A Comparison of Modified Food Chaining and Simultaneous Presentation Plus Nonremoval of the Spoon to Treat Food Selectivity in Children with Autism Spectrum Disorder

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Abstract

Feeding disorders can range from mild (e.g., food selectivity by taste or texture) to severe (e.g., total food refusal; Bachmeyer, 2009). If left untreated, feeding disorders can result in serious health ramifications, including malnutrition, growth delays, and developmental delays (Kern & Marder, 1996). Recent studies comparing commonly used occupational therapy (OT) treatments and empirically supported applied behavior analysis (ABA) treatments found that the ABA treatments were effective for all children while the OT treatments were ineffective for all children exposed to the OT treatment (Addison et al., 2012; Peterson, Piazza, & Volkert, 2016). We used a multielement design to compare a modified version of a commonly used treatment, food chaining, and an empirically validated ABA treatment to treat the food selectivity of 2 children with autism spectrum disorder (ASD). For both children, consumption of the target foods only increased during the ABA-treatment condition. We subsequently faded the size of the preferred food within the simultaneous-presentation arrangement, moved to a sequential-presentation arrangement, and then thinned the schedule of reinforcement. We will discuss the results within the context of treatment implications, limitations, and suggestions for future research.

Key words: applied behavior analysis, simultaneous presentation, nonremoval of the spoon, escape extinction, feeding disorders, occupational therapy, modified food chaining

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A child is diagnosed with a feeding disorder when he or she does not consume an adequate amount or variety of food to grow (Piazza, Patel, Gulotta, Sevin, & Layer, 2003). Feeding disorders range from mild (e.g., food selectivity by type or texture) to severe (e.g., total refusal; e.g., Bachmeyer, 2009). Children who display selective eating may eat during mealtimes; however, the amount they consume may be insufficient for growth and development (Bachmeyer, 2009) or they may eat foods with little or no nutritional value (e.g., french fries, candy; Peterson, Piazza, & Volkert, 2016). If left untreated, food selectivity can result in social isolation (Bachmeyer, 2009; Hodges, Davis, Crandall, Phipps, & Weston, 2017), lethargy (Bachmeyer, 2009), weight loss, growth delays, and developmental delays (Kern & Marder, 1996). In severe cases in which the child is, or is at risk for, failure to thrive, food selectivity can result in the need for medical intervention in the form of gastrostomy or nasogastronomy tubes (Bachemeyer, 2009). Given these possible social and health ramifications of untreated feeding disorders, it seems prudent to identify effective treatments to increase the consumption and range of healthy foods for children who display food selectivity.

Eating as a Behavior Chain

Eating is conceptualized as a chain of behaviors that begins at the presentation of a bite of food and concludes upon swallowing the food (Gulotta, Piazza, Patel, & Layer, 2005). Silbaugh, Swinnea, and Penrod (2018) provided a detailed description of this behavior chain for children with typical feeding skills in which the presentation of food sets the occasion for acceptance of food. The stimulus change produced by accepting the food (i.e., food in the mouth) reinforces accepting food into the mouth and also serves as a discriminative stimulus for mastication (i.e., chewing the food) and lateralization until the bolus is formed. The stimulus change produced by mastication and lateralization (i.e., formed bolus) reinforces mastication and lateralization and also serves as a discriminative stimulus for moving the bolus further into the oral cavity to the tonsillar pillars and pharyngeal wall, which elicits the reflexive movement of the bolus to the pharynx. The bolus is then transferred to the stomach via reflexive movement through the pharyngeal and esophageal phases, which sets the occasion for the gastrointestinal phase. The subsequent removal or reduction of hunger pangs may function as the terminal reinforcer for all preceding voluntary behaviors (i.e., acceptance and bolus formation) in the behavior chain (Silbaugh et al., 2018). The authors suggested that one implication of this conceptualization is that not only can researchers and practitioners implement behavioral interventions to treat feeding difficulties by function (as is best practice; e.g., Addison et al., 2012; Allison et al., 2012; Bachmeyer et al., 2009; Knapp, Simmons, Verstraete, & McAdams, 2012; LaRue, Stewart, Piazza, Volkert, Patel, & Zeleny, 2011; Najdowski, Wallace, Doney, & Ghezzi, 2003), but they can also use behavioral interventions to treat the disordered link in the behavior chain. For example, if the child does not accept food, a practitioner might implement nonremoval of the spoon (e.g., Hoch, Babbit, Coe, Krell, & Hackbert, 1994); however, if the child accepts food but unsuccessfully chews it, a reasonable treatment approach might include teaching the child to chew (e.g., Volkert, Peterson, Zeleny, & Piazza, 2014).

Interdisciplinary Assessment and Treatment

Rommel, DeMeyer, Feenstra, and Veereman-Wauters (2003) evaluated data from 700 children referred for assessment and treatment of feeding difficulties and found that over 60% had combined causes, including medical, behavioral, and oral motor difficulties. Given this finding, it is not surprising that several researchers recommend an interdisciplinary approach in which two or more disciplines work together in communication and sharing of knowledge towards a common goal for an individual (e.g., Arvedson, 2008; Friman & Piazza, 2011; Morris, Knight, Bruni, Layers, & Drayton, 2017).

Behavioral Treatments

Behavioral treatment strategies for feeding disorders can be broadly categorized in three ways: antecedent-based, consequent-based, or antecedent- and consequence-based strategies. Antecedent-based strategies involve manipulation of an environmental event or condition prior to the target behavior (Cooper, Heron, & Heward, 2007; Smith, 2011). Consequence-based strategies involve manipulation of an environmental event or condition contingent on the target behavior (Cooper et al., 2007). Finally, combined antecedent- and consequence-based strategies tend to be multi-component treatment packages that involve at least one antecedent-based strategy and at least one consequence-based strategy (Cooper, Wacker, & McComas, 1995).

Antecedent-based strategies.

Stimulus fading. This procedure has been used to systematically alter food texture (e.g., Kadey, Piazza, Rivas, & Zelney, 2013; Patel, Piazza, Layer, Coleman, & Swartzwelder, 2005; Patel, Piazza, Santana, & Volkert, 2002; Shore, Babbit, & Williams, 1998) and food taste (e.g., Luiselli, Ricciardi, & Gilligan, 2005; Mueller, Piazza, Kelley, & Pruett, 2004; Pizza, Kelly, Ochsner, & Santana, 2001; Tiger & Hanley, 2006). When using stimulus fading to increase the texture of the target food, researchers often begin treatment at a texture with which the child is successful and systematically increase the texture of the target food until the child consumes the food at an appropriate texture based on the child's age or oral motor skills (Patel et al., 2005). For example, Shore, Babbit, Williams, Coe, and Snyder (1998) used a treatment package consisting of differential reinforcement of alternative behaviors (DRA), nonremoval of the spoon

(NRS), and texture fading in which they increased the texture of food from puree (i.e., foods blended until smooth), junior (i.e., thicker than puree), ground (i.e., pureed with small chunks), to a chopped-fine (i.e., regular table foods chopped into small pieces) texture for three children with food selectivity (Shore, Babbitt, Williams, Coe, & Snyder, 1998). When using stimulus fading to alter the taste of a food or liquid, researchers often begin treatment with a preferred food or liquid the child is consuming and gradually alter the taste by systematically increasing the amount of the target nonpreferred food relative to that of the preferred food (Tiger & Hanley, 2006). For example, Tiger and Hanley (2006) increased one child's milk consumption by gradually decreasing the amount of chocolate syrup added to the milk. One advantage of this procedure is that it has generally not been associated with IMB, presumably because the fading procedure begins with foods the child is currently consuming and progresses gradually and systematically (Shore et al., 1998). One limitation of this procedure is that the gradual nature of stimulus fading may result in increased treatment durations (Bachmeyer, 2009). To offset this limitation, researchers can conduct intermittent probes at higher textures to determine the necessity of continued stimulus fading, which can subsequently reduce the length of the fading treatment (Bachmeyer, 2009; Shore et al., 1998). Another limitation to this procedure is that if researchers are not able to hold one stimulus variable constant, one could confound the results. For example, adding chocolate syrup could alter colour, taste, smell, and texture of the milk.

High-probability sequence. This procedure involves presenting a sequence of demands with which the child has a high probability of complying followed by a demand with which the child has a low probability of complying (i.e., taking a bite of nonpreferred food). For example, Patel et al., (2007) used the high-probability sequence to increase one child's acceptance. The authors presented an empty spoon three times to the child then presented one bite of a nonpreferred food. One advantage of this procedure is that it may not require escape extinction (see Ewry & Fryling, 2016; Meier et al., 2012; Patel et al., 2007; Penrod et al., 2012 for examples of studies in which the high-probability sequence did not include extinction), which some researchers have found can produce short-term increase in problem behavior (Ahearn et al., 1996) or inappropriate mealtime behavior. In fact, Bachmeyer (2009) suggested that the repeated presentations of a high-probability request preceding a low-probability request might decrease the aversive properties of the meal or nonpreferred food presentation (Bachmeyer, 2009). One limitation of this procedure is that findings within and across studies are somewhat mixed. While several researchers have demonstrated the efficacy of the high-p sequence (e.g., Ewry & Fryling, 2016; McComas, Wacker, Cooper, Peck, Golonka, Millard, & Richman, 2000; Meier, Fryling, & Wallace, 2012; Patel, Reed, Piazza, Bachmeyer, Layer, Pabico, 2006; Patel, Reed, Piazzam Mueller, Bachmeyer, & Layer, 2007; Penrod, Gardella, Fernand, 2012), several others have failed to replicate these effects (Lipschultz, Wilder, & Enderli, 2017; Rortvedt & Miltenberger, 1994; Silbaugh & Swinnea, 2018).

Noncontingent access to preferred items. This procedure involves providing the child with continuous access to a preferred item or attention throughout the feeding session (Wilder, Normand, & Atwell, 2005; Reed, Piazza, Patel, Layer, Bachmeyer, Bethke, & Gutshall, 2004). For example, Wilder, Normand, and Atwell (2005) increased acceptance of new foods and decreased self-injury in one child with food refusal by providing her with noncontingent access to a preferred video during feeding sessions. There are three possible primary advantages of this procedure. First, it is very easy to implement because items are continuously available rather than being arranged in a contingency (e.g., Kahng, Iwata, DeLeon, & Wallace, 2000; Wilder, Carr, & Gaunt, 2000). Next, it may help to create a positive treatment context because the individual has the opportunity to interact with the preferred items through the session (Cooper et al., 2007). Finally, reinforcement may become paired with appropriate feeding behavior (e.g., acceptance and consumption) or other appropriate behaviors (e.g., play, sharing), which could increase the probability of those behaviors occurring in the future under similar conditions (Roscoe, Iwata, & Goh, 1998). However, because the contingency between reinforcement and the target feeding behavior is unclear in this procedure, the target feeding behavior may decrease, inappropriate mealtime behavior (IMB) may be incidentally reinforced, or both (Reed et al., 2004; Van Camp, Lerman, Kelley, Contruccki, & Vorndran, 2000).

Simultaneous presentation. This procedure involves presenting the child with a preferred and a nonpreferred food at the same time. For example, Ahearn (2003) increased one child's vegetable consumption by presenting vegetables with preferred condiments. One advantage of this procedure is that presenting a preferred food in the same bite presentation as the nonpreferred food may decrease the aversive properties of the nonpreferred food, the mealtime, or both (Bachmeyer, 2009). Piazza et al. (2002) suggested that simultaneous presentation might result in "flavor-flavor" conditioning, meaning that the repeated pairings of preferred and nonpreferred food may establish the nonpreferred food as preferred. However, it is possible that flavor-flavor conditioning could have the opposite effect. That is, if the nonpreferred food is highly aversive, the repeated pairings of preferred and nonpreferred food could establish the preferred food as nonpreferred and could actually decrease acceptance (Ahearn, 2003).

Consequence-based strategies.

Differential reinforcement of alternative behaviors (DRA). This procedure involves providing the child a preferred item or activity contingent on specific feeding behavior (e.g., acceptance, consumption; Bachmeyer, 2009). One advantage of this procedure is that it involves social positive reinforcement of a desired behavior, which may be perceived by some as being less intrusive than other consequence-based strategies (e.g., escape extinction, punishment). One minor limitation of DRA when applied to the treatment of feeding disorders is that researchers have only used preferred foods as reinforcers within this contingency. Therefore, it is unclear if preferred activities or items other than food would increase consumption of nonpreferred foods (Bachmeyer, 2009), whether any of these items may function as positive reinforcement for bite acceptance for children with feeding disorders, or whether these items could compete with negative reinforcement in the form of escape from mealtime.

Sequential presentation. This procedure looks the same as DRA, however the reinforcer is always food. The delivery of the preferred food likely serves as reinforcement for acceptance or consumption of the target nonpreferred foods – so long as the preferred food functions as a reinforcer (Piazza et al., 2002). For example, Piazza et al. (2002) compared the effects of sequential presentation and simultaneous presentation on the acceptance in three children with food selectivity. During the sequential presentation phase, the researchers provided the child a bite of preferred food contingent on acceptance of a nonpreferred food. However, results showed that sequential presentation alone did not produce an increase in acceptance and that sequential presentation was only effective when combined with escape extinction.

Nonremoval of the spoon. This procedure involves continuously holding the nonpreferred food to the child's lips until he or she opens his or her mouth to accept (Piazza, Patel, Gulotta, Sevin, & Layer, 2003). Nonremoval of the spoon is procedurally identical to escape extinction but is generally referred to as NRS when an escape function was not first confirmed via a functional analysis. The primary advantage of this procedure is its effectiveness;

escape extinction or NRS alone has been repeatedly proven to be effective for treating feeding disorders (Ahearn et al., 1996; Bachemeyer, Piazza, Fredrick, Reed, Rivas, & Kadey, 2009; LaRue et al., 2011; Voulgarakis & Forte, 2015) or when combined with other procedures, including stimulus fading (Freeman & Piazza, 1998); high-probability sequence (Dawson et al., 2003); noncontingent access to preferred stimuli (Addison et al., 2012; Peterson et al., 2016; Wilder et al., 2000); simultaneous presentation (Piazza et al., 2002; VanDalen & Penrod, 2010); sequential presentation (Piazza et al., 2002; VanDalen & Penrod, 2010); DRA (Cooper et al., 1999). A notable limitation of NRS is that it may evoke maladaptive behaviors (e.g., negative vocalizations, disruption, self-injury; Ahearn et al., 1996).

Antecedent- & consequence-based strategy treatment packages. Perhaps the most common treatment strategies are those that consist of both antecedent- and consequence-based procedures (Cooper, Wacker, & McComas, 1995). Because a recent review of functional analyses conducted for IMB indicated that escape functioned as the maintaining variable in 86% of cases (Hodges, Davis, & Kirkpatrick, 2018), it is not surprising that many treatment packages for feeding disorders include an escape extinction component, even when a functional analysis has not been conducted. Therefore, we have grouped treatment by packages with escape extinction and without escape extinction.

Treatment packages with extinction. There are two procedural variations of escape extinction: NRS and physical guidance (Riordan et al., 1984). Physical guidance involves gently opening the child's mouth by applying pressure to his or her jaw contingent on refusal (Ahearn et al., 1996). As stated previously, NRS involves holding the bite of food to the child's mouth until he or she accepts it (Ahearn et al., 1996). Ahearn et al. (1996) compared the effectiveness of these two iterations on the acceptance of nonpreferred food with three children with food refusal.

During the physical guidance condition, the therapist gently opened the child's mouth if the child did not accept the bite within 5 s of presentation. During the NRS condition, the therapist presented a bite to the child and held the bite at the child's lower lip until the child opened his or her mouth, at which point the therapist deposited the bite in the child's mouth (Ahearn et al., 1996). During both conditions, the therapist re-presented expelled bites. The results showed that both procedures were effective; however, the authors noted that fewer challenging behaviors were associated with physical guidance and that parents preferred physical guidance to NRS. The current evidence supports the use of escape extinction with simultaneous presentation (Kern & Marder, 1996; Piazza et al., 2002; VanDalen & Penrod, 2010); sequential presentation (Kern & Marder, 1996; Piazza et al., 2002; VanDalen & Penrod, 2010) noncontingent access to preferred items (Addison et al., 2012; Peterson et al., 2016); social positive reinforcement (Coe et al., 1997); stimulus fading (Freeman & Piazza, 1998); social negative reinforcement (LaRue et al., 2011; Voulgarakis & Forte, 2015); and spoon distance fading (Rivas et al., 2010). One limitation of using a treatment package with escape extinction is that extinction may evoke challenging behavior (Ahearn et al., 1996).

Treatment packages without extinction. Given that escape extinction has been associated with an increase in problem behavior (Ahearn et al., 1996), several researchers have evaluated the efficacy of treatment packages that do not include extinction. The current evidence supports the use of several procedures without escape extinction, such as DRA plus demand fading (Riordan et al., 1980); DRA plus motivating operation analysis (Levin & Car, 2001); and simultaneous presentation plus DRA (Buckley & Newchok, 2005).

Occupational Therapy Treatment

Along with behavior analysts, OTs are an integral part of an interdisciplinary team for the assessment and treatment of feeding disorders (Arvedson, 2008; Fraker et al., 2007). In addition to assessment of oral sensory, oral motor, and body positioning (Morris et al., 2017), OT's have also developed treatments for feeding disorders. The three primary treatments used by OT's to treat feeding difficulties include: (a) sensory integration therapy, (b) sequential oral sensory approach, and (c) food chaining (Niagara Children's Centre, 2018). To date, researchers have compared behavioral interventions to sensory integration therapy (Addison et al., 2012) and modified sequential oral sensory approach (Peterson et al., 2016) and have found that not only were the behavioral interventions superior to these OT approaches, but neither OT approach produced an increase in consumption of the target foods for any subjects.

Sensory Integration. Sensory integration is based on the idea that individuals, especially individuals with ASD, can suffer from sensory processing disorders that may result in behavioral challenges. As such, the focus of this treatment is on how one processes sensory stimulation (e.g., sound, taste, touch) from the environment. Dysfunction of sensory processing is said to *manifest* in a variety of different ways. With respect to feeding disorders, sensory processing dysfunction may take the form of poor fine and gross motor performance, deficient social skills, and lack of emotion regulation (The American Occupational Therapy Association, Inc., 2015). These sensory processing dysfunctions are purported to impact normal development of feeding and may result in challenging behavior (e.g., aggression, social avoidance, self-injury; Addison et al., 2012).

To address these sensory dysfunctions, sensory integration therapy aims to target *sensory modulation*, which is purported to improve sensory responsiveness (The American Occupational Therapy Association, Inc., 2015). Occupational therapists design individual sensory integration therapy treatments based on the individual needs of the child. As such, there are several possible components to this treatment, including: (a) remedial intervention (i.e., gross motor activities); (b) accommodations or adaptations (e.g., wearing ear plugs for noise sensitivity); (c) environmental modifications (e.g., lighting, white noise, wall murals); (d) education (i.e., informing others how to be proactive); and (e) sensory diets (e.g., rhythm and music, proprioceptive activities, heavy work, and sensory modulation techniques; The American Occupational Therapy Association, Inc., 2015).

To date, only one study has evaluated the efficacy of sensory integration therapy as a viable treatment for children with feeding disorders – and the researchers found that sensory integration therapy did not improve either participant's food refusal (Addison et al., 2012). Addison et al. (2012) compared the effects of a behavioral approach (noncontingent reinforcement plus escape extinction) and sensory integration therapy on the food refusal of two children admitted to a pediatric feeding disorders day treatment program. During the behavioral treatment condition, the therapist provided free access to a preferred toy and attention throughout the meal and if the child refused a bite, the therapist held the cup or spoon to the child's mouth until he or she opened his or her mouth. During the sensory integration therapy condition, the therapist administered 10 min of an individualized sensory integration therapy program designed by an OT before the feeding session. The treatment consisted of: (a) placing a vibrating bug on the child's feet, legs, hands, arms, stomach, back, cheeks, and lips; (b) encouraging the child to crawl through a vinyl tunnel; (c) stroking the child's hands, legs, feet, and back with a therapeutic brush with firm pressure; (d) providing joint compression to the child's elbow, shoulders, knees, and hips; (e) blowing bubbles for the child; (f) helping the child to roll on a therapy ball; and (g) placing a toy designed to provide different forms of stimulation to different parts of the child's body (e.g., teeth, tongue, and cheeks). Immediately following this 10-min sensory integration therapy, the therapist brought the child to a separate feeding room to conduct the feeding session. During feeding sessions, the therapist presented a bite of food on a spoon in front of the child and removed the spoon if the child engaged in IMB. Results showed that the behavioral treatment was more effective than the sensory integration therapy for both children. Although an OT developed and approved the sensory integration component of the treatment, it can be argued that the prescribed procedures may have been too rigid or that the therapist did not follow the child's lead – as is recommended in sensory integration therapy (Addison et al., 2012); however, the researchers included these procedural modifications to ensure (a) the study was technologically precise and (b) they could compare data across conditions.

Sequential Oral Sensory Approach. This procedure was developed for assessing and treating children with feeding difficulties (Toomey, 2010). The treatment includes motor, oral, behavioral/learning, medical, sensory, systematic desensitization, and nutrition components that purportedly strive to help children meet feeding norms for their developmental stage (Toomey, 2010). This approach is a 12-week program that uses a hierarchy of six steps: visual tolerance, interaction, smell, touch, taste, and eating. This hierarchy is developed for each child by presenting a food and observing the child's response to the food (e.g., does the child tolerate looking at the food, playing with the food with a utensil, or smelling, touching, or eating the food). The sequential oral sensory approach incorporates food play (as the relaxation response) within the systematic desensitization component in which the therapist helps the child progress through the six steps in the hierarchy.

Similar to sensory integration therapy, there is little or weak empirical support for this treatment and, as a result, the procedures are unclear. In one notable exception, Peterson et al.

(2016) compared a behavioral intervention (NRS and continuous interaction or an avoidance procedure) and a modified version of sequential oral sensory approach to a behavioral intervention). During NRS and continuous interaction, the therapist provided continuous attention to the child and presented a bite of food with the instruction to "take a bite." If the child accepted the bite, the therapist would praise the child. If the child did not accept the bite, the therapist would implement NRS. The avoidance procedure was similar to the NRS and continuous interaction, except if the child did not accept the bite within 8 s, the therapist would feed the child the bite plus four bites of the same food at a pureed texture. The modified sequential oral sensory approach consisted of several components, including a 10-min sensory preparation routine in an indoor playground; transition to the therapy room; and a routine consisting of washing the child's hands and face, washing and setting the table, and blowing bubbles in the therapy room. Next, the therapist presented the food according to the six-step hierarchy described above. Results showed that the modified sequential oral sensory approach was ineffective, whereas the behavioral approach produced an increase in acceptance for all participants. Similar to Addison et al. (2012), Peterson et al. noted that OT's might find fault with their procedures for being too rigid, not implemented the way in which they are intended, or both.

Food Chaining. A speech and language pathologist named Cheryl Fraker developed food chaining in 2004 when she was treating an 11-year-old boy with feeding difficulties who stopped eating foods he was previously eating. Food chaining is a six-step treatment designed to help children with feeding problems to increase the number of different foods they eat "safely and naturally" (Fraker et al., 2007). Fraker et al. (2007) stated that food chaining is not only designed for the child, but also for the parents and the needs of the family. Finally, Fraker et al.

(2007) stated that eating is a complex process that can be the result of many different issues, such as a medical condition, an oral motor skill deficit, a sensory processing disorder, a behavioral issue, or a combination of these, which is reflected in the six steps involved in food chaining.

Step 1. The first step involves ruling out medical variables. Proponents of food chaining encourage practitioners to consult with a physician prior to treating feeding disorders to rule out any physiological barriers to feeding (e.g., digestive disorders, breathing problems, or inflammation of the esophagus) that may contribute to the child's feeding problems (Fraker et al., 2007).

Step 2. The second step expands on the first and involves assessing the child's allergies and nutritional deficiencies. To assess for food allergies, clinicians are encouraged to consult with physicians. To assess for nutritional deficiencies, clinicians are encouraged to consult with a nutritionist who can evaluate what nutrients the child may be missing with his or her current diet (Fraker et al., 2007). If not considered in Step 1, a physician will assess the child's weight and growth (Fraker et al., 2007).

Step 3. The third step involves assessing the child's oral motor skills, such as chewing and swallowing. Clinicians are encouraged to consult with an occupational therapist or speech and language pathologist who can assess the child's (a) oral motor skills to ensure he or she can safely bite, chew, and swallow food before treatment and (b) fine and gross motor skills related to self-feeding (Fraker et al., 2007).

Step 4. The fourth step involves assessing how the child responds to "sensory input" (e.g., look, smell, taste, or texture of a food) by exploring textures and tastes of food. Proponents of food chaining suggest that parents or clinicians assess this by providing the child with a small portion of foods with different tastes, textures , appearances, and smells and observing how the child responds to each. Parents and clinicians are directed to use this information to determine the initial target foods for treatment. Specifically, proponents of food chaining state that treatment should begin with foods that share a similar quality to foods the child consistently consumed during this assessment. For example, if the child eats apples but not bananas, treatment should start with a sweet food with a similarly dense composition (e.g., pear) rather than a softer fruit (e.g., kiwi).

Step 5. The fifth step involves addressing IMB. Fraker et al. (2007) refer to several common negative mealtime behaviors (which we will refer to as IMB), such as refusing to come to the table, leaving the table during the meal, crying when food is presented, spitting food out, throwing food, disrupting others who are trying to eat, and being unable to focus on a meal. The authors recommend that behavioral psychologists should address these behavioral problems and that (a) feeding problems may be a “control issue between the child and her parents, where she is manipulating her parents with food intake” (Fraker et al., 2007, p.97) and (b) IMB may be an attempt to gain attention. However, they also state, “more often, negative mealtime behavior indicates an underlying sensory issue with food” (p. 143). Despite this assertion, Fraker et al. recommend several strategies for managing IMB, such as (a) use praise when the child consumes preferred food; (b) if the child throws or spits food, turn his or her chair away from you and the table for a minute, return the child back to the table and re-present the food, repeat this procedure three times, and remove all nonpreferred food if the child continues to throw or spit food; (c) ignore all crying and food refusal; (d) provide a rule that includes a promise to provide preferred activities if the child complies when he or she attempts to leave the table (e.g., “You can leave the table when the family is done eating, if you sit the whole time you can watch a movie”); (e) minimize stimuli in the environment, and (f) provide a preferred activity (e.g., bubbles or music) for every bite of nonpreferred food and stop the delivery of preferred activity if the child engages in IMB. In addition to these strategies, Fraker et al. (2007) also suggest using rewards to increase the value of touching, tasting, and eating new food; including the child in the mealtime routine; and creating and signing a contract.

Step 6. The sixth step involves identifying the qualities of the food (e.g., sweet or salty, soft or firm) the child currently eats, selecting new food that share those qualities, and manipulating the new food to appear like the preferred food. Fraker et al. (2007) suggest that the texture, flavour, temperature, or appearance of food may be the reason why a child will eat one food but not another. For example, proponents of food chaining suggest that if the child currently eats crackers, chips, and cheese, parents and clinicians should try offering quesadillas or thin crust pizza because they taste and look very similar. The authors recommend slowly expanding the number of foods the child eats while keeping taste, texture, or appearance the same (Fraker et al., 2007). For example, if a child is currently eating McDonalds's chicken nuggets, the authors suggest that parents and clinicians increase the variety of food by starting with a different brand of chicken nuggets, chicken fries or popcorn chicken, home cooked chicken nuggets, fried chicken breast or chicken leg, baked chicken with a breading, to fried fish, breaded pork, and vegetables (Fraker et al., 2007). The authors note that not all children will need as many steps as those described above, and that some children may only require the new food to be a similar taste, shape, or colour.

To date, only one study has evaluated the effectiveness of food chaining on the consumption of new food with children with feeding disorders (Fishbein et al., 2006). The authors found that food chaining was effective for all 10 children such that all children increased the number of different foods they ate over a three-month period. However, these findings should be interpreted with caution. First, the authors did not report their procedures with sufficient detail. That is, the authors did not (a) operationally define the dependent variables, (b) describe the measurement system by which they collected and measured treatment success, and (c) describe how they conducted food chaining. Without adequate description of these methodological details, it remains unclear what the authors measured and if they demonstrated experimental control of the food chaining procedure. Second, eight of the 10 children received previous feeding interventions and it remains unclear if these previous interventions contributed to the success of the food chaining procedure.

For the purpose of this study, we will refer to the OT treatment as modified food chaining because of the following: (a) food chaining does not use discrete presentations or time criteria, (b) consumption is not the primary goal of food chaining, and (c) the primary investigator is not an OT and therefore cannot assess sensory qualities of the food in the same way a trained OT can. To ensure that we implemented the modified food chaining procedure as described by Fraker (2007), I read the book, *Food Chaining: The Proven 6-step Plan to Stop Picky Eating, Solve Feeding Problems, and Expand Your Childs Diet*, successfully completed the online SLP training course on food chaining, and consulted with Cheri Fraker and two local OTs who have specific training in implementing food chaining. We invited these two OTs to be involved in this study; however, both declined our offer. Both did acknowledge that the procedures outlined in this paper were consistent with how sessions are typically conducted, with the exception of the modifications laid out above. It is important to note that our use of the term *modified food chaining* does not imply endorsement by Cheri Fraker, the developer of food chaining; she has not authorized or approved this evaluation.

Purpose and Significance of Research

Interventions based on applied behaviour analysis have the most empirical support for treating pediatric food selectivity (Bachmeyer, 2009). Conversely, only one study has evaluated the viability of food chaining as a treatment for pediatric feeding disorders and it contained several methodological flaws that called into question the validity of the findings. Despite the weak support for food chaining, it is a commonly recommended treatment in Ontario (Canadian Association of Occupational Therapists, 2010). What may be more problematic is that in Ontario, with a physician referral, children with ASD can access government funded feeding clinics that provide OT treatment, speech language pathology treatment, or both (Ontario Ministry of Children, Community, and Social Service, 2018). To date, there are no government funded feeding clinics that offer ABA feeding interventions. Given the high prevalence of food selectivity in children with ASD, the negative health risks associated with feeding disorders, and that Ontario government funding is allocated to feeding clinics providing OT interventions, the purpose of this study was to compare modified food chaining to simultaneous presentation plus NRS for the treatment of food selectivity with two children with ASD.

Methods

Participants

Two children with food selectivity participated. Colin was 3 years old and Aiden was 5 years old. Both children had been diagnosed with ASD, were nonvocal, and communicated through gestures. Both children consumed at least 90% of caloric needs by mouth (i.e., they were not receiving any additional modes of nutrition via tubes) and were physician-identified safe oral feeders. Prior to treatment, both children ate less than 10 foods on a daily basis, with a few others they ate more sporadically and inconsistently (i.e., once a week or less). The majority of these foods they ate daily fell into the “junk food” category. Colin consumed four carbohydrates, two dairy products, no fruits or vegetables, and six junk foods daily. Aiden ate four carbohydrates, four dairy products, one protein, two fruits, one vegetable, and six junk foods daily. Parents of both children reported that they prepared special meals for their children because neither child ate what the family ate. Further, Colin’s parents reported that they supplemented the majority of his meals with PediaSure to ensure he received a sufficient amount and variety of nutrients.

Setting and Materials

We conducted all feeding sessions in a room within a university-run clinic. We seated the child upright in an age-appropriate booster seat for safety. Other materials included gloves, a scale, wipes, paper towels, a Munchkin soft tip infant spoon, and small white plastic plates. We also used a red plastic divided plate for modified food chaining. We assigned different coloured scrubs and tablecloths to both conditions to help facilitate discrimination among session contingencies. We conducted one to five sessions per day, one to three days a week.

In both conditions, we included four nonpreferred foods that (a) the child did not eat, (b) the family ate and the parents reported were important for the child to eat, and (c) the parents rated as “chews food, but strongly aversive to the taste, grimaces, refusing to try more” on the Food Chaining Rating Scale (described below). We used an additional criterion for foods assigned to modified food chaining to ensure we included foods in a consistent manner with which food chaining practitioners select target foods. Specifically, we ensured that all four foods in modified food chaining shared a similar quality (e.g., look, texture, taste) to foods the child currently ate (e.g., if a child currently ate chicken nuggets, we might select fish nuggets as the target food because these two foods look similar and also share a similar texture). Table 1 lists the foods assigned to the ABA and modified food chaining for Colin and Aiden.

Table 1

Target food for each child ABA and modified food chaining conditions

Colin		Aiden	
ABA Food	Modified Food Chaining Food	ABA Food	Modified Food Chaining Food
Chicken	Scrambled egg	Kiwi	Cottage cheese
Macaroni & cheese	Rice	Chicken	Spaghetti
Corn	Banana	Broccoli	Pineapple
Cheese	Soup	Strawberries	Sweet potato

Therapist and Observers

The primary student investigator served as the therapist for all sessions, was a Board Certified Behavior Analyst®, completed the online food chaining training, and consulted with the developer of food chaining (Cheri Fraker) when designing the modified food chaining procedures. The therapist and two masters level graduate students served as observers.

Response Measurement, Reliability, Procedural Integrity, and Data Analysis

Observers used paper and pencil to collect trial-by-trial data throughout all phases of this study.

Preference assessments. Observers collected data on selection, consumption, and expulsion (see Appendix D). Observers scored *selection* when a child pointed to or grabbed the food presented within 5 s of the instruction (e.g., “You can try this if you want”). Observers scored *consumption* when there was no visible food in the child’s mouth following 30 s of acceptance. Observers scored *expulsion* when the child emitted food larger than the size of a pea past the plane of the lips. We summarized all dependent variables individually by dividing the number of trials with the dependent variable by the total number of trials and multiplying by 100.

We ranked foods by percentage of consumption; the higher the percentage of consumption, the higher the preference ranking for that food.

Treatment comparison. The primary dependent variable was consumption (see Appendix E). Observers scored *consumption* when there was no visible food in the child's mouth following acceptance within 8 s. The secondary dependent variables were (a) acceptance, (b) refusal, (c) expulsion, and (d) inappropriate mealtime behavior. Observers scored *acceptance* when the entire bite of food entered the child's mouth within 8 s of its presentation. Observers scored *expulsion* when the child emitted food larger than the size of a pea past the plane of the lips. Observers scored *inappropriate mealtime behavior* when the child threw food or the spoon or engaged in negative vocalizations (e.g., crying, screaming, saying "No"). Observers also scored *inappropriate mealtime behaviour when* the child turned his head or closed his mouth when the food was within 2.5 cm of his mouth or pushed the food away. We summarized all dependent variables individually by dividing the number of trials with the dependent variable by the total number of trials and multiplying by 100.

Interobserver Agreement. A second independent observer calculated trial-by-trial interobserver agreement on a minimum of 33% of preference assessment and treatment comparison sessions within and across all conditions and phases for both children. We defined agreement as both observers recording the occurrence or nonoccurrence of the same dependent variable during the same trial. We defined disagreement as one observer scoring one dependent variable and the other observer either scoring a different dependent variable or scoring the nonoccurrence of that dependent variable. We calculated interobserver agreement by dividing the number of agreements by the number of agreements plus the number of disagreements and multiplying by 100. Mean agreement for all dependent variables was 100% across all preference assessment and treatment comparison sessions for both children.

Procedural integrity. Observers collected procedural integrity data during at least 33% of preference assessment and treatment comparison sessions within and across conditions and phases for both children. Unless otherwise specified, we calculated procedural integrity for each therapist behavior (described below) individually by dividing the number of accuracies by the number of accuracies plus the number of inaccuracies then converting this ratio to a percentage.

Preference assessments. Observers scored the accuracy with which the therapist delivered the food, delivered the prompt, and terminated the trial. Observers scored *correct food delivery* when the therapist placed a bite of food on the plate in front of and within arm's reach (i.e., 0.7 m) of the child. Observers scored *correct prompt delivery* when the therapist gave the instruction to select a food 5 s after food presentation. Finally, observers scored *correct trial termination* when, after the child did not select a food within 5 s of the second prompt to do so, the therapist terminated the session (see Appendix F for preference assessment procedural integrity data sheet). Mean correct prompt delivery was 97% (range, 93% to 100%) and 100% for all other therapist behavior.

Treatment comparison.

ABA treatment. For simultaneous presentation plus NRS, stimulus fading, and sequential presentation plus NRS plus demand fading, observers recorded the accuracy with which the therapist presented the foods, delivered praise, and delivered attention (see Appendix G). During all phases, observers scored *correct food presentation* when the therapist (a) presented the bite of food on a spoon on a plate in front of and within arm's reach of the child while saying, "take a bite," (b) removed the plate after the child accepted the bite, and (c) presented the next bite 30 s after the child consumed the previous bite. During baseline, observers also scored *correct food presentation* when the therapist removed the plate if the child did not accept the food within 30 s of its presentation. During treatment, if the child did not accept a food within 8 s of its presentation, observers scored *correct food presentation* when the therapist (a) touched the spoon to the child's lips; (b) followed the child's head with the spoon and ensured the food touched the child's lips if the child engaged in IMB; and (c) left food touching the child's lips if the child vomited, coughed, or gagged while the therapist held food at the child's lips. Observers also scored *correct food presentation* during treatment when the therapist returned the plate in front of and within arm's reach of the child if the child moved the plate out of arm's reach. For expelled bites during treatment, observers scored *correct food presentation* when the therapist (a) scooped up expelled food within 3 s of expulsion and placed the food back to the child's lips and (b) presented the next bite when the child consumed the previously expelled bite. During all phases, observers scored *correct praise* when the therapist provided enthusiastic praise (e.g., Good job!) within 5 s of acceptance and within 5 s of mouth clean. Mean correct praise delivery was 99% (range, 98% to 100%) and 100% for all other therapist behaviors.

During all phases, observers scored *incorrect attention* when the therapist (a) attempted to coax the child to try the target food or (b) comforted or reprimanded the child within 5 s following IMB. We calculated procedural integrity for incorrect attention by dividing the number of trials with incorrect praise by the total number of trials in that session then converting this ratio to a percentage. The therapist never delivered incorrect attention.

Modified food chaining. Observers recorded the accuracy with which the therapist presented the food and delivered praise (see Appendix H). Observers scored *correct spoon presentation* in baseline when the therapist placed a bite of the target food on a spoon on a plate in front of and within arm's reach of the child and delivered a nondirective statement (e.g., "Can you pop the grape like a balloon with your teeth?"). During treatment, observers scored *correct spoon presentation* when the therapist (a) placed a bite of the target food on a spoon on a plate in front of and within arm's reach of the child, (b) placed a bite of preferred food on the divided plate, and (c) delivered a non-directive statement. During both phases, observers scored *correct praise* when the therapist delivered praise within 5 s of the child accepting the target food. Mean procedural integrity was 100% for all therapist behaviors.

During both phases, observers scored *incorrect attention* with the same definition and procedures as during the ABA treatment; the therapist never delivered incorrect attention.

Experimental Design

We used a multielement within a multiple baseline across participants design. Because multielement designs are prone to multiple treatment interference, we included two proactive strategies to mitigate this threat to internal validity. First, we assigned coloured scrubs and tablecloths to each condition; we used blue for the ABA condition and red for modified food chaining. Second, we included pre-session rules that described the contingency associated with the session. In addition, the antecedent conditions of the ABA and the modified food chaining conditions differed in several ways that may have also facilitated discrimination, including: (a) the instruction (directive versus non-directive), (b) the target foods, (c) the preferred foods, (d) the presentation of the preferred foods, and (e) the materials present in both conditions. We conducted treatment conditions in a quasi-random order, such that we did not conduct more than two of the same treatment conditions consecutively.

Procedure

Pre-Experimental Assessments

Indirect assessments.

Behavioral feeding assessment. The purpose of this assessment was to identify potential target foods. The therapist gave the parents a document containing a list of 118 foods and asked the parents to denote which foods the child was eating at the time of the study and which foods the child was not eating. Of the foods the child was not eating at the time of the study, the therapist asked the parents to identify those foods that the family ate on a regular basis and that were also important for the parents that the child eat. From that list, we selected four foods for the ABA condition and an additional four foods that (a) the child did not eat and (b) shared a similar quality to foods the child currently ate for modified food chaining. For example, Aiden ate white potatoes, grapes, yogurt, and bread daily. Therefore, we selected sweet potatoes, pineapple, cottage cheese, and pasta noodles which all shared several qualities. Finally, we asked the parents for their feedback on our target food selection and made any necessary modifications to accommodate their preferences.

Food Chaining Rating Scale. The purpose of the OT assessment was to ensure that we selected target foods for both conditions that food-chaining practitioners would also likely select as target foods for treatment (see Appendix I for a copy of the Food Chaining Rating Scale). To complete the Food Chaining Rating Scale, the therapist asked the parents to rate how the child reacted to the foods we assigned to the ABA and modified food chaining using a Likert scale with values ranging from strongly dislikes (1) to strongly prefers (10) that also includes scale points with examples of behavior the child emits in response to food. For example, a score of 1 represents foods to which the child "gags and/or vomits upon touching, smelling, or seeing…" Fraker (2007) recommends that practitioners select target foods rated as a 4 (i.e., "chews and swallows the food, tolerates it, but doesn't enjoy it"). However, because foods rated at a 4 on this scale met our definition of consumption, we selected foods rated at a 3 (i.e., "chews the food, but strongly aversive to the taste, grimaces, refusing to try more") because these are foods that the child may have accepted at one point, but was not consuming at the start of the study. Both parents rated each food we assigned to the ABA and modified food chaining as a 3 on this scale.

Direct assessments.

Paired choice preference assessment. The purpose of this assessment was to determine the child's two most preferred foods for use in the ABA and OT treatment conditions. We used procedures similar to those described by Fisher et al. (1992). Prior to the preference assessment, the therapist exposed the child to each item by placing one bite-size piece (i.e., dime-sized or 17.91 mm) of food on a plate in front of and within arm's reach of the child, naming the food, and asking the child if he wanted to try it. If the child reached for the food, the therapist gave him the food. The therapist did not provide a differential consequence if the child did not reach for the food within 30 s of its presentation. During the preference assessment, the therapist placed a pair of foods on a plate in front of and within arm's reach of the child and prompted the child to select one. When the child selected one food, the therapist provided access to that food and removed the other food. The therapist delivered a clean-mouth prompt (e.g., "show me" while modeling an open mouth) 30 s after the child put the selected food in his mouth. If there was food in the child's mouth after 30 s of acceptance, the therapist prompted the child to "swallow the food" every 10 s until he swallowed the food. Once the child consumed the food, the therapist presented the next pair of foods. If the child tried to select both foods, the therapist moved the plate out of the child's reach and instructed him to place his hands on the table. Once the child placed his hands on the table, the therapist re-presented the pair of foods. If the child did not select a food from the pair within 30 s of presentation, the therapist provided a second prompt to "pick one." If the child did not select a food after the second prompt to do so, the therapist removed the pair of foods and presented the next food pair. If the child pushed the plate away or vocally indicated that he did not want to select a food (e.g., "no"), the therapist removed the plate and delivered the next pair of foods. The therapist presented all six foods in pairs, in a randomized order, until she presented all possible food pairs.

General Procedure

Similar to Peterson et al. (2016), we needed to modify the food chaining condition to include discrete bite presentations (i.e., similar to those in the ABA treatment condition) to ensure we could compare data across conditions because food chaining does not include discrete bite presentations as a part of its regular treatment procedure. To do this, we included 12 discrete bite presentations every 30 s in all sessions for both conditions. This allowed us to equate the number of opportunities for the child to accept a bite of food in both conditions. For each bite presentation, the therapist placed one bite-sized (i.e., 17.91 mm in diameter) piece of food on a spoon on a plate in front of and within arm's reach of the child. We ended a session after we presented 12 bites or when 30 min elapsed. We conducted sessions 1 hr before and after the child's last meal or snack. Mastery criteria for this study was 100% consumption in three consecutive baseline probes.

ABA Treatment

Baseline. Prior to each session, the therapist said, "I'm going to put a bite of food in front of you and say, 'take a bite.' If you take a bite, I will say 'good job.' If you swallow your bite, I will say 'good job.'" At the start of the session, the therapist placed a spoon containing a dime-sized (17.91 mm) bite of the target food on a plate in front of and within arm's reach of the child and simultaneously instructed the child to, "take a bite." If the child accepted the bite within 8 s, the therapist provided praise and started a 30-s timer. When the timer lapsed, the therapist said, “show me” while modeling an open mouth. If the child had food larger than the size of a pea in his mouth, the therapist prompted the child to “swallow the food” every 30 s until the child swallowed the food, at which point the therapist presented the next bite. If the child consumed the food, the therapist provided praise and presented the next bite. If the child did not accept the bite within 8 s, the therapist removed the spoon and presented the next bite at the end of the 30-s interval. The therapist did not provide differential consequences for IMB or for expulsion.

Simultaneous presentation plus NRS. Sessions were identical to baseline with the exception of (a) the pre-session rule, (b) the consequence for nonacceptance, and (c) the consequence for expulsion. Prior to each session, the therapist said, “I’m going to put a bite of food in front of you and say, ‘take a bite.’ If you take a bite, I will say ‘good job.’ If you swallow your bite, I will say ‘good job.’ If you don’t take the bite, I will help you.” At the start of the session, the therapist placed a spoon containing the target food, with a bite-sized piece of the preferred food on top, on a plate in front of and within arm’s reach of the child and simultaneously instructed the child to, “take a bite.” If the child did not accept the bite within 8 s of the initial presentation, the therapist used a hand over hand prompt to help the child bring the spoon to his mouth and insert food when he opened his mouth. If the child pulled his hand away, the therapist held the spoon to the child’s mouth. The therapist re-presented expelled bites by scooping up the expelled bites with the spoon and placing the bite to the child’s mouth.

Stimulus fading. We decreased the size of the preferred food for Colin because he did not consume any bites during ABA baseline probes despite consuming all bites during ABA treatment sessions. Once Colin consumed 100% of bites for 2 consecutive sessions, we decreased the size of the preferred food to one-quarter of its original size. During stimulus fading, we held the size of the target (nonpreferred) food constant at a dime size while we systematically decreased the size of the preferred food. We first decreased the size of the preferred food by half.

Sequential presentation plus nonremoval of the spoon plus demand fading. We re-arranged the food presentation format for Colin because he did not consume 100% of bites during the ABA baseline probe following stimulus fading (first administration) or ABA treatment (second administration). Prior to each session, the therapist said, "I'm going to put a bite of food in front of you and say, 'take a bite.' If you take a bite, I will say 'good job.' If you swallow your bite, I will say 'good job and I will give you a piece of X [while holding up a bite of the preferred food].' If you don't take the bite, I will help you. First, eat this [while holding up a bite of target food], then eat this [while holding up a bite of the preferred food]." At the start of the session, the therapist placed a spoon containing the target food on a plate in front of and within arm's reach of the child and simultaneously instructed the child to "take a bite." If the child consumed a bite of the target food, the therapist gave him a bite of the preferred food. If the child did not accept the bite within 8 s, we implemented NRS. We systematically increased the bite requirement across sessions when Colin consumed all bites of the target food for two consecutive sessions. Following this progression criterion, we thinned the schedule in the following sequence: fixed ratio (FR) 1, FR 2, FR 4, FR 8, FR 12 (first implementation) and FR 1, FR 2 (second implementation) at which point Colin began consuming 100% of bites during the ABA baseline probes.

Modified Food Chaining

Baseline. These sessions were identical to the ABA baseline sessions with the exception of the instruction. Prior to session, the therapist said, "I'm going to put a bite of food in front of you. If you take a bite, I will say 'good job.' If you swallow your bite, I will say 'good job.'" At the start of the session, the therapist placed a spoon containing the target food on a plate in front of and within arm's reach of the child and simultaneously delivered a nondirective statement, such as "Can you make cracker go crunch?" (Fraker, 2017).

Modified food chaining. These sessions were identical to the OT baseline sessions except: (a) we included pictures of other children enjoying eating, (b) the therapist interacted with the child and the foods throughout the session by commenting on the foods (i.e., "Carrots are such a nice orange colour. They come from the ground and crunch when you bite them,"), and (c) the therapist provided free access to one dime-sized piece of preferred food on a divided plate within arm's reach during every trial. Prior to the session, the therapist said, "I'm going to put a bite of food in front of you. If you take a bite, I will say 'good job.' If you swallow your bite, I will say 'good job.'" At the start of the session, the therapist placed a spoon containing the target food on a plate in front of and within arm's reach of the child and simultaneously delivered a nondirective statement. If the child accepted a bite of the target food, the therapist provided praise and presented a new bite after the 30-s interval elapsed. The therapist did not provide a differential consequence for nonacceptance of the target food after 30 s, IMB, or consumption of the preferred food. Although it did not occur in this study, if the child threw or spit the food, the therapist would turn the child's chair away from the table, ignore him for one minute, and then re-orient the child's chair to the table (Fraker et al., 2007). The therapist would then re-present the bite. If the child threw or spit the food again, the therapist would implement the same chair-turn procedure described above. If, after the third attempt, the child threw or spit the food again, the therapist would terminate the meal.

Best Treatment Phase

For both children, the ABA treatment was the only treatment that increased consumption of the target foods. Therefore, we conducted the ABA baseline and treatment phases with the foods previously assigned to the modified food chaining condition.

Results

Treatment Comparison

Figure 1 depicts the outcomes of the treatment comparison for Colin and Aiden. The top panel displays results for Colin. During baseline in the ABA condition, Colin did not consume any bites of the target food and his level of IMB was high (*M* = 99%; range, 96% to 100%). During baseline in the modified food chaining condition, Colin's level of consumption was low (*M* = 5%; range, 0% to 8%) and his level of IMB was high (*M* = 97%; range, 92% to 100%). During the initial treatment comparison phase in the ABA condition, Colin consumed 100% of bites and his level of IMB was moderate (*M* = 29%; range, 0% to 100%). During the initial treatment comparison phase in the modified food chaining condition, Colin did not consume any bites and his level of IMB was moderate (*M* = 38%; range, 0% to 100%). When we systematically reduced the size of the preferred food presented with the target food during stimulus fading in the ABA condition, Colin continued to consume 100% of bites and he did not engage in IMB. We conducted this phase because he was not consuming foods in the ABA baseline probes. During the intermittent baseline probes, Colin's level of consumption was low (*M* = 8%; range, 0% to 25%) and he did not engage in IMB in the ABA baseline probes. Finally, Colin did not consume any bites in the modified food chaining baseline probes and he did not engage in IMB.

During sequential presentation plus NRS plus demand fading, Colin's level of consumption was high (*M* = 92%; range, 50% to 100%) and his level of IMB was low (*M* = 8%; range, 0% to 50%).

When we returned to the treatment comparison phase in which we alternated ABA baseline probes and OT treatment sessions, Colin's level of consumption was high (*M* = 81%; range, 25% to 100%) and he did not engage in IMB in the ABA baseline probes and Colin met the mastery criterion in the ABA condition (three consecutive sessions of 100% consumption during baseline probes). During the modified food chaining condition, Colin's level of consumption remained low (*M* = 2%; range, 0% to 8%) and he did not engage in IMB.

During the best treatment baseline phase, we introduced the foods originally assigned to the modified food chaining to the ABA condition. During baseline, Colin's level of consumption was low to moderate (*M* = 43%; range, 25% to 50%) and he did not engage in IMB. During the treatment phase, Colin consumed 100% of bites but his level of consumption decreased to 25% in the baseline probe. We conducted a 1-week follow-up baseline probe with the foods originally assigned to the ABA condition and Colin consumed 100% of bites and he did not engage in IMB.

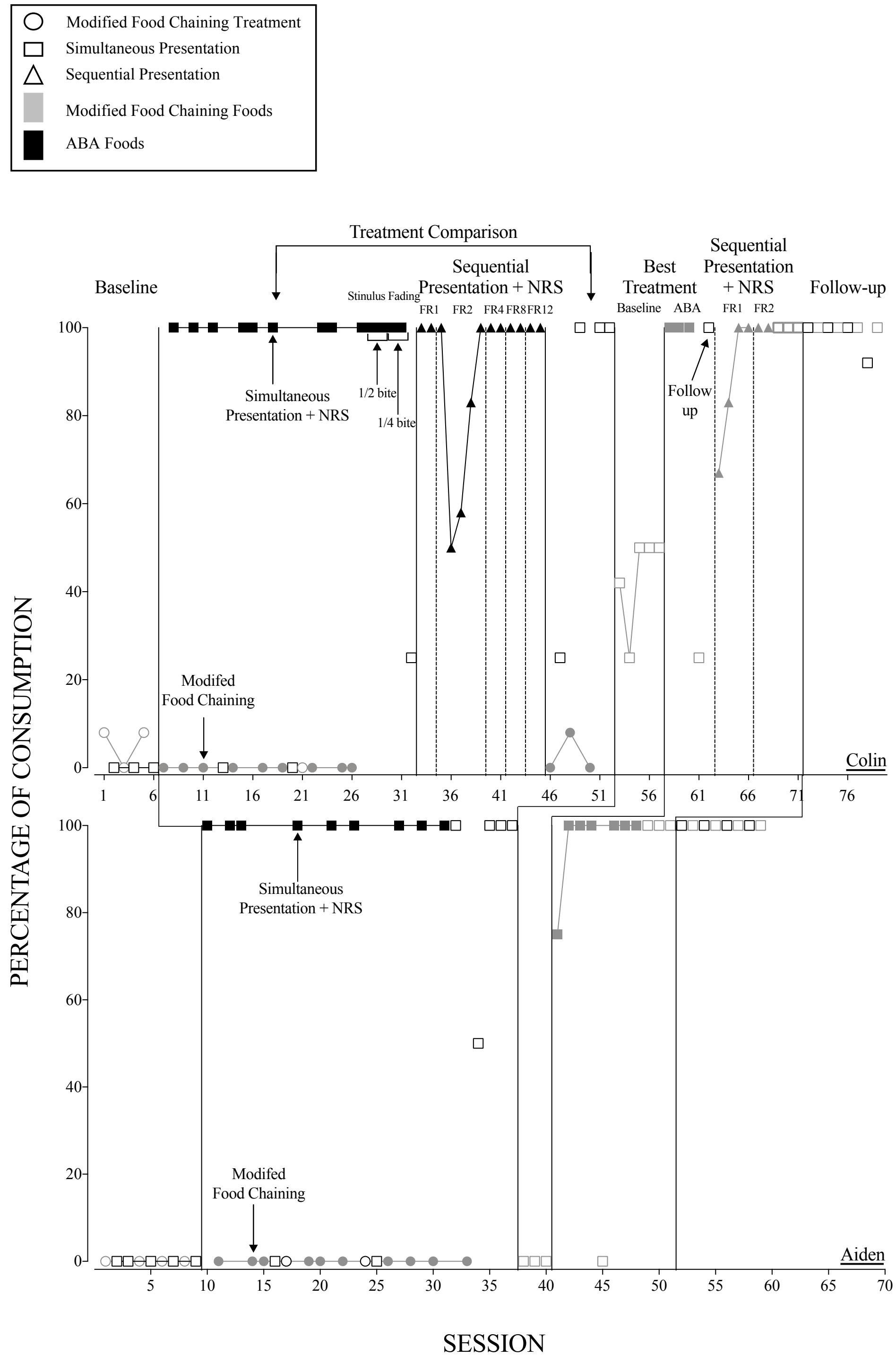

Figure 1. Percentage of consumption for Colin and Aiden. Circles denote consumption percentages during the modified food chaining condition and squares denote these percentages during the ABA condition. Open data points denote consumption percentages during baseline and baseline probes. Closed data points denote consumption percentages during treatment sessions. Grey symbols denote consumption percentages for foods initially assigned to the

modified food chaining condition and black symbols denote these percentages for foods initially assigned to the ABA foods.

The bottom panel displays results for Aiden. During baseline in the ABA condition, Aiden did not consume any bites of the target food and his level of IMB was low (*M* = 15%; range, 0% to 42%). During baseline in the modified food chaining condition, Aiden did not consume any bites of the target food and he did not engage in IMB. During the initial treatment comparison phase in the ABA condition, Aiden consumed 100% of bites in the ABA condition and he did not engage in IMB. During the initial treatment comparison phase in the modified food chaining condition, Aiden did not consume any bites and did not engage in IMB. During the ABA baseline probes, Aiden consumed variable levels (M = 64%; range, 0% to 100%) of the target food and did not engage in IMB. In the modified food chaining baseline probes, Aiden did not consume any bites and he did not engage in IMB.

During the best treatment baseline phase, we introduced the foods originally assigned to the modified food chaining condition to the ABA condition. During baseline, Aiden did not consume any bites of the target foods and he did not engage in IMB. During the treatment phase, Aiden consumed high levels (*M* = 96%; range, 75% to 100%) of bites and his level of IMB was low (*M* = 3%; range, 0% to 25%). Aiden consumed high levels (*M* = 75%; range, 0% to 100%) of bites in the baseline probes and he did not engage in IMB.

When we assessed his consumption during a series of three ABA baseline probes, Aiden consumed 100% of bites and met the mastery criterion. During weekly follow-up baseline probes, Aiden's level of consumption remained at 100% for all eight foods.

Discussion

This is the first study to compare modified food chaining, to an ABA treatment for the food selectivity in children with ASD. Similar to the outcomes of previous studies comparing other OT and ABA treatments (Addison et al., 2012; Peterson et al., 2016), we found that the ABA treatment was more effective than modified food chaining in this study. For both children, we observed an immediate increase in consumption in the ABA condition and no increase in consumption in the modified food chaining condition. Further, we replicated this immediate increase in consumption in the ABA condition with both children when we introduced the foods originally assigned to the modified food chaining condition to the ABA condition.

The ABA intervention in our initial treatment comparison phase consisted of simultaneous presentation plus NRS. Under this treatment package, the level of both children's consumption immediately increased to 100% before they contacted the NRS contingency. In fact, both children did not contact the NRS contingency until *after* the initial treatment comparison phase. There are two possible explanations for this increase in consumption. First, this finding seems to suggest – at least initially – that NRS was not needed to produce an increase in consumption. However, we provided children with a pre-session rule in which we described the NRS contingency. That is, immediately before these ABA treatment sessions, we told each child, "I'm going to put a bite of food in front of you and say, 'take a bite.' If you take a bite, I will say 'good job.' If you swallow your bite, I will say 'good job.' If you don't take the bite, I will help you." Therefore, it is possible that the pre-session rule in which we described the NRS contingency exerted stimulus control over their consumption behavior. Although the influence of rules has not been evaluated in the feeding literature, their influence on behavior in other areas in applied behavior analysis seems to support our hypothesis that providing pre-session rules may have exerted control over the child's consumption. For example, Tiger and Hanley (2004) evaluated the effects of mixed and multiple schedules with and without rules and found that both children's behavior conformed to the rules. The children requested at a higher rate when the therapist gave the rule versus when the therapist did not give the rule even though the contingency was still in place. This suggests that, although there may be discriminative stimuli in the environment to signal reinforcement for a response, explicitly giving rules may increase the rate of responding. However, we did not systematically evaluate the influence of this rule on consumption in this study; therefore, we cannot definitely conclude what, if any, influence the rule had on the child's consumption.

Second, it is also possible that simultaneous presentation alone was sufficient to produce an increase in consumption for both children – at least initially. Previous researchers have demonstrated the effectiveness of simultaneous presentation alone for the treatment of feeding disorders (Ahearn, 2003; Buckley & Newchok, 2005; Piazza et al., 2002). Although the exact mechanism responsible for the effectiveness of simultaneous presentation is unclear, there are three possible explanations. First, it is possible that presenting the preferred food with the nonpreferred food may act as an establishing operation by decreasing the aversiveness of the nonpreferred food, which also decreases the value of escape as a reinforcer (Piazza et al., 2002). Second, it is possible that presenting two foods together might function as flavor-flavor conditioning (Capaldi, 1996; Piazza et al., 2002). That is, by pairing a nonpreferred food and a preferred food, it is possible that we conditioned the taste of nonpreferred food to be preferred. Finally, Kern and Marder (1996) suggested that simultaneous presentation may function as immediate reinforcement for acceptance and consumption of a nonpreferred food. Although outside the scope of this study, we did not identify the exact operant mechanisms responsible for the increase in consumption we observed with both children.

This study is important in light of (a) the frequent use of the OT treatment in Ontario (Autism Ontario, 2018; Children's Hospital of Eastern Ontario, 2018; Niagara Children's Centre, 2018; Ontario Health Promotion E-Bulletin, 2018; The Hospital for Sick Children, 2018; The National Eating Disorders Information Centre, 2018) and (b) the limited empirical support for food chaining. To our knowledge, there is only one other study that has evaluated the effectiveness of food chaining (Fishbein et al., 2006) and this study contained several noteworthy limitations. First, the study evaluated the effectiveness of a treatment package of which food chaining was only one component. That is, their feeding treatment package consisted of sensory integration, "behavioral modification techniques," and food chaining. As such, the individual contribution of each of these components is unclear. Second, this study was a retrospective chart review; as such, it failed to provide sufficient technological description of several procedural details. For example, the authors did not provide an operational definition of the primary dependent variable(s); it was also unclear if the authors used *acceptance* or *tolerance* as the primary dependent variable – neither were defined. Finally, the authors did not provide any procedural details regarding any of the components of their treatment package. Third, the authors collected indirect report data on acceptance of foods by asking caregivers to rate foods on a 10-point acceptance scale ranging from 1 (*tolerated poorly*) to 10 (*tolerated well*). Indirect data often do not correspond to direct assessment results; therefore these results should be interpreted with caution.

Despite these limitations and the overall lack of empirical support for food chaining, service providers in Ontario advocate for the use of food chaining (Autism Ontario, 2018; Children's Hospital of Eastern Ontario, 2018; Niagara Children's Centre, 2018; Ontario Health Promotion E-Bulletin, 2018; The Hospital for Sick Children, 2018; The National Eating Disorders Information Centre, 2018). Therefore, it seems prudent to identify factors why this treatment may have been ineffective for the children. As outlined in the food chaining procedure, we provided free access to a small amount of the child's preferred food during the modified food chaining condition. Proponents of food chaining suggest that "the presence of the preferred or anchor food comforts the child and signals them to eat" (Fraker et al., 2007). However, we did not observe an increase in consumption of the target food in the presence of the preferred food. Rather, we observed that both children only consumed the preferred food on a high percentage of trials (*M* = 95%; range, 42% to 100%) for Colin and 100% for Aiden. We did not find these results surprising given that (a) we conceptualized this free access to a small amount of the preferred food as noncontingent reinforcement and (b) continuous escape was available throughout modified food chaining.

Despite our proposed rationale for why modified food chaining did not work, OT's may argue that our findings were a function of our modifications; namely, we included (a) discrete bite presentations, (b) a *sterile* treatment environment, (c) short session durations, and (d) limited understanding of sensory properties and processing. First, food chaining does not include discrete bite presentations; however, as previously noted, we needed to equate the treatments for an equal number of opportunities to accept and consume all foods. Consistent with Peterson et al. (2016), removal of the bites did not appear to alter indicators of stress. In addition, we provided the children access to the bite for 30 s and the therapist would deliver praise for acceptance and consumption during any point of the trial. Most importantly, the lack of technological procedures is what made it difficult to replicate and evaluate the treatment as intended; therefore, we decided to include a more precise protocol (Peterson et al., 2016). Second, we conducted sessions in a *sterile* environment similar to what was described in the Peterson et al. study. We received feedback from the OT that because typical food chaining sessions are conducted in play-like settings, our use of a *sterile* environment likely impacted the outcomes. Third, when discussing session duration with the OT, she suggested that it may have been too short. Often food chaining sessions are longer; however, the actual time spent with food was equated. A final piece of feedback given by the OT was that behavior analysts do not have the training to assess *sensory properties and processing*. Because this is true, we invited the OT to participate in this study to compensate for our gaps in knowledge; however, she respectfully declined our invitation.

Despite the notable strengths of this study, we have identified three primary limitations. First, we did not include a control food group, which precludes our ability to detect maturation and history effects. That is, because we did not assign a group of foods to a control group, we cannot rule out the possibility that changes observed in the treatment comparison phase were a function of changes describe maturation effects and describe history effects, respectively. However, we used a multielement design to compare the two treatments, which tends to guard against these two threats in two ways. First, because the multielement design allowed us to complete the treatment comparison phases in a relatively brief period of time, it is not likely that maturation and history effects influenced our findings. Second, because we only observed an increase in consumption when, and only when, the ABA treatment was in effect and because we replicated this effect within both children (i.e., intrasubject replication) when we exposed the children to the best treatment phase, it is highly unlikely that maturation or history effects influenced our findings. Despite this, future researchers comparing the effectiveness of two or more treatments should include a control food group to allow for the detection of maturation and history effect.

We included several other measures to demonstrate experimental control in this study. First, the multiple baseline across participants design successfully demonstrated an immediate change in consumption when, and only when, the ABA treatment was in effect (Gast & Ledford, 2010). However, we only included two children in our multiple baseline design, whereas guidelines for this design typically recommend using three participants. According to Kazdin and Kopel (1975), two demonstrations of the effect of the intervention provides useful information but three or more demonstrations strengthens the design. Despite this limitation, Kazdin and Kopel further state that using a multiple baseline across individuals (as opposed to behaviors or settings) increases baseline independence because it is unlikely that any extraneous variables will impact two different individuals.

To further enhance the internal validity of our study, we conducted intermittent baseline probes throughout the evaluation. These intermittent baseline probes served as brief returns to baseline. For example, when we conducted the first two ABA baseline probes in the initial treatment comparison phase for both children, we re-captured low to zero levels of consumption, which was similar to the level we observed in the initial baseline phase. We also planned to use these intermittent baseline probes to rule out multi-treatment interference; however, because the modified food chaining condition never produced an increase in consumption, we were confident that the interventions did not influence responding in the sessions of the other intervention condition. Finally, because multielement designs involve the rapid alternation of conditions, which may produce carryover effects and discrimination failure across conditions, we assigned different colored scrubs and table clothes to both conditions to signal the change of conditions (Perone & Hursh, 2013).

Second, we included a small number of participants (N = 2) within a narrow age range (range, 3 to 5). In addition, both children had a diagnosis of ASD and presented with moderate food selectivity. Therefore, we cannot definitively conclude that participants outside of this narrow age range and limited demographic diversity would show the same pattern of responding we observed in this study and if the results of this study will generalize to individuals who do not have these characteristics. Therefore, future researchers should compare the effectiveness of food chaining and ABA treatments with a larger sample size and with a more diverse sample of participants.

Finally, and although outside the scope of this comparison, we did not assess generalization to the parents in the clinic or in the home. Although we did not assess this generalization of treatment effects, we took two steps to increase the likelihood that our treatment effects would generalize to the parents in the home. First, after we demonstrated the superiority of the ABA treatment, we re-arranged the food presentation to a sequential presentation to approximate a typical meal structure where a child would be required to eat the meal before his or her dessert. Second, we are currently conducting parent training with one (Aiden) or both (Colin) parents to ensure both children will consume a wide range of foods in the home. Future researchers should (a) conduct generalization probes before, during, and after treatment to assess for generalization of treatment effects to the parents in the home and (b) evaluate strategies to enhance this generalization to the people and the setting where feeding ultimately matters most.

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Appendix A

Brock University
Research Ethics Office
Tel: 905-688-5550 ext. 3035
Email: reb@brocku.ca

Social Science Research Ethics Board

Certificate of Ethics Clearance for Human Participant Research

DATE:	5/8/2018
PRINCIPAL INVESTIGATOR:	ZONNEVELD, Kimberley - Applied Disabilities Studies
CO-INVESTIGATOR(S):	Nancy Leathen (nl12ap@brocku.ca); Adam Carter (ac15ly@brocku.ca); Reghann Munno (rmunno@brocku.ca); Madeline Asaro (ma16lp@brocku.ca)
FILE:	17-344 - ZONNEVELD
TYPE:	Masters Thesis/Project STUDENT: Catherine McHugh SUPERVISOR: Kimberley Zonneveld

TITLE: A Comparison of a Modified Food Chaining Procedure and Simultaneous Presentation on Food Refusal in Children with Intellectual and Developmental Disabilities

ETHICS CLEARANCE GRANTED

Type of Clearance: NEW Expiry Date: 5/1/2019

The Brock University Social Science Research Ethics Board has reviewed the above named research proposal and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement. Clearance granted from 5/8/2018 to 5/1/2019.

The Tri-Council Policy Statement requires that ongoing research be monitored by, at a minimum, an annual report. Should your project extend beyond the expiry date, you are required to submit a Renewal form before 5/1/2019. Continued clearance is contingent on timely submission of reports.

To comply with the Tri-Council Policy Statement, you must also submit a final report upon completion of your project. All report forms can be found on the Research Ethics web page at http://www.brocku.ca/research/policies-and-forms/research-forms.

In addition, throughout your research, you must report promptly to the REB:

a) Changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) All adverse and/or unanticipated experiences or events that may have real or potential unfavourable implications for participants;
c) New information that may adversely affect the safety of the participants or the conduct of the study;
d) Any changes in your source of funding or new funding to a previously unfunded project.

We wish you success with your research.

Approved:

Ann-Marie DiBiase, Chair
Social Science Research Ethics Board

Note: Brock University is accountable for the research carried out in its own jurisdiction or under its auspices and may refuse certain research even though the REB has found it ethically acceptable.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and clearance of those facilities or institutions are obtained and filed with the REB prior to the initiation of research at that site.

Appendix B

Research Consent for Participants

Project Title: A comparison of modified food chaining to simultaneous presentation plus nonremoval of the spoon for the treatment of food refusal in children

Principal Investigators (PI):
Dr. Kimberley Zonneveld, BCBA-D, Assistant Professor, Department of Applied Disability Studies; Ph: (905) 688-5550 x6708; Email: kzonneveld@brocku.ca

Principal Student Investigators:
Catherine McHugh, M.A. Student, Department of Applied Disability Studies; Ph: (905) 688-5550 x3218; Email: cmchugh@brocku.ca

INVITATION
Your child is invited to participate in a research project to teach him or her to try nonpreferred food. We will compare an Occupational Therapy (OT) approach to an Applied Behaviour Analysis (ABA) approach to treat picky eating for your child. Both procedures will have preferred food, and a nonpreferred food present for your child. In the OT treatment we will not instruct your child to take a bite, rather we will comment on the characteristics of the food and model how to eat it. In the ABA treatment we will instruct your child to take a bite and we will keep the food presented for when they are ready to take a bite. Both treatments involve presentation of a preferred food item, and we encourage independent eating. All sessions will be videotaped, reasons for this will be discussed below. We ask that we conduct a range of 1-5 sessions per week, lasting maximum 2 hours in length. After treatment is complete we would also like to follow up (once per week for up to six weeks) to see how your child has improved over time. Dr. Zonneveld has 10 years of experience in feeding, and Catherine has 3 years of experience in feeding. All research assistants will be trained to 100% competency in all aspect of the study, and will be supervised by Dr. Zonneveld and/or Catherine.

WHAT'S INVOLVED

We will begin by asking you to go through a brief survey to give us more information about your child and the foods he or she currently eats or does not eat, and food that you wish he or she would eat. Finally, before starting formal assessments we would like a doctor's note indicating that your child is not at risk for choking due to swallowing issues.

Next, we will run a preference assessment to give us information about your child's favourite food. We will use this information in treatment to make sure your child's most preferred food is present for both ABA and OT treatment sessions.

To get a better idea about how often your child will eat his or her nonpreferred food, we will present 12 small bites of the selected target foods to your child and observe how often he or she will eat the food. This is merely an information gathering process, and no treatment will be in place yet.

The ABA treatment will include presenting your child with a bite of a nonpreferred food, as well as a preferred food. If your child accepts the bite within eight seconds we will deliver a praise statement (e.g., Good job!) and move on, if not, we wait until he or she accepts the bite, and then move to the next bite. If your child does not accept the bite, we will keep the spoon ready for them until they are, or until 30 minutes has elapsed and that session ends. There will only be 12 bites per session, but we hope to have your child stay with us for an hour or two at maximum.

The OT treatment will include presenting your child with a bite of a nonpreferred food and a preferred food. We will use non-directive statements about the food, such as, what it looks like, what it smells like, tastes like, etc. If your child accepts the bite at any time within the second trial we will deliver a praise statement (e.g., Nice work!) and present the next bite. If your child does not accept the bite, a new bite will be presented and we will try again. These sessions will also be short, but we hope to have an hour or two to spend with your child.

Once we determine which method is most effective for your child, we will conduct more sessions of the most effective treatment to ensure mastery of the skill for all food. You will also be asked about you experience in a questionnaire at the completion of the study to help us improve our methods in the future.

This information may help to increase the number of foods your child eats and determine your child's preferred method for doing so in the future. It will also add to the literature regarding comparisons of treatments across disciplines.

POTENTIAL BENEFITS AND RISKS

Your child may not enjoy all aspects of this study. We will be presenting small pieces of food that we identify as non-preferred to your child. Some children may engage in problematic behaviours as a result of being asked to eat nonpreferred food (e.g., crying or food refusal). To mitigate these potential risks of this experiment, a positive environment will be maintained for the entirety of the experiment. In addition, we never will never force your child to take a bite of food, we will wait until your child shows us he or she are ready (i.e., opening his or her mouth). We will also present food that have been identified as highly preferred. Sessions will only last 30 minutes maximum. If challenging behaviour occurs, Catherine McHugh is trained in Non-Violent Crisis Intervention, and will intervene to ensure safety for all involved.

There may be a risk that your child may choke on the food he/she is consuming; however, this risk is not higher than the risk of choking outside of research sessions. However, to ensure that your child is safe in the event that he or she does choke, all researchers conducting sessions with your child will be first aid trained. This is not a risk that is greater than your child would encounter in his/her everyday life while eating a typical meal.

Food selectivity and refusal can have a substantial negative impact on child nutrition and health (e.g., unbalanced diets, growth and nutrition deficits, weight loss, and malnutrition), by participating in this study we hope to increase the variety of healthy food your child eats. The proposed research will have large effects for practitioners and parents using behavioural interventions to treat food selectivity and refusal. Specifically, if the results show that one or both procedures are effective, then practitioners and parents can use this treatment method to treat food selectivity and refusal. Identifying the most effective method of treatment will increase treatment success for children. If both treatment methods are found to be effective, the efficiency of the two methods will be compared. Identifying the most efficient method will reduce the time children are required to undergo treatment, meaning that children will be more quickly reintegrated into family meals and snacks. In addition, shorter treatment durations will result in children receiving the nutrients from a healthy and balanced diet that are necessary for optimal health. If found to be effective and efficient, teachers and parents can successfully implement this treatment in a school or home setting.

CONFIDENTIALITY

Your child's data, video recordings of your child, and any information you provide us is considered confidential. Only members of the research team will have access to your child's data. We will refrain from using identifying information in e-mail correspondence, during presentations, or in publication of these results. Once your child's data is fully collected, his or her name will be changed into a pseudonym. A master list that links pseudonyms to real names will be stored on a network secured through Brock University's Information Technology Services. These pseudonyms will be the names that appear on any representation of your child's data.

Paper data collected during this study will be stored in a locked cabinet behind a locked door. Electronic data, including video recordings will be kept on a network secured through Brock University's Information Technology Services. All data will be kept for 10 years, after which time paper data will be securely shredded, and all electronic data (excluding video recordings) will be securely deleted from the secure network. If you provide consent for video recordings, all video recordings will be stripped of all personal identifiers and will be kept indefinitely for the purpose of teaching and/or dissemination at conferences.

Only the principal investigator and the students under her supervision will have access to the data.

VOLUNTARY PARTICIPATION

Participation in this study is voluntary. You may decline to answer any questions or have your child participate in any component of the study. Further, you may decide to withdraw from this study at any time up to and including the last study session and may do so without any reprisal from Brock University. If you choose to withdraw from the study, you will have the opportunity to decide what happens to your child's data. You may ask for it to be securely destroyed, for it to be used in the study, or for it to be returned to you. If you choose to have the data returned to you, Catherine McHugh will be available to meet with you should you have any questions.

We will also obtain verbal assent from your child to participate in this study. For children with limited communication abilities, we will ask for a list of ways they show that they do not want to do something. If a child revokes assent on three consecutive sessions, we will schedule a meeting with you (either via phone or in person) and indicate that she/he has indicated that she/he does not want to participate. We will then ask if you would like us to offer your child another opportunity to attend our research or if you would like to withdraw your child. If your child revokes assent on our next attempt, we will excuse her/him from the study.

PUBLICATION OF RESULTS

Your child's individual results may be published in professional journals and may be presented at conferences or workshops. Please note that only pseudonyms will appear on any representation of your child's data. Only the province, age, sex, and diagnosis (or lack thereof) of your child will be made available. The name, pseudonym, or specific location of residence of your child will not be made available in any published reports.

If you provide consent for video recordings, all names will be deleted from the video before the video is shown to anyone outside of our research team. Feedback about your child's results will be made available to you throughout the study. You can receive a graph of your child's results during the study. Further, you will be able to sit in on any (or all) sessions to observe your child while he or she participates in the study. Feedback regarding the final results of the study will either be mailed or emailed to you (depending on your preference). This feedback will be sent to you one month after the study ends. Throughout the study, you may contact Catherine McHugh, at cmchugh@brocku.ca, or Dr. Kimberley Zonneveld, BCBA-D at 905-688-5550 ext. 6708, or through email at kzonneveld@brocku.ca.

*Please note that none of the members of this research team are psychologists and, as such, are not in a position to provide a clinical assessment of your child.

CONTACT INFORMATION AND ETHICS CLEARANCE

If you have any questions about this study or require further information, please contact Dr. Kimberley Zonneveld or Catherine McHugh using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at Brock University 17-344. If you have any comments or concerns about your child's rights as a research participant, please contact the Research Ethics Office at (905) 688-5550 Ext. 3035, reb@brocku.ca.

PARTICIPANT CONSENT

I , ________________________________, agree to allow my child to participate in the study described above. I have made this decision based on the information I have read in this form. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time.

If necessary, I consent to my child participating in this study:

☐ Yes
☐ No

Please note that members of the research team are under obligation to follow mandatory reporting laws. That is, if any instance of child abuse is disclosed to or observed by a member of the research team, that member is required to report it to child protective services.

Video Consent:
Please note that video consent is not required for your child to participate in this study.
If you provide any video consent, the name, pseudonym, or specific location of residence of your child will not be made available in the video. You will have the option to have your child's face to be blurred and your child's voice to be stripped from the video.

I agree for video recordings of my child to be used for data-collection purposes. I am aware that these videos will only be viewed by members of the research team.
☐ Yes
☐ No

I agree for video recordings of my child to be used for educational purposes in (please select all that apply):
☐ Classes
☐ Workshops
☐ Conferences

I would like my child's face to be blurred out in any video used for education purposes to protect the identity of my child:
☐ Yes
☐ No

I would like all audio removed in any video used for education purposes to protect the identity of my child:
☐ Yes
☐ No

Notification of Results

I would like to be notified of the final results of the study:

☐ Yes ☐ No

I would like to receive a graph of my child's progress in the study:

☐ Yes ☐ No

Child's Name: ___________________________________

Caregiver's Name: ______________________________ Ph./Email: ________________

Signature : ____ Date: ___________________
(dd/mm/yy)

Appendix C

Food Preference Inventory

<u>Food Preference Inventory</u>

Circle about how often your child eats at least a *portion* of this food (the portion is listed after the food); **No =** a *portion* of this food is never eaten; **Week** = at least once per week; **Day** = once per day, **Many =** more than once per day. If the child eats other foods not included here, write them in the blanks below.

Food	**How often is food eaten by your child?**	Is this food eaten by the family ?	Food	**How often is food eaten by your child?**	Is this food eaten by the family ?
Apple	No Week Day Many	Yes	Crackers	No Week Day Many	Yes
Apple Juice	No Week Day Many	Yes	Fruit Roll-up/Snacks	No Week Day Many	Yes
Applesauce	No Week Day Many	Yes	Other Candy	No Week Day Many	Yes
Apricots	No Week Day Many	Yes	Pie	No Week Day Many	Yes
Avocado	No Week Day Many	Yes	Potato Chips	No Week Day Many	Yes
Banana	No Week Day Many	Yes	Pretzels	No Week Day Many	Yes
Banana Chips	No Week Day Many	Yes	Bacon	No Week Day Many	Yes
Berries	No Week Day Many	Yes	Baked Beans	No Week Day Many	Yes
Cantaloupe	No Week Day Many	Yes	Chicken	No Week Day Many	Yes
Cherries	No Week Day Many	Yes	Chicken Nugget	No Week Day Many	Yes
Cranberry Sauce	No Week Day Many	Yes	Chicken salad	No Week Day Many	Yes
Cranberry Juice	No Week Day Many	Yes	Clams/oysters	No Week Day Many	Yes
Fruit Cocktail	No Week Day Many	Yes	Crab/lobster	No Week Day Many	Yes
Grapefruit	No Week Day Many	Yes	Eggs	No Week Day Many	Yes
Grapefruit Juice	No Week Day Many	Yes	Fish	No Week Day Many	Yes
Grapes	No Week Day Many	Yes	Fish Stick	No Week Day Many	Yes
Grape Juice	No Week Day Many	Yes	Ham	No Week Day Many	Yes
Honeydew	No Week Day Many	Yes	Ham salad	No Week Day Many	Yes
Kiwi	No Week Day Many	Yes	Hamburger	No Week Day Many	Yes
Lemonade	No Week Day Many	Yes	Hot Dog	No Week Day Many	Yes

Mango	No Week Day Many	Yes	Lamb	No Week Day Many	Yes
Nectarine	No Week Day Many	Yes	Lentils	No Week Day Many	Yes
Oranges	No Week Day Many	Yes	Liver	No Week Day Many	Yes
Orange Juice	No Week Day Many	Yes	Lunchmeat	No Week Day Many	Yes
Peaches	No Week Day Many	Yes	Meatloaf	No Week Day Many	Yes
Pear	No Week Day Many	Yes	Other Beans	No Week Day Many	Yes
Pineapple	No Week Day Many	Yes	Other nuts/seeds	No Week Day Many	Yes
Plums	No Week Day Many	Yes	Peanut Butter	No Week Day Many	Yes
Prunes	No Week Day Many	Yes	Peanuts	No Week Day Many	Yes
Prune Juice	No Week Day Many	Yes	Popcorn	No Week Day Many	Yes
Strawberry	No Week Day Many	Yes	Pork	No Week Day Many	Yes
Raisins	No Week Day Many	Yes	Roast Beef	No Week Day Many	Yes
Watermelon	No Week Day Many	Yes	Sausage	No Week Day Many	Yes
American Cheese	No Week Day Many	Yes	Shrimp	No Week Day Many	Yes
Cheese Spread	No Week Day Many	Yes	Steak	No Week Day Many	Yes
Chocolate Milk	No Week Day Many	Yes	Tuna salad	No Week Day Many	Yes
Cottage Cheese	No Week Day Many	Yes	Turkey	No Week Day Many	Yes
Cream Cheese	No Week Day Many	Yes	Veal	No Week Day Many	Yes
Hot Chocolate	No Week Day Many	Yes	Venison	No Week Day Many	Yes
Ice Cream	No Week Day Many	Yes	Chili	No Week Day Many	Yes
Milk	No Week Day Many	Yes	Pot Pie	No Week Day Many	Yes
Milk Shake	No Week Day Many	Yes	Soup	No Week Day Many	Yes
Other Cheese(s)	No Week Day Many	Yes	Stew	No Week Day Many	Yes
Pudding	No Week Day Many	Yes	Stuffing	No Week Day Many	Yes
Sherbet	No Week Day Many	Yes	Bagel	No Week Day Many	Yes
Sour Cream	No Week Day Many	Yes	Breakfast Bars	No Week Day Many	Yes
Tofu	No Week Day Many	Yes	Cereal (cold)	No Week Day Many	Yes
Yogurt	No Week Day Many	Yes	Corn Bread	No Week Day Many	Yes
Asparagus	No Week Day Many	Yes	Cream of Wheat	No Week Day Many	Yes
Beets	No Week Day Many	Yes	Donut/pastry	No Week Day Many	Yes
Broccoli	No Week Day Many	Yes	Egg Noodles	No Week Day Many	Yes
Cabbage	No Week Day Many	Yes	Farina	No Week Day Many	Yes

Carrots	No Week Day Many	Yes	French Fries	No Week Day Many	Yes
Cauliflower	No Week Day Many	Yes	French Toast	No Week Day Many	Yes
Coleslaw	No Week Day Many	Yes	Grits	No Week Day Many	Yes
Celery	No Week Day Many	Yes	Lasagna/ravioli	No Week Day Many	Yes
Corn	No Week Day Many	Yes	Macaroni	No Week Day Many	Yes
Creamed Corn	No Week Day Many	Yes	Muffins/rolls	No Week Day Many	Yes
Cucumbers	No Week Day Many	Yes	Noodles	No Week Day Many	Yes
Greens	No Week Day Many	Yes	Oatmeal	No Week Day Many	Yes
Green or Wax Beans	No Week Day Many	Yes	Pancake	No Week Day Many	Yes
Lettuce (salad)	No Week Day Many	Yes	Pita	No Week Day Many	Yes
Lima beans	No Week Day Many	Yes	Pizza	No Week Day Many	Yes
Onion	No Week Day Many	Yes	Poptart	No Week Day Many	Yes
Peas	No Week Day Many	Yes	Potato(mashed/baked)	No Week Day Many	Yes
Green Pepper	No Week Day Many	Yes	Potato salad	No Week Day Many	Yes
Pickles	No Week Day Many	Yes	Ramen Noodles	No Week Day Many	Yes
Radish	No Week Day Many	Yes	Rice	No Week Day Many	Yes
Sauerkraut	No Week Day Many	Yes	Spaghetti	No Week Day Many	Yes
Spinach	No Week Day Many	Yes	Spaghettios	No Week Day Many	Yes
Squash	No Week Day Many	Yes	Stuffing/filling	No Week Day Many	Yes
Sweet Potato	No Week Day Many	Yes	Taco/burrito	No Week Day Many	Yes
Tomato	No Week Day Many	Yes	Waffle	No Week Day Many	Yes
Turnip	No Week Day Many	Yes	Wheat/grain Bread	No Week Day Many	Yes
Cake (any type)	No Week Day Many	Yes	White Bread	No Week Day Many	Yes
Cheese Puffs/Curls	No Week Day Many	Yes	FRUIT (any variety)	No Week Day Many	Yes
Chocolate Candy	No Week Day Many	Yes	Sugar free gum	No Week Day Many	Yes
Cookies	No Week Day Many	Yes		No Week Day Many	Yes
Corn/tortilla Chips	No Week Day Many	Yes		No Week Day Many	Yes

Appendix D

Paired Choice Preference Assessment

Child: _______________ Date: _________________

Evaluator: ____________ Primary/Reliability

Item	# Accept	% Accept	# of Accept & Consume	% of Accept & Consume	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					

Trials:

1 x 2	1 x 3	1 x 4	1 x 5	1 x 6	1 x 7	1 x 8
2 x 3	2 x 4	2 x 5	2 x 6	2 x 7	2 x 8	
3 x 4	3 x 5	3 x 6	3 x 7	3 x 8		
4 x 5	4 x 6	4 x 7	4 x 8			
5 x 6	5 x 7	5 x 8				
6 x 7	6 x 8					
7 x 8						

Appendix E

Treatment Data Sheet

Student:
Session__________ Start Time:________ Stage: ___________
Date_____ Stop Time:________
Therapist_______ Pre-meal weight:
Observer_________ Post-meal weight:

Trial	Food	Accept	Expel	Consume	Pb
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Definitions

Expel: food larger than size of pea, which was previously in mouth, is visible outside mouth following acceptance

Refuse:
failure to open mouth or accept spoon into mouth within 5s.

Problem Behavior: Cry/Scream, AGG, SIB, PD

Appendix F

Procedural Integrity: Preference Assessment

<u>*Definitions*</u>:

Item delivery is defined as the therapist placing a food on the plate within 0.7 m of the participant

Correct *prompt delivery* is defined as the therapist giving the instruction to select a food 5 s after the food is presented

Correct *termination of the trial* will be scored when the participant does not select a food within 5 s of the second prompt

Trial	**Item delivery**	**Prompt delivery**	**Termination of trial**	**Trial**	**Item delivery**	**Prompt delivery**	**Termination of trial**
1	Y N	Y N	Y N N/A	15	Y N	Y N	Y N N/A
2	Y N	Y N	Y N N/A	16	Y N	Y N	Y N N/A
3	Y N	Y N	Y N N/A	17	Y N	Y N	Y N N/A
4	Y N	Y N	Y N N/A	18	Y N	Y N	Y N N/A
5	Y N	Y N	Y N N/A	19	Y N	Y N	Y N N/A
6	Y N	Y N	Y N N/A	20	Y N	Y N	Y N N/A
7	Y N	Y N	Y N N/A	21	Y N	Y N	Y N N/A
8	Y N	Y N	Y N N/A	22	Y N	Y N	Y N N/A
9	Y N	Y N	Y N N/A	23	Y N	Y N	Y N N/A
10	Y N	Y N	Y N N/A	24	Y N	Y N	Y N N/A
11	Y N	Y N	Y N N/A	25	Y N	Y N	Y N N/A
12	Y N	Y N	Y N N/A	26	Y N	Y N	Y N N/A
13	Y N	Y N	Y N N/A	27	Y N	Y N	Y N N/A
14	Y N	Y N	Y N N/A	28	Y N	Y N	Y N N/A

Appendix G

Procedural Integrity: Treatment

Procedural Integrity: Treatment

Phase (circle one): BASELINE TREATMENT

Condition (circle one): ABA

Definitions

Correct food presentation is defined as presenting the spoon with a bite of food on a plate within 0.7 m of the participant

Praise is delivered contingent on acceptance, and consumption

Correct food removal will be scored when the participant does not accept the bite within 30 s of presentation

Correct *nonremoval of the spoon* will be scored if the participant does not accept the food within 8 s. The therapist will: (a) prompt the participant to bring the spoon to the lips, (b) follow the participant's head with the spoon and holds the spoon to the participant's mouth if the participant engages in inappropriate mealtime behavior, (c) leave the spoon at the mouth if the bite of food does not remain on the spoon and the researcher needs to obtain another bite, (d) deposit the bite when the participant opens his or her mouth, and (e) hold the spoon to the side of the participant's mouth if the participant vomits, coughs, or gags while the researcher holds the spoon at the mouth

Incorrect attention is defined as the researcher providing attention of any kind (e.g., reprimands, coaxing, eye contact, physical contact, descriptive statements) immediately after inappropriate mealtime behavior

Circle Y for correct implementation or N for incorrect implementation or N/A for not applicable

Trial	Food Presentation	Praise	Food removal	Nonremoval of spoon	Attention
1	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A
2	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A
3	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A
4	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A
5	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A
6	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A
7	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A
8	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A
9	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A
10	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A
11	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A
12	Y N N/A	Y N N/A	Y N N/A	Y N N/A	Y N N/A

Appendix H

Procedural Integrity Checklist: Modified Food Chaining

Step	Trial (circle a response in each box)								
	1	2	3	4	5	6	7	8	9
1. Have pictures of children eating visible to participant	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A
2. Present a bite of preferred food on a divided plate and present a bite of the target food on a separate plate	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A
3. Deliver a nondirective statement (e.g., I wonder if you can make the carrot crunch?"	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A
Start the 30 s timer	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A
Contingent on acceptance within 30 s deliver praise	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A
No consequence for nonacceptance	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A

Present a new bite of preferred and target every 30 s with nondirective statement	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A
Ignore all crying	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A
Contingent on spitting or throwing food, turn the participant away for 1 minute	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A
Second turn away for spitting or throwing	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A
Terminate session if the participant throws or spits for the third time	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A
Terminate session after all bites are presented	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A	CORR INCOR N/A

Appendix I

Food Chaining Rating Scale

Strongly Dislikes									***Strongly Prefers***
1	2	3	4	5	6	7	8	9	10

1 = Gags and/or vomits upon touching, smelling, or seeing the food

1+ = Gags upon tasting the food

2 = Chews the food or manipulates it briefly in the mouth

3 = Chews the food, but strongly aversive to the taste, grimaces, refusing to try more

4 = Chews and swallows the food, tolerates it, but doesn't enjoy it

5 = Chews and swallows the food, tolerates it with a "so-so" reaction

6 = Chews and swallows several bites of the food, no major grimaces or reaction, but still hesitant

7 = Chews and swallows several bites of the food with no hesitation, child appears relaxed

8 = Chews and swallows the food, takes a small serving easily, pleasant look on the face

9 = Chews and swallows the food, asks or reaches for more, appears to like the food very much

10 = Chews and swallows the food, a strong favorite, accepts it at any time