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The Use of Descriptive Analysis to Identify and Manipulate Schedules of Reinforcement in the Treatment of Food Refusal

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The feeding behaviors of a child diagnosed with failure to thrive were assessed using descriptive analysis methodology to identify the schedules of reinforcement provided by the child's parents. This analysis revealed that the child's appropriate feeding behaviors (i.e., bite acceptance, self-feeding) were on a lean schedule of positive reinforcement and that the child's refusal behaviors (e.g., non-acceptance, expulsion) were on a rich schedule of negative reinforcement. A treatment package consisting of differential positive reinforcement for bite acceptance with and without escape extinction was evaluated by manipulating the schedules of reinforcement that were identified to be used by the child's parents. The results showed a reduction of the child's inappropriate mealtime behaviors and increases in the child's acceptance of offered food items. The results also suggested that the differential reinforcement component appeared to be most responsible for ongoing effectiveness of the treatment. These results are discussed in terms of treating the food refusal behavior of children diagnosed with failure to thrive as a preventive measure for later development of developmental disabilities.

KEY WORDS: descriptive analysis; extinction; failure to thrive; positive reinforcement; schedules of reinforcement.

Among the main focuses of early intervention is to prevent "at risk" children from developing developmental disabilities and/or severe behavior problems and to promote the adaptive behaviors of these children. One "at risk" population that

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has been received little attention in the education literature are children diagnosed with Failure to Thrive (FTT). A diagnosis of FTT is given to a child when he or she does not develop normally due to improper feeding or any of a number of medical conditions that prevent the adequate assimilation of essential nutrients (Piazza, Fisher, et al., 2003). In either case, FTT results in the retardation of the child's growth and development. If FTT is left inadequately treated the child may experience developmental delays (Krugman & Dubowitz, 2003), lower IQs (Kelleher et al., 1993), behavior problems (Budd et al., 1992), and retardation of adaptive behaviors such as walking, ambulation, language development (Kristiansson & Fallstrom, 1987; Miles & Reed, 2004). Moreover, these effects can be more pronounced in the first two years of life, during the period of most rapid postnatal brain development.

One of the presenting behaviors of a child diagnosed with FTT is the refusal to eat. Once medical factors have been ruled out (e.g., metabolic disorders), the predominant hypothesis regarding a child's refusal to eat is behavioral (i.e., a learned behavior). More specifically, it is generally hypothesized that after medical factors have been eliminated, the child's refusal to eat is maintained by negative reinforcement (Ahearn, Kerwin, Eicher, Shantz, & Swearingin, 1996; Cooper et al., 1995, 1999). As a result, behavioral assessments of any potential positive reinforcers maintaining food refusal are often neglected because it is presumed that the child's food refusal is to escape or avoid food. As a result, escape extinction (e.g., non-removal of the food presented) is often emphasized as the primary behavioral treatment component (e.g., Kerwin, Ahearn, Eicher, & Burd, 1995; Piazza, Patel, Gulotta, Sevin, & Layer, 2003; Reed et al., 2004). Thus, positive reinforcement strategies alone may be insufficient to adequately treat food refusal and to increase bite acceptance (e.g., Piazza, Patel, et al., 2003; Reed et al., 2004).

One notable exception is a recent study by Piazza, Fisher, and colleagues (2003). In this investigation, the authors initially observed the parents of the children who displayed inappropriate mealtime behaviors feed their children as they normally would (i.e., a descriptive analysis). These observations revealed that the parents used a variety of consequences for their children's food refusal (e.g., reprimands, withdrawing food, offering preferred activities). Subsequent to these analyses, the authors adapted functional analysis technology (Iwata, Kahng, Wallace, & Lindberg, 2000) to further isolate and explore specific consequences on the child's inappropriate mealtime behaviors. The data from these subsequent analyses were used to create successful treatments based on the functions identified by the functional analysis for each child's food refusal behavior.

One limitation of the Piazza, Fisher, et al. (2003) investigation was that the meals used during the functional analysis were conducted with trained clinical staff. Therefore, the dynamics between the parents who typically fed the child were not used as a framework for developing the child's feeding intervention. An unaddressed issue was whether the children's display of chronic food refusal could

have been successfully remediated using only the descriptive analysis information. One of the advantages of descriptive analysis over functional analysis is that it allows clinicians to identify existing schedules of reinforcement by the parents for the child's appropriate and inappropriate behaviors (Thompson & Iwata, 2001). Based on this information, systematic modifications of the schedules of reinforcement might lead to more immediate improvements in the child's feeding behaviors. This analysis can also assist in the identification of specific care-provider behaviors that can be shaped to support the long-term implementation of the feeding intervention. That is, one can target specific care-provider behaviors to support enduring treatment effectiveness. This approach was not used in the naturalistic assessment portion of the Piazza, Fisher, et al. investigation.

There were two main purposes of the current investigation. The first was to employ descriptive analysis technology (Lalli & Goh, 1993; Thompson & Iwata, 2001) to identify the schedules of reinforcement implemented by the child's parents. These data were then used to select treatment components by modifying the schedules of reinforcement to produce reductions of the child's food refusal and to increase the child's bite acceptance. The second purpose was to ascertain if positive reinforcement strategies alone would be an effective intervention component to increase the child's oral food intake and to decrease the child's refusal behaviors.

METHOD

Participant and Setting

Sally was 20 months old, diagnosed with FTT, and was admitted to an inpatient unit for evaluation and treatment of inappropriate feeding behaviors. All meals were conducted in this setting. Developmental milestones were within normal limits and there were no medical or physiologic explanations for her poor growth. Attempts to offer food items frequently resulted in active food refusal, including pushing away the food or spoon, turning her head, and spitting out accepted bites. Due to the severity of Sally's malnutrition, nighttime nasogastric (NG) feedings (consisting of approximately 25% of her total caloric needs) were implemented during the fourth day of admission. Nighttime feedings ended several hours before the first meal of the next day.

Response Definitions and Data Collection

All meals were videotaped. Child and adult measures were collected using an event recording system. Two dependent measures were recorded. *Bite acceptance*

was defined as receipt of food into Sally's mouth either independently or when fed by an adult. Drink acceptances were not included in bite totals. *Refusal* was defined as Sally turning her head away from a bite offered within 1 in. of her mouth, pushing away the bite/spoon, or expelling from her mouth any food or drink following an acceptance. Refusals were scored as an event occurrence (i.e., multiple refusals on a single offer were scored as one event). Bite acceptance and refusal were not mutually exclusive. That is, data collection permitted the possibility for Sally to refuse a bite offer and accept the bite after the refusal (Sally could also initially accept the bite offer and then expel the bite) so that a bite offer was scored as accepted with a refusal.

Two measures of adult behavior were also scored. *Positive interactions* were defined as the provision of verbal or physical praise and/or non-food related activities (e.g., toys) following a bite acceptance. *Escape* was defined as the adult removing an offered bite by more than 6 in. from Sally's mouth, offering a different bite, or ending the meal following the occurrence of refusal behavior.

Bite acceptance was scored as the total number of bites accepted. Bite acceptance and escape were mutually exclusive. That is, if a bite was accepted, then expelled, and escape was provided (Phases 1, 3, 4, and 5), the bite was not scored as a bite acceptance but instead as an escape. Refusals were reported as the number of bite offers with refusals divided by the total number of bites offered (including independent bites) per meal.

Experimental Design and Procedures

A descriptive analysis (Lalli & Goh, 1993) was initially used in baseline to identify the components of the initial treatment. This comprised the initial baseline for the study. A reversal design (CBABC) was subsequently used to assessed the relative effectiveness of the two treatment components: differential positive reinforcement (i.e., positive interactions after bite acceptance) and escape extinction (i.e., not allowing escape from an offered bite). Finally, parent training was conducted that comprised the final treatment phase of the study.

Parent's Baseline (Phase 1)

During the initial baseline phase one of Sally's parents was instructed to conduct each meal as they normally would at home. Parents brought food from home during the first day of baseline (i.e., first three meals) and subsequent food was selected from a menu offered by the hospital with occasional selections brought from the hospital cafeteria (e.g., pizza). A variety of food items were offered during meals (e.g., starches, proteins, vegetables, and fruits), however, we did not control what items the parents selected during this phase. For safety reasons, all food items were cut into pieces no larger than a 1/2″ by 1/2″ diameter.

Baseline was conducted over seven meals. Baseline meals with Sally's parent's lasted approximately 15 min (range, 3 to 35 min) and consisted of Sally's parent presenting food items one item at a time to Sally (she was rarely permitted to eat independently). Typically, the parents would alternate bites of food, starting with items that they reported she typically would eat at home, albeit inconsistently. The variability in meal length appeared to be inversely related to whether Sally was accepting food items from her parents.

The schedules of positive reinforcement (i.e., positive interactions) and negative reinforcement (i.e., escape from offered bites) implemented by the parents were calculated in this phase and applied by therapist's in subsequent phases. The schedule of positive reinforcement was calculated as the ratio of the total number of bites accepted during the initial baseline to the total number of positive interactions following a bite acceptance. The resulting schedule of reinforcement was calculated to be a Variable Ratio 30 schedule (i.e., VR 30; there were three praise statements provided after a total of 86 bites accepted across 7 meals in the initial baseline). That is, the parent who was feeding Sally provided positive interactions, on average, approximately every 30th bite acceptance. The schedule for negative reinforcement was calculated as the ratio of the number of times a refusal behavior occurred to the number of times that a refusal behavior occurred that resulted in an escape. The resulting schedule of reinforcement was calculated to be a Variable Ratio 2 schedule (i.e., VR 2). That is, the parent who was feeding Sally provided escape from the bite offer, on average, approximately every other time they offered a food item.

Treatment (Phases 2, 3, 5, and 6)

During the treatment, nutritious high-calorie foods were offered as choices at each meal (Cooper et al., 1995). Three to four bites of each target food were placed on a plate in front of Sally with a spoon. If she touched a food or in any other way indicated a choice, she was offered that bite of food. If Sally did not indicate a choice within approximately 5 s, the therapist chose a bite of food, alternating among the choices. Food was replaced from an exhausted item when Sally consumed a bite of any other food item. Sally was prompted to eat independently by handing her the bite or the spoon of the selected food.

Staff conducted the meals without Sally's parents present consisting of the treatment procedures described below. Food items selected were based on parent selections from a menu offered by the hospital with guidance provided by a registered dietician on healthy food choices. A variety of food items were present during each meal consisting of three to five items.

All meals lasted 25 min. During escape extinction conditions meals would end after the acceptance of the last bite offered, therefore meals could extend beyond

25 min. This occurred only once, during the first meal of the initial implementation of treatment resulting in a meal lasting a total of 26 min.

Differential Positive Reinforcement and Escape Extinction (Phases 2 and 6)

Bite acceptance was placed on a Fixed Ratio 1 (FR 1) schedule of reinforcement. That is, each bite acceptance resulted in 20–30 s of positive interactions. Positive interactions were provided regardless of whether any refusal behavior occurred. In addition, refusal behaviors were placed on escape extinction. That is, if Sally engaged in a refusal behavior, the therapist followed Sally's mouth with the offered bite of food until she opened her mouth and accepted the bite. No food was forcibly placed into Sally's mouth during an initial bite offer. However, any food that was initially accepted and then expelled was replaced into Sally's mouth.

Differential Positive Reinforcement only (Phases 3 and 5)

Each bite acceptance resulted in 20–30 s of positive interactions and refusal behaviors resulted in escape from bite offers for 20–30 s and that particular food item (e.g., another food item was selected for the next scheduled bite offer) on a VR 2 schedule (i.e., the same schedule used by the parents in baseline). Thus, escape from a bite offer was permitted after approximately every other bite offer that was associated with any refusal behavior.

Therapist's Baseline (Phase 4)

During the therapist's baseline, the therapist conducted the meal using the same schedules of reinforcement used by Sally's parents during the parent's baseline (Phase 1). Bite acceptances resulted in 20–30 s of positive interactions on a VR 30 schedule and refusal behaviors resulted in escape from bite offers for 20–30 s and that particular food item on a VR 2 schedule. That is, approximately every 30th bite acceptance resulted in 20–30 s of positive interactions from the therapist and approximately every other refusal behavior resulted in escape from bite offers for 20–30 s and that particular food item.

Parent Training (Phase 7)

Parents were coached to implement the treatment package (Differential Positive Reinforcement and Escape Extinction). Both parents observed at least one treatment session prior to implementing treatment. Parent training also consisted of providing the parents with written descriptions of the treatment procedures and reading these aloud prior to the first treatment session (Sally's father was unable

to read). In addition, any questions or concerns by Sally's parents were addressed prior to each parent training session.

During the training sessions, any departures displayed by the parents from the treatment procedures were immediately corrected by the observer scoring the session (e.g., Sally accepted that bite, provide praise and interaction for the next 20–30 s). The last six meals were conducted without therapists present. However, feedback from the previous meal (via videotape) was provided to parents prior to the start of each meal (e.g., you are providing less time during breaks than the last session, make sure you provide about 20–30 s).

Given the treatment results, implementation of the Differential Positive Reinforcement component was emphasized, particularly with Sally's mother who displayed difficulties with the delivery of high quality, enthusiastic, positive interactions after Sally accepted a bite of food. Increasing the quality of Sally's mother's interactions was the focus of these extra meals (e.g., delivering more enthusiastic interactions) towards the end of parent training.

Interobserver Agreement

Interobserver agreement was scored by having a second observer (i.e., a combination of the first, second, or fourth authors) simultaneously but independently record the target behaviors. Interobserver agreement was calculated on a bite offer-by-bite offer basis. For bite acceptance, refusals and parent/therapist behaviors, occurrence agreement was calculated on a point-by-point basis by respectively dividing the number of bite acceptance and refusal agreements by the number of bite acceptance and refusal agreements plus disagreements and multiplying by 100%. Interobserver agreement was scored on at least 33% of meals in each phase. Occurrence agreement for bite acceptance averaged 95% (range, 88 to 100%). Occurrence agreement for refusals averaged 93% (range, 85 to 100%). Occurrence agreement for adult behaviors averaged 84% (range, 58 to 100%).

RESULTS

The number of bite acceptances and percentage of bite offers with refusals per meal are shown in Fig. 1. During the parent's baseline, both parents were observed to provide positive interactions for Sally's bite acceptance on a VR 30 schedule (i.e., approximately once out every 30 bite acceptances) following bite acceptances and to provide escape on a VR 2 schedule following a refusal. Bite acceptance was low ($M = 8$) and on a downward trend and refusal was high ($M = 57\%$) and variable when Sally's mother conducted meals. Bite acceptance was higher ($M = 18$) but more variable and refusal was consistently lower ($M = 27\%$) when Sally's father conducted meals.

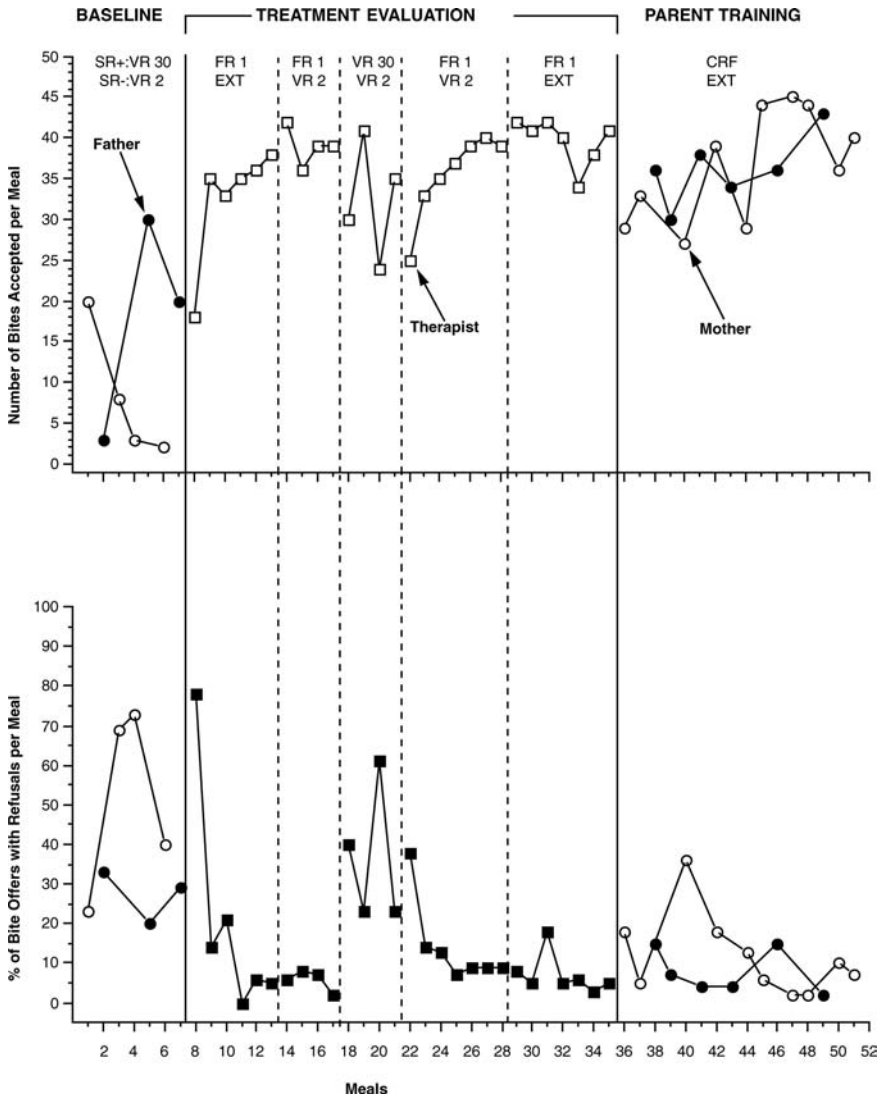

Fig. 1. Top panel: Number of bites accepted per meal during baseline, treatment evaluation, and parent training. Bottom panel: Percentage of bite offers that contained refusal behaviors during baseline, treatment evaluation, and parent training. SR+: schedule of reinforcement for bite acceptance; SR−: schedule of reinforcement for refusal; VR 30: Variable Ratio 30 schedule; VR 2: Variable Ratio 2 schedule; FR 1: Fixed Ratio 1 schedule; EXT: Escape Extinction schedule.

During the first phase of treatment (Differential Positive Reinforcement and Escape Extinction), when every bite acceptance received positive interactions (FR 1) and every refusal was exposed to escape extinction (EXT), Sally's bite acceptance increased ($M = 35$) and her refusal decreased ($M = 9\%$). In the next phase (Differential Positive Reinforcement only), when every bite acceptance received positive interactions (FR 1) but every other refusal was permitted to be escaped (VR 2), Sally's bite acceptance remained high ($M = 39$) and her refusal remained low ($M = 6\%$).

When staff implemented baseline conditions, that is, when only one in thirty bite acceptances received praise (VR 30) and every other refusal was permitted to be escaped (VR 2), Sally's bite acceptance ($M = 32$) decreased slightly and possessed greater variability and her refusal returned to levels similar to initial baseline ($M = 44\%$). When the previous treatment was re-implemented (Differential Positive Reinforcement only), praise was delivered again on a FR 1 schedule for bite acceptance (escape was still provided on a VR 2 schedule). During this phase, Sally's acceptances increased ($M = 37$) and her refusal decreased ($M = 14\%$). When the initial treatment phase (Positive Reinforcement and Escape Extinction) was re-implemented Sally's bite acceptance remained high ($M = 40$), and her refusal continued to remain low ($M = 7\%$).

Bite acceptance consistently stayed above the initial baseline levels in only 1 phase (Phase 3). However, there were overlapping data points in the other two phases (Phases 4 and 5). In the therapist baseline (Phase 4) half of the data points for bite acceptance overlapped the data points from the initial baseline. The results of the refusals provide stronger evidence suggesting that an enduring effect of extinction did not occur because refusal in the therapist baseline was comparable to the initial baseline. If extinction had enduring effects then one would expect that refusal behaviors would have remained low. Close evaluation of these three phases (Phases 3, 4, & 5) reveals that bite acceptances increased with the initial treatment plan and the withdrawal of extinction had no effect. However, the withdrawal of the FR 1 schedule of positive interactions contingent on bite acceptance resulted in immediate increases in refusal behaviors and bite acceptance decreased slightly and became more variable. Re-implementation of a FR 1 schedule for positive interactions contingent on bite acceptance resulted in immediate decreases in inappropriate behavior (as similar to Phase 2) and steady increases in bite acceptance without the benefit of extinction.

During parent training, Sally's bite acceptance remained high when either her mother ($M = 37$) or father ($M = 36$) conducted meals. Although refusal was lower than initial baseline levels ($M = 52\%$ during initial baseline; $M = 19\%$ during first 4 meals of parent training), Sally's mother received additional coaching prior to her fifth meal about increasing the quality of her positive interactions.

Prior to intervention, Sally was consuming approximately 200–300 calories daily, by mouth. Sally's caloric needs were estimated to be 925 calories per day by

the medical team and nutritionist. After treatment was initiated, Sally consumed no less than 1200 calories a day per mouth. In addition to these outcomes, the NG tube feedings were discontinued 4 days after the initiation of treatment as a result of sufficient caloric intake during the meals.

DISCUSSION

A focus of early intervention for newborns through children 3 years of age has been a mandate in recent legislation (i.e., PL 105-17 Part C). Timely identification and treatment for this population is critical for long-term remediation and prevention (Miles & Reed, 2004). The outcomes of successful treatment of food refusal behaviors for children who are diagnosed with FTT may not only improve the child's nutritional outcomes, but may prevent the child from developing developmental disabilities or behavior problems later.

We have extended the literature of on food refusal this population in 3 ways. First, we exclusively utilized descriptive analysis technology to assess and treat a child that displayed chronic food refusal. Even though the researchers in the Piazza, Fisher, et al. (2003) investigation used descriptive analysis methodologies with the children's parents, the interventions were based on the functional analyses conducted with therapists. The results of the descriptive analysis provided valuable insights into the reciprocal influence between the child and her parents in relation to bite acceptance and refusal behaviors. Specifically, the analysis showed that when Sally accepted a bite she rarely received any positive interaction. When Sally refused a bite, her parents usually withdrew the spoon or the food item, tried a different food item, or ended the meal.

A second related extension, was that we manipulated the schedules of reinforcement that were in place by the parents as an intervention. To the best of our knowledge this is a novel approach to intervention with children who display food refusal.

A third extension was that this study illustrated that positive reinforcement alone was an effective intervention for treating food refusal, one of the few studies to reach this conclusion. This is specifically shown in the second through fourth treatment phases (i.e., Phases 3, 4, and 5). Escape from offered bites was permitted on the same schedule as baseline across these phases, but when the schedule of reinforcement for positive interactions was made lean (VR 30), refusals increased and bites decreased. This suggested two possible explanations: (a) a positive reinforcement function for refusal, or (b) the "value" of escape for refusal behaviors increased when reinforcement for bite acceptance became very lean. The final treatment package included escape extinction; however, the treatment analysis suggested that the positive reinforcement component appeared to be the most responsible for treatment success. This is further evidenced by the increased

effectiveness after Sally's mother received specific training on increasing the quality of her interactions after Sally's bite acceptance.

Sally responded differentially to each parent, even though the schedules of reinforcement by both parents were similar. Possible explanations were that her father's reinforcement of bite acceptances was of greater quality than that delivered by her mother and/or that Sally experienced a different history of reinforcement from each parent. We addressed this concern with Sally's mother in parent training, however the effectiveness of the extra training emphasized "quality" interactions is speculative.

Although these results appear pronounced, there are several limitations that should be noted. First, during the initial treatment, three changes occurred at the treatment outset (parents to therapists as feeders, VR 30 to a FR 1 for positive reinforcement, and a VR 2 to escape extinction for negative reinforcement). However, within our analysis we conducted an additional baseline phase (Phase 4) with therapists to partially address the therapist change. The result for refusal was similar to baseline levels for Sally's parents during the therapist's baseline. Also, bite acceptance was lower and decreasing slightly, compared to any of the treatment phases; however they did not approach levels commensurate to the initial baseline. Given that it would have been preferable to have continued with the therapist's baseline, time constraints prevented us from evaluating this effect further.

A second limitation of the study is the use of extinction in the initial treatment phase. Some studies suggest that the effects of extinction are enduring (e.g., Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997); however our results did not appear to show this effect. After its initial implementation, three consecutive phases without escape extinction occurred. Bite acceptance remained stable during these phases, however, refusals co-varied based on whether DRA was implemented, providing some evidence that an enduring effective extinction did not occur. However, like Shirley et al. (1997), we believed incorporating both treatment components into the final treatment plan for this family increased the possibility of treatment effects being maintained. Researchers may wish to evaluate the effects of treatment with an extinction only condition to circumvent this issue. Future investigations may also benefit from evaluating the treatment components in a different order than was used in this investigation (i.e., reversing the order of phases 2 & 3 and phases 5 & 6).

An additional limitation of this study includes the absence of treatment integrity data. Reporting the data on these measures would have strengthened this study. Furthermore, we decided to collapse all topographies of refusal behaviors. Data separated by topography may provide some additional insights into the refusal behaviors for some children.

Although behavioral assessments have seldom been used to develop treatments for children who display severe food refusal, analyses of the schedules of reinforcement delivered by parents with children with food refusal may assist in

the determination treatment components to effectively combat food refusal. At the very least, these efforts can provide valuable insights into the dynamic between the child and the care providers during mealtime situations. As a result, descriptive analyses that identify schedules of reinforcement may be a beneficial undertaking for future research with this early intervention population.

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