THE EFFECTS OF REINFORCER PAIRING ON FOOD PREFERENCE AND SUBSEQUENT REINFORCER VALUE IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDER

By

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ABSTRACT OF THE THESIS

The Effects of Reinforcer Pairing on Food Preference and Subsequent Reinforcer Value in Individuals with Autism Spectrum Disorder

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Food selectivity (severe "picky eating") is commonly seen in individuals with Autism Spectrum Disorder (ASD), with prevalence rates ranging from 59-83%. It presents a challenge for caregivers of individuals with ASD, as these children tend to display high rates of problem behavior when presented with nonpreferred foods (Ledford & Gast, 2006; Sharp, Jaquess & Lukens, 2013). Food selectivity has been associated with inadequate nutrient consumption and is a risk factor for obesity in children with ASD (Bandini et al., 2010). Additionally, poor eating habits can also become increasingly problematic as children grow older and gain more independence and greater access to foods (Ho, Eaves & Peabody, 1997). The treatment of feeding problems can be challenging, and most of this research has been conducted in populations without ASD. The results from these populations may have limited applicability to children with ASD, as those studies tend to examine individuals with medical conditions that are related to the feeding problems (Ledford & Gast, 2006). Therefore, further research is needed to fill this gap by extending research to individuals with ASD. The present study partially replicated and extended a pairing and fading procedure used by Solberg, Hanley, Layer,

and Ingvarsson (2007) to shift preferences to healthier food items, with the addition of a reinforcer assessment both before and after the pairing procedure in order to determine whether the targeted foods also functioned as reinforcers. The present study employed a multiple baseline across subjects design. Two participants achieved a stable baseline and were introduced to the pairing procedure but did not demonstrate a shift in preference to other food items. The third participant did not achieve the necessary baseline in order to continue with the pairing and fading portion of the intervention. These results indicate that this pairing and fading procedure may not be appropriate for low functioning individuals with ASD. Possible explanations and future research directions are discussed.

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I. Introduction

Definition of Food Selectivity

Food selectivity, sometimes called "picky eating," is a behavior that is commonly seen in individuals with Autism Spectrum Disorder (ASD) (Holcomb et al., 2009). This term has been used to refer to food refusal, limited food repertoire, high frequency intake of a single food, consumption of a narrow diet that is nutritionally inadequate, or eating only a narrow variety of foods as defined by type, texture, or presentation (Sharp, Jaquess, & Lukens, 2013; Bandini et al., 2010; Pizzo, Coyle, Seiverling, & Williams, 2012). Although this behavior is seen in typically developing children as well, the literature suggests that it is both more prevalent and more enduring in children with ASD, with prevalence rates ranging from 59-83% (Cermak, Curtin, & Bandini, 2010). A review by Ledford and Gast (2006) found that up to 89% of individuals with ASD may exhibit maladaptive feeding behavior.

Another way food selectivity may manifest itself is by selecting foods based on features. Sensory-based food aversions are commonly reported in children with ASD, particularly those associated with certain textures (Schwarz, 2003). Field, Garland, and Williams (2003) conducted a review of feeding concerns for individuals diagnosed with ASD, Down syndrome, and cerebral palsy that were referred to an interdisciplinary feeding program. The authors reviewed patient records as well as the results of the interdisciplinary evaluation to identify concerns. The results indicated that the most common feeding problem amongst those with ASD was food selectivity by type and texture, and that the prevalence of these behaviors was higher in this group as compared to the other two groups in the sample. In contrast, the most common feeding problem

amongst those with Down syndrome and cerebral palsy was oral motor delay (e.g. difficulty chewing, tongue protrusion, etc.).

Prevalence of Food Selectivity

Bandini et al. (2010) conducted a study with 53 children with ASD and 58 typically developing children in order to assess the prevalence of food selectivity (defined as food refusal, limited food repertoire, and nutrient inadequacy and food selectivity) in each population. Parents were interviewed about their child's eating habits, completed questionnaires regarding their child's diet, and kept a three day food log of all food consumed. Although food refusal was observed in both typically developing children as well as those with ASD, on average, children with ASD refused more foods than their neurotypical peers. Children with ASD also consumed fewer fruits and vegetables and more sugar-sweetened beverages than typically developing peers. According to parental reports, on average, children with ASD ate fewer types of foods than their peers. Additionally, children with ASD displayed increased nutrient inadequacy when compared to typically developing children.

As food selectivity has been defined in a number of different ways, it can be challenging to determine the ways it presents in individuals with ASD. Schreck and colleagues (2006) examined food preferences and selectivity in a parent survey study of 138 children with ASD. They found that restricted food acceptance was noted in 72% of children, and food refusal occurred in 57% of children. Preference was assessed across a variety of food groups such as fruit, vegetables, proteins, starches, and dairy by

examining foods eaten for each group. They found that, within most presented food groups, children with ASD tended to eat less than half of the listed foods, and tended to prefer more energy-dense (higher calorie) foods. For example, they tended to consume ice cream in the dairy group, cake, cookies, french fries, and pizza in the starches group, and hot dogs, chicken nuggets, and peanut butter in the protein group (Schreck & Williams, 2006).

Evans et al. (2012) found similar results in a study of 111 children ages 3-11 with and without ASD. They found that children with ASD had lower levels of vegetable consumption as well as higher consumption levels of low-nutrition, energy-dense foods such as snacks, "kid's meals," juice, and sweetened beverages when compared to typically developing children.

Ho, Eaves, and Peabody (1997) examined the nutrient intake of 45 children with ASD. Caregivers were instructed to complete a 3 day food diary, which was then analyzed for nutrient intake, including energy, protein, fat, and certain vitamins and minerals, which were compared to the nation's standard dietary recommendations. They found that although all children in the sample consumed a sufficient amount of protein, 93% did not meet the nation's dietary recommendations for consumption in the four basic food groups. Consequences of certain nutrient deficiencies include iron deficiency anemia, increased susceptibility to infection, poor growth, altered immune function, increased risk of osteoporosis, and increased risk of various cancers (Kirby & Danner, 2009). Behavioral consequences of nutrient deficiency have also been documented. Lozoff, Jimenez, Hagen, Mollen, and Wolf (2006) found that children who had severe iron deficiency as infants displayed lower verbal and full scale IQ scores at a 10 year

follow up, as well as lower writing, arithmetic, and motor achievement scores when compared to those without iron deficiency. Additionally, children who were iron deficient as infants were more likely to repeat a grade and have higher levels of behavior problems than children with normal iron levels.

Adverse Effects of Food Selectivity

Food selectivity is concerning not only because of its high prevalence in children with ASD, but for a number of other reasons as well. Selective eating has been associated with inadequate nutrition consumption, which can lead to further health complications if this behavior persists (Bandini et al., 2010). Caregivers and teachers of children with ASD have also reported that food selectivity represents a significant challenge; with 80% of caregivers expressing concern regarding their child's eating habits (Ledford & Gast, 2006; Sharp et al. 2013). Additionally, children with ASD often display high rates of problem behavior when presented with nonpreferred foods, which can present challenges to caregivers (Sharp et al., 2013). As children grow older, poor eating habits can also become more difficult to handle or attempt to treat as these habits become more ingrained and children gain more independence as well as easier access to foods (Ho et al., 1997).

Food selectivity can have negative effects on health and nutritional status (Fodstad & Matson, 2008; Bruns & Thompson, 2011). For example, Curtin, Jojic, & Bandini (2014) identified food selectivity as a potential risk factor for obesity in children with ASD. This is concerning because the prevalence of obesity in children with ASD seems to be comparable to if not higher than that seen in typically developing peers. Additionally, there are several adverse health conditions associated with obesity, which

have important implications in regard to quality of life for such individuals (Curtin, Jojic, & Bandini, 2014).

The Assessment of Feeding Problems

Although feeding problems are clearly prevalent in both typically developing children as well as children with developmental disabilities, there has been surprisingly little research on the assessment of feeding problems. Piazza et al. (2003) hypothesized that feeding problems can be conceptualized similarly to other problem behaviors, in that they are learned behaviors that are maintained by the child's environment. In order to test this hypothesis, they used parent observation and functional analysis to determine what environmental factors maintained feeding problems in 15 children who were patients in a pediatric feeding disorders program.

First, through observing parents during typical feeding sessions with their child, they found that parents tend to respond to their child's feeding in several different ways. Contingent upon problem behavior, all parents in this study provided attention in the form of coaxing the child to eat or soothing comments and removed food to allow the child to take a break or escape eating. Additionally, several of the parents also gave their child a tangible item such as a preferred toy or edible contingent upon problem behavior.

Second, Piazza and colleagues (2003) conducted a functional analysis for each participant. Each session was 10 minutes in duration. During sessions, bites of food were presented every 30 seconds by holding a spoon next to the child's lips and instructing them to "take a bite". The functional analysis included four conditions. In the baseline (play) condition, no consequences were provided for eating behaviors, and toys and

attention were available noncontingently. This condition was used to observe the frequency of problem behavior when given access to preferred items and attention. In the escape condition, the therapist removed the spoon of food for the remainder of each 30 second interval contingent on problem behavior. In the attention condition, coaxing and statements of concern were delivered for 5-10 seconds contingent on problem behavior. Finally, in the tangible condition, the child was given access to preferred items or foods contingent upon problem behavior. High levels of problem behavior in the escape, attention, and tangible conditions would allow the researchers to determine if inappropriate mealtime behavior was maintained by escape from eating, access to attention, or access to preferred items, respectively.

The results of the functional analyses showed that inappropriate eating behavior was maintained by environmental variables for 10 of the 15 participants. That is, 10 of the 15 participants demonstrated higher rates of problem behavior in one or more of the test conditions (escape, attention, and/or tangible) compared to the baseline (play) condition. The results of this study demonstrate that not only are feeding problems sensitive to environmental variables, but that these maintaining variables can be assessed via experimental functional analysis. In addition, the use of functional analyses in assessing feeding problems can be useful in the development of function based treatments.

The Treatment of Feeding Problems

While a considerable amount of research exists regarding the treatment of feeding disorders, relatively few studies have targeted the unique challenges involved when

intervening with feeding difficulties for individuals with ASD. Additionally, the current literature may not be applicable to children with ASD, as those studies tend to examine individuals with medical conditions that are related to the feeding problems (Ledford & Gast, 2006). Although the literature examining feeding problems in children with ASD is limited, food selectivity is the most frequently studied feeding problem (Matson & Fodstad, 2009). Additionally, most of the literature uses applied behavior analysis as the treatment model of choice in such cases (Matson & Fodstad, 2009).

The Use of Escape Extinction in Treating Food Selectivity

A large number of treatment studies of food selectivity in children with ASD use a combination of escape extinction and a number of other procedures. Escape extinction involves holding a spoon with food in front of a child (nonremoval of spoon) until the bite has been consumed, or not terminating a session until the child consumes the required amount of food. Escape extinction is not force feeding, but rather, typically involves a utensil or cup remaining in front of a student contingent upon the food being consumed rather than moving them contingent upon problem behavior (i.e. escape). The idea behind this method is to put escape maintained behavior (e.g. tantrums or refusing to eat) on extinction.

Ahearn (2002) found that differential reinforcement alone did not produce acceptable improvement in food acceptance in six children with ASD who presented for food selectivity. As such, escape extinction in the form of nonremoval of spoon and physical guidance was introduced into the treatment package. Ahearn examined whether single-item presentation or multiple food presentation was more effective in increasing

food acceptance when combined with EE. Individuals in the single-item group were presented with one food until the eating criterion was met, whereas individuals in the multi-item group were presented with three different foods from the same food group until the eating criterion was met for that food group. Treatment was successful in that all participants reached the treatment goal of consuming three foods from each of the four presented food groups. While participants in the single item group reached criteria sooner than those in the multi-item group, the participants in the multi-item group was more likely to consume novel foods during generalization probes.

The Use of Escape Extinction and Noncontingent Reinforcement in Treating Food Selectivity

Reed and colleagues (2004) evaluated the efficacy of noncontingent reinforcement (NCR) plus escape, escape extinction (EE), and NCR plus EE on food refusal, inappropriate behavior, and negative vocalizations in four children with feeding problems. They found that for all four children, consumption only increased when EE was implemented, regardless of whether or not NCR was implemented. NCR without EE did not increase bite acceptance, but did help to decrease inappropriate behavior and negative vocalizations when combined with EE. Although this study is not specific to children with ASD, the results suggest that escape extinction may be necessary in the treatment of feeding problems. The results of this study are consistent with previous research by Piazza, Patel, Gulotta, Sevin, and Layer (2003), who found that positive reinforcement alone was not effective in increasing consumption for 4 children with feeding problems, and that the addition of EE was necessary for treatment to work.

The Use of Escape Extinction and Differential Reinforcement in Treating Food Selectivity

Allison and colleagues (2012) evaluated the effects of differential reinforcement of alternative behavior (DRA) with escape extinction (EE) compared to noncontingent reinforcement (NCR) with EE on bite acceptance, problem behavior, and negative vocalizations in a 3 year old with ASD and food selectivity. They found that both treatments were effective for increasing bite acceptance and decreasing problem behavior. Although both treatments were equally effective, a social validity measure indicated that NCR plus EE was rated as more acceptable and easier to implement.

Najdowski, Wallace, Doney, and Ghezzi (2003) also examined the effects of DRA on food selectivity. Specifically, they examined DRA versus CRA plus EE and demand fading on the food selectivity of a 5 year old with ASD whose diet consisted mostly of candy, chips, chicken nuggets, and french fries. During baseline and DRA, non-preferred foods were never consumed. The DRA plus EE plus demand fading condition, however, was successful in increasing acceptance of non-preferred foods. By the end of the study and during follow up visits, the child was consuming five non-preferred foods as well as novel foods. Valdimarsdóttir, Halldórsdóttir, and Sigurådóttir (2010) conducted a systematic replication of Najdowski et al., in which they evaluated the generalization of treatment across settings and caregivers. The results of this study demonstrated that this treatment package could be generalized, as evidenced by the participant's increased consumption of non-preferred foods across settings and caregivers.

The effects of differential reinforcement of alternative behavior were also evaluated in a study by Patel, Piazza, Kelly, Ochsner, and Santana (2001). They examined the effects of DRA in combination with stimulus fading and escape extinction on increasing the consumption of a calorie-dense fluid by a 6 year old boy with pervasive developmental disorder. In this procedure, small quantities of Carnation Instant Breakfast and milk (both of which the child did not consume prior to treatment) were gradually added in increasing amounts to water (which the child consumed 100% of the time prior to treatment). Treatment was successful in that the child was receiving 100% of his caloric requirements by the end of the study. Freeman and Piazza (1998) also found support for the use of stimulus fading, reinforcement, and escape extinction in the treatment of food refusal in a child with ASD. They found that food acceptance remained at or near zero when only verbal prompts were given; in contrast, the treatment package caused an increase in compliance even when the consumption requirement increased. The treatment package was also effective in maintaining low rates of problem behavior during mealtimes.

The Use of Escape Extinction and Simultaneous vs. Delayed Reinforcement in Treating Food Selectivity

Kern and Marder (1996) took a slightly different approach in treating food selectivity in a child with pervasive developmental disorder who consumed only five different food items. They compared simultaneous reinforcement plus EE for fruits with delayed reinforcement plus EE for vegetables as well as a baseline condition (30 second presentation) for proteins and starches using a multielement design. For both treatments,

corn chips were used as a reinforcer. During the simultaneous reinforcement condition, the chip and fruit were presented at the same time, while during the delayed reinforcement condition, the chip was provided after the vegetable was consumed. Both treatments were effective in increasing acceptance of novel foods, and reinforcement was completely faded at the same time for both treatments. However, the simultaneous reinforcement procedure was slightly more effective in regard to initial response to treatment as well as mean level of food acceptance (85% versus 76%).

The Necessity of Escape Extinction

Researchers in the field have attempted to treat food selectivity or food refusal with a number of interventions, including EE alone, NCR plus EE, and DRA plus EE. Overall, it is clear that escape extinction is the essential component that makes the intervention effective. NCR and DRA are not sufficient on their own without EE to treat feeding problems, although they might lessen some of the associated disruptive behavior.

Treatments of Food Selectivity Using Techniques Other Than Escape Extinction

Although escape extinction has been shown to be effective in increasing consumption of novel foods in individuals with food refusal or food selectivity, it is a rather invasive procedure and can result in extinction bursts that may involve behavioral escalation. Therefore, several researchers have recently begun to investigate other treatment options for food selectivity that do not require escape extinction, such as sequential presentation, pairing, and simultaneous presentation.

Pizzo et al. (2012) examined the effects of sequential presentation of foods and appetite manipulation on food selectivity in a 16 year old boy with ASD. Prior to intervention, the individual consumed only 10 foods and one beverage. The treatment involved presenting a plate containing small bites of novel foods, followed by a plate containing larger bites of highly preferred foods. Access to preferred foods was restricted outside of designated meal or snack times. The intervention was successful in increasing consumption of novel foods without increasing maladaptive behavior, and by the end of treatment the number of foods that the participant would eat had more than doubled.

In addition to sequential presentation of foods, simultaneous presentation has also been examined as a treatment for food selectivity. Ahearn (2003) presented nonpreferred vegetables with a certain amount of preferred condiments on top to a 14 year old boy with ASD in a multiple baseline across food items design. During baseline, the participant was presented with either carrots, broccoli, or corn, and was told to "take a bite." No differential consequences were put into place for consuming or refusing the food. During intervention, the vegetables were presented with a small amount of preferred condiment (determined by a previously conducted preference assessment) placed on top. The intervention was successful and resulted in 100% bite acceptance in treatment conditions, compared to baseline sessions in which the food was consumed only once.

Similarly, Tiger and Hanley (2006) used a simultaneous presentation with fading procedure to increase milk consumption in a 4 year old boy. During baseline, the child was prompted to pour milk into his cup, with no additional prompts to drink the milk and no differential consequences in place. During intervention, a small amount of chocolate

syrup was mixed into a glass of milk, and the chocolate syrup was gradually faded out and eliminated. The treatment was successful in increasing milk consumption from a baseline rate of 0% to consumption of a full serving of milk at every meal.

In a study similar to Kern and Marder (1996), Piazza et al. (2002) compared the effectiveness of both simultaneous and sequential presentation of preferred and nonpreferred food in the treatment of food selectivity in three children with developmental disorders. During the simultaneous presentation condition, a nonpreferred food was either embedded in a preferred food or presented together on the same spoon. During the sequential presentation condition, a bite of a preferred food was provided after each bite of a nonpreferred food. For the first participant, percentage of bites consumed increased from zero to 100% in both the simultaneous and sequential conditions. For the second participant, consumption increased from zero to 50-100% in the simultaneous condition and remained at zero percent during the sequential condition. The third participant did not respond to either treatment condition and consumption increased to 100% only when physical guidance and pre-presentation were added to the treatment.

Penrod, Gardella, and Fernand (2012) examined the use of a high-probability instructional sequence with low-probability demand fading in the treatment of food selectivity in two children with ASD. In this antecedent based procedure, instructions with a high probability of compliance were given prior to instructions with a low probability of compliance. High-probability instructions required physical contact with the target foods (e.g., touching the food, smelling the food) and low-probability instructions required increasingly closer approximations to the desired response of chewing and swallowing the food. The difficulty of the low-probability instructions were

gradually increased until the goal of consuming the food was met. For example, initial low-probability instructions were “kiss the food” or “balance food on tongue,” while later more difficult instructions were “chew the food into little pieces” or “swallow the little pieces.” Once participants reached 100% compliance in food consumption, the high-probability instructions were removed and the bite requirement was increased. This procedure was effective for increasing consumption of non-preferred foods for both participants.

A similar treatment study of food selectivity in a 2 year old girl with ASD was conducted by Meier, Fryling, and Wallace (2012). During treatment, three bites of highly preferred foods were presented, followed by one bite of a low preferred food. The number of high preference items were systematically reduced as compliance increased, with the goal of fading the high preference items out completely. The results indicated that the high-preference sequence was effective in increasing acceptance of all three non-preferred foods. High preference foods were effectively faded completely for 2 of the 3 targeted foods.

Solberg, Hanley, Layer, and Ingvarsson (2007) assessed the effects of a pairing and fading procedure on the snack selections of three typically-developing children, ages 3-4 years. An MSWO was conducted during baseline to determine which snacks were low, medium, and high preference. During the pairing and fading procedure, the snack ranked as least preferred during baseline was paired with social, edible, and activity reinforcers. Paired-stimulus assessments were conducted, and when the child selected the target low preference snack, they were provided access to the high preference items as well. During the pairing procedure, participants shifted their preference to the target low

preference item until it became the most preferred snack. Once the target snack moved up to the highest rank, the food, attention, and activity reinforcers were simultaneously and gradually faded. They found that as paired reinforcement was faded, the ranking of the target snack decreased either to baseline or just above baseline levels. As such, the authors suggested that the initial shift in preference was due to the added reinforcers, rather than a conditioning effect of pairing the target snack with the reinforcers.

Gap in the Literature

The majority of treatments for food selectivity in ASD have focused on consequence-based interventions and involved some form of escape extinction (Ledford & Gast, 2006). However, escape extinction is not always a viable treatment choice. To effectively implement EE, practitioners generally require intensive training to prevent injury and to manage extinction bursts. For example, experts need to provide medical clearance indicating that the child can swallow safely, and medical staff need to be present in the event of choking or aspiration. Not all individuals are trained to implement such a procedure and manage any emotional behavior that may result from such a procedure. Additionally, using escape extinction may be challenging as using extinction often produces unwanted effects such as aggression and emotional behavior, and may be ill-advised in individuals with severe or frequent maladaptive behaviors (Allison et al., 2013; Pizzo et al., 2012). There have been several non-EE procedures that have shown promise, and the studies described above detail several ways in which new foods can be introduced and in which preference can be shifted towards foods that were originally nonpreferred. However, there has been relatively little research overall on non-EE

treatments, particularly with students with ASD and focusing on the unique challenges that they present.

Additionally, the extent to which the effects of non-EE procedures maintain after treatment is unclear. The question also remains whether these newly preferred or accepted items can subsequently function as reinforcers. Many children with ASD receive ABA as a treatment where foods are often used as a primary reinforcer (Curtin, Jojic, & Bandini, 2014). Caregivers or therapists may also be more inclined to use food as a reinforcer as children with ASD may not respond as readily to social reinforcement as typically developing children (Zuckerman, Hill, Guion, Voltolina, & Fombonne, 2014). Treatments for children with ASD often focus on primary deficits, problematic behaviors, or functional skills, with less emphasis on adverse health behaviors such as eating patterns (Strahan & Elder, 2013). Another notable gap in the literature is a lack of research on whether it is possible to shift to healthier rewards. If food preference can be shifted to healthier, more nutritional choices, the next logical step is to then incorporate such foods into the child's daily routine, thereby replacing the unhealthier options.

Current Study

The present study addressed this gap in the literature. This study intended to extend the literature by first shifting children with ASD's preference to healthier food options, and then exploring whether these newly preferred foods could function as reinforcers during their typical school day. The ultimate goal of this study was to determine whether healthier foods could be used as reinforcers throughout a typical school day in an ABA setting, in place of unhealthy snacks. The present study was a

partial replication of the procedures employed in Solberg, Hanley, Layer, and Ingvarsson (2007), with the addition of a reinforcer assessment both before and after the pairing procedure in order to determine whether the targeted foods also functioned as reinforcers. The fading procedure was also modified in order to see if newly preferred foods could maintain their higher ranking. This study employed a multiple baseline across three subjects design.

II. Method

Participants and setting

Three adolescents with ASD and food selectivity participated in this study. All participants were males between the ages of 15-17 years. Food selectivity was defined as consuming a narrow range of foods. Participants were referred for food selectivity based on a food checklist completed by parents and staff. The study participants were functioning in the moderately impaired range of intellectual ability and attended the Douglass Developmental Disabilities Center at Rutgers University, a specialized school for individuals with ASD.

All sessions took place in a 7 by 10 foot room containing chairs and a table, with a one way mirror to allow for unobtrusive observation. No other students were present. Sessions were conducted at the same time each day in order to control for hunger. Informed Parental Consent (Appendix B) was obtained for each participant and parents had the option to keep the findings for their child confidential or shared with the classroom teacher as they preferred.

Assessment of Food Selectivity

Prior to the start of the study, parents were asked to fill out a food checklist to identify high and low preference food items. The list included healthy and non-healthy food items (see Appendix A). Based on the results to the survey, food selectivity was assessed using a multiple stimulus with replacement assessment (DeLeon & Iwata, 1996). The MSW procedure was chosen because it allowed participants the option to select the same item over and over when given the choice, and was therefore the best way to demonstrate food selectivity. A plate with a small amount of several types of food evenly spaced out was presented to the child, who was instructed to "eat what you want." Each time a food was selected and consumed, the chosen food was replaced with more of the same food, and the plate of food was presented again to the child (with the same instruction, "eat what you want"). Pencil and paper data were collected on the order in which the foods were selected and consumed as well as the number of foods consumed. If students consumed less than 25% of the foods presented, they were considered to demonstrate food selectivity. The purpose of the assessment was to document that when several food items were available, they would limit responding to a select few, therefore confirming their food selectivity.

Pre-Post Assessments

Edible MSWO Assessment. Multiple stimulus without replacement assessments were used as pre- and post-test measures of preference in order to determine whether a shift in preference took place (DeLeon & Iwata, 1996). The preference assessment was conducted both before and after the pairing procedure, until a clear pattern of preference

was established. Each time a food was selected and consumed, the plate of foods was presented again to the child (with the same instruction, "eat what you want"), but with the selected snack absent from the array. This process continued until all foods were chosen and consumed. The results from the MSWO assessments were used to create a hierarchy of food preference, which was partitioned into 3 groups representing low, medium, and high preference foods (mean rank of 1-3 in the first group, mean rank of 4-6 in the second group, and mean rank of 7-9 in the third group). One food from each group was selected to be used in the study procedure (however, only the item from the low-preference group was actually paired with tangible/social reinforcement).

Activity/Tangible MSWO Assessment. MSWO assessments were conducted with up to five tangible items or activities in order to determine which items were most highly preferred. Pictorial representations of each item or activity were presented evenly spaced out on the table in front of the participant, who was instructed to "pick what you want." Pencil and paper data were collected on the order in which activities or preferred items were selected. Item selection was defined as the child making physical contact with the item. Each time an activity or item was selected, the array was presented again to the child (with the same instruction, "pick what you want"), but with the selected activity or item absent from the array. This process continued until all activities or items had been chosen. The most highly preferred item or activity was subsequently used during the pairing procedure.

Reinforcer assessment. A progressive ratio reinforcer assessment was conducted before baseline and after fading was complete in order to determine if the value of paired objects had changed. During this procedure, the child was presented with a stack of

envelopes and index cards. The experimenter told the child to "stuff the envelope." Reinforcement (the target low-preference food) was provided contingent upon the target behavior (envelope stuffing). Response requirements were increased until the student stopped responding (e.g., to access reinforcement, the child must first stuff 1 envelope, then 2 envelopes, 4 envelopes, 8 envelopes, 16 envelopes, etc.). The break point, or the point where the child stopped responding (30 seconds of no responding), was recorded. The results of this assessment determined how long the child would work for the target food item, as well as whether the target low-preference food increased its reinforcing value after the pairing procedure was complete.

Pairing Procedure

Baseline. During baseline, paired-choice preference assessments were conducted with the three foods selected from the MSWO assessment of edibles (high, medium, and low preference items). For each trial, two plates, each containing one food, were presented in front of the child, who was told to "pick one." The pairs and side presentations were presented in random order, and trials were conducted until each of the three pairings had been presented. Pencil and paper data were collected on the relative rank of each item. Once a stable preference hierarchy was established, the pairing procedure began. The relative rank of the target low-preference food was graphed.

Pairing procedure. During the reinforcement pairing, the target low-preference food (the item with the lowest rank during baseline) was paired with high-preference tangible and social reinforcers. Social reinforcement was delivered in the form of praise and/or shoulder squeezes. Paired-stimulus assessments were conducted in the same way

as during the baseline phase, except that a preferred tangible item/activity as well as preferred social attention were delivered to the participant contingent upon choosing the target low-preference food. During the pairing procedure, if the child selected the target low-preference food, he was given access to the tangible/activity item for one minute as well as social attention for one minute. If the child selected the medium or high preference food, he was given access that item alone, with no additional tangible or social reward, as in baseline. Once the target low-preferred food was selected consistently (top rank for three consecutive sessions), the fading procedure began. In order to expose the participant to this new contingency, three teaching trials were first conducted in which the participant was prompted to choose the plate with the target low-preference food plus the tangible/activity item.

Fading procedure. During the fading procedure, the additional paired reinforcement (e.g. the tangible/activity item and social attention) was faded until the target low-preference food item was presented alone. The schedule of reinforcement for social attention and access to the preferred activity or item were faded from an FR1 schedule (e.g. reinforcement delivered after every selection) to an FR2 schedule (e.g. reinforcement delivered after every two selections), then FR5 and FR10 in order to see if the food rank would be maintained. Once the target food was faded to an FR10 schedule, the magnitude of the reinforcers was faded. Social attention and access to the preferred activity or item were faded 15 seconds at a time (60 seconds of access, then 45 seconds, 30 seconds, 15 seconds), and then 5 seconds at a time (15 seconds of access, then 10 seconds, then 5 seconds, then 0 seconds). Fading was conducted using the modified fading rules published by Solberg et al. (2007) and listed in Table 1.

Table 1: Fading rules modified and adapted from Solberg et al., (2007)

Rule Number	Description
1.	If the target food remains at the top rank (rank 1) for three consecutive sessions, move to the next fading step
2.	If the rank of the target food drops to rank 2 and remains at rank 2 for three consecutive sessions, move to the next fading step. If the rank of the target food drops to rank 2 but stays within ranks 1 and 2 for three consecutive sessions, move to the next fading step.
3.	If the target food drops to rank 3, return to the previous fading step and remain on that step until the target food is ranked 1 or 2 for three consecutive sessions.
4.	If you return to the previous fading step 3 times, wait until responding is stable (consistent for 3 consecutive trials) and then end the assessment.
5.	During the return to baseline, if the target food drops to rank 3, return to the previous step and continue to follow the fading rules.

Data Collection and Interobserver Agreement

Data were collected on the dependent variable, snack selection, using pencil and paper during baseline and pairing sessions. Interobserver agreement for snack selection

was calculated by dividing the number of agreements by the total number of trials. The principal investigator trained undergraduate research assistants on data collection and verified accuracy before they were allowed to take interobserver agreement (IOA) data. Researchers stood and took data from the opposite end of the room in order to prevent coders from seeing each other's data sheets. IOA data were recorded for at least 30% of baseline and pairing sessions.

III. Results

Pre-Pairing Assessment Results

Edible MSWO Assessments. Multiple stimulus without replacement assessments were used as pre/post measures to examine preferences for edible items. The pre-pairing MSWO assessments were used to determine a ranking of foods and select a low, medium, and high preference food for each participant to be used in the pairing and fading procedure.

Josh's three edible items selected for the pairing and fading assessment from the MWSO were celery (low preference), jelly beans (medium preference), and kale (high preference). Evan's three snacks were fruit snacks (low preference), pretzels (medium preference), and Skittles (high preference). Finally, Alex's three edibles were "Cheez-It" crackers (low preference), popcorn (medium preference), and pretzels (high preference).

Tangible MSWO Assessments. Multiple stimulus without replacement assessments were also used as pre/post measures to examine preferences for tangible items. These assessments were used to determine which preferred items to use during the pairing procedure.

Josh did not exhibit a preference for tangible items (consistent with staff report), but did prefer social attention in the form of shoulder squeezes and praise. Evan's most preferred tangible item was the iPad, and his most preferred form of social activity was social attention in the form of praise and shoulder squeezes. Lastly, Alex's most preferred tangible item was the iPad, and he preferred social attention in the form of squeezes.

Reinforcer Assessment. A progressive ratio reinforcer assessment was also used as a pre/post measure to examine whether participants were more likely to work for the target food after the pairing and fading procedure was implemented. Reinforcer assessment results are displayed in Figure 4. Josh's mean break point during the pretest assessments was 1, indicating that he only stuffed an average of 1 envelope when working for celery, his target food. During the pretest assessments, Evan's mean break point was 25 when using fruit snacks as a reinforcer, indicating that he was willing to stuff an average of up to 25 envelopes in when working for fruit snacks. Finally, during the pretest assessments, Alex's mean breakpoint was 11, indicating that he was willing to stuff up to an average of 11 envelopes when "Cheez-It" crackers were used as reinforcement.

Pairing Results

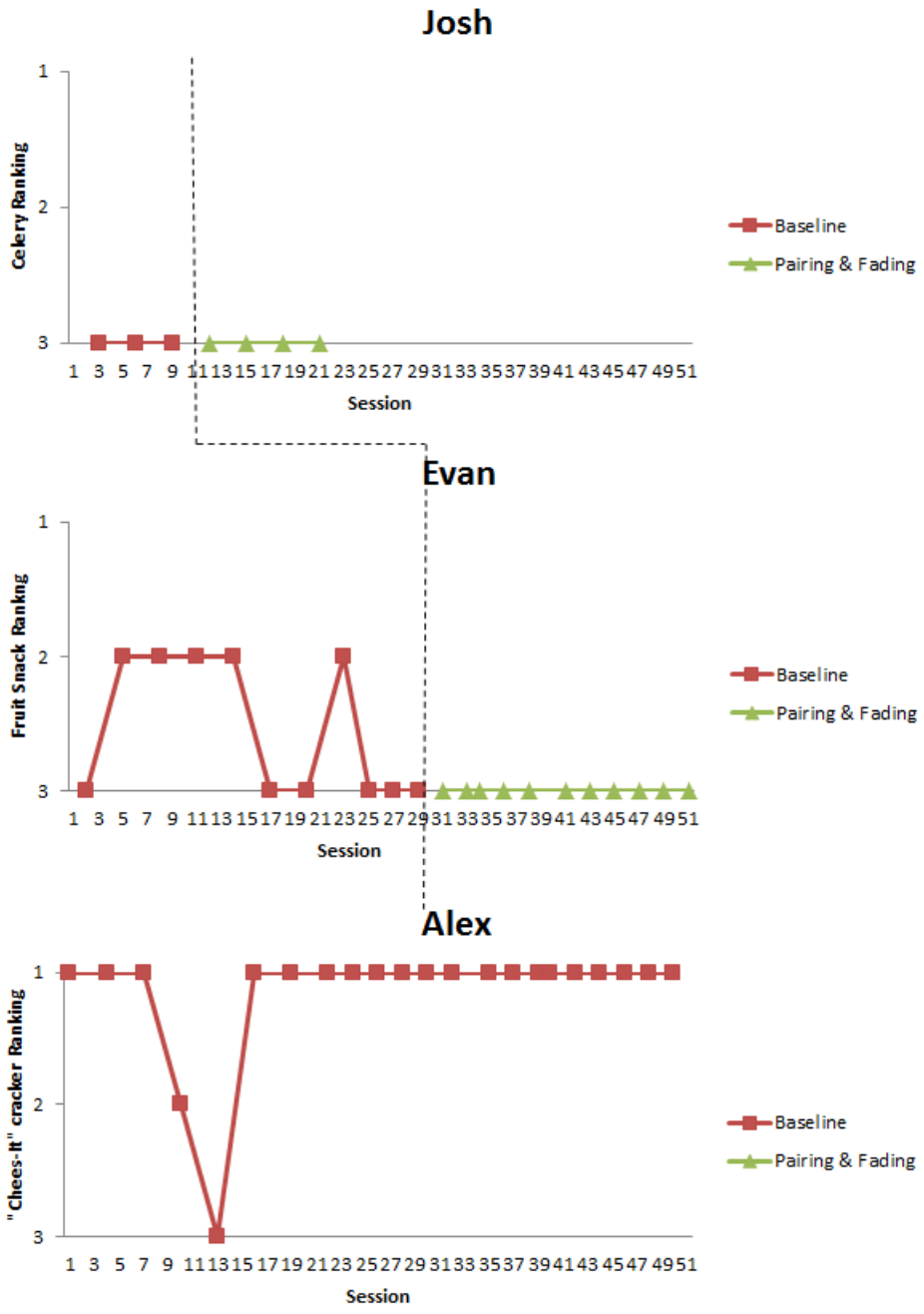
Pairing and Fading. Data for all three participants can be found in Figure 1. Consistent with the pre-intervention MSWO, Josh's least preferred food item during baseline was celery. After a stable baseline was achieved (three sessions at which the target food was ranked as 3rd, or least preferred), the pairing procedure was implemented. Celery was paired with access to praise and squeezes, and was presented in a paired

choice preference assessment format along with jelly beans alone and kale alone. The pairing procedure did not affect Josh's choices, as he did not choose celery even when it was paired with preferred social attention. After four sessions of unchanged rankings (celery retained a rank of three, indicating it was least preferred), data collection for Josh was discontinued.

Based on the MSWO preference assessment, Evan's least preferred food was fruit snacks. Once a stable baseline was obtained (three consecutive sessions at which the target food, fruit snacks, was ranked as least preferred), the pairing procedure was implemented. Evan was given a choice between fruit snacks plus iPad plus social attention versus pretzels and skittles in a paired choice paradigm. Similar to Josh, Evan's preferences did not change once the pairing procedure was put into place. That is, even when fruit snacks were paired with his preferred social and tangible items, Evan still ranked fruit snacks as least preferred.

We were unable to achieve a stable baseline for Alex, the third participant. "Cheez-It" crackers were chosen as the target food for the pairing procedure, as they had been ranked as least preferred in the MSWO assessment. However, once baseline began, Alex demonstrated a fairly consistent preference for "Cheez-It" crackers over his previously ranked high preference foods, popcorn and pretzels. "Cheez-It" crackers retained a rank of 1 (indicating it was the most preferred item) throughout baseline, even though no pairing procedure had yet to be put into place.

Figure 1. Pairing and fading assessments for Josh, Evan, and Alex. Squares represent baseline sessions, and triangles represent pairing and fading sessions.



Post-Pairing Assessment Results

Edible MSWO Assessments. Multiple stimulus without replacement assessments were conducted as a post measure to examine changes in preferences for edible items. Results of the pre/post edible MSWO assessments can be found in Figures 2 and 3, which display mean ranks and relative ranks of the foods used. All participants demonstrated some change in preferences compared to the initial set of preference assessments. Results from Evan's post-pairing assessment revealed that fruit snacks, the target low preference food, changed from a relative ranking of 8 to a relative ranking of 4, indicating that this food became more highly preferred over time. Pretzels, his medium preferred food, also increased in rank from 5 to 3, and skittles, his high preference food, shifted from a ranking of 1 to 2.

Josh's results also indicated a shift in rankings. Although his target low preference food, celery, maintained a ranking of 9 both before and after the pairing procedure, the other two foods in the assessment also experienced a change in rankings. Jelly beans, the medium preferred food, was initially given a rank of 5, whereas after the procedure, they were given a rank of 2. Kale, Josh's high preference food item, decreased slightly in rank, from 1 to 3.

Alex also demonstrated a change in food preferences. Pretzels maintained their rank of 1 as the most highly preferred item. Popcorn, his medium preference item, changed in ranking from 4 to 9, whereas "Cheez-It" crackers, the target low preference food, shifted in ranking from 9 to 7.

Figure 2. Pre and post MSWO preference assessment results for Evan, Josh, and Alex presented as mean rank. Pretest results are represented with an opaque triangle, while posttest results are represented with an open circle.

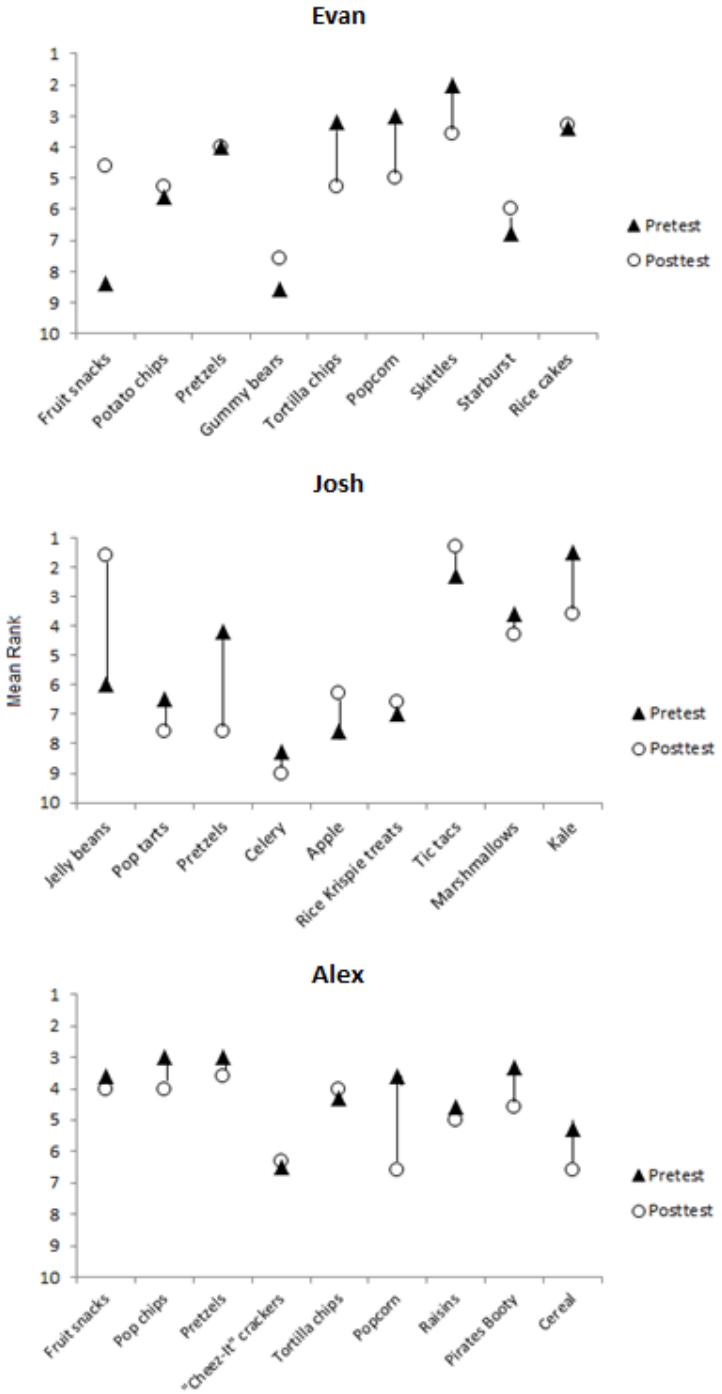
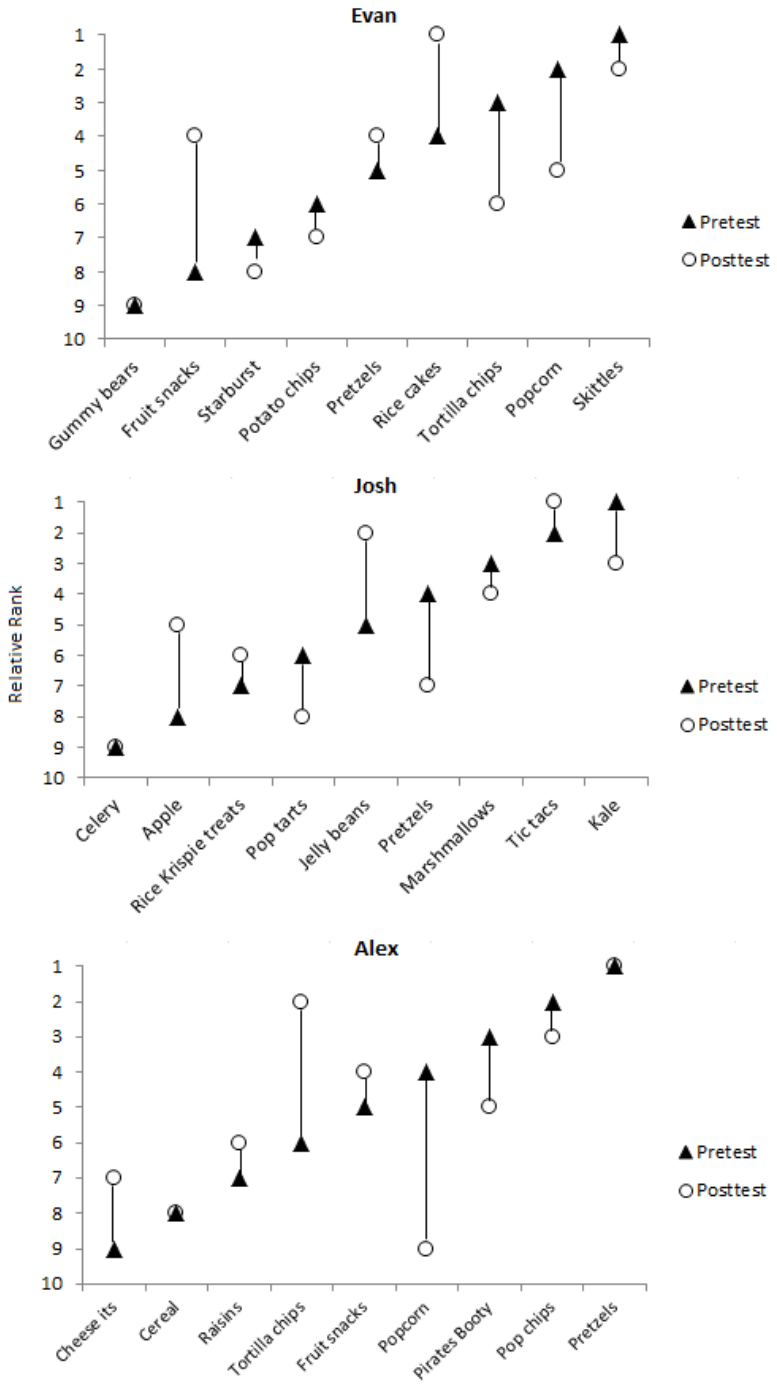
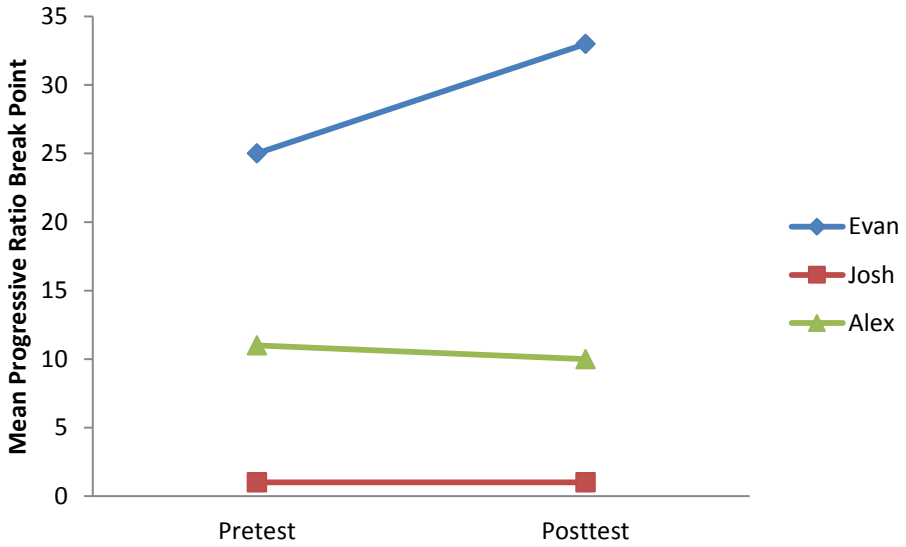


Figure 3. Pre and post MSWO preference assessment results for Evan, Josh, and Alex presented as relative rank. Pretest results are represented with an opaque triangle, while posttest results are represented with an open circle.



Reinforcer Assessment. A progressive ratio reinforcer assessment was conducted post-pairing to assess whether participants were more likely to work for the target food in comparison to pre-pairing. Josh's data indicate that there was no change in the reinforcing value of celery over time, as Josh's mean break point during the posttest assessments remained at 1. Evan displayed a different pattern. Although his mean break point pre-pairing was 25, following the pairing procedure, Evan's break point increased to 33 when the posttest assessment was conducted, indicating that the reinforcing value of fruit snacks had increased. Alex's data followed a similar pattern to Josh, in that the reinforcing value of "Cheez-It" crackers remained approximately the same – during the posttest assessments, Alex's mean break point was 10.

Figure 4. Mean progressive ratio break points for pretest and posttest assessments for Evan, Josh, and Alex. Evan's break points are represented by blue diamonds, Josh's break points are represented by red squares, and Alex's break points are represented by green triangles.



Interobserver Agreement. Interobserver agreement data were collected for 35% of baseline and pairing sessions on the dependent variable, snack selection, using pencil and paper. IOA for these sessions was 100% across both baseline and pairing sessions. IOA data were also collected for 35% of sessions for both preference and reinforcer assessments. Data were collected on snack selection and number of envelopes stuffed, respectively. IOA for these sessions was 100% for both preference and reinforcer assessments.

IV. Discussion

The treatment of food selectivity is a significant challenge that affects both typically developing individuals as well as individuals with developmental disorders. Cermak and colleagues (2010) estimated that food selectivity can be found in 59-83% of children diagnosed with ASD. While feeding problems are clearly common in individuals with ASD, there is a surprisingly small amount of research literature on interventions with this population. Most of the research that has been conducted focuses on demonstrating the efficacy of EE, but this technique is often not a viable treatment option. Additionally, although some studies have shown that it may be possible to temporarily shift preferences in young typically developing children without the use of EE, it is unclear whether these strategies would work with an ASD population.

The present study sought to replicate and extend research by Solberg et al. (2007) on the use of a pairing and fading procedure to shift food preferences without the use of EE. Interestingly, we were unable to replicate the efficacy of this procedure with

individuals with ASD. During baseline, Josh chose celery (his target low-preference food) last, which was consistent with the results of his preference assessment. Once a stable baseline was achieved, the pairing procedure was implemented. The pairing procedure appeared to have no effect, as celery remained at the lowest rank throughout the intervention.

Unlike Josh, Evan did not immediately demonstrate a stable baseline. This difficulty in establishing a stable baseline may have been due to the fact that no foods maintained a consistent rank during the initial preference assessment. Once a stable baseline was achieved the pairing procedure was implemented. Like Josh, the pairing seemed to have no effect on his preferences for different food items. Fruit snacks remained at the lowest rank for all remaining sessions, and pairing was eventually discontinued. Although the rank of fruit snacks did not change, it is important to note that its reinforcing value did. According to the results of the progressive ratio reinforcer assessment, the reinforcing value of fruit snacks increased from the pre-test to post-test, indicating that Evan was willing to work longer for fruit snacks at the end of the study compared to the beginning.

During baseline, Alex ranked his low preference item (according to the preference assessment) as the most highly preferred throughout the majority of baseline assessments. Similar to Evan, Alex showed significant variability in his rankings during the initial MSWO assessment. One possible explanation of these data is that Alex was "saving the best for last", and that the MSWO procedure was not sensitive enough to reflect this choice. If Alex did indeed choose his most preferred food item last, then the results of the MSWO would be backwards. During baseline, Alex was given a choice between two

food items each time. Unlike the MSWO, the food item not chosen first could not be saved for later. That is, if Alex was presented with "Cheez-It" crackers versus pretzels, he would only gain access to the one item that he chose. If "Cheez-It" crackers were in fact his high preference food rather than his low preference food, then his choices throughout baseline could be viewed as consistent with that preference. Since the necessary baseline was never achieved with Alex, the pairing procedure was never implemented.

There are several possibilities as to why our results differed from that of Solberg and colleagues' (2007) findings. First, Solberg et al. (2007) conducted their study with typically developing preschoolers, whereas this study was conducted with adolescents with ASD. It is possible that the participants in this study were not able to fully comprehend or attend to the choices given to them once the pairing procedure was introduced. The students in this study have been exposed to preference assessments before and may have been familiar with those instructions, whereas they may not have understood the bonus reinforcement (e.g. the paired tangible items) aspect of the novel pairing procedure. It is also possible that the bonus paired rewards were not powerful enough to evoke a change in preference.

A particularly interesting finding was the instability of preferences over time, throughout both the baseline and pairing procedures. All participants showed a shift in preference for at least 4 of the 9 foods from the MSWO assessments, and not just for the three low/medium/high preference items used for each child. The fact that food preferences were not stable across time may help explain why we were unable to obtain stable baselines or see an effect of the intervention across participants. It is also possible that the three foods chosen for each participant were not far enough away in preference,

and that they could be seen as interchangeable with one another, or "good enough" if one option was not available. The participants in this study had rather dramatic changes in preference over time, which highlights the need for frequent assessments to ensure that appropriate reinforcers are being used – not just in the treatment of food selectivity, but during their general day-to-day schooling as well.

Another possible reason as to why our results differed from the findings of Solberg et al. (2007) is due to possible choice overload. Although it is widely believed that having multiple options is both beneficial and preferred, there is research indicating that this may not be the case. Choice overload refers to adverse experiences that may occur when an individual is presented with too many options or choices (Reed, Reed, Chok, & Brozyna, 2011). This concept can be conceptualized as a form of effort discounting, in that increased amounts of necessary effort (e.g. the effort required to scan, identify, and consider an array of choices) cause the subjective value to decrease. It is possible that the complex array presented to the participants of this study (e.g. a plate with a fruit snack, iPad, and icon for social attention versus a plate with either pretzels or skittles) may have resulted in a form of choice overload. We probed this hypothesis by presenting Evan with the following choice: a plate with a skittle (high preference food) vs. a plate with a skittle, iPad, and icon for social attention. When presented with this choice, Evan chose skittle alone, even though he could have gained access to the skittle plus other preferred social/tangible items had he chosen the other plate. Consistent with the concept of choice overload, it would take much less effort to simply choose the plate with one immediately apparent item than to attend to both plates, scan and identify the items, and then choose accordingly.

There are several limitations to this study. First, although it is clear that food preferences were not stable over time, it is unclear as to when these changes occurred. Future studies could periodically assess overall preference of all 9 items throughout baseline and pairing to see if/when these changes occur. Second, Alex's preferences could have been inaccurately captured by the MSWO preference assessment. A paired choice preference assessment could be used to confirm whether or not he was "saving the best for last", as this type of assessment presents each possible food pairing and determines a rank based on data from all pairings.

However, the present study also has several strengths. This is the first study to examine a pairing and fading procedure in moderately impaired individuals with ASD to determine if food preferences can be shifted. The study did not employ escape extinction, which, although effective, requires proper training and may produce unwanted effects such as challenging emotional behavior or aggression (Allison et al., 2013; Pizzo et al., 2012). Although it is unclear whether the pairing procedure was responsible for effectively shifting food preferences in any of the three participants, it is just as important to know what procedures are ineffective with this population as well as what procedures are effective. Additionally, this study found an appropriate use for the MSW assessment. We used an MSW in order to assess for food selectivity, as this procedure allowed students to choose the same item multiple times, thereby demonstrating selectivity. MSW's are not frequently used as they are subject to position biases, produce more unselected items than an MSWO or PS assessment, and do not create a hierarchy of preference, as participants tend to select their high preference items multiple times since they are always available (DeLeon & Iwata, 1996).

Finally, the present study highlights several areas to focus on when studying food selectivity within an ASD population – the stability (or instability) of food preferences, limitations in evaluating preferences with non-verbal individuals, and the possibility of choice overload. This last concept is particularly relevant, and while a brief search of the literature reveals many studies on choice and ASD, very few have examined choice overload or effort discounting in this population.

It is clear from the literature that food selectivity is a concerning behavior in the ASD population, with prevalence rates ranging from 59-83% (Cermak, Curtin, & Bandini, 2010). Although a number of studies have been conducted on various behavioral treatments for maladaptive feeding behaviors, the vast majority of these studies employ escape extinction, which may not always be a viable treatment option. The present study once again demonstrates the unique challenges associated with treating food selectivity in low functioning individuals with ASD. It is important to continue this line of research in order to elucidate the most effective and least intrusive procedure that can help to treat this common but serious problem.

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