A Component Analysis of a Feeding Intervention with Siblings as

Peer Models for Children with Autism

By

Heather Skinner

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Co-Chairperson Jan Sheldon, Ph.D., J.D.

Co-Chairperson James A. Sherman, Ph.D., BCBA-D

Pamela L. Neidert, Ph.D., BCBA-D

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The Thesis Committee for Heather Skinner
certifies that this is the approved version of the following thesis:

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Co-Chairperson Jan Sheldon, Ph.D., J.D.

Co-Chairperson James A. Sherman, Ph.D., BCBA-D

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Abstract

The prevalence of feeding problems in children with autism spectrum disorder (ASD) has been estimated to be as high as 90% (Kodak & Piazza, 2008). This can cause serious malnutrition, stress on the child and family, and limit a family's ability to engage in activities outside of the home. Various intervention methods have been used effectively to increase food consumption. Among these methods are differential reinforcement (DR) and peer modeling (PM). Two studies have been conducted that assessed the effects of PM and DR with children with ASD and both resulted in increases in food consumption (Fu et al., 2015; Sira & Fryling, 2012). However, both studies introduced DR and PM simultaneously. The purpose of the current study was to assess the differential effects of DR and PM on the eating behavior of two preschoolers with autism who engaged in food selectivity. To encourage generalization to the home environment, the peer models selected for this study were the participants' siblings. An alternating treatments design was used to evaluate the separate effects of each component, followed by a multiple baseline across food groups to evaluate the combined effects. Results indicated that both components when implemented independently were somewhat effective in increasing certain food groups, but other food groups required a combination of components to increase consumption. Once both components were combined, we observed further increases in consumption in both participants as well as generalization to one food that had never been consumed with one participant. The results suggest that the most effective intervention using PM and DR for the treatment of food selectivity in children with ASD is a combination of both components.

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Table of Contents

List of Tables and Figures

List of Appendices

A Component Analysis of a Feeding Intervention with Siblings as Peer Models for Children with Autism

Pediatric feeding disorders (PFDs) are a broad set of disorders (e.g., food refusal, food selectivity) that are classified based on the presence of clinically significant social, developmental, behavioral (e.g., elopement, aggression, turning head away, crying) (Sharp, Jaquess, Morton, & Herzinger, 2010; Silbaugh et al., 2016), or health problems (Piazza, 2008; Silbaugh et al., 2016). The causes of PFDs vary and often interact. These include both biological and behavioral variables such as medical problems (e.g., gastro-esophageal reflux disease, dysphagia) (Manikam & Perman, 2000; Piazza, 2008), skill deficits (e.g., oral motor problems, fine motor problems) (Piazza, 2008), and motivational deficits (Piazza, 2008). Feeding problems occur across multiple populations such as children who are typically developing, children with medical problems, children with intellectual and developmental disabilities (IDD) who are not diagnosed with autism spectrum disorder (ASD), and children with IDD who are diagnosed with ASD (Manikam & Perman, 2000).

Problems with feeding are extremely broad and range from being overly selective in one food group to not consuming any food by mouth. There are multiple diagnoses and types under the umbrella of PFDs that guide treatment decisions based on severity, topography, and underlying causes. These include food refusal, food selectivity (e.g., by type, by texture), oral motor delays, and dysphagia (Field, Garland, & Williams, 2003; Piazza, 2008). Food refusal is characterized by a refusal to eat all or most foods resulting in a child not meeting their caloric or nutritional needs (Piazza, 2008). Food selectivity is characterized by a strong preference for a few limited foods and rejection of less preferred and novel foods (Fu et al., 2015; Piazza, 2008). Oral motor delays consist of problems with chewing, tongue movement, lip closure, or other oral motor areas (Field et al., 2003; Piazza, 2008). Dysphagia is characterized by an inability or difficulty with swallowing. Despite the variability in diagnoses and types of PFDs, all four have been found to be amenable to behavioral intervention.

The prevalence of PFDs is a widespread problem that has been reported in 25% to 40% of all toddlers and early school-aged children (Manikam & Perman, 2000; Kerwin, 1999). However, only 3% to 10% of these children have a severe, long-term feeding problem that requires intensive intervention (Kerwin, 1999). The prevalence of PFDs in typically developing children has been reported to be as high as 35% (Bachmeyer, 2009). In children with chronic medical problems, the prevalence has been reported to be between 10% and 49% (Manikam & Perman, 2000; Patel & Piazza, 2001). Among those referred for treatment of a PFD, individuals with IDD have been reported to comprise a majority of cases (e.g., 64%, 74%; Burklow, McGrath, Valerius, & Rudolph, 2002; Field et al., 2003). The prevalence of PFDs in children with IDD has been estimated to be 33% to 85% (Bachmeyer, 2009; Fischer & Silverman, 2007; Sharp et al., 2010).

Feeding difficulties are frequently observed in individuals with ASD (Twachtman-Reilly, Amaral, & Zebrowski, 2008). Prevalence of PFDs in children with ASD has been estimated to be as high as 90% (Kodak & Piazza, 2008; Sharp et al., 2010). Almost 70% of children with ASD have been reported to engage in food selectivity (Twachtman-Reilly et al., 2008). The selective diets of these children are often comprised primarily of foods that are high in fat, sodium, and sugar, and low in nutritional content (Peterson, Piazza, & Volkert, 2016). As compared to their typically developing peers, children with ASD have significantly more and varying feeding problems (Schreck, Williams, & Smith, 2004). These include refusing more food, requiring specific utensils, requiring particular food presentations (e.g., bites cut a certain way, always the same plate), only accepting foods with low texture (e.g., pureed foods), and eating a narrow variety of foods in each food group. Data suggest that children with ASD often do not outgrow their feeding problems as they mature (Peterson et al., 2016). Thus, treatment is necessary to address these constraints.

PFDs may result in negative consequences for all children with a PFD as well as their parents or caregivers. Effects of PFDs include malnutrition (Kodak & Piazza, 2008), dehydration (Patel & Piazza, 2001), limited social interactions (e.g., lunchroom, outings), inadequate caloric and nutritional intake and growth failure (Bandini et al., 2010; Piazza, 2008), potential cognitive impairment, increased susceptibility to illness, and reduced energy (Manikam & Perman, 2000). Additionally, parents may be limited in their ability to engage in activities (e.g., meals at restaurants; Kodak & Piazza, 2008), be required to spend additional time and resources to provide meals, have increased stress regarding the health of their child (Schreck et al., 2004), and have decreased confidence in their parenting (Greer, Gulotta, Masler, & Laud, 2008). The vast and potentially serious effects of PFDs make treatment vital for a child's and family's well being.

Behavioral Interventions for Pediatric Feeding Disorders

Overview of behavioral interventions. Although the variables of behavioral interventions for PFDs are diverse, the primary emphasis of the numerous methodologies is a focus on environmental antecedent and consequent events (Silbaugh et al., 2016). Antecedent-based interventions include peer modeling (PM) (e.g., Sira & Frying, 2012), which includes another individual in the session who models the behavior and/or contingencies; high-probability instructional sequence (e.g., Ewry & Fryling, 2016), which involves presenting a number of instructions that the child will likely respond in, followed by an instruction to engage in the target behavior; and stimulus fading (e.g, Tiger & Hanley, 2006), which involves gradually changing the proportion of preferred and non-preferred foods presented together. Experimenters use stimulus fading in numerous methods. These include simultaneous presentation (e.g., Ahearn, 2003), which involves presenting the target food at the exact same time as a preferred food (e.g., mixed, one on top of the other), as well as modifications to bite presentation such as the size of the bite (e.g., Sharp & Jaquess, 2009), the texture of the bite (e.g., Kadey, Piazza, Rivas, & Zeleny, 2013), or the utensil used (e.g., Girolami, Boscoe, & Roscoe, 2007). An additional antecedent-based intervention is noncontingent reinforcement (NCR) (e.g., Sharp, Odom, & Jacquess, 2012), which involves presenting a preferred stimulus regardless of the occurrence of the target behavior.

Consequent-based interventions include differential reinforcement (DR) or sequential presentation (e.g., Pizzo, Coyle, Seiverling, & Williams, 2012), which involves presenting a preferred stimulus contingent on the child engaging in the target behavior; negative reinforcement (e.g., Vaz, Volkert, & Piazza, 2011), which involves the removal or termination of a non-preferred stimulus or activity contingent on the child engaging in the target behavior; shaping (e.g., Siegel, 1982), which is the process of gradually modifying the target behavior by providing reinforcement for successive approximations; and finally, escape extinction (EE) (e.g., Peterson et al., 2016), a procedure in which the child is no longer allowed to escape the demand of eating after an instruction has been given.

Research has been conducted using trained practitioners (e.g., Vaz et al., 2011), as well as parents (e.g., Seiverling, Williams, Sturmey, & Hart, 2012), grandparents (e.g., Kahng, Tarbox, & Wilke, 2001), and teachers (e.g., Tiger & Hanley, 2006). Similarly, research has been conducted across multiple environments including clinics (e.g., VanDalen & Penrod, 2010), schools (e.g., Greer, Dorow, Williams, McCorkle, & Asnes, 1991), and homes (e.g., Werle, Murphy, & Budd, 1993). Further, the generality of behavioral interventions for PFDs has been demonstrated by the application of methods to children with many diagnoses (e.g., ASD, cerebral palsy, Down syndrome, congenital heart disease, cleft palate) as well as typically developing children (Field et al., 2003). Discussed below are the behavioral interventions with children who are typically developing, children who have medical conditions, children who are diagnosed with IDD, and children who are diagnosed with ASD.

Interventions with children who are typically developing. Several methods have been evaluated with children who are typically developing. These include antecedent-based interventions, consequent-based interventions, and combinations of both.

Antecedent-based interventions. One method that uses antecedent manipulations, stimulus fading, involves the gradual changing of the proportion of preferred and non-preferred foods with the terminal goal of the child consuming the originally non-preferred food by itself (Tiger & Hanley, 2006). For example, if a child never ate broccoli but reliably consumed cheese, cheese could be added to broccoli to increase consumption. As the child successfully consumed the broccoli and cheese, the amount of cheese would gradually be faded until he ate the broccoli by itself. Tiger and Hanley (2006) used a similar procedure in which they added chocolate to a participant's glass of milk and then slowly faded the amount of chocolate out. Consumption remained very high throughout the pairing and fading procedure, but became more variable upon a return to baseline following complete fading. However, consumption amounts always remained above the initial baseline levels. An interesting component of Tiger and Hanley (2006) was that the teachers at the participant's preschool conducted the entire intervention. This suggests that stimulus fading may be an appropriate intervention to train others to conduct. Additionally, no direct prompts were provided.

A second antecedent-based intervention that has been used in this population is PM. This involves the addition of a model (e.g., peer, adult) who demonstrates the target behavior and/or contacts the contingency that is in place (Seiverling, Harclerode, & Williams, 2014). To increase a child's consumption of broccoli, an experimenter would place a peer at the table who would model taking bites of broccoli. In a study by Birch (1980), the results indicated that by surrounding a participant with children who had different food preferences, the experimenter was able to change the foods the participants chose during meals from preferred to non-preferred in 10 of 17 participants, affect the allocation of tablespoons consumed between preferred to non-preferred, and increase the preference for non-preferred foods (as determined by a preference assessment) in 12 of 17 participants.

Consequent-based interventions. In addition to antecedent-based procedures, multiple consequent-based procedures have been studied with this population. Among these, reinforcement procedures have been evaluated frequently in the literature. DR or sequential presentation involves providing the child with a preferred stimulus (e.g., food, toy, activity, praise) contingent on the child engaging in the specified behavior (e.g., consuming a bite of food; Kelley, Piazza, Fisher, & Oberdorff, 2003). For example, if a child usually ate M&Ms, but never ate broccoli, the M&M would be provided only after he ate a bite of broccoli. During the positive reinforcement condition in the Kelley, Piazza, Fisher, and Oberdorff (2003) study, the experimenters provided the participant with a spoon of peaches (i.e., a highly-preferred food) contingent on drink consumption. Consumption increased to 100% following implementation of the contingency.

Procedures including another type of reinforcement, negative reinforcement, involve the removal or termination of a non-preferred stimulus or activity contingent on the child engaging in the target behavior (Kelley et al., 2003; Vaz et al., 2011). For example, to increase a child's consumption of broccoli (a non-preferred food), he could be allowed to leave dinner (a non-preferred activity) immediately following one bite of broccoli. Vaz et al. (2011) increased consumption and self-feeding of target foods in a typically developing 6-year-old using an avoidance intervention that manipulated the response effort of consumption. The experimenters provided the participant the option of self-feeding one bite of target food (i.e., determined by a preference assessment to be non-preferred, but not previously targeted for intervention) to avoid being fed one bite of the target food plus five bites of the avoidance food (i.e., non-preferred and refused when targeted previously). Although a change in avoidance food was necessary to increase the final two foods, results indicated that the negative reinforcement contingency was effective in increasing self-feeding in three target foods.

A final consequent-based procedure evaluated with children who are typically developing is shaping. Shaping is a procedure in which gradual modifications of the target behavior (e.g., swallowing a bite) are produced by reinforcing successive approximations (Catania, 2013). An example of the use of shaping to get a child to eat broccoli would be to first reinforce touching the food. When the child was successful at this step, the experimenter would then require him to pick up the food, then touch the food to their tongue, then place the food in their mouth, and finally take a bite of it. Following an ineffective DR procedure using television and family time as the reinforcers, Siegel (1982) implemented a shaping procedure (with the same reinforcers) that included requiring the participant to smell the plate of food, touch a piece of food to his tongue, place a piece of food in his mouth, chew a bite, swallow a bite, and finally, increase the amount consumed. This procedure was effective in increasing consumption as well as decreasing disruptive behavior (e.g., gagging, vomiting).

Combination interventions. To increase the probability of further behavior change, experimenters often have combined the previously discussed procedures into treatment packages. Among all of the studies that contain multiple procedures, DR, EE, or both, are reliably one of the components included. For example, Mueller, Piazza, Patel, Kelley, and Pruett (2004) combined a DR procedure with EE followed by blending and stimulus fading for the first participant, and NCR with EE followed by blending and stimulus fading for the second participant. Groff, Piazza, Volkert, and Jostad (2014) used stimulus fading, DR, and EE to teach one child to consume solid foods from a spoon and liquids from a cup. Experimenters have used DR and PM to intervene in a school-wide lunchroom setting (Hendy, Williams, & Camise, 2011) and a preschool classroom setting (Horne et al., 2011). Seiverling et al. (2014) used a combination of PM, DR, and EE to increase consumption with one participant. Mueller et al. (2003) taught parents to use DR and EE for 11 participants and NCR and EE for one participant. Greer et al. (1991) used DR and PM (school peers) in a preschool environment to increase consumption in one participant. The experimenters evaluated DR and PM in two ways: peer-mediated (bites alternated between model and participant) and peer-modeling (bites were given at the same time). The data suggested that the DR and peer-mediated intervention was the most effective in increasing consumption.

Interventions with children who have medical conditions. A second population for which feeding interventions are commonly necessary is children with medical conditions. Although the procedures used are often the same as with children who are typically developing, there are very few published studies within this population that evaluate one method (antecedent or consequent) independent of other components.

Antecedent-based interventions. Both of the studies that include independently evaluated antecedent interventions involved a modification to the way in which the bite was presented (e.g., type of utensil, texture of food). For example, the way broccoli is presented could potentially influence a child's behavior. An experimenter could present it several ways (e.g., on a plate, on a spoon, on a fork) and evaluate the effects. The abundance of presentation modifications could potentially be a product of the differences in topographies of PFDs within this population as well as the number of participants who have oral motor difficulties. Although there is literature evaluating typical food refusal or selectivity, many participants in this population have behavior problems such as packing (i.e., holding food in mouth and not swallowing) (Kadey et al., 2013), expulsions (i.e., food being outside of mouth after it has already been placed in mouth) (Girolami, Boscoe, & Roscoe, 2007), or skill deficits such as an inability to chew or swallow.

The different antecedent manipulations used include presenting food on a brush or a spoon (Girolami et al., 2007) and changing levels of textures (e.g., pureed versus solid) (Kadey et al., 2013). For example, Girolami et al. (2007) evaluated the effects of presenting and re-presenting food on a Nuk® brush versus a spoon on the number of expulsions emitted by a child with multiple medical conditions (i.e., gastrostomy-tube dependent, premature birth, gastroesophageal reflux, tracheomalacia, bronchopulmonary dysplasia, pneumonia, a Nissen fundoplication). The Nuk® brush resulted in fewer expulsions when used for re-presentation of expelled food and even fewer expulsions when used for the initial bite presentation.

Consequent-based interventions. Of the methods that were evaluated independently, only one study isolated a consequent intervention. The notable exception, Riordan, Iwata, Finney, Wohl, and Stanley (1984), used a procedure consisting of simultaneous presentation that was gradually faded to sequential presentation to increase consumption and decrease disruptive behaviors in three children (of the four total) who were diagnosed with medical conditions (i.e., chromosomal aberration, seizure disorder and left hemiplegia, hydrocephalus). Consumption increased and expulsion and disruptive behaviors decreased in all four participants. Additionally, maintenance was observed in three of the participants during follow-up.

Combination interventions. As previously mentioned, the overwhelming majority of literature with children who have medical diagnoses involves a combination of methods. Similar to the literature with children who are typically developing, DR, EE, or both, are reliably one of the components included in the interventions with children who have medical diagnoses. DR has been used with shaping (Bernal, 1972), PM (Greer et al., 1991), and punishment via response cost (Kahng et al., 2001). Kahng et al. (2001) implemented a procedure that included both DR and response cost with a child who was diagnosed with mild to moderate mental retardation and failure to thrive and was reliant on a gastrostomy-tube (G-tube) for 100% of his caloric intake. The experimenters provided preferred items to the participant at the beginning of each session. If the participant engaged in problem behavior, the items were removed (i.e., response cost). Additionally, when the participant consumed the next bite without problem behavior, the items were delivered again (i.e., DR). The intervention led to an increase in consumption, a decrease in problem behavior, and a decrease in the amount of food the participant was receiving through his G-tube. A noteworthy component of this intervention was that the participant's mother and grandmother were trained to implement the procedures and the behavior change maintained.

EE has been used with multiple manipulations of bite presentation (Nuk® brush; Sevin, Gulotta, Sierp, Rosica, & Miller, 2002; spoon distance fading; Rivas, Piazza, Patel, & Bachmeyer, 2010) and with NCR and manipulations of bite presentation (food type and texture; Patel, Piazza, Santana, & Volkert, 2002). Physical manipulations (e.g., chin prompt) have been used with EE both with other components (i.e., flipped spoon with NCR; Dempsey, Piazza, Groff, & Kozisek, 2011), as well as without other components (Wilkins, Piazza, Groff, & Vaz, 2011). Another method that has been used with EE is the high-probability instructional sequence (Dawson et al., 2003; Patel et al., 2006). A final combination that has been evaluated is EE and NCR. Reed et al. (2004) compared the separate and combined effects of EE and NCR with three children diagnosed with varying medical conditions (e.g., poor oral intake, failure to thrive, severe food allergies, nasogastric-tube dependence, G-tube dependence) and one with IDD. Results indicated that EE was more effective than NCR when they were evaluated individually. However, the combination of EE and NCR produced higher consumption of foods in one participant as well as lower rates of problem behavior in three participants, suggesting that EE was necessary to cause behavior change, but that NCR enhanced the effects.

EE and DR have been used together along with many other methods. First, they have been used with multiple methods of bite presentation manipulations such as a flipped spoon (Rivas, Piazza, Kadey, Volkert, & Stewart, 2011; Sharp et al., 2012), a bristled massaging toothbrush (Gulotta, Piazza, Patel, & Layer, 2005), and texture fading (Patel, Piazza, Layer, Coleman, & Swartzwelder, 2005; Shore, Babbitt, Williams, Coe, & Snyder, 1998). Second, DR and EE are often used simultaneously using positive reinforcement (Ahearn, Kerwin, Eicher, Shantz, & Swearingin, 1996; Coe et al., 1997; Patel, Piazza, Martinez, Volkert, & Santana, 2002; Vaz et al., 2012) and negative reinforcement (Rivas et al., 2014), added sequentially (i.e., DR and then DR plus EE; Hoch, Babbitt, Coe, Krell, & Hackbert, 1994), as well as evaluated separately and then together (LaRue et al., 2011; Piazza, Patel, Gulotta, Sevin, & Layer, 2003). Piazza et al. (2003) evaluated the separate and combined effects of DR and EE with four children diagnosed with medical conditions (e.g., gastroesophageal reflux, deficiencies in pancreatic enzyme activity, iron deficiency, severe immune deficiency, lymphopenia, nystagmus, torticollis, failure to thrive) who engaged in total food refusal. When the components (i.e., DR and EE) were evaluated separately, Piazza et al. (2003) found that EE was necessary to increase consumption. However, similar to Reed et al. (2004), the addition of DR to EE resulted in lower rates of problem behavior in two of the four participants.

Interventions with children who are diagnosed with an intellectual and developmental disability. A third population in which feeding interventions have been evaluated is children who are diagnosed with an intellectual or developmental disability. More specifically, research has been conducted across many populations such as those with cerebral palsy, Down syndrome, Riley-Day syndrome, Angelman's syndrome, and Pierre Robin syndrome (Field et al., 2003; Manikam & Perman, 2000). In an analysis conducted by Field et al. (2003), the most common type of PFD in children with Down syndrome or cerebral palsy was oral motor delays. Due to the commonality of deficits in oral motor development (e.g., poor lip closure, muscle rigidity or weakness, poor tongue movement), the interventions used tend to address motor ability. Similar to the methods used with children who have medical conditions that were previously discussed, there are very few published studies that evaluate one independent variable by itself with individuals with IDD. Of the studies that do evaluate a single variable, none are antecedent-based interventions.

Consequent-based interventions. Several consequent-based interventions have been evaluated with this population. The most common intervention that has been evaluated is differential reinforcement (e.g., Brown, Spencer, & Swift, 2002; case 1, Riordan et al., 1984; Werle et al., 1993). Werle et al. (1993) trained three mothers to use "contingent attention skills" to address their children's selective eating. The mothers were trained to provide "positive attention" (e.g., praise, preferred foods, games) contingent on appropriate eating behaviors, withdraw attention following disruptive eating behaviors, and provide clear instructions to consume the targeted food. The intervention produced increases in all three children's consumption of targeted foods and an increase in self-feeding in one participant. All three of the mothers who served as therapists increased the fidelity with which they implemented the intervention (i.e., increased the number of times they offered non-preferred foods, increased the number of specific instructions they delivered, increased rate of "positive attention").

A second consequent-based procedure is negative reinforcement. Voulgarakis and Forte (2015) evaluated the use of a negative reinforcement contingency with one child with cerebral palsy. The experimenters arranged each session with a pre-determined bite criterion that resulted in escape from the meal. The participant was first asked to consume five bites of a non-preferred food before he could be done with his meal. A changing criterion design was used and the intervention resulted in consistent compliance with up to a 12-bite requirement.

Combination interventions. Many combinations of independent variables have been evaluated with children with IDD. EE is a very common component in these interventions. EE has been used with multiple manipulations of bite presentation (flipped spoon/upright spoon/brush, Sharp, Harker, & Jacquess, 2010; spoon or Nuk, Wilkins et al., 2014) as well as physical manipulations (e.g., chin prompt; Wilkins et al., 2011). As previously discussed, Reed et al. (2004) evaluated the separate and combined effects of EE and NCR with four participants, one of whom was diagnosed with IDD. Cooper et al. (1995) conducted a component analysis using EE, DR, NCR, and choices. EE and DR have been evaluated together as a treatment package (Anderson & McMillan, 2001; Vaz et al., 2012) as well as together with a prompt method involving a swallow inducing avoidance response (Hoch, Babbitt, Coe, Ducan, & Trusty, 1995). In a novel combination of DR and EE, Kahng, Boscoe, and Byrne (2003) used a token economy, EE in the form of physical guidance, and differential negative reinforcement (i.e., escape contingency) to increase consumption of a 4-year-old with food refusal. Following unsuccessful intervention attempts using differential positive reinforcement (i.e., praise) and differential positive reinforcement plus EE, the treatment package (i.e., tokens, EE, differential negative reinforcement) resulted in increases in consumption and decreases in disruptive behavior

Interventions with children who are diagnosed with autism spectrum disorder. Within the IDD population, feeding difficulties are often observed in individuals with ASD (Twachtman-Reilly, Amaral, & Zebrowski, 2008). Because of this, a final population in which feeding interventions have been evaluated is children with ASD. Because of the high prevalence (i.e., 90%) of PFDs in children with ASD, finding effective interventions is imperative. Consequently, many methods have been evaluated with children in this population.

Antecedent-based interventions. An antecedent-based intervention that is based on the theory of behavioral momentum is high-probability instructional sequence. This methodology involves presenting the child with instructions that he or she is likely to comply with immediately before presenting the child with the low-probability instruction (e.g., a bite of non-preferred food) (Ewry & Fryling, 2016; Meier, Fryling, & Wallace, 2012; Patel et al., 2007). For example, if a child liked M&Ms, macaroni and cheese, and chicken nuggets, but did not like broccoli, the experimenter could instruct the child to eat a bite of M&Ms, then macaroni and cheese, then chicken nuggets, and then broccoli immediately following. In a recent study, Ewry and Fryling (2016) found that presenting three bites of preferred food (high-p) immediately before presenting a bite of non-preferred food (low-p) increased the consumption of non-preferred foods in a teenager with ASD. Additionally, his parents were trained to implement the intervention and consumption remained high.

Another antecedent-based procedure, NCR, involves the delivery of a preferred stimulus either continuously or on a predetermined schedule, regardless of the behavior that is occurring. For example, a child could be given access to their favorite ball (i.e., a highly-preferred stimulus) for the entire session and the child would continue to have access to the ball regardless of whether he or she consumed the bite or engaged in problem behavior. Wilder, Normand, and Atwell (2005) evaluated this method with a child with ASD who engaged in self-injurious behavior (SIB) and food selectivity. The intervention produced large decreases in problem behavior as well as increases in consumption of non-preferred foods.

Stimulus fading has also been evaluated with children with ASD. Luiselli, Ricciardi, and Gilligan (2005) evaluated the effects of gradually fading a preferred drink, Pediasure®, out of a mixture of Pediasure® and milk. The participant's parents had given her a 50% Pediasure®/50% whole milk mixture previously, but had been unsuccessful at fading the Pediasure®. An 8-step fading protocol was successful in increasing milk consumption and resulted in the participant drinking milk by itself (i.e., Pediasure® was completely faded out).

A type of stimulus fading, simultaneous presentation, has also been evaluated. In this procedure, a non-preferred food is presented with (e.g., on the same utensil, blended, on top of) a low-preferred food. For example, to increase consumption of broccoli, a piece of broccoli could be served on the same fork as a piece of chicken (i.e., a preferred food). One study has evaluated this method with children with ASD. Ahearn (2003) increased consumption of vegetables (i.e., non-preferred food) in a child with ASD by adding preferred condiments (i.e., ketchup, barbecue sauce, salad dressing) on the vegetables.

Consequent-based interventions. Numerous consequent-based interventions have been evaluated with children with ASD. The most commonly evaluated method is DR or sequential presentation (Levin & Carr, 2001; Pizzo et al., 2012; Wood, Wolery, & Kaiser, 2009). In an interesting demonstration of this methodology, Levin and Carr (2001) manipulated both the establishing operations as well as the consequences for eating non-preferred foods. They manipulated two variables related to consumption: access to preferred or non-preferred food prior to the meal and the availability of reinforcement (i.e., the participants' top three preferred snacks) following consumption. The experimenters found that both deprivation of the preferred item and a reinforcement contingency were necessary to increase consumption of non-preferred foods. All three participants consumed two non-preferred foods following intervention. Additionally, the experimenters conducted a functional analysis at the beginning of the study and hypothesized that the function of problem behavior was escape from demands. To address the escape function, another component of the intervention was the gradual increase of bite size contingent on successful sessions. The experimenters proposed that by gradually increasing the size of the non-preferred food (i.e., aversive stimulus), the participant would not engage in problem behavior because escape would not be as valuable. Although problem behavior decreased during intervention, the effect of bite size on problem behavior was not systematically evaluated.

Researchers have suggested that most mealtime problem behavior is maintained by access to negative reinforcement in the form of escape (Bachmeyer et al., 2009). EE, a procedure in which the child is no longer allowed to escape the demand of eating, is a feeding intervention commonly used to address PFDs. For example, one type of EE, nonremoval of the spoon (NRS), involves the experimenter continuing to hold the bite of food in front of the child's mouth for an extended amount of time until the bite is accepted. If a participant's target food was broccoli, the bite of broccoli would be held in front of the child's mouth until he or she consumed it, regardless of the behavior the child was emitting. This procedure has been evaluated independently with children with ASD in two studies (Peterson et al., 2016; Tarbox, Schiff, & Najdowski, 2010). In a recent evaluation of this methodology, Peterson et al. (2016) compared applied behavior analysis (ABA) to a modified sequential oral sensory approach (M-SOS), a 12-week program composed of systematic desensitization and play that conceptualizes food as an anxiety-provoking stimulus. The ABA intervention involved an EE procedure consisting of NRS and representation. If the participant did not accept the bite independently in 8 s, the experimenter first used hand-over-hand prompting to direct the bite, and then held the bite in front of the participant's mouth without the participant's hand if needed until the bite was consumed (i.e., EE in the form of NRS). If bites were expelled, the experimenter hand-over-hand prompted the participant to scoop up the expelled bite and put it back in the participant's mouth. ABA procedures consisting of EE resulted in increased consumption and decreased problem behavior in three children who began with the ABA intervention, although one participant required additional components (see combined methodology, p. 16), as well as three participants who were first exposed to the M-SOS intervention and then the ABA (i.e., EE) intervention. The ABA intervention, as compared to the M-SOS intervention, resulted in greater increases in a much shorter amount of time. Following treatment, parents were trained to implement the ABA procedure. However, data were not provided on the implementation of the intervention by parents.

Combination interventions. Similarly to the three populations (i.e., children who are typically developing, children diagnosed with a medical issue, children with IDD) previously discussed, the majority of research conducted with children with ASD includes interventions with multiple components. Again, DR, EE, or both, are reliably one of the components included in the interventions with children with ASD.

The majority of studies within this population involve interventions that include both EE and DR. EE and DR have been evaluated both when they were combined simultaneously (Vaz et al., 2012) as well as sequentially (i.e., first DR, then EE, then DR plus EE; Seiverling, Kokitus, & Williams, 2012). Similarly, EE and DR have been evaluated with modifications to the timing (i.e., simultaneous and delayed/sequential) of reinforcement (i.e., highly preferred food). Again, these components have been evaluated when introduced simultaneously (Kern & Marder, 1996) as well as sequentially (i.e., sequential and simultaneous were compared, then EE was added to both; Piazza et al., 2002; VanDalen & Penrod, 2010). Allison et al. (2012) compared DR plus EE to NCR plus EE. PM has been evaluated in an intervention including EE and DR (Fu et al., 2015). A final method that has been evaluated several times with EE and DR is demand fading (Freeman & Piazza, 1998; Najdowski, Wallace, Doney, & Ghezzi, 2003; Penrod, Wallace, Reagon, Betz, & Higbee, 2010; Valdimarsdottir, Halldorsdottir, & Sigurdardottir, 2010). In an interesting application of this methodology, Penrod et al. (2010) conducted a sequential component analysis in which they first introduced DR plus bite fading (i.e., increased bite requirement), then DR plus bite fading plus reinforcer manipulation (i.e., access to whole plate of highly preferred food instead of just one small piece), then finally, DR, bite fading, reinforcement manipulation, and EE. One participant began consuming the target foods during the second phase (i.e., DR, bite fading, reinforcer manipulation). Thus, they were not exposed to the phase that included EE. However, the other two participants required the addition of EE for increases in consumption to be observed.

DR has been evaluated with a number of other components. It has been evaluated with PM (Sira & Fryling, 2012), simultaneous presentation with (Najdowski, Tarbox, & Wilke, 2012) and without (Buckley & Newchok, 2005) texture fading, and demand fading or shaping (Barahona, DuBard, Luiselli, & Kesterson, 2013; Knox, Rue, Wildenger, Lamb, & Luiselli, 2012; Koegel et al., 2012; Tanner & Andreone, 2015). Penrod, Gardella, & Fernand (2012) combined DR, demand fading, and the high-probability instruction sequence to increase consumption of non-preferred foods with two participants. All instructions (i.e., low-probability and high-probability) involved engaging in responses relevant to consumption of the target foods and followed a shaping progression. For example, one high-probability instruction was “kiss the food” whereas the low-probability instruction was “take a bite”. Consumption of the target food resulted in praise and access to a highly preferred food. Additionally, the requirements to access reinforcement were gradually increased (i.e., demand fading). The intervention produced increases in consumption in both participants and maintained when one participant’s mother introduced the intervention at home.

EE is usually combined with DR. It has, however, been evaluated without DR in a small number of studies. Although DR was not included in these studies, an additional component to reduce the establishing operation for escape was consistently included. These components include NCR with size and texture modifications (Sharp & Jaquess, 2009), demand fading

(Seiverling et al., 2012), and an avoidance contingency with backward chaining (Peterson et al., 2016). As previously mentioned, one participant in Peterson et al. (2016) required additional components to be added to the original intervention (i.e., EE in the form of NRS) before increases in consumption were observed. Following refusal of the target food, an avoidance contingency was implemented that involved the experimenter feeding the participant one bite of the target food plus four bites of the same food that was pureed. When independent consumption still remained at zero, a backward chaining procedure was implemented. After the third component (i.e., backward chaining) was added, the participant began to independently consume the target foods. Thus, an intervention consisting of EE, an avoidance contingency, and backward chaining was successful in increasing consumption in one child with ASD when EE alone was not effective.

Selecting the most effective behavioral intervention. Although results of prior research are extremely promising when treating PFDs, the majority of studies introduce multiple components within a treatment package, thus making it unclear which independent variables are necessary for behavior change. As seen in the above review, few studies have evaluated the individual effects of common independent variables used for feeding interventions. Evaluating independent variables by their separate effects is important for several reasons. First, the efficiency of interventions is important, especially when treating children who do not consume enough to meet their nutritional needs. Understanding which variables are necessary for behavior change is vital for effective treatment. Second, the ease of implementation when training others should be considered. Children need to eat across many environments and with many caregivers. It is important that other caregivers are trained to implement effective interventions across environments and that they are able to implement them with high fidelity. For example, a classroom teacher who is responsible for many students during a lunch period is more likely to be able to implement an intervention with fidelity when it is composed of one or two components as compared to an intervention that requires her to implement five different components.

Even though the importance of evaluating independent variables is clear, it can be challenging to determine which methods to select. Across all three populations included in the previously discussed literature, the two most common procedures were DR and EE. Further, EE was frequently hypothesized to be the main controlling independent variable responsible for behavior change (e.g., Piazza et al., 2003; Reed et al., 2004; Seiverling et al., 2012). Because many individuals' feeding related problem behavior is maintained by escape (i.e., negative reinforcement), EE is often effective in quickly bringing about changes in consumption.

Although there are benefits associated with EE, there are also limitations. A major concern when implementing EE is the possibility of an extinction burst, a temporary increase in intensity, frequency, or duration of problem behavior (Lerman & Iwata, 1995). EE has also been associated with agitated and emotional behavior (Reed et al., 2004), crying, and aggression (Allison et al., 2012). Clinicians and experimenters must weigh the benefits and potential issues before using EE. It may be possible that treatment decisions can be made based on the severity of the PFD presented in each individual (Penrod et al., 2010; Silbaugh et al., 2016). For example, if the individual referred for treatment is not receiving the nutrients he or she needs to survive, EE may be worth the potential issues. However, if possible, less intrusive methods should be evaluated.

Two additional considerations to weigh when deciding whether to include EE is the location of the intervention and who will be implementing the intervention. Because of the challenges associated with EE, treatment should only be administered under the supervision of a trained professional (Kodak & Piazza, 2008). Issues with treatment integrity may likely occur, especially outside of a controlled clinic and with people who may not be trained to respond to extinction induced behavior. Low treatment integrity of an EE intervention can result in intermittently reinforcing and consequently increasing problem behavior. Additionally, parents or caregivers may feel that EE methods are intrusive and discontinue services or decide to not implement them at home or school. Thus, evaluating interventions that do not involve EE is very clinically relevant.

In order to compete with the motivating operation for escape from eating, consumption must result in a high level of reinforcement for the individual. A DR procedure, differential reinforcement of alternative behavior (DRA), is one way to increase the motivation to consume a non-preferred food. When DRA is used in feeding interventions, the stimulus selected as a potential reinforcer is generally a small bite of a highly-preferred food or a short amount of time with a highly-preferred tangible item. A challenge with feeding behavior is the frequency with which it needs to occur to maintain the health of an individual. Because of this, simply increasing the magnitude (e.g., time, quantity) of reinforcement or terminating the session (i.e., negative reinforcement) following one target response (e.g., a bite of preferred food) may be counter therapeutic. Manipulating the reinforcer value alone may not be sufficient or possible when treating PFDs. Therefore, it is important to evaluate additional ways motivation for consuming non-preferred foods can be enhanced.

One possible way to enhance motivation is to add an antecedent manipulation. As previously mentioned, PM, in which a peer is present to model the behavior or contingencies, is an antecedent arrangement that has been evaluated in previous literature. Although PM has been successful with children with ASD at teaching many other behaviors (e.g., pretend play, Reagon, Higbee, & Endicott, 2006; Taylor, Levin, & Jasper, 1999; social play interactions, Oppenheim-Leaf, Leaf, Dozier, Sheldon, & Sherman, 2012; expressive labeling of actions, professions, and opposites, Jones & Schwartz, 2004; shoe-tying, Rayner, 2011b; matching coins, responding to questions in a group discussion, and preparing a snack, Rayner, 2011a; imitation and joint engagement, Ferraioli & Harris, 2011; Walton & Ingersoll, 2012), it has not been extensively evaluated with children diagnosed with autism who have PFDs. Two notable exceptions (Fu et al., 2015; Sira & Fryling, 2012) expanded on previous research that used PM and DR with children who were typically developing as well as children who had medical issues (Greer et al., 1991; Seiverling et al., 2014) by evaluating this methodology with children with ASD.

First, Sira and Fryling (2012) evaluated the effects of PM and DR on the consumption of non-preferred foods by one child with ASD who engaged in selective eating. The peer model in this study was the participant's younger, typically developing sister. The participant's mother selected three foods (i.e, spaghetti, hamburger, scrambled eggs) to be targeted that were exposed to intervention in a multiple baseline design. The participant and his sibling were seated together at the family table for intervention sessions. Following a preference assessment, the experimenter first gave the sibling a bite and told her, "Take a bite." When the sibling complied, a preferred food or tangible item was delivered. Immediately following this interaction, the participant was given the same bite with the same instruction "Take a bite", followed by a preferred food or tangible item if that bite was consumed. This continued until both the sibling and the participant had been given 10 bites. After behavior change was observed when implemented by the experimenter, the participant's mother was trained to implement the intervention and follow-up data were also collected. Consumption of all three foods was increased and maintained at 100% during a two-month follow-up.

A second study, Fu et al. (2015) evaluated the effects of PM, DR, EE (i.e., NRS), and statement of rules and contingencies on the consumption of non-preferred foods by two children with ASD who engaged in selective eating. The method was similar to Sira and Fryling (2012) with the following exceptions: the model was an adult, the bites were presented to the model and the participant simultaneously, four bites of food had to be consumed before reinforcement was delivered, and the model demonstrated the NRS following problem behavior contingency. In the modeling plus DR phase, two plates of food with four bites at a time were placed in front of both the model and the participant. After the contingency was stated (i.e., "If you finish all of your [food], you can pick one of your favorite treats, and you can play with [preferred item]"), the model demonstrated appropriate consumption. Following consumption of all four bites, a preferred food and 3 min of a preferred tangible were given. In the modeling plus DR plus NRS phase, the same contingency was stated as before except "but if you don't eat your [food], I will have to help you" was added. If the participant did not begin eating within 5 s, the model would engage in an inappropriate behavior. The experimenter would then give a model prompt, then a warning of NRS, followed by the experimenter placing the food in front of the models mouth until (e.g., 30-60 s) the model consumed it. After all four bites were consumed, reinforcement was given to the model. If the participant did not begin eating in the 5 seconds following the model receiving reinforcement, the same NRS procedure would have been implemented. However, neither participant ever had to be exposed to it. One participant began consuming non-preferred foods during the modeling plus DR phase. The second participant did not show a large increase until he observed the model contacting the NRS contingency.

Although both of these studies (i.e., Fu et al., 2015; Sira & Fryling, 2012) had positive outcomes across all participants, there were some limitations. First, the multiple components of each intervention were introduced as a package. Because of this, it is unclear which variable was controlling behavior or if all variables were necessary components. Second, the food selected for intervention was fairly limited. Sira and Fryling (2012) only intervened on three foods that were all in the same food group (i.e., protein). Fu et al. (2015) improved upon Sira and Fryling (2012) by selecting six target foods per participant. However, neither participant was served protein. Third, the number of trials (i.e., bites) per session was minimal. Sira and Fryling (2012) conducted 10 bites sessions and Fu et al. (2015) conducted 12 bite sessions. Thus, a normal meal duration or amount was not reflected. Fourth, the participants in both studies all had fairly extensive repertoires. All three participants had well-developed verbal repertoires, the ability to follow complex or multi-step instructions, and strong imitative repertoires. This could potentially limit the generality of results in future replications.

Purpose

As discussed previously, methods that have been commonly used in feeding literature are EE and DR. Based on the limitations associated with EE, we wanted to evaluate an intervention that did not include that variable. Previous literature suggests that the addition of PM to DR can produce increases in consumption. However, because the two variables have always been implemented simultaneously, the primary purpose of the current study was to evaluate both the separate and combined effects of DR and PM on the consumption of non-preferred foods in children with ASD who engage in food selectivity. To accomplish this and to expand Sira and Fryling (2012) and Fu et al. (2015), we attempted to isolate the most effective variable by initially evaluating the two independent variables (i.e., PM, DR) separately using an alternating treatment design.

We addressed the previously mentioned limitations of Sira and Fryling (2012) and Fu et al. (2015) in several other ways. First, we selected multiple target foods across four food groups (i.e., dairy, fruits, proteins, vegetables). Second, we increased the number of trials to more closely approximate a meal. Third, the two participants, one of whom did not have a vocal verbal repertoire, were less homogenous than the participants in Fu et al. (2015) and Sira and Fryling (2012).

Additionally, similarly to Sira and Fryling (2012), siblings were selected to serve as peer models. However, unlike Sira and Fryling (2012), the siblings in the current study were older than the participants. Siblings were hypothesized to be good peer models for multiple reasons. First, siblings are natural, long-term partners (Shivers & Plavnick, 2015) from whom children often learn. Second, siblings are frequently with the child across many environments, allowing for many opportunities to practice skills. Third, according to Jones and Schwartz (2004), two of the factors that have been found to influence the efficacy of peer models for children with disabilities are the nature of the model/learner relationship and the length of the model/learner relationship. Presumably, choosing a sibling as a peer model could positively influence these two factors. Finally, siblings may serve as a common stimulus to promote generalization across environments (Stokes & Baer, 1977). Therefore, an additional goal of the current study was to develop an intervention that would include siblings.

Method

Participants

Two participants, Carter and Marshall, participated in this study. Participants were recruited from a university-based early intervention preschool based on the following selection criteria: (a) between the age three and eight, (b) have a diagnosis of ASD, (c) have an older sibling, (d) possess an imitative repertoire, (e) able to manipulate utensils, and (f) have a history of food selectivity. The experimenter obtained informed consent from both participants' parents prior to beginning sessions. An independent professional diagnosed both participants with ASD. Prior to the start of the study, both of the participants' parents reported that their child did not have any food allergies, that they were not underweight, nor did they have any diagnoses that would prevent them from safely self-feeding. Because of this and the participants engaging in food selectivity, not food refusal, additional medical evaluations were not conducted. At the beginning of the study, both participants attended a university-based early intervention preschool for children with ASD. During their time there, they received 37.5 hours a week of intensive one-on-one applied behavior analysis teaching. Throughout the course of the intervention both participants transitioned into a public school kindergarten classroom.

Carter was a 7-year-old boy. He had the ability to self-feed foods of varying textures, drink from a cup, and use utensils appropriately. His diet, however, was limited to approximately 10 foods that he would consistently eat (based on parent report). Of the 10 foods, none were vegetables, two were fruits, one was protein, and one was dairy. He had a limited vocal-verbal repertoire and occasionally spoke in one or two-word approximations. His older 9-year-old sister served as his peer model. Although Carter engaged in single and sequenced imitation, he did not engage in spontaneous imitation. This deficit was observed in vivo as well as reported in his Assessment of Basic Language and Learning Skills- Revised (ABLLS-R; Partington, 2010).

Marshall was a 6-year-old boy. He had the ability to self-feed foods of varying textures, drink from a cup, and use utensils appropriately. His diet, however, was limited to approximately seven foods that he would consistently eat (based on parent report). Of the seven foods, none were vegetables, none were fruits, three were protein, and none were dairy. He had the ability to speak in full sentences but engaged mostly in scripted or stereotypic responses. His older 8-year-old brother served as his peer model. Marshall engaged in single and sequenced imitation. Additionally, as observed in vivo and reported in his ABLLS-R, he engaged in frequent spontaneous imitation. Throughout the course of the study, Marshall regularly spontaneously imitated his brother's behavior (i.e., feeding-related, not feeding-related) during sessions.

Setting and Materials

Carter's sessions were conducted at the dinner table in his family home. His sister (if applicable to the phase), the experimenter, and a research assistant were present during sessions. Carter sat at the head of the table with his sister to his left and the experimenter to his right. This position was selected based on parent report of his usual location during mealtime. Marshall's sessions were conducted at a child-sized table in a partitioned area of a separate classroom in the preschool he attended. His brother (if applicable to the phase), the experimenter, and a research assistant were present during sessions. Marshall sat across from his sibling and beside the experimenter (i.e., experimenter at head of table). Because this environment was not the same as Marshall's usual mealtime environment, the experimenter selected a spot at the table based on what would allow Marshall to easily see his sibling's behavior. During all sessions, the participant and sibling (if present) were provided identical paper plates, necessary utensils (i.e., fork, spoon), and a cup, if needed. The prepared food was placed on a small table to the side (Marshall) or beside the experimenter (Carter).

Sessions took place at a time (i.e., 3:30 p.m., 4:15 p.m.) that both the participant and the sibling could be present and were conducted two to four days a week. Once the experimenter and the participants' parents selected a time, the session time was held constant (a 30-minute window was given to allow for deviations based on late arrivals or conflicts in schedule) throughout the study. The time selected prevented interruption to the families' mealtimes, while also ensuring that deprivation was adequate to establish a motivating operation for consumption. Sessions continued until the experimenter presented all 40 trials. Because of this, the length of sessions varied throughout baseline and intervention (M=30.03 min; range, 13.02 min-56.98 min).

Pre-intervention Target Selection

In vivo observation. Prior to the beginning of the intervention, the experimenter and research assistants observed both participants during mealtimes at the preschool they attended. The experimenter and research assistants collected data on foods the participants consumed as well as disruptive behaviors. In vivo observations served several purposes. First, it provided an initial opportunity to identify if there were any trends in foods the participants would and would not consume based on variables such as utensil used, texture of the item, or food group. Second, it contributed to the selection of disruptive behaviors included as dependent variables as well as the development of operational definitions for disruptive behavior. Third, it provided opportunities for the experimenter to train the research assistants and establish reliability measurements (the observations served as practice only; no data are included in the final reliability calculations).

Food selection. The experimenter selected target foods in this study based on two components: the United States Department of Agriculture (USDA) recommendations ("United States Department of Agriculture Choose My Plate", 2017) and the surveys given to parents. The experimenter used the surveys to determine what foods to not target for intervention (i.e., the foods the participants were already eating) as well as what foods to target for intervention (i.e., the foods the parents would like for their child to be able to eat). An open-ended survey was sent home first (Appendix A). This survey asked the parents to list foods their child would not eat, would occasionally eat, and would always eat, to respond if the sibling would eat it (*yes* or *no)*, to circle how often it was served in the home (*more than once a week, once a week, once a month,* or *less than once a month*), and to rank the foods in order of importance (1-5, 1 being *most important* and 5 being *not at all important*). Additionally, the survey inquired about disruptive behaviors that the parents had observed, the time and place that would be the most convenient for sessions to occur, and the goal the parents had for their child.

The responses on the first survey resulted in a very limited variety of foods to be selected for intervention. In order to develop a second survey that was more close-ended, the USDA recommendations found on choosemyplate.gov were evaluated. These food suggestions and the results of the first survey informed development of the second survey (see Appendix B for an example). Thus, Carter and Marshall's surveys were very similar but differed slightly based on foods their parents included on the first survey. The second survey included a section for each food group (i.e., fruits, vegetables, grains, proteins, dairy) with specific foods listed (e.g., fruits: apple, applesauce, banana, fruit cocktail, grapes, orange, pear, pineapple, raisins, strawberry). Additionally, this survey included a section for "combined foods" (e.g., pizza, sandwich) and condiments (e.g., ketchup, mayonnaise). The survey asked a series of close-ended questions regarding each food: Will your child eat it (*yes* or *no*)? How often will he eat it (*always, occasionally*, or *never*)? Will his sibling eat it (*yes* or *no*)? How often is this served in your home (*more than once a week, once a week, once a month*, or *less than once a month*)? Please rate the importance of eating this food (1-5, 1 being *most important* and 5 being *not at all important*). A section was included that asked parents to select behaviors (both appropriate and inappropriate) that their child engaged in during mealtime (e.g., gags or throws up food, sits in chair appropriately, throws food, uses utensils correctly). Finally, a section was included that allowed parents to select or write in goals they had for their child.

Based on the results of the second survey, foods were then placed into a hierarchy of target foods (Appendices C & D). First, the hierarchy listed foods based on how often the participant would consume the food (i.e., a response of *never* was prioritized). Second, the hierarchy listed foods by the parent-rated level of importance (i.e., a response of *1* was prioritized). Third, the hierarchy listed foods by how often the food was served in the family's home (i.e., *more than once a week* was prioritized). Additionally, four food groups (i.e., vegetables, fruits, proteins, dairy) were selected for intervention based on the needs of both participants. The hierarchy was used to select targets for baseline beginning with the food that was ranked at the top of the list. If a food was introduced and consumed in baseline (i.e., three sessions at 70% or above), it was no longer presented and the next food on the list was introduced. This procedure continued until there were two foods in each food group that met inclusion criterion (i.e., three sessions at 30% or below).

Dependent Measures and Data Collection

The experimenter and research assistants used a paper and pencil data sheet to record data during sessions. The research assistants recorded sessions with a video camera so that reliability data could be calculated at a later time. The primary dependent variable was the percentage of bites consumed, recorded as independent or prompted, out of 40 possible bites. An *independent bite consumed* was defined by the participant picking up the bite, putting the bite past the plane of his lips, and swallowing the full bite; this could occur in one bite or several bites. A *prompted bite consumed* was defined by the experimenter picking up the bite and bringing it to the participant's mouth, the bite entering past the plane of the participant's lips, and the participant swallowing the full bite. If a bite was not consumed in a trial, the experimenter and research assistants recorded an "N" for not consumed. Each trial was recorded as a bite (i.e., not consumed, independent bite, prompted bite) and was then converted to the total percentage of bites consumed per session (e.g., number of independent bites consumed/40 total bites presented).

Additional behaviors recorded were the frequency of disruptive behaviors (i.e., aggression, expulsion, head turn, inappropriate personal hygiene, moving away from table, out of seat, negative vocalizations, stereotypy, swipes food) per session and the percentage of bites the participant was attending to (i.e., looking directly at) his sibling while the sibling was consuming the bite. *Aggression* was defined as engaging in behavior directed towards another person that did or could have potentially caused injury (e.g. grabbing, hitting, kicking, biting). *Expulsion* was defined as discarding food from the mouth after it had crossed the plane of the lips and been released (e.g., spitting, removed from mouth with hands). *Head turn* was defined as moving the head up, down, left, or right after a bite was presented, resulting in the bite not being put in mouth. *Inappropriate personal hygiene* was defined as engaging in behavior that was unsanitary and a deviation from acceptable table manners (e.g., nose picking, hands in pants). *Moving away from table* was defined as moving body in chair resulting in the chair being 6 inches or more away from the original position at the table. *Negative vocalizations* was defined as expressing a scream, cry, or protest (e.g., “No!” “Stop!” “Let go!”) after a bite was presented. *Out of seat* was defined as moving bottom at least 3 inches away from chair. *Stereotypy* was defined as engaging in repetitive behavior (i.e., behavior occurred at least 2 times with no more than 1 second in between instances) that was not functionally related to eating (e.g., biting shirt, playing with food/items at table, covering mouth). *Swipes food* was defined as moving food off of the table, plate, or utensil with hands or arms in a direction that resulted in food not going toward the mouth (e.g., throwing on floor, knocked food off utensil onto table). Additionally, we categorized these nine disruptive behaviors into two categories: those that impeded on the participants' ability to eat, and those that did not impede on the participants' ability to eat. Behaviors that impeded on the participant's ability to eat (i.e., aggression, expulsion, head turn, moving away from table, out of seat, swipes food) were grouped together. Behaviors that could be considered disruptive but did not impede on the participant's ability to eat (i.e., inappropriate personal hygiene, negative vocalizations, stereotypy) were grouped together.

Interobserver Agreement and Treatment Integrity

The experimenter and trained research assistants independently viewed videos of the sessions and scored participant behavior across both participants and all phases. Interobserver agreement (IOA) for bites consumed was calculated by dividing the total number of bites with agreement (i.e., both observers scored not consumed, independent bite, or prompted bite) over the total number of bites possible (i.e., 40). The experimenter then multiplied this number by 100 to get a percentage of agreement. IOA for disruptive behavior was calculated using proportional agreement. The experimenter calculated agreement for disruptive behavior by adding the total frequency of the occurrence of that specific behavior per bite and dividing the smaller frequency per bite recorded by one observer by the larger frequency per bite recorded by the other observer. The experimenter then added the numbers together, divided by 40 (i.e., the total number of trials), and multiplied by 100 to get a percentage of agreement. The IOA calculations were completed for each individual behavior as well as an aggregate of disruptive behavior per session.

The experimenter calculated reliability for 40.74% of the total baseline sessions for Carter and 37.14% of the total baseline sessions for Marshall (see Table 1 for phase- and behavior-specific reliability). Mean agreement for Carter was 100% for bites and 95.80% (range, 93.48%-97.43%) for aggregate disruptive behavior. Mean agreement for Marshall was 99.62% (range, 95%-100%) for bites and 93.55% (range, 83.29%-97.88%) for aggregate disruptive behavior. We scored reliability for 37.31% of the total intervention sessions for Carter and for 39.29% of the total intervention sessions for Marshall. Mean agreement for Carter was 99.7% (range, 97.5%-100%) for bites and 94.98% (range, 90.23%-98.35%) for aggregate disruptive behavior. Mean agreement for Marshall was 99.77% (range, 97.5%-100%) for bites and 91.81% (range, 89.23%-93.84%) for aggregate disruptive behavior.

A trained research assistant recorded the experimenter's behavior and calculated treatment integrity (TI) across both children and all phases. The behaviors recorded differed based on the condition, but included different steps of the presentation of instructions, bite delivery, and reinforcement delivery. The experimenter calculated TI by dividing the number of correct steps implemented per session over the total number of correct plus incorrect steps and multiplying by 100.

The experimenter calculated TI for 40.7% of the total baseline sessions for Carter and 37.1% of the total baseline sessions for Marshall (see Table 7 & 8 for phase-specific TI). Mean TI was 99.92% (range, 98.89%-100%) for Carter and 99.81% (range, 98.06%-100%) for Marshall. We calculated TI for 37.3% of the total intervention sessions for Carter and 39.3% of the total intervention sessions for Marshall. Mean TI was 99.91% (range, 99.29%-100%) for Carter and 99.84% (range, 99.11%-100%) for Marshall.

An additional component that was evaluated was the siblings' implementation of peer modeling. Throughout all of the sessions, neither sibling ever refused to consume a bite. Therefore, treatment integrity was 100% across all phases for both Carter and Marshall.

Design

We used an alternating treatments design to evaluate the separate effects of the independent variables. Using visual inspection, we evaluated the effects of both variables on each participant's behavior and, based on moderate increases, we decided to combine the variables in an attempt to see greater improvements in consumption. Thus, to further evaluate the combined effects of the independent variables, we used a multiple baseline across food groups design. Participants progressed to the next food group in the multiple baseline when they met mastery criterion (i.e., 70% independent consumption for three sessions) for one food in that food group.

Procedures

General procedure. Certain procedures were consistent across all phases (excluding free-operant probes). The experimenter selected one food per food group (i.e., protein, dairy, fruit, vegetables) per session. Each session included 10 bites of each food, totaling 40 bites. The experimenter randomized the food selections both across and within sessions. The experimenter or research assistant cut or measured each food to be very similar in size (i.e., covering the first ¼ of a spoon, 1 TSP using a dropper, no more than 3 cm in length, no more than .75 cm thick). Each session began with the instruction "It's time to eat!" The participant began with an empty plate and the experimenter placed each bite one at a time on the plate. Next, each trial began with the general instruction "Take a bite of the [food]." In an effort to allow for the age appropriate behavior of self-feeding, the experimenter placed each bite on the participant's plate for 15 s. If during the first 15 s the participant did not consume the bite independently or was not engaging in behavior towards consuming the bite (e.g., bite was in his hand going to mouth, but not yet consumed), the experimenter picked up the bite and brought it to the participant's mouth for 5 s.

If the participant still did not consume the bite, it was removed and the next bite was presented. To emulate a natural mealtime, the experimenter, sibling, and participant engaged in conversation throughout the session. If disruptive behavior occurred during session, it was ignored, and, if needed (e.g., out of seat behavior, moves away from table), the participant was redirected back to the current trial.

Baseline. Baseline sessions included only the participant and experimenter. Each trial began with the general instruction (i.e., “Take a bite of the [food].”) The experimenter did not provide any programmed consequences following consumption or disruptive behavior. The experimenter selected foods during baseline based on the hierarchy developed from the parent report, and each session still consisted of 40 bites (10 of each food). Certain foods may have been present during baseline sessions that later met the exclusion criterion (i.e., three sessions at or above 70%). Therefore, there were baseline sessions that included foods that were subsequently selected for intervention as well as foods that were later not selected for intervention. For example, one baseline session for Carter included pudding and carrots (i.e., foods that were selected for intervention) as well as eggs and grapes (i.e., foods that met exclusion criterion and were not selected for intervention).

Baseline with sibling. Once eight foods (i.e., two from each food group) met inclusion criterion, we conducted an additional baseline with the sibling present but not participating. The experimenter conducted these sessions to ensure that the presence of the sibling alone did not have an effect on the participants’ behavior so that the PM procedure could be isolated in future sessions. These sessions were identical to baseline sessions except that the sibling was present at the table. The sibling did not have a plate or food and was asked to remain seated and interact as he or she typically would.

Peer modeling. The experimenter, participant, and sibling were present during this condition. Both the participant and his sibling had a plate and utensils. The experimenter gave bites in an alternating pattern. The experimenter began each trial with "Look, [sibling] is going to take a bite of [food]" followed by the general instruction. The experimenter then placed the target bite on the sibling's plate. Following the sibling's consumption of the target bite, the experimenter provided a praise statement (e.g., "Awesome job eating your broccoli!") The experimenter then gave an identical bite of target food to the participant, followed by the general instruction. If the participant consumed the full bite, the experimenter provided a praise statement to him as well.

Differential reinforcement. Only the participant and experimenter were present during this condition. Prior to beginning intervention, the experimenter conducted a paired stimulus preference assessment (Fisher et al., 1992) with both participants. The top three items were selected and presented in a paired-choice arrangement before each DR session. The item selected was then used for the entirety of that session. Following the selection of the preferred food, each bite began with the general instruction. Each bite was placed individually on the participant's plate. If the participant independently consumed the full bite, the experimenter gave him a small bite of his highly-preferred food and proceeded to the next trial.

Combined peer modeling and differential reinforcement. The experimenter, participant, and sibling were present during this condition. Each session began with a paired-choice preference assessment. Following the selection of a preferred food, the experimenter followed the same procedures as described in PM with one exception. When the sibling consumed the bite of target food, he or she was given a piece of the highly-preferred food that the participant selected. Similarly, if the participant independently consumed the bite, he was also given a piece of his highly-preferred food. The experimenter delivered highly-preferred foods in each session based on each food group phase of the multiple baseline. For example, when Carter was in the PM and DR for protein condition, the reinforcement contingency (i.e., consumption resulted in delivery of a highly-preferred food) was only in place for the protein food in the session. Consumption of the other three foods (i.e., dairy, fruit, vegetables) resulted in praise but did not result in the delivery of a highly-preferred food.

Addition of rules. We added rules to Carter's DR sessions following the first phase of alternating DR and PM and combined DR and PM. Rules were added based on Carter's behavior during session which lead to the hypothesis that Carter was not able to identify, nor had he frequently contacted (i.e., two bites total), the reinforcement contingency. The experimenter replaced the general instruction by a rule statement "First [target food], then [highly-preferred food]." when the contingency was in place (i.e., DR, combined PM and DR). Because the combination of independent variables was introduced in a multiple baseline design, one session could include both the general instruction for non-targeted foods and the rule statement for targeted foods.

Free-operant probes. Following intervention, the experimenter conducted free-operant probes with Carter using the same foods that were targeted during intervention. These probes took place in the same location and with the same materials as all previous sessions. The experimenter gave a plate of 40 bites (10 of each target food) to Carter all at the same time. The first probe included grilled chicken, pineapple, carrots, and pudding. The second probe included the remaining foods: turkey sandwich, raisins, broccoli, and milk. The experimenter gave him the instruction "It's time to eat! You can eat whatever you want." No additional instructions or prompting occurred throughout the session. The experimenter selected a time limit of 30 minutes based on the average of the previous sessions.

Results

Consumption of Target Foods

The results displayed in Figure 1 show Carter's independent bites consumed across food groups. During the first baseline, his consumption was at near zero (i.e., milk, pineapple, carrots, broccoli) or zero (i.e., grilled chicken, turkey sandwich, pudding, raisins) across food groups. During the first baseline with his sibling present, the second baseline, and the second baseline with his sibling present, consumption was at zero for all foods. When DR and PM were implemented in the alternating treatment design, Carter's consumption still did not increase. Similarly, when the components were combined, consumption remained at baseline levels. After this, the conditions were implemented again in an alternating treatment design. When the rule instructing him of the contingency was implemented in the DR condition, increases were observed in four of the eight target foods (i.e., milk, pineapple, carrots, broccoli) during the DR condition only. We then returned to the combined PM and DR with the rule condition, and increases were observed across all eight target foods. Although consumption of protein showed delayed effects, the two other foods he had never consumed during baseline or previous intervention phases (i.e., pudding and raisins) increased very quickly after the two components were added to the dairy and fruit food groups respectively. Carter eventually reached 100% independent consumption with all eight target foods.

The results displayed in Figure 1 show Marshall's independent bites consumed across food groups. During baseline, Marshall's independent consumption was at zero for five foods (i.e., spaghetti, scrambled eggs, milk, cantaloupe, potato). Three foods (i.e., string cheese, banana, carrot) had higher levels in the beginning of baseline but decreased rapidly to zero levels. With the exception of one bite of carrots consumed, all target foods remained at zero during baseline with his sibling present. When we implemented PM and DR in an alternating treatment design, increases were observed in banana, cantaloupe, and carrots. Although increases occurred in both conditions, DR resulted in the highest increase in responding for all three foods that were consumed.

When the multiple baseline design across food groups began (protein was targeted first), increases from zero were quickly achieved with both spaghetti, which met mastery criterion, and scrambled eggs. However, we saw a consistent decrease in the non-target foods that Marshall had previously consumed (i.e., banana, cantaloupe, carrots). Similarly to protein, when DR was added to PM for dairy, both targets (i.e., milk, string cheese) increased above baseline levels. Further increases were observed in scrambled eggs, banana, cantaloupe, and carrots. Additionally, we observed generalization when potatoes, a food he had never consumed, increased as well. Unfortunately, Marshall moved out of state before we could conduct any more sessions to target additional food groups. The data, however, show increases in all eight target foods compared to baseline and 100% consumption in six of the eight foods.

Figures 3 and 4 show the overall prompted and independent bites consumed across phases for Carter and Marshall, respectively. The data contained on these graphs are only the sessions that occurred after the targets had been selected (i.e., all eight targets met the inclusion criterion) (see Method section, Baseline, for further explanation). Patterns of responding were similar across both Carter and Marshall. The highest percentage consumed during a baseline session following target selection was 2.5% (two sessions with one prompted bite and one session of one independent bite for Carter; one session with one independent bite for Marshall).

For both participants, DR (Carter, M=41.50% independent consumption; Marshall, M=32.25% independent consumption) was more effective than PM (Carter, M=0.23% independent consumption; Marshall, M=11.14% independent consumption) when implemented individually. However, Marshall had similar levels of responding in two PM sessions. Another response pattern that both participants displayed was a temporary decrease in overall consumption when PM and DR for protein was implemented. Marshall required the addition of the second food group (i.e., dairy) to increase above baseline levels, whereas Carter's percentage of responding did not require as many sessions to increase. Both Carter and Marshall began consuming target foods at higher than previously observed percentages after the DR contingency was added to PM for the second food group (i.e., dairy). After the combination of components was added to the third food group (i.e., fruit) with Carter, consumption consistently increased to 100% or near 100% levels. Additionally, during post-intervention free-operant probes, Carter consumed 80% (session included: chicken, pineapple, pudding, and carrots) and 30% (session included: turkey sandwich, raisins, milk, and broccoli) of the previously non-preferred target foods. As previously stated, Marshall moved before we could introduce the intervention for the third food group (i.e., fruit). Consequently, we were also unable to conduct any free-operant probes.

Rates of Disruptive Behavior

The rates of disruptive behavior are shown in Figures 5 and 6. The data displayed in these graphs are presented by instances per minute and include the aggregate count of behaviors that impeded on the participant's ability to eat (i.e., aggression, expulsion, head turn, moving away from table, out of seat, swipes food). With Carter, we observed a gradual increase in disruptive behavior during the first baseline (M=1.43; range, 0.7-2.47), the first baseline with his sibling (M=1.79; range, 1.34-2.25), the second baseline (M=2.06; range, 1.56-2.35), and the second baseline with sibling (M=2.24; range, 1.98-2.48). After the alternating treatments sessions began, rates of disruptive behavior were initially similar to baseline, but then increased during DR (M=2.62; range, 1.74-3.6). Rates remained near baseline levels during PM (M=2.13 range, 1.77-2.48). We observed an additional increase during the first PM and DR with protein condition (M=2.79; range, 1.77-4.16). When the alternating treatments sessions began again with the rules added to the DR condition, large decreases were seen during the DR condition (M=1.35; range, 0.75-1.89). When PM and DR were combined a second time (i.e., DR included rules), we observed a slight increase followed by a gradual decrease to near zero rates of responding (M=0.99; range, 0.0-2.56).

Marshall's rate of disruptive behavior is displayed in Figure 6. Similar to Carter's data, we observed a gradual increase in rate of responding during baseline (M=1.43; range, 0.0-2.72) and baseline with his sibling (M=2.23; range, 2.03-2.41). However, Marshall engaged in a lower rate of disruptive behavior when we introduced PM (M=1.12; range, 0.91-1.64) and DR (M=1.33; range, 0.74-1.77) in an alternating treatment design. We observed similar rates when PM and DR were combined for the first food group (i.e., PM & DR of protein) (M=1.59; 0.9-2.27). When the components were combined for the second food group (i.e., PM & DR of protein/dairy) the rate of disruptive behavior decreased (M=1.12; range, .79-1.71). Overall, rates of disruptive behavior for both participants were lower during intervention (Carter, 1.56; Marshall, 1.29) than in baseline (Carter, 1.62; Marshall, 1.52).

Discussion

In this study, we evaluated the separate and combined effects of DR and PM on consumption of non-preferred foods in children with ASD who engaged in food selectivity. We found that both components were somewhat effective in increasing consumption. When evaluated alone, DR resulted in greater increases in consumption with both participants. Additionally, PM slightly increased one participant's bite consumption. Although we observed moderate increases during the alternating of single independent variables, certain foods and food groups (i.e., protein, dairy, fruit) required a combination of both components before consumption increased.

The data suggest that although DR was the more effective component of the intervention, PM enhanced the effects of DR. Additionally, further increases and generalization appeared to be enhanced by an increase in reinforcer density. For example, when the peer model was present and the preferred food was only available for 10/40 bites (i.e., DR and PM for protein) total consumption temporarily decreased. When the peer model was present and the preferred food was available for 20/40 bites (i.e., DR and PM for protein and dairy) total consumption increased across food groups. Finally, when the peer model was present and the preferred food was available for 30/40 bites (i.e., DR and PM for protein, dairy, and fruit) we observed the highest percentages of total consumption for all food groups. We observed increases in previously consumed foods as well as generalization in a food that had never before been consumed (i.e., potatoes with Marshall).

An interesting consideration regarding reinforcer density is that although it improved consumption when the reinforcement schedule increased within the PM and DR condition, it was not powerful enough to increase consumption when an even denser schedule of reinforcement was available (i.e., DR alone) without PM. This indicates that a dense schedule of reinforcement and PM were both necessary components for optimal behavior change in the current intervention. These results are consistent with those of Sira and Fryling (2012) and Fu et. al (2015) in that an intervention consisting of both DR and PM was successful in increasing consumption. However, our methodology added to previous literature by first evaluating the variables separately.

A goal of this study was to increase the variety and amount of foods the participants would consume. We were successful in increasing the previously non-preferred foods to 100% (Carter) or near 100% (Marshall) levels of consumption. Not only was consumption increased, but the increases were also observed across multiple foods in all four food groups (i.e., protein, dairy, vegetables, fruit) with both participants. This expanded on previous literature that included a more limited number of food groups in the target foods.

The disruptive behavior data for both participants show that the intervention resulted in lower than baseline rates. Although rates were fairly low throughout the study, Carter's rates of disruptive behavior increased to above baseline rates during intervention before decreasing to near zero. There are several hypotheses regarding his behavior change. First, during the first alternating treatments condition, Carter transitioned from the early intervention program to a kindergarten classroom in a public school. Thus, he was adapting to many environmental changes. Anecdotal data indicate that changes in topography and increases in disruptive behavior occurred following this transition. The change in environment and teachers could have potentially affected his behavior in this study. Second, the highly-preferred foods that were presented during a preference assessment and available contingent on consumption, were visible during sessions. Because Carter did not meet the contingency for reinforcement, however, he was not able to access them. This could have contributed to higher rates of disruptive behavior in some conditions. These conditions were in place during the highest rates of disruptive behavior (i.e., DR without rules, PM and DR for protein without rules). As discussed previously, Carter displayed behavior during sessions (e.g., reaching for candy during trials, manding for the highly-preferred food) that indicated he wanted the highly preferred food, but the reinforcement contingency may not have been discriminable to him. It is possible that this contributed to his disruptive behavior as well.

Although it is unclear what controlled the temporary increase in Carter's disruptive behavior, rates of disruptive behavior greatly decreased as the intervention progressed. Additionally, the data from both participants do not indicate that either PM or DR results in consistently higher rates of disruptive behavior when implemented separately. However, the combination of PM and DR for two or more food groups produced the lowest rates of disruptive behavior for both participants. Lastly, it should be noted that the severity of disruptive behavior during sessions was very minimal. The most frequent behaviors recorded were head turns. Although this slightly impeded the individuals' ability to eat, it was not harmful towards themselves or others and would be minimally disruptive if it occurred in another environment.

The current study adds to the limited feeding literature that evaluates DR and PM together. There are, however, several limitations worth discussing. First, although we attempted to have a number of trials (i.e., 40) that approximated a typical meal amount and duration, this made sessions very long. The length of sessions paired with the contrived nature of the trials may have made sessions boring for both the participants and their siblings. Further, participants engaged in disruptive behavior that appeared to be attention seeking (e.g., getting out of seat, grabbing sibling's and experimenter's face) as the session progressed. Although this was not ideal for a research setting, it presumably is typical of what might be observed as the meal duration progressed in a natural environment. For example, if a family went out to eat at a restaurant, a child may be able to sit calmly for a short amount of time. As the mealtime length increases while a family waits for their food, the child may begin to engage in disruptive behaviors. This information could ultimately be helpful in making suggestions on goals for the participants. For instance, if disruptive behavior is generally observed after 25 minutes, a clinical goal for that participant may be to increase his ability to sit appropriately at a meal for a longer period of time, for example, 30 minutes.

Second, both participants attended to their siblings during the siblings' target bite consumption at fairly low amounts (Carter: 18.65%; Marshall: 27.25%). This could have affected the efficacy of PM. Interestingly, both participants' percentages of attending increased as the study progressed and bites consumed increased. It is possible that the percentage of attending influenced responding. This remains an empirical question and the data would need to be evaluated with further analyses to ascertain if a correlation was present.

Third, although both participants were able to imitate movements and sequences of movements of both adults and other children (as evidenced by direct observations as well as their ABLLS-R report), their imitative repertoire in response to their sibling was never directly assessed. If they did not have this skill in their repertoire, their ability to benefit from PM would be limited. It would be beneficial to adapt the inclusion criteria to require the ability to imitate a sibling or to directly assess and teach the skill if necessary.

Fourth, certain elements of the session (e.g., alternating bites of food, pre-cut portions, instructions for every bite) did not resemble a natural meal. This could potentially affect the generality of the results. However, as previously mentioned, some contrived elements were necessary to ensure consistency across sessions.

Fifth, it took awhile before optimal increases in consumption were observed. The use of the component analysis potentially extended the length of the intervention. Further, because we chose siblings as the peer models, the research schedule had to accommodate their schedule as well. Consequently, this limited the number of sessions we were able to conduct within a week. These costs would need to be evaluated based on the urgency with which participants required intervention. For example, if an individual had significant nutritional deficiencies, a more intensive intervention that allowed for more frequent sessions may be better.

These limitations as well as the findings of the study lead to several interesting suggestions for future research. First, future research may consider including a method to increase attending during the sibling's consumption. For example, the sibling (or other peer model) could provide a prompt to the participant such as "Look at what I'm doing!" The experimenter could also delay the instruction until the participant engaged in an observing response. Fu et al. (2015) provided a prompt such as "I feel tired" or "Look at me". Unfortunately, however, Fu et al. (2015) did not provide data on attending. Thus, the effects of the prompt were unclear. Research could also evaluate the effects of observing the initial bite consumption, the delivery of reinforcement, or both.

Second, future research should consider evaluating and programming for generalization across environments and people. Generalization programming could include conducting sessions in several environments as well as having multiple people serve as the model and therapist. Although we received anecdotal reports from one participant's parents and public school paraprofessionals who worked with him that the effects of our intervention generalized to other environments, we did not directly evaluate this. Nevertheless, this anecdotal information suggests that generality might be likely with more systematic programming.

Third, an interesting consideration would be to evaluate the effects of the relationship between the participant and the peer model on the efficacy of an intervention involving PM. Previous research has suggested that certain elements such as the length of the relationship and the nature of the relationship with the model can influence responding (Jones & Schwartz, 2004). Although siblings are very natural models for children with ASD, there may be more effective options (e.g., a close friend at school, a parent).

Fourth, research could be conducted that systematically evaluates participant characteristics associated with increases during particular conditions. For example, Marshall spontaneously imitated his brother's behavior frequently. This was observed anecdotally during sessions as well as reported in his ABLLS-R assessment. This could have impacted his ability to imitate his brother's feeding behavior. Perhaps due to this characteristic, PM alone and PM with DR was more effective with Marshall than Carter. It would be beneficial to identify the characteristics pre-intervention to determine which intervention components would be the most effective with a particular participant.

Fifth, in the current study, we did not systematically fade the schedule of reinforcement. Free-operant probes with Carter occurred immediately following the intervention. Although he continued to consume much higher amounts than in baseline, his consumption was not as high as his final intervention session. Future research could evaluate ways in which the intervention can be faded from a discrete trial format to a more natural, free-operant arrangement while maintaining the levels of consumption that were reached in intervention. An additional consideration would be to conduct free-operant probes periodically throughout the study. This would allow for a comparison of a more natural occurring meal arrangement throughout the study and inform the experimenter's decisions regarding treatment needs of the participant.

The current study demonstrated that a treatment package consisting of DR and PM could increase consumption of non-preferred foods in children with ASD. This study extended previous research by evaluating PM and DR both separately and in combination. We found that both components were somewhat effective when implemented individually, but that differential reinforcement was the more effective component. Although the component analysis potentially extended the duration of the intervention, the results allow for more confidence in informing clinical and future research recommendations. The data from the present study suggest that the most effective intervention using PM and DR for the treatment of food selectivity in children with ASD would be a combination of both components.

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Table 1

Reliability Results for Carter's Bites Consumed

	% of Sessions Scored	Interobserver Agreement
Baseline	36.36%	**100%**
Baseline with Sibling Present	60%	**100%**
Peer Modeling	36.36%	**100%**
Differential Reinforcement	42.86%	**100%**
Combined Peer Modeling & Differential Reinforcement (Protein)	33.33%	**100%**
Differential Reinforcement plus Rule	60%	**100%**
Combined Peer Modeling & Differential Reinforcement plus Rule (Protein)	37.5%	**99.17%** **(Range, 97.5%-100%)**
Combined Peer Modeling & Differential Reinforcement plus Rule (Protein & Dairy)	35%	**99.29%** **(Range, 97.5%-100%)**
Combined Peer Modeling & Differential Reinforcement plus Rule (Protein, Dairy, & Fruit)	40%	**100%**
OVERALL MEAN	42.38%	**99.83%**

Table 2

Reliability Results for Marshall's Bites Consumed

	% of Sessions Scored	Interobserver Agreement
Baseline	35.48%	**99.55%** **(Range, 95%-100%)**
Baseline with Sibling Present	50%	**100%**
Peer Modeling	42.9%	**100%**
Differential Reinforcement	37.5%	**100%**
Combined Peer Modeling & Differential Reinforcement (Protein)	37.5%	**100%**
Combined Peer Modeling & Differential Reinforcement (Protein & Dairy)	40%	**98.75%** **(Range, 97.5%-100%)**
OVERALL MEAN	40.56%	**99.72%**

Table 3

Reliability Results for Carter's Aggregate Disruptive Behavior

	% of Sessions Scored	Interobserver Agreement
Baseline	36.36%	**95.88%** **(Range, 93.48%-97.23%)**
Baseline with Sibling Present	40%	**95.1%** **(Range, 93.59%-97.43%)**
Peer Modeling	36.36%	**93.77%** **(Range, 90.23%-97.44%)**
Differential Reinforcement	42.86%	**94.73%** **(Range, 92.55%-95.9%)**
Combined Peer Modeling & Differential Reinforcement (Protein)	33.33%	**92.07%** **(Range, 91.9%-92.24%)**
Differential Reinforcement plus Rule	40%	**94.25%** **(Range, 93.67%-94.82%)**
Combined Peer Modeling & Differential Reinforcement plus Rule (Protein)	37.5%	**93.91%** **(Range, 93.55%-94.24%)**
Combined Peer Modeling & Differential Reinforcement plus Rule (Protein & Dairy)	35%	**95.92%** **(Range, 94.69%-97.36%)**
Combined Peer Modeling & Differential Reinforcement plus Rule (Protein, Dairy, & Fruit)	40%	**97.35%** **(Range, 96.86%-98.35%)**
OVERALL MEAN	37.23%	**94.78%**

Table 4

Reliability Results for Marshall's Aggregate Disruptive Behavior

	% of Sessions Scored	Interobserver Agreement
Baseline	35.48%	**93.11%** **(Range, 83.29%-96.35%)**
Baseline with Sibling Present	50%	**96.51%** **(Range, 94.14%-97.88%)**
Peer Modeling	42.86%	**92.28%** **(Range, 91.64%-93.84%)**
Differential Reinforcement	37.5%	**92.91%** **(Range, 90.42%-92.6%)**
Combined Peer Modeling & Differential Reinforcement (Protein)	37.5%	**91.26%** **(Range, 92.2%-93.55%)**
Combined Peer Modeling & Differential Reinforcement (Protein & Dairy)	40%	**90.14%** **(Range, 89.23%-91.05%)**
OVERALL MEAN	38.1%	**91.81%**

Table 5

Reliability Results for Carter's Individual Disruptive Behavior

	% of Sessions	A (Aggression)	E (Expulsion)	HT (Head Turn)	IPH (Inappropriate Personal Hygiene)	NV (Negative Vocalization)	OS (Out of Seat)	MA (Moves Away from Table)	S (Stereotypy)	SF (Swipes Food)
Baseline	36.36%	100%	99.7% (Range, 97.5%-100%)	88.53% (Range, 75%-96.7%)	96.15% (Range, 92.5%-100%)	91.2% (Range, 81.4%-98.8%)	99.84% (Range, 98.75%-100%)	99.69% (Range, 97.5%-100%)	87.81% (Range, 66.8%-99.0%)	100%
Baseline with Sibling Present	40%	100%	100%	77.7% (Range, 57.9%-96.7%)	100%	88.6% (Range, 86.9%-90.2%)	100%	100%	93.8% (Range, 90.0%-97.5%)	100%
PM	36.36%	100%	100%	83.08% (Range, 77.5%-88.1%)	91.25% (Range, 75.0%-100%)	79.84% (Range, 62.2%-90.4%)	100%	97.61% (Range, 92.9%-100%)	94.67% (Range, 81.2%-100%)	97.5% (Range, 90.0%-100%)
DR	42.86%	99.17% (Range, 97.5%-100%)	99.17% (Range, 97.5%-100%)	86.18% (Range, 82.7%-92.5%)	99.17% (Range, 97.5%-100%)	79.88% (Range, 65.4%-88.8%)	98.33% (Range, 95.0%-100%)	100%	92.33% (Range, 90.0%-94.3%)	98.33% (Range, 95.0%-100%)
Combined PM & DR (Protein)	33.33%	100%	100%	75.20% (Range, 73.1%-77.3%)	90.0% (Range, 87.5%-92.5%)	77.18% (Range, 73.6%-80.8%)	99.38% (Range, 98.8%-100%)	95.0% (Range, 95.0%-95.0%)	96.88% (Range, 96.3%-97.5%)	95.0% (Range, 92.5%-97.5%)
DR plus Rule	40%	100%	100%	87.19% (Range, 83.5%-90.8%)	87.5% (Range, 77.5%-97.5%)	87.28% (Range, 84.5%-90.1%)	100%	92.5% (Range, 85.0%-100%)	93.75% (Range, 92.5%-95.0%)	100%
Combined PM & DR plus Rule (Protein)	37.5%	100%	100%	82.21% (Range, 78.8%-84.8%)	92.22% (Range, 86.7%-95.0%)	77.83% (Range, 75.3%-81.9%)	100%	100%	93.33% (Range, 91.9%-95.9%)	99.58% (Range, 81.8%-100%)
Combined PM & DR plus Rule (Protein & Dairy)	35%	100%	99.64% (Range, 97.5%-100%)	87.38% (Range, 77.9%-92.5%)	94.39% (Range, 87.5%-100%)	90.92% (Range, 78.8%-100%)	99.82% (Range, 98.8%-100%)	98.57% (Range, 95.0%-100%)	92.56% (Range, 85.8%-97.5%)	100%
Combined PM & DR plus Rule (Protein, Dairy, & Fruit)	40%	100%	100%	97.71% (Range, 93.3%-100%)	90.88% (Range, 84.0%-95.0%)	98.09% (Range, 96.1%-100%)	100%	100%	89.41% (Range, 87.7%-91.4%)	100%
OVERALL MEAN	**37.23%**	**99.91%**	**99.83%**	**85.02%**	**93.52%**	**85.65%**	**99.71%**	**98.15%**	**92.73%**	**98.93%**

Table 6

Reliability Results for Marshall's Individual Disruptive Behavior

	% of Sessions	A (Aggression)	E (Expulsion)	HT (Head Turn)	IPH (Inappropriate Personal Hygiene)	NV (Negative Vocalization)	OS (Out of Seat)	MA (Moves Away from Table)	S (Stereotypy)	SF (Swipes Food)
Baseline	35.48%	99.77% (Range, 97.5%-100%)	98.98% (Range, 92.5%-100%)	89.47% (Range, 78.8%-96.3%)	89.20% (Range, 70.2%-100%)	80.58% (Range, 49.6%-100%)	99.32% (Range, 92.5%-100%)	99.55% (Range, 97.5%-100%)	85.55% (Range, 43.1%-97.5%)	95.53% (Range, 90%-100%)
Baseline with Sibling Present	50%	99.8% (Range, 99.5%-100%)	100%	88.1% (Range, 82.5%-93.8%)	98.5% (Range, 97.5%-99.5%)	87.41% (Range, 85.2%-89.7%)	100%	100%	92.8% (Range, 85.6%-100%)	97.5% (Range, 95%-100%)
PM	42.86%	99.17% (Range, 97.5%-100%)	100%	85.42% (Range, 76.3%-91.3%)	84.53% (Range, 73.1%-93.7%)	82.37% (Range, 74.8%-90.4%)	96.67% (Range, 93.7%-100%)	100%	86.75% (Range, 82.5%-90.3%)	96.53% (Range, 95%-97.5%)
DR	37.5%	100%	98.13% (Range, 96.9%-100%)	87.36% (Range, 79.6%-91.3%)	93.33% (Range, 90%-95%)	78.35% (Range, 63.2%-89.2%)	96.39% (Range, 91.67%-100%)	99.17% (Range, 97.5%-100%)	83.51% (Range, 73%-97.5%)	100%
Combined PM & DR (Protein)	37.5%	98.71% (Range, 96.1%-100%)	93.75% (Range, 90.0%-96.3%)	88.47% (Range, 87.9%-88.8%)	78.89% (Range, 75.5%-85.4%)	82.24% (Range, 76.5%-87.5%)	92.85% (Range, 89.8%-98.8%)	99.17% (Range, 97.5%-100%)	88.17% (Range, 84.5%-95.0%)	98.06% (Range, 96.7%-100%)
Combined PM & DR (Protein & Dairy)	40%	100%	97.5% (Range, 97.5%-97.5%)	94.17% (Range, 88.3%-94.2%)	75.04% (Range, 73.3%-76.8%)	92.8% (Range, 85.6%-100%)	83.23% (Range, 73.9% 92.5%)	93.13% (Range, 86.3%-100%)	77.87% (Range, 73.6%-82.1%)	97.5% (Range, 97.5%-97.5%)
OVERALL MEAN	**38.1%**	**99.42%**	**97.33%**	**88.37%**	**83.94%**	**83.13%**	**93.11%**	**98.30%**	**84.64%**	**98.07%**

Table 7

Treatment Integrity Results for Carter

	% of Sessions Scored	Treatment Integrity
Baseline	36.4%	**99.83%** **(Range, 98.89%-100%)**
Baseline with Sibling Present	60%	**100%**
Peer Modeling	36.4%	**100%**
Differential Reinforcement	42.9%	**100%**
Combined Peer Modeling & Differential Reinforcement (Protein)	33.3%	**99.74%** **(Range, 99.47%-100%)**
Differential Reinforcement plus Rule	40%	**100%**
Combined Peer Modeling & Differential Reinforcement plus Rule (Protein)	37.5%	**99.88%** **(Range, 99.82%-100%)**
Combined Peer Modeling & Differential Reinforcement plus Rule (Protein & Dairy)	35%	**99.90%** **(Range, 99.64%-100%)**
Combined Peer Modeling & Differential Reinforcement plus Rule (Protein, Dairy, & Fruit)	40%	**99.82%** **(Range, 99.29%-100%)**
OVERALL MEAN	38.30%	**99.91%**

Table 8

Treatment Integrity Results for Marshall

	% of Sessions Scored	Treatment Integrity
Baseline	35.5%	**99.75%** **(Range, 98.06%-100%)**
Baseline with Sibling Present	50%	**99.86%** **(Range, 99.72%-100%)**
Peer Modeling	42.9%	**99.70%** **(Range, 99.11%-100%)**
Differential Reinforcement	37.5%	**100%**
Combined Peer Modeling & Differential Reinforcement (Protein)	37.5%	**99.94%** **(Range, 99.82%-100%)**
Combined Peer Modeling & Differential Reinforcement (Protein & Dairy)	40%	**99.73%** **(Range, 99.64%-99.82%)**
OVERALL MEAN	38.09%	**99.83%**

Table 9

Attention to Sibling's Bites across the Study

	Mean	*Range*
Carter	18.65%	2.5% - 45%
Marshall	27.25%	7.5% - 57.5%

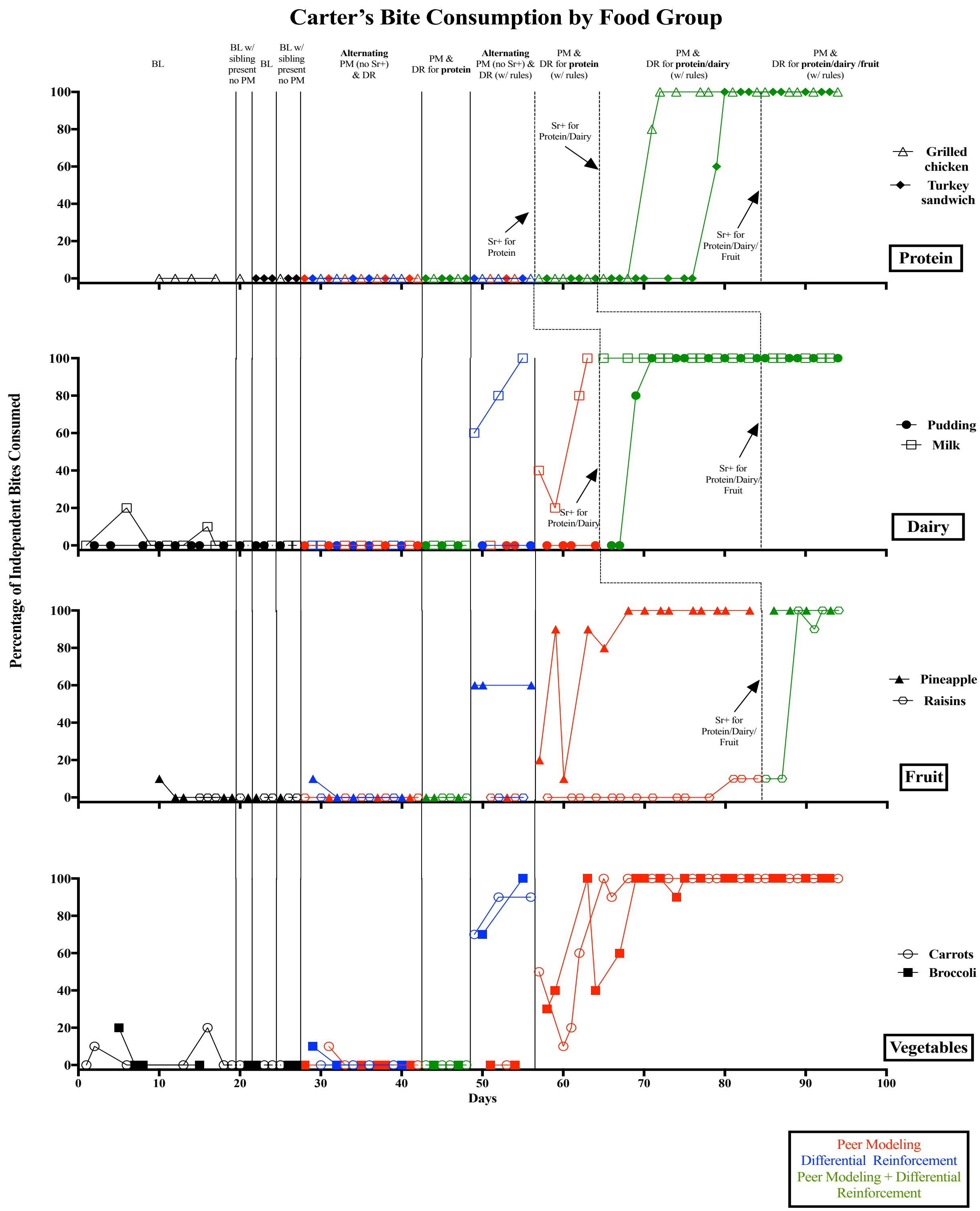

Figure 1. Bites consumed across all four food groups with Carter. The x-axis displays days in which sessions were conducted. The y-axis displays the percentage of independent bites consumed. The red data path shows the peer modeling sessions. The blue data path shows the differential reinforcement sessions. The green data path shows the combined peer modeling and differential reinforcement sessions.

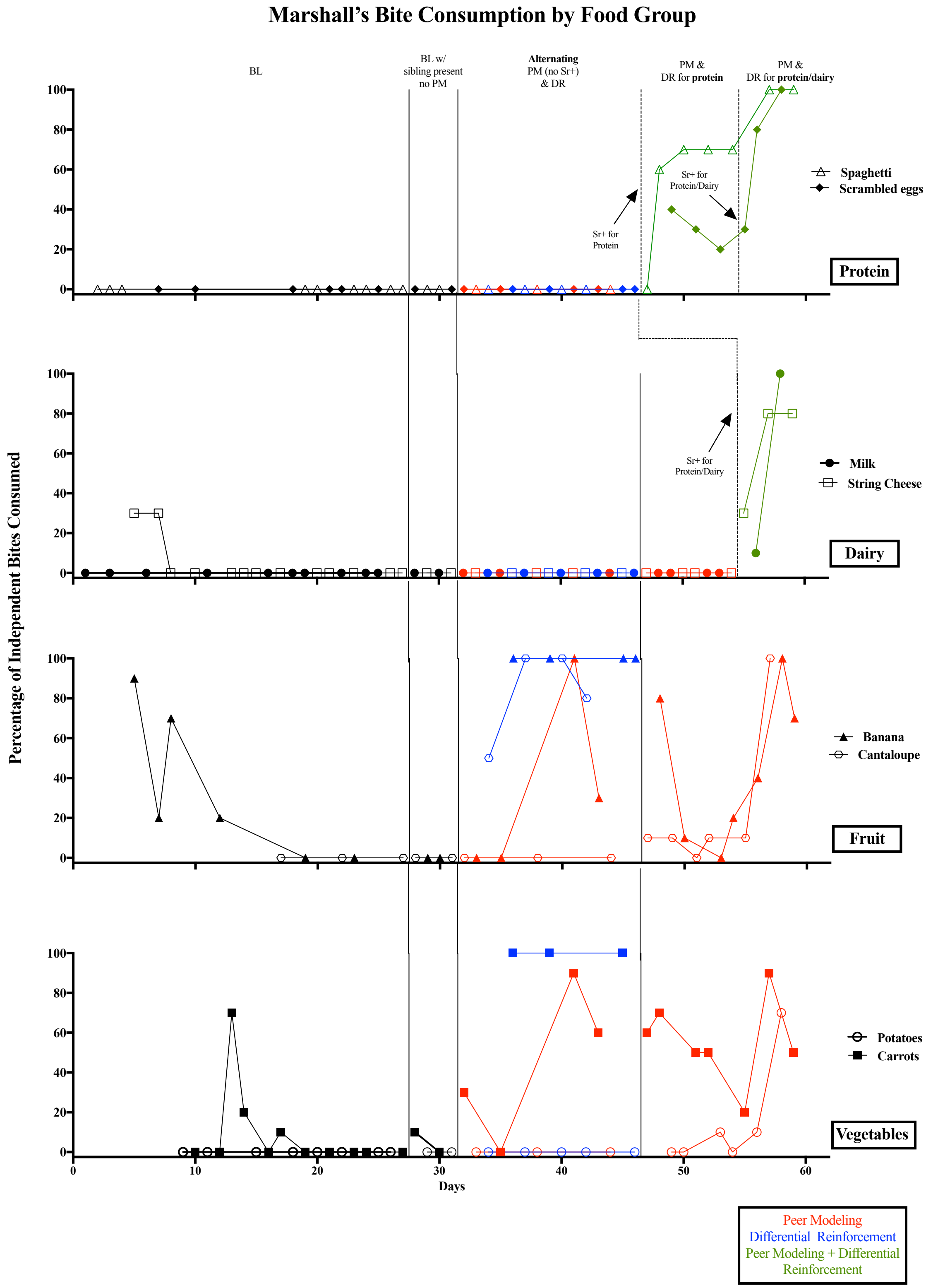

Figure 2. Bites consumed across all four food groups with Marshall. The x-axis displays days in which sessions were conducted. The y-axis displays the percentage of independent bites consumed. The red data path shows the peer modeling sessions. The blue data path shows the differential reinforcement sessions. The green data path shows the combined peer modeling and differential reinforcement sessions.

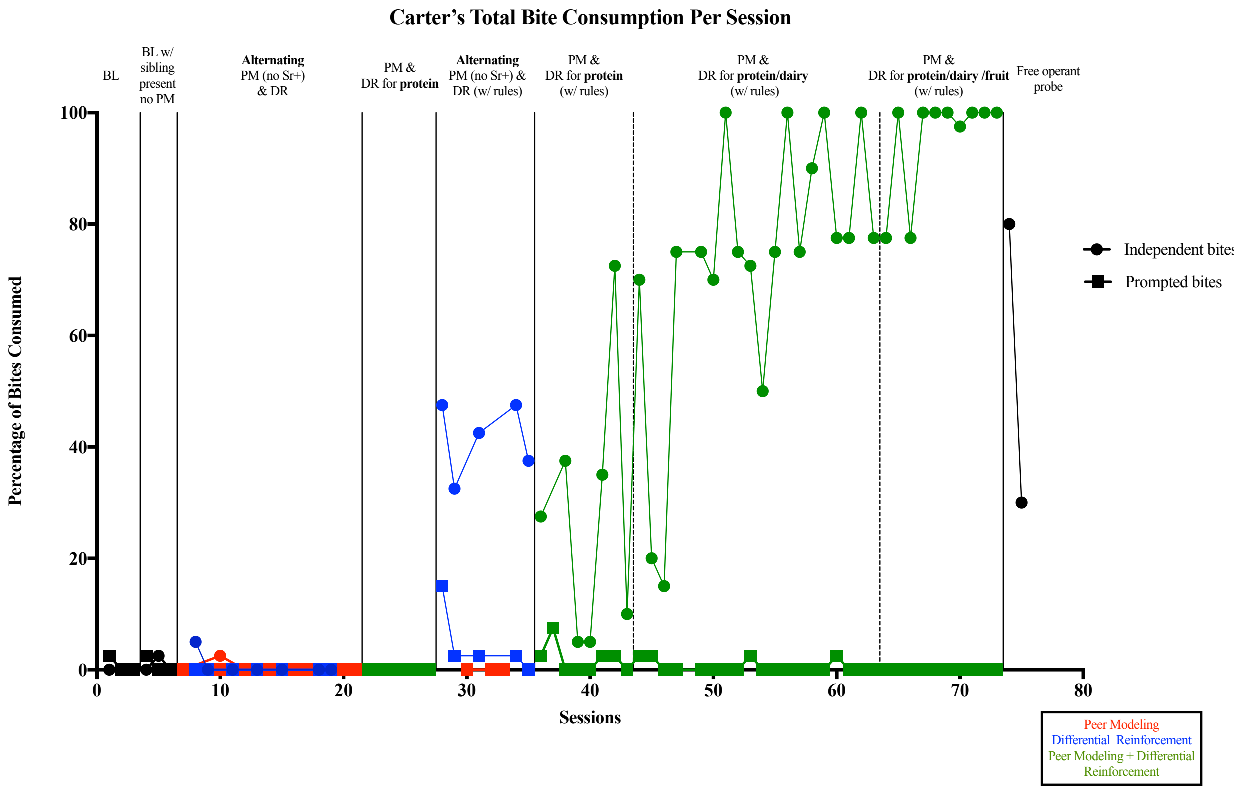

Figure 3. Total independent and prompted bites consumed across phases for Carter. The x-axis displays days in which sessions were conducted. The y-axis displays the percentage of bites consumed. The red data path shows the peer modeling sessions. The blue data path shows the differential reinforcement sessions. The green data path shows the combined peer modeling and differential reinforcement sessions. The final black data path shows the free operant probes.

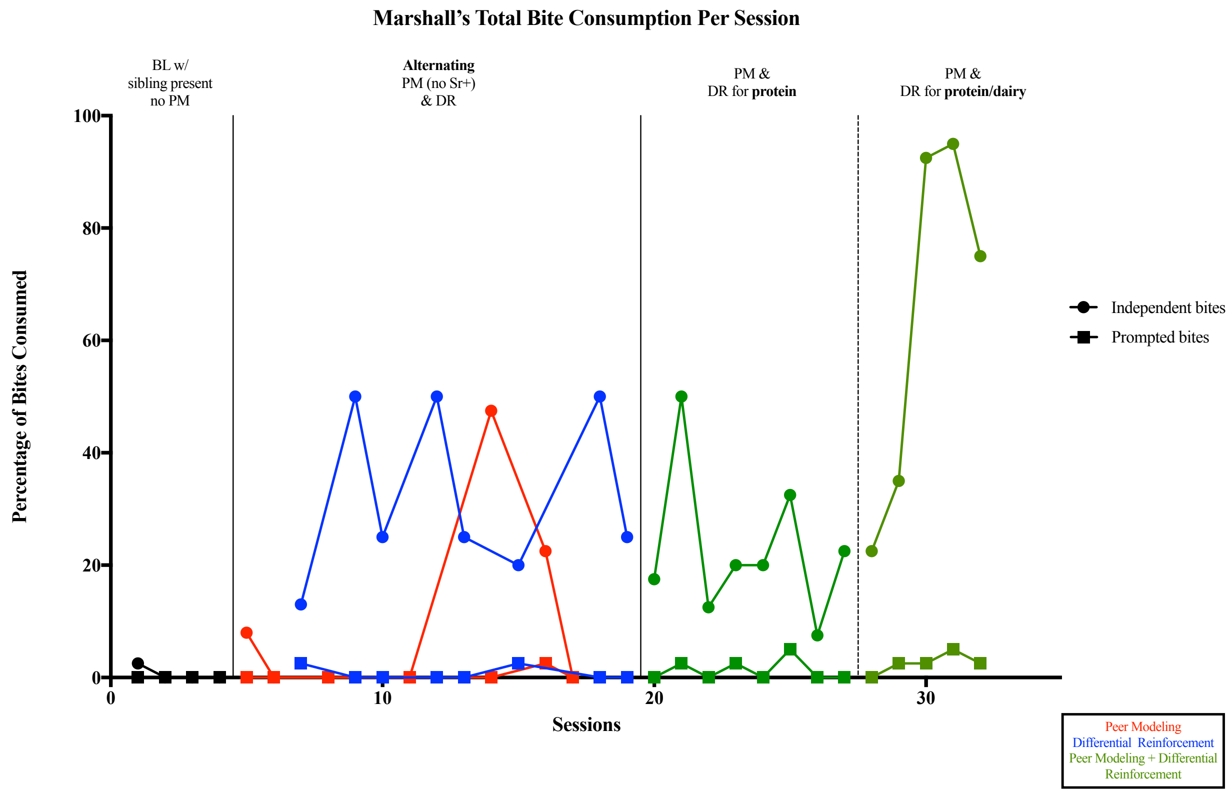

Figure 4. Total independent and prompted bites consumed across phases for Marshall. The x-axis displays days in which sessions were conducted. The y-axis displays the percentage of bites consumed. The red data path shows the peer modeling sessions. The blue data path shows the differential reinforcement sessions. The green data path shows the combined peer modeling and differential reinforcement sessions.

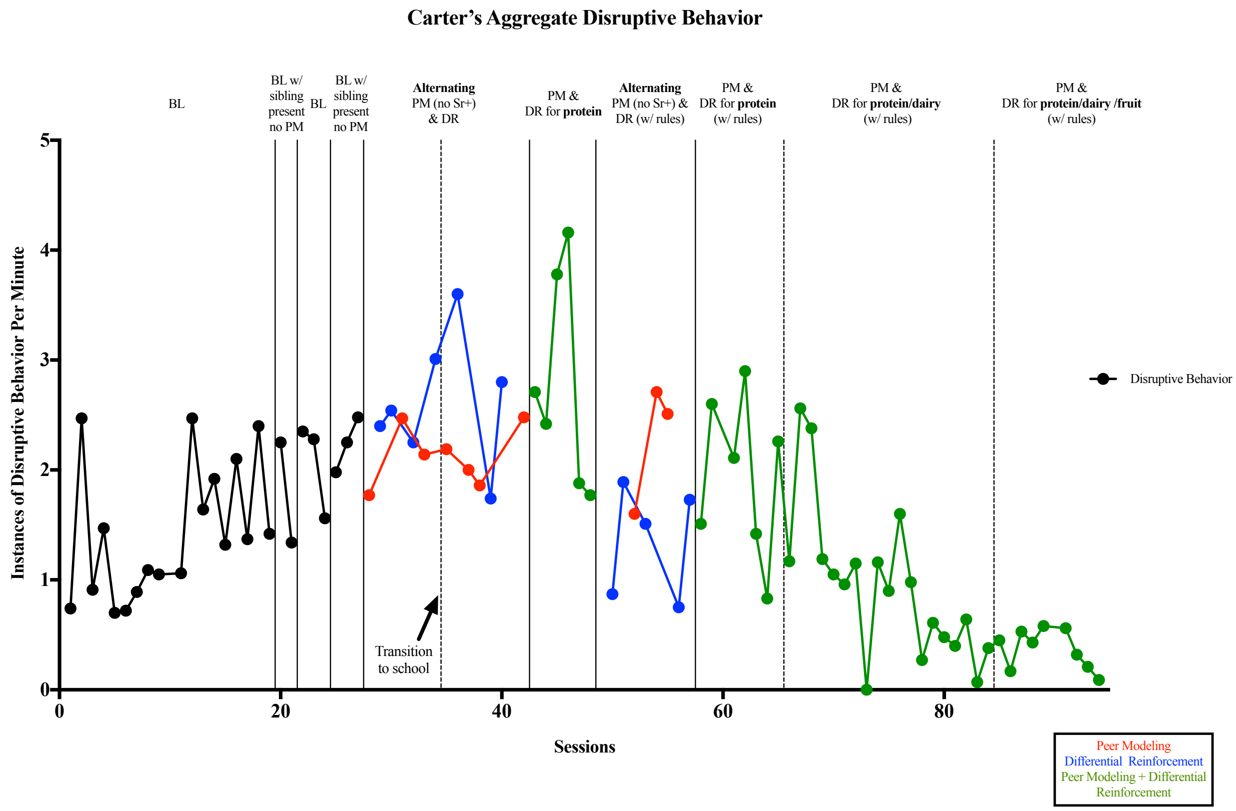

Figure 5. Rates of aggregate disruptive behavior across phases for Carter. The x-axis displays days in which sessions were conducted. The y-axis displays the rate of disruptive behavior (instances per minute). The red data path shows the peer modeling sessions. The blue data path shows the differential reinforcement sessions. The green data path shows the combined peer modeling and differential reinforcement sessions.

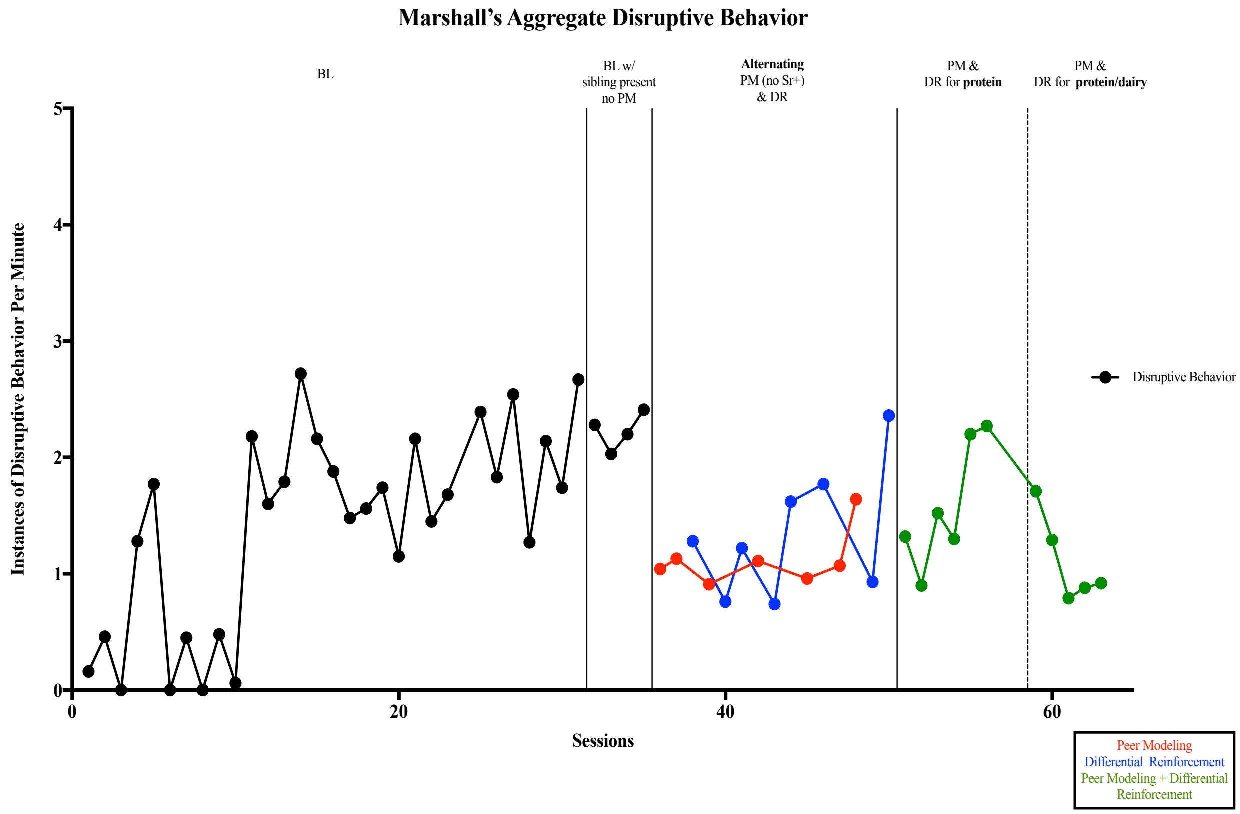

Figure 6. Rates of aggregate disruptive behavior across phases for Marshall. The x-axis displays days in which sessions were conducted. The y-axis displays the rate of disruptive behavior (instances per minute). The red data path shows the peer modeling sessions. The blue data path shows the differential reinforcement sessions. The green data path shows the combined peer modeling and differential reinforcement sessions.

Appendix A

First Parent Survey

Please list foods your child will <u>not</u> eat	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

Please list foods your child will <u>occasionally</u> eat	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

Appendix A, continued

Please list foods your child will <u>almost always</u> eat	**Will his sibling eat it?**	**How often is this served in your home?**	**Please rate importance of eating this food (1 being "most important", 5 being "not at all important")**
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

Does your child engage in any problem behaviors during mealtime? If so, please list what behaviors occur.

What is your goal for your child regarding mealtime with your family?

What time is most convenient for your family between 4pm and 9pm for sessions to be conducted?

Where is most convenient for sessions to be conducted?

Home Child Development Center

Appendix B

Second Parent Survey

Please circle the best responses for each item. If there are items that are not listed that you would like to add, please write them in the blank spaces at the end of each food group. Thank you for your input!

FRUITS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Apple	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Applesauce	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Banana	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Fruit Cocktail	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Grapes	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Orange	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Pear	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

FRUITS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Pineapple	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Raisins	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Strawberry	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

Appendix B, continued

VEGETABLES	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Broccoli	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Carrots	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Cauliflower	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Celery	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Corn	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Green beans	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Peas	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

VEGETABLES	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Potatoes	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Salad	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Vegetable juice	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

Appendix B, continued

GRAINS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Bagel	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Bread	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Cereal	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Cornbread	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Crackers	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Muffin	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Noodles	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

GRAINS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Oatmeal	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Pancakes	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Rolls	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

Appendix B, continued

PROTEINS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Beans	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Chicken Nuggets/Strips	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Grilled Chicken	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Ham	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Lunchmeat	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Meatballs	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Peanut/Almond Butter	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

PROTEINS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Pork	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Scrambled Eggs	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Steak	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Turkey	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

Appendix B, continued

DAIRY	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Cottage Cheese	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Ice cream	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Milk	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Pudding	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
String cheese	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Yogurt	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

COMBINED FOODS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Macaroni and cheese	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Pizza	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Sandwich	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
Spaghetti	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5

Appendix B, continued

CONDIMENTS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Barbeque sauce	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
What do they eat it on?					
Ketchup	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
What do they eat it on?					
Mayonnaise	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
What do they eat it on?					
Mustard	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
What do they eat it on?					
Ranch	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
What do they eat it on?					

CONDIMENTS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Syrup	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
What do they eat it on?					
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
What do they eat it on?					
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
What do they eat it on?					
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
What do they eat it on?					
	Yes / No	Always Occasionally Never	Yes / No	More than once a week Once a week Once a month Less than once a month	1 2 3 4 5
What do they eat it on?					

Appendix B, continued

Please select any of the following behaviors that your child engages in during mealtime:

- ☐ Aggression (e.g., grabbing, hitting, kicking)
- ☐ Eats at appropriate pace
- ☐ Gags or throws up food
- ☐ Gets out of his seat
- ☐ Inappropriate social behaviors (e.g., picking nose, playing with food/items at table, unrelated/inappropriate comments/singing)
- ☐ Interacts with his siblings
- ☐ Makes requests for items
- ☐ Negative vocalizations (e.g., "no!", yells, cries)
- ☐ Self-injurious behavior (e.g., scratching himself, hitting himself)
- ☐ Sits in chair appropriately
- ☐ Spits food out
- ☐ Swipes food from the table
- ☐ Takes appropriately sized bites
- ☐ Throwing food (e.g., on ground, on table)
- ☐ Turning head away from food being presented
- ☐ Uses napkin
- ☐ Uses utensils correctly

What is your goal for your child regarding mealtime with your family?

- ☐ Be able to go out to eat
- ☐ Have family meals with everyone seated
- ☐ Increase the food your child will eat
- ☐ Other ______________________

Appendix C

Carter's Hierarchy of Foods to Target

FRUITS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Grapes	No	Never	Yes	Once a week	1
Orange	No	Never	Yes	Once a week	1
Strawberry	No	Never	Yes	Once a month	1
Applesauce	No	Never	Yes	Once a week	2
Pear	No	Never	Yes	Once a month	2
Pineapple	No	Never	Yes	Once a month	3
Raisins	No	Never	Yes	Less than once a month	4
Fruit Cocktail	No	Occasionally	Yes	Once a week	2
Apple	Yes	Always	Yes	More than once a week	1
Banana	Yes	Always	Yes	More than once a week	1

Appendix C, continued

VEGETABLES	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Salad	No	Never	Yes	More than once a week	1
Broccoli	No	Never	Yes	Once a month	1
Celery	No	Never	Yes	Once a week	2
Potatoes	No	Never	Yes	Once a week	2
Corn	No	Never	Yes	Once a month	3
Green Beans	No	Never	No	Once a month	3
Cauliflower	No	Never	No	Less than once a month	4
Peas	No	Never	No	Less than once a month	4
Carrots	No	Occasionally	Yes	More than once a week	1

Appendix C, continued

GRAINS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Oatmeal	No	Never	Yes	Once a month	3
Muffin	No	Never	Yes	Less than once a month	4
Cornbread	No	Never	Yes	Less than once a month	5
Bread	Yes	Occasionally	Yes	Once a week	1
Rolls	Yes	Occasionally	Yes	Once a week	2
Bagel	Yes	Occasionally	Yes	Once a month	2
Crackers	Yes	Always	Yes	More than once a week	1
Pancakes	No	Always	Yes	More than once a week	1
Cereal	Yes	Always	Yes	More than once a week	3

Appendix C, continued

PROTEINS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being “most important”, 5 being “not at all important”)
Grilled Chicken	No	Never	Yes	Once a week	1
Peanut/Almond Butter	No	Never	Yes	Once a week	1
Bacon	No	Never	Yes	Once a week	1
Lunchmeat	No	Never	Yes	Once a week	2
Scrambled Eggs	No	Never	Yes	Once a week	2
Beans	No	Never	Yes	Once a week	3
Turkey	No	Never	Yes	Less than once a month	4
Ham	No	Never	No	Less than once a month	4
Meatballs	No	Never	No	Less than once a month	4
Steak	No	Never	No	Once a month	5
Pork	No	Never	No	Less than once a month	5
Chicken Nuggets/Strips	Yes	Always	Yes	More than once a week	2

Appendix C, continued

DAIRY	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Milk	No	Never	Yes	Once a week	1
Yogurt	No	Never	Yes	Once a week	1
Pudding	No	Never	Yes	Less than once a month	5
Cottage Cheese	No	Never	No	Less than once a month	5
Ice Cream	Yes	Occasionally	Yes	Once a month	3
String Cheese	Yes	Always	Yes	Once a week	2

COMBINED FOODS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Spaghetti	No	Never	Yes	Once a week	1
Sandwich	No	Never	Yes	Once a week	2
Pizza	No	Never	Yes	Once a week	3
Macaroni and Cheese	Yes	Always	Yes	Once a week	2

Appendix D

Marshall's Hierarchy of Foods to Target

FRUITS	**Will your child eat it?**	**How often will they eat it?**	**Will his sibling eat it?**	**How often is this served in your home?**	**Please rate importance of eating this food (1 being "most important", 5 being "not at all important")**
Apple	No	Never	No	Once a month	2
Banana	No	Never	No	Once month	2
Orange	No	Never	No	Once a month	2
Raisins	No	Never	No	Once a month	2
Strawberry	No	Never	No	Once a month	2
Grapes	No	Never	No	Less than once a month	3
Applesauce	Yes	Occasionally	Yes	More than once week	2
Pineapple	Yes	Occasionally	Yes	Once a month	2
Pear	Yes	Occasionally	No	Once a week	2
Fruit Cocktail	Yes	Occasionally	No	Once a month	4

Appendix D, continued

VEGETABLES	**Will your child eat it?**	**How often will they eat it?**	**Will his sibling eat it?**	**How often is this served in your home?**	**Please rate importance of eating this food (1 being "most important", 5 being "not at all important")**
Corn	No	Never	Yes	More than once a week	1
Green Beans	No	Never	Yes	More than once a week	1
Peas	No	Never	Yes	More than once a week	1
Potatoes	No	Never	Yes	More than once a week	1
Broccoli	No	Never	No	Once a month	1
Salad	No	Never	No	Once a week	3
Cauliflower	No	Never	No	Once a month	3
Celery	No	Never	No	Once a month	3
Vegetable Juice	No	Never	No	Less than once a month	5

Appendix D, continued

GRAINS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being “most important”, 5 being “not at all important”)
Cereal	No	Never	Yes	More than once a week	2
Noodles	No	Never	Yes	More than once a week	3
Pancakes	No	Never	Yes	Once a week	3
Cornbread	No	Never	Yes	Once a month	3
Oatmeal	No	Never	No	Once a month	3
Bagel	Yes	Occasionally	Yes	Once a month	3
Muffin	Yes	Occasionally	Yes	Once a month	4
Bread	Yes	Always	Yes	More than once a week	1
Rolls	Yes	Always	Yes	Once a week	3
Crackers	Yes	Always	Yes	More than once a week	4

Appendix D, continued

PROTEINS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Turkey	No	Never	Yes	Once a month	1
Scrambled Eggs	No	Never	No	Once a week	2
Beans	No	Never	No	Once a month	2
Lunchmeat	No	Never	Yes	Once a week	3
Ham	No	Never	Yes	Once a month	3
Meatballs	No	Never	Yes	Once a month	3
Chicken Nuggets/Strips	Yes	Occasionally	Yes	Once a week	3
Pork	Yes	Always	Yes	More than once a week	1
Steak	Yes	Always	Yes	More than once a week	1
Peanut/Almond Butter	Yes	Always	Yes	More than once a week	2
Grilled Chicken	Yes	Always	Yes	Once a week	2

Appendix D, continued

DAIRY	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Milk	No	Never	Yes	More than once a week	1
Yogurt	No	Never	Yes	More than once a week	1
Pudding	No	Never	Yes	Once a week	3
String Cheese	No	Never	No	Once a month	3
Cottage Cheese	No	Never	No	Less than once a month	3
Ice Cream	Yes	Occasionally	Yes	Once a month	2

COMBINED FOODS	Will your child eat it?	How often will they eat it?	Will his sibling eat it?	How often is this served in your home?	Please rate importance of eating this food (1 being "most important", 5 being "not at all important")
Macaroni and Cheese	No	Never	Yes	Once a week	2
Sandwich	No	Never	Yes	Once a week	2
Spaghetti	No	Never	Yes	Once a week	2
Pizza	Yes	Always	No	Once a week	3