessions; 40–50 trials of bite to lip with verbal prompt; no differential consequences for any response OR differential attention.

Design. Reversal.

Assessment. Acceptance; interruptions; negative vocalizations; grams consumed; parent satisfaction.

Treatment protocol. Eighty to one hundred thirty sessions. Nonremoval of spoon for refusal and praise whenever spoon entered mouth.

Outcome. Greater than 70% acceptance; decrease in interruptions (95%–10%) and negative vocalizations (40%–10%); increase in grams consumed (0–100 or 300). Parents satisfied mean 4.9 out of 5. Meal duration as long as 120 minutes at beginning with bites taking more than 20 minutes.

Follow-up. At 3 and 9 months; telephone contact for parental satisfaction only (dislike procedure: one did not use it and the other only when child was ill); all nutrition administered orally.

Kerwin, M. L., Ahearn, W. H., Eicher, P. S., & Burd, D. M. (1995). The costs of eating: A behavioral economic analysis of food refusal. *Journal of Applied Behavior Analysis, 28,* 245–260.

Sample. *N* = 1 (3-year-old male with complex medical problems; inpatient).

Inclusion/exclusion criteria. Total food refusal and medical treatment of organic problem.

Baseline and procedures. Forty-seven sessions. Forty trials of bite presented to lip with verbal prompt; differential attention for acceptance and refusal; spoon volume varied.

Design. Multi-element and multiple baseline across spoon volume.

Assessment. Acceptance; refusal; expulsion; mouth clean.

Treatment protocol. Six sessions. Positive reinforcement for accepting spoon; nonremoval of spoon for refusal.

Outcome. Four session after intervention on dipped spoon, independent acceptance >80%.

Follow-up. At 6 months; maintained gains and amount consumed increased.

Ahearn, W. H., Kerwin, M. L. E., Eicher, P. S., Shantz, J., & Swearingin, W. (1996). An alternating treatments comparison of two intensive interventions for food refusal. *Journal of Applied Behavior Analysis, 29,* 321–332.

Sample. $N = 3$ (1 male, 2 females; age = 2 years, 9 months–3.5 years; complex medical problems; inpatient).

Inclusion/exclusion criteria. Total food refusal and medical treatment of organic problem.

Baseline and procedures. Eight to twenty-five sessions; trials of bite presented to lip with verbal prompt; differential attention for acceptance and refusal; disruptions blocked and level spoonfuls for each trial.

Design. Multi-element in multiple baseline across subjects.

Assessment. Accept; expels; negative vocalization; disruption.

Treatment protocol. Eighteen to twenty-six meals; premeal instruction; positive reinforcement of acceptance; nonremoval of spoon for refusal; expels replaced back into mouth.

Outcome. Independent acceptance >90%; decrease in expels (65.2%–6.75%); for 2 subjects, parents did not choose this procedure; corollary negative behaviors relatively high at initiation of treatment.

Follow-up. At 2–10 months; 1 subject did not return, other 2 maintained gains with advances.

Appendix 4: Swallowing Induction Interventions

Lamm, N., & Greer, R. D. (1988). Induction and maintenance of swallowing responses in infants with dysphagia. *Journal of Applied Behavior Analysis, 21,* 143–156.

Subjects. $N = 3$ (2 males, 1 female; age = 10–13 months; medical problems; inpatient).

Inclusion criteria. No swallow of food; tube fed; FTT

Baseline. Four days; 10 trials for 3 feeding devices; food or liquid on anterior part of tongue.

Design. Reversal/multiple baseline.

Assessment methods. Number of swallows; oral intake; weight.

Treatment protocol. Twelve sessions; forward chaining; verbal prompt; finger over lips, gums, posterior right quadrant of tongue; positive events for swallow at any time; position varied as child acquired swallowing skill; parent training protocol.

Outcome. Swallows after the first treatment: 0–52.3; ounces consumed: 0–4.4.

Follow-up. Fifteen months to 2 years; increase in swallows and ounces consumed.

Hagopian, L. P., Farrell, D. A., & Amari, A. (1996). Treating total liquid refusal with backward chaining and fading. *Journal of Applied Behavior Analysis, 29,* 573–575.

Subjects. $N = 1$ (12 years old; autism; GI problems,; inpatient).

Inclusion criteria. Total food and liquid refusal; frequent emesis.

Baseline. Three sessions; 10cc of water in cup with verbal prompt.

Design. Reversal.

Assessment methods. Acceptance, expulsion, and swallows.

Treatment protocol. Thirty-six to 125 sessions; backward chaining and fading; praise for swallowing without water; amount in syringe gradually increased.

Outcome. Swallows: 0%–100% transitioned to 3cc in cup; subject advanced to 90cc in cup.

Follow-up. None.

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