SOME EFFECTS OF IMMEDIACY ON FOOD SELECTIVITY

A Thesis

presented to

the Faculty of the Graduate School

at the University of Missouri-Columbia

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

TANIGHA MCNELLIS

Dr. Jennifer Weyman, Thesis Supervisor

MAY 2021

EFFECTS OF IMMEDIACY ON FOOD SELECTIVITY

The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

SOME EFFECTS OF IMMEDIACY ON FOOD SELECTIVITY

presented by Tanigha McNellis,

a candidate for the degree of Master of Science, Master of Applied Behavior Analysis, and hereby certify that, in their opinion, it is worthy of acceptance.

_____

Dr. Lea Ann Lowery

_____

Dr. Wesley Dotson

_____

Dr. Jennifer Weyman

ACKNOWLEDGEMENTS

I would like to thank Dr. Jennifer Weyman for her guidance and advice throughout my time as a student in the Applied Behavior Analysis program at the University of Missouri-Columbia. She was instrumental in helping me develop a plan for how to complete this study and provided all the support one could ask for. I would also like to thank Olivia Healzer, Kendall Condict, Sarah Coakley, and Danielle Kelly who helped conduct sessions and collect data throughout this process.

TABLE OF CONTENTS

LIST OF FIGURES

Abstract

Food selectivity is a common problem reported by parents of children diagnosed with autism spectrum disorder. Individuals who engage in food selectivity tend to consume a small variety of items that are low in nutritional value. Food selectivity may lead to health risks such as malnourishment and obesity. Therefore, it is important to evaluate ways to increase the consumption of a variety of foods. Thus, the purpose of this study is to extend previous research by examining whether manipulating the delay to reinforcement will increase healthy food selection in a concurrent-operants arrangement. Multiple-stimulus preference assessments were conducted to identify high preferred edibles. Reinforcer assessments were conducted to identify the reinforcing effectiveness of edibles and identify the average breakpoint of demands to implement in the treatment analysis. Fruits were sometimes preferred over snack food edibles, however, the reinforcing effectiveness of fruits was lower. Results of this study showed that a switch in responding from unhealthy food options (i.e., snack food edibles) to healthy food options (i.e., fruits) occurred at the 30 s delay for the first participant and 60-s delay for the second participant during the treatment analysis. Future researchers should evaluate different reinforcement parameters, such as magnitude, to evaluate if a switch in responding will occur from unhealthy foods to healthy foods without the need for a delay.

Introduction

Food Selectivity in Individuals with Autism Spectrum Disorder

Autism spectrum disorder (ASD) is characterized as a neurodevelopmental disability with persistent deficits in social communication, interaction, and repetitive, restrictive behavioral patterns (American Psychiatric Association, 2013). Food selectivity is restrictive behavior and a common problem reported by parents of children diagnosed with ASD or other neurodevelopmental disabilities (Curtin et al., 2015; Zobel-Lachiusa et al., 2015). More specifically, it occurs in 25-35% of typically developing individuals and approximately 80% of individuals with ASD (Saini et al., 2019). Food selectivity is characterized as failing to ingest a variety of foods and only consuming a few options (Bandini et al., 2017). It is often associated with feeding problems such as food refusal, swatting at food, and tantrum behavior upon the presentation of the food (Johnson et al., 2014).

Children with food selectivity are more likely to encounter nutritional inadequacies (Chistol et al., 2018). These children are more likely to select foods that lack nutritional value (e.g., chips, crackers, candy) over nutritionally dense foods (e.g., carrots, strawberries, yogurt). The reason for choosing snack food edibles over nutritionally dense foods varies for each individual. For some, the crunchy or gummy texture of snack food edibles is preferable to fruits and vegetables and for others, sugar content may play a factor (Schreck & Williams, 2006).

Health Risks Associated with Food Selectivity

There are several health risks associated with food selectivity in children including obesity, malnourishment, and diabetes. Bandini et al. (2017) assessed the

persistence of food selectivity in children with ASD and included body mass index (BMI) as a measure of importance. It was found that the percentage of individuals considered overweight/obese increased from 28% in baseline to 50% in the follow-up visit. This suggests that food selectivity could increase the child's risk of maintaining an unhealthy weight which then increases other medical risks.

An illness that has been identified as a potential risk of food selectivity is scurvy (Ma et al., 2016). Scurvy is a disease caused by a Vitamin C deficiency from lack of fruit in their diet and includes swollen and bleeding gums and opening of previously healed wounds. Other implications of food selectivity may include diabetes, obesity, and malnourishment. Because there are so many of these foods that include added sugars, excess pressure is put on the pancreas to put insulin into the body. After an extended period, the pancreas loses its effectiveness in secreting insulin which can lead to diabetes and obesity. Malnourishment can occur because the child is only consuming limited foods. This repertoire may exclude essential vitamins found in nutritionally dense foods such as fruit and vegetables.

As mentioned previously, 80% of individuals with ASD have some form of food selectivity and that increases their health risks (Saini et al., 2019). One thing to consider is the reinforcers used in the clinic with these children. Edibles are often used during treatment as reinforcers in behavior analysis clinics (Conine & Vollmer, 2019). These edibles often displace leisure items (toys) and are less socially stigmatizing when incorporated in public (DeLeon & Iwata, 1996). These edible reinforcers often include foods identified by parents as highly preferred and often include snack food edibles that are high in carbohydrates and low in essential vitamins. Another edible option that could

be used as a reinforcer is fruit. Fruit is nutritionally dense and a good source of Vitamin C which can prevent scurvy. However, fruit is not often mentioned as a highly preferred edible as it requires keeping fresh food over extended periods and can be perceived as more costly. Although, some research determined that the price of maintaining a healthy diet with fresh food is similar to the price of an unhealthy diet consisting of processed foods (Kuchler & Stewart, 2008).

Reinforcer Effectiveness of Different Foods

Previous researchers have explored the reinforcing effectiveness of different foods. Kronfli et al. (2020) examined the reinforcing effectiveness of healthy food options (i.e., fruits and vegetable) versus unhealthy food options (i.e., sweet and salty food). The experimenters examined participant preferences for the edibles using a multiple stimulus without replacement (MSWO) preference assessment (DeLeon & Iwata, 1996). The results showed that participants preferred the sweet and salty foods over fruits and vegetables. Next, the experimenters conducted a progressive-ratio reinforcer assessment to determine the reinforcing effectiveness of different edibles. A progressive-ratio reinforcer assessment involves gradually increasing the number of demands that must be completed before an edible is provided. The gradual increase could follow an arithmetic (e.g., Fixed ratio (FR)2, FR4, FR6, FR8, FR10) or geometric progression (e.g., FR1, FR2, FR4, FR8, FR16). That is, the initial session would start by providing a reinforcer following every correct response, then the next trial would provide a reinforcer following every two correct responses. The goal of this assessment is to identify the participant's breakpoint for every potential reinforcer. A breakpoint is the maximum number of demands the participant is capable of completing in order to receive

the edible. Typically, the experimenter would see a decrease in responding or an increase in inappropriate behavior following reaching the breakpoint. Kronfli et al. found that the breakpoint was lower for fruits and vegetables in comparison to sweet and salty foods. This corresponds with the idea that sweet and salty foods are a higher quality reinforcer. The authors also identified that fruits were more preferred compared to vegetables, which may be attributed to its natural sugar content (Garcia et al., 2016).

Treatments for Food Selectivity

Current treatments to decrease food selectivity include repeated exposure with escape prevention, differential reinforcement of alternative behavior, a progressive high-probability instructional sequence with low-probability demand fading, and manipulating parameters of reinforcement (Penrod et al., 2010; Penrod et al., 2012; Tarbox et al., 2010; Lerman et al., 2006; Zonneveld et al., 2019). Tarbox et al. (2010) evaluated the effectiveness of escape prevention in the form of non-removal of the meal (NRM) with escape contingent on eating the whole meal. This study included one participant diagnosed with ASD. The experimenters did not conduct a functional analysis (evaluation of environmental antecedents and consequences that maintain a behavior) of the participant's behavior before the implementation of procedures. In this study, the parent of the participant collected data following each meal on the percentage of meal consumed. In baseline, the parent provided a meal that consisted of a combination of vegetables, starches, and meat while maintaining their typical behavior during a meal. If the participant did not eat the meal within 20 min, the session was terminated. In the intervention phases, the participant's parent provided the meal along with a contingency rule. The contingency rule was as follows: "This is what is for lunch/dinner. You cannot

have anything else. If you eat your whole meal, then you can go play. If you don't eat, then you just have to sit here. If you are not done with your meal by bedtime, then you need to eat it for breakfast the next morning." This rule was provided every 10 min if the participant was not eating. The meals continued until the next mealtime arrived, there was a scheduled activity to attend, or until the participant finished their food. The experimenters found that the treatment of non-removal of the meal was successful at increasing the participant's consumption of food and encouraged self-feeding. By encouraging self-feeding, it limited the intrusiveness of the treatment. That is, the therapist did not have to deliver the bites of food. While this study has promising evidence for escape prevention in the form of non-removal of the meal, only one participant was included. The participant did not engage in any refusal behaviors other than stating "No" and taking an excessive amount of time to eat. The authors also noted that there may have been alternative explanations for why consumption increased such as, alternative meals were no longer provided and food deprivation if the participant did not eat the meal the day before.

Similarly, LaRue et al. (2011) evaluated the effects of repeated exposure and escape prevention in five children who had been admitted to an intensive outpatient pediatric unit feeding disorders program. Repeated exposure with escape prevention includes the use of non-removal of the spoon. This procedure incorporates escape prevention by constantly representing the food item if it has been swatted away or expulsed. LaRue et al. found that the treatment decreased problem behavior associated with feeding behaviors and increased the appropriate behaviors of accepting bites and swallowing food. While this treatment is effective, it does not examine the changes in

food preference. The participant did show increased tolerance to consuming the food, however, it is unknown if they would actively seek out that food to consume either as a meal or reinforcer.

An alternative treatment for food selectivity is differential reinforcement of alternative behavior (DRA). Penrod et al. (2010) examined DRA for feeding problems in three children diagnosed with ASD or pervasive developmental disorder (PDD). This was conducted by providing reinforcement in the form of praise and highly preferred food for accepting a bite, chewing a bite, and swallowing a bite of food. The experimenters evaluated DRA + escape baseline, DRA + escape + bite fading, DRA + escape + bite fading + reinforcer manipulation, and DRA + bite fading + reinforcer manipulation + escape prevention. During the DRA + escape baseline condition, bites of nonpreferred food were presented and the participants' mothers followed three-step prompting procedures (i.e., verbal, model, physical). The terminal bite requirement was the average number of bites the participant consumed during their last three meals. If the bite of nonpreferred food was consumed, then the participant received praise and one bite of high preferred food. If the participant engaged in inappropriate mealtime behavior or failed to accept the bite of nonpreferred food within 5 s of the physical prompt, the participant was allowed to escape from the nonpreferred food for 30 s. During DRA + escape + bite fading, the bite requirement was decreased from baseline to a 1-bite target criteria. Similar to the baseline procedures, three-step prompting was implemented, and escape was provided if the participant engaged in inappropriate mealtime behavior. Once the participant met the bite criteria for three consecutive meals, the number of bites increased by 150% of the previous bite criteria. In DRA + escape + bite fading +

reinforcer manipulation, the magnitude of the reinforcer was altered. Contingent on swallowing a bite of non-preferred food, the participant was provided a plate of highly preferred food. Following three consecutive meals of the participant meeting the bite criteria, the bite criterion was increased, and the schedule of reinforcement was thinned (i.e., the magnitude of the highly preferred foods provided once the participant swallowed the nonpreferred food was systematically decreased). The DRA + escape + bite fading + reinforcer manipulation + escape prevention phase was identical to the previous phase, however, if participants did not accept or swallow a bite within three meals of the addition of reinforcer manipulation, then escape prevention (i.e., representing the bite even if food refusal or problem behavior occurred) was implemented. This study demonstrated that food acceptance could be increased by sequentially introducing treatment components. Through sequentially introducing components, the experimenters were able to show that less intrusive measures can be effective with some participants and allows for individuals to identify what component was responsible for the behavior change.

In addition to DRA, high probability instructional sequences have been implemented to increase food consumption in individuals with ASD. Penrod et al. (2012) evaluated the effectiveness of a progressive high probability instructional sequence. During baseline, initial low probability instructions (instructions that are not likely to be completed) and high probability instructions (instructions that are very likely to be completed) were identified by placing food in front of the participant. If the participant did not independently take a bite, the therapist provided a vocal prompt of "Take a bite." This prompt was provided twice before the therapist removed the food. Treatment

procedures started at the step of difficulty (e.g., kiss the food, lick the food) the participant was observed completing during baseline. That is, if the participant had licked the food during baseline, licking the food would be the starting requirement for the low probability instruction during treatment. During the treatment phase, therapists provided two high probability instructions followed immediately by one low probability instruction using model prompts. The high probability instructions were instructions the participant was likely to complete without prompting. Low probability instructions were instructions that the participant was unlikely to complete. To implement demand fading, therapists changed instructions as they achieved closer approximations of chewing and swallowing a bite of food. What was once a low probability instruction would later become a high probability instruction and would take the place of a high probability instruction that was previously implemented. For example, in one session, the high probability instructions could be “smell the food” and “kiss the food,” and the low probability instruction would be “lick the food.” Once the participant had completed the low probability instruction for three consecutive sessions without engaging in food refusal, the experimenters would have the new high probability instruction as “kiss the food” and “lick the food” and the low probability instruction as “put the bite on your tongue.” When the participant complied with the two high probability instructions, they received verbal praise. When participants complied with the last instruction, they received praise as well as a small portion of their high preferred food. This study was successful in increasing the consumption of nonpreferred foods in both participants using the high probability instructions with low probability demand fading. Consumption increased to 100% for both participants and generalized to other therapists.

Silbaugh and Swinnea (2018) then replicated Penrod et al. (2012) by evaluating the effects of the high-probability instructional sequence on feeding in children with autism and food selectivity. Their study showed a failure to replicate previous findings of high-probability sequencing effects on food selectivity. In fact, the study failed to replicate findings across all participants included. This indicates that more research is necessary to find alternative treatments for food selectivity.

Another treatment for food selectivity is manipulating different parameters of reinforcement. Parameters of reinforcement include quality, duration, and delay. Previous researchers have shown that response allocation can be shifted from a problematic response to an appropriate response by manipulating these parameters (e.g., Athens & Vollmer, 2010; Zonneveld et al., 2019). For example, Zonneveld et al. (2019) evaluated parameters of reinforcement to determine factors that influence food selection in typically developing children. The experimenters conducted a paired stimulus preference assessment of unhealthy food (e.g., broccoli with cheese, Lays, refined grains) and healthy food (e.g., steamed broccoli, baked Lays, whole grains). It was determined that 76% of the participants preferred the unhealthy food options. Participants who preferred the unhealthy food options were selected for a competing parameters assessment to determine which factors influence their choices. More specifically, the participants were allowed to choose between stepping on a block a specified number of times to obtain X pieces of X food. In the immediacy versus quality condition, participant responding could result in one piece of high-quality edible 1 hr after the session or one piece of low-quality edible immediately after session. In the magnitude versus quality condition, responding to one option resulted in one piece of high-quality food immediately after the session and

responding to the other option resulted in five pieces of low-quality food immediately after session. The third condition was immediacy versus magnitude in which participant responding to one option resulted in one piece of high-quality food immediately after session or five pieces of the high-quality food 1 hr after session. Of the participants included, four were sensitive to the quality and immediacy of reinforcement and two participants did not show a clear sensitivity to any parameter (e.g., one session would have responses for the high-quality option then the next session had responses for the low-quality option). A limitation for this study is the incorporation of a 1-hr delay for the immediacy condition. While this delay did identify clear influences, it may not be feasible in clinics. A shorter delay may have demonstrated the same results.

Purpose

Parameters of reinforcement have been used to shift response allocation from inappropriate behavior to appropriate behavior. In addition, researchers have used the same procedures to shift response allocation from unhealthy food to healthy food in individuals with ASD. Zonneveld et al. (2019) identified that both quality and immediacy affected response allocation. However, it is important to note that the experimenters only evaluated the effects of a 1-hr delay which may be infeasible in practical settings. It is unknown if shorter delays to unhealthy food options would result in healthy food selection. Thus, the purpose of this study is to extend previous research by examining whether manipulating the delay to reinforcement will increase healthy food selection in a concurrent-chains arrangement.

Method

Participants and setting

Three participants who attend a local autism center were recruited for this study. All participants have an ASD diagnosis and were selected based on the identification of food selectivity by their Board Certified Behavior Analyst (BCBA) or caregiver.

Harry was a Caucasian 7-year-old male diagnosed with ASD and Attention Deficit Hyperactivity Disorder (ADHD). Parent report stated that he would occasionally eat fruits when provided but would actively seek out unhealthy alternatives or would almost always select the unhealthy food option when presented with a healthy food option. Parent report also identified food selectivity as a concern that they wanted to address for both fruits and vegetables. Harry's mom identified fruit snacks, goldfish crackers, pretzels, and popcorn as snack food edibles that he would often consume. Four fruits that were selected for the study included apples, oranges, banana, and strawberries. Harry's mom stated that he had consumed these fruits at least once before and did not display any adverse reactions. Harry's BCBA also expressed that Harry displayed food selectivity in the clinic and wanted to increase the number of healthy foods consumed at the clinic. Harry did engage in problem behaviors such as self-injurious behavior (SIB), screaming, and property destruction.

Atticus was a Hispanic 4-year-old male diagnosed with ASD. Parents reported that he would not eat any fruits that were provided to him and would engage in behaviors such as spitting it out or stating "no." Parents identified four fruits that Atticus had consumed at least once before and that they stated as fruits they would like him to consume as watermelon, cantaloupe, apples, and bananas. Four snack food edibles that Atticus often consumed were Oreos, Donuts, Goldfish Cracker, and Chips. The BCBA

identified yelling, SIB, and shutdown behaviors as behaviors that Atticus may engage in during work tasks.

Orion was a Hispanic 5-year-old male diagnosed with ASD. Parent report stated that he would refuse to eat any fruits at home and would only consume foods unhealthy foods. When asked what would happen when fruits were provided, Orion's mother stated that he would take the food and spit it out or immediately throw it in the trash. Orion's mother identified watermelon, oranges, grapes, and strawberries as four fruits that he has consumed at least once before. Four snack food edibles identified were cheese crackers, oatmeal cream pies, fruit snack (Mott's), and fudge rounds that Orion would consume often. Orion's BCBA did not identify any problem behaviors that Orion would engage in during work tasks.

Session rooms contained a table, chairs, and all necessary stimuli for the preference assessments and treatment intervention. The materials necessary for the preference assessment included the four snack food edibles and fruits identified by parents, data collection sheets, a timer for preexposure, gloves, eating utensils, and paper plates to place the edible on. Multiple pieces of the edibles were be kept in the room in a container in case of the accidental dropping of the edibles. Materials for the treatment intervention varied for each participant, however, the general materials for all included a timer for the therapist, fruit and snack food edibles in a container, gloves, eating utensils, paper plates, and the task items specific to each child.

Response measurement and Reliability

The dependent variable during preference assessments was the consumption of the edible. *Consumption* was defined as placing any part of the edible past the plane of

the lips and swallowing. Data was collected on the frequency of *demands completed* in the reinforcer assessment. The treatment intervention collected data on the percentage of trials an edible was selected. *Selection* was defined as the individual reaching for or requesting a specific edible vocally or with a communication device. A second observer was present to collect reliability data across participants on average for 55% of snack MSWO sessions, 64% of fruit MSWO sessions, 54% of combined MSWO sessions, 33% of reinforcer assessment sessions, 33% of baseline sessions in the treatment analysis and 33% of intervention sessions in the treatment analysis. Interobserver agreement was calculated using interval-by-interval agreement. This was calculated by dividing the smaller number by the larger number for each interval then averaging it across all intervals and converting to a percentage by multiplying by 100.

Interobserver agreement (IOA) for the MSWO sessions was collected on 92% of MSWO sessions for Harry, 36% of sessions with Atticus, and 33% with Orion. Agreement was 100% across all participants. IOA for the reinforcer assessment was collected for 33% of sessions for Harry, Atticus, and Orion, and was calculated to be 100%, 100%, and 98.5% (range, 94% - 100%). IOA for the treatment analysis was calculated for 33% of all sessions across baseline and intervention for all three participants. 100% agreement was calculated for all three participants.

Treatment Integrity

Treatment integrity was collected on 33% of total sessions across all phases by an independent observer across all phases of the study. Treatment integrity evaluated whether the delay time matched the condition, the therapist provided the edible option following completion of each trial, properly followed error correction protocols, and

ensured that the correct number of tasks were completed before providing the reinforcer. It was calculated by taking the number of correct steps divided by the total number of steps then multiplied by 100. Treatment integrity must remain above 90% across sessions to ensure that the changes in procedure do not affect treatment outcomes. This percentage is chosen as the integrity value so that it still falls within the "high-integrity" range (Carroll et al., 2013).

Treatment integrity was collected on 33% of sessions for each MSWO condition (i.e., fruit alone, snack food alone, and combined) for all participants. Treatment integrity was 100% across all participants. Treatment integrity was collected on 33% of sessions for the reinforcer assessment for Harry, Atticus, and Orion. Fidelity was calculated to be 100% across all three participants. Treatment integrity was collected for 33% of sessions for both baseline and intervention sessions by a second observer during the treatment analysis. Treatment integrity conducted with Harry was 98% (range, 95%-100%) during baseline sessions and 100% for the intervention sessions. Treatment integrity for baseline session and intervention sessions conducted with Atticus and Orion was 100% for both participants.

Preference Assessment

Prior to conducting the preference assessment, caregivers received a document requesting a list of four snack food edibles their child consumed regularly and four fruits that have been consumed at least once before. Once the caregivers identified the edibles, three MSWO preference assessments (DeLeon & Iwata, 1996) were conducted. The first MSWO was snack foods only, the second MSWO was fruits only, and the third MSWO was a combined (snack food edibles and fruit) assessment. A post-MSWO was conducted

after the participant completed the treatment. The MSWO preference assessment consisted of presenting all of the edible stimuli to the participant and then asking them to choose one. For this assessment, the phrase “Choose one” was implemented. Once the participant selected an edible and consumed it, that edible was removed from the table. The edible was not replaced, and the procedure continued by asking the participant to choose their favorite from the new array.

Reinforcer Assessment

A reinforcer assessment was conducted to determine the number of demands the participant completed before discontinuing responding or engaging in problem behavior for each individual edible (e.g., goldfish cracker, strawberry, or cookie). For this assessment, the two snack food edibles with a preference at least 10% higher than the fruits and two fruit edibles identified in the combined edibles MSWO were used. This assessment closely followed the reinforcer assessment in Kronfli et al. (2020). A single component task was selected for each participant to complete (e.g., putting Legos in a bin, placing blocks in bin). The edible was placed in view of the participant, so they could identify what edible they can receive. The number of tasks necessary to receive the reinforcer increased on a progressive ratio schedule with a step size of one (e.g., 1, 2, 3, 4). Tasks stopped at 20 demands because it is double the average number of tasks a client does in one sitting at the clinic. The assessment ended when responding to a demand ceased for 30 s after it was presented, 30 s of screaming or SIB occurred, property destruction of the materials occurred, or the participant received all 20 edibles.

Once the participant consumed the edible it was immediately replaced from a container. The purpose of immediately representing the edible was to ensure that the

individual maintained a visual of what edible was available. The assessment was conducted using a multielement design. The average number of demands identified in the reinforcer assessment of the selected fruit edible was implemented in the treatment analysis to ensure that number of demands did not affect responding to the delay. By using the breakpoint associated with the fruit, the study ensured that the number of tasks was not the variable decreasing responding. If the number of tasks chosen is attainable for both snack food edibles and fruit, then the study is controlling for any potential problem behavior associated with extended work periods. For example, if participants were able to complete more than 10 demands in the reinforcer assessment, only 10 demands were incorporated into the treatment analysis. A post-treatment reinforcer assessment was also conducted with Harry. This assessment was conducted to evaluate the change in the number of demands completed to obtain the edible reinforcer of orange or fruit snack. The post-assessment allowed for a comparison to be made between pre-treatment breakpoints and post-treatment breakpoints. This allowed researchers to determine if the number of demands completed increased for the fruit edible after repeatedly receiving it as a reinforcer following task completion.

Treatment Analysis

The treatment analysis is depicted in a concurrent-operants arrangement embedded within a reversal design. Once the average breakpoint was determined in the reinforcer assessment, that number of demands (or 10 if more than 10 is achieved in the assessment) was used during the treatment analysis. One fruit edible and one snack food edible were presented to the participant. After the participant completed the number of demands, they were asked to choose between the fruit edible and snack food edible. A

motivator kept in the therapist pocket indicated when the snack food edible was to be provided if it has an associated delay with it. Tasks were included in the treatment analysis because the participants currently complete work before receiving edibles in their clinic. Each session consisted of five choice trials. A phase will continue until at least three data points or stable responding has occurred.

Baseline

Each session consisted of five trials. Each trial consisted of the number of demands identified in the reinforcer assessment. The demands implemented were previously mastered targets identified by the participant's BCBA. In this phase, both the edibles were at a 0-s delay for all trials. Both reinforcers were present on the table in front of the participant. The therapist provided the demands for the child to complete. Once the participant completed their tasks, they were asked to choose an edible and it was provided immediately. Any problem behavior that occurs during the session was ignored as it was not a variable being examined.

Delayed reinforcement for snack food edibles

In this phase, the fruit edible remained available at the 0-s delay. If the participant were to choose this at the end of the trial, it was provided immediately. The snack food edible was on a progressive ratio delay schedule (30 s, 60 s, 120 s, 240 s). In the first intervention phase, the delay to the snack food edible was 30 s. In the second intervention phase, the delay doubled to 60 s for the snack food edible. The delay increased after three sessions without a switch in responding from snack food edibles to fruit edibles. Similar to the baseline, both edibles were present on the table where the participant could see them. This intervention continued until a clear switch occurred in which the participants

were choosing the immediate fruit edible over the preferred snack food edible. Once this occurred a reversal reestablished baseline responding. After stable responding occurred, a reversal back to the phase in which fruits were chosen more frequently occurred.

Delay reinforcement for both edibles

A delay to the fruit edible was added to the procedure if the switch in responding from snack food edibles to fruit did not occur. The intervention changed so that both edibles incorporated a delay. The fruit edible had a smaller delay added to it so that none of the edibles were available immediately following the completion of tasks. The snack food edible reverted to 30 s and continued with the initial intervention progressive ratio increases. The delay to the fruit edible started at 10 s and progressed by 10 s each phase. Once stable responding occurred for the immediate fruit edible, a reversal occurred to reintroduce baseline responding. Following this, a reversal back to the condition that resulted in choosing the fruit reinforcer occurred. This phase then continued until there were four consecutive sessions with 100% of choice being allocated to the fruit edible.

Results

Pre-MSWO

The results of the pre-MSWO assessments are illustrated in Figure 1. The snack food MSWO conducted with Harry identified fruit snack as the highest preferred edible and popcorn as the lowest preferred edible. Results for Atticus indicated donut as the highest preferred edible and goldfish cracker as the lowest preferred edible. Snack MSWO results for Orion show fruit snack as the highest preferred edible and oatmeal cream pie as the lowest preferred edible. The fruit edible MSWO identified banana as the highest preferred and orange as the lowest preferred edible for Harry. The fruit edible

MSWO results for Atticus indicated watermelon as the highest preferred and banana as the lowest preferred edible. Results for the fruit edible MSWO indicated orange as the highest preferred and grape as the lowest preferred edible for Orion. The combined MSWO for all participants demonstrated that snack food edibles are the most preferred with fruit snack, donuts, and fruit snack (Motts) ranking first for participants Harry, Atticus, and Orion. Contrary to the findings by Kronfli et al. (2020), the snack food edibles and fruit edibles were selected at about the same percentage. In fact, all participants had a fruit as their second highest preferred edible.

Reinforcer Assessment

The reinforcer assessment identified that the breakpoint of demands was lower for the fruit edible compared to the snack food edible for all participants. Figure 2 depicts the following findings. Harry's average breakpoint for oranges was four demands and the average breakpoint for fruit snack was 13 demands. Atticus was able to complete three demands on average for apples and 11 demands for donuts. Orion was able to complete six demands for fruit and 18 demands for snack food. Because the number of demands incorporated in the treatment analysis was based on the reinforcer assessment of fruit, Harry had four demands, Atticus had three demands and Orion had six demands in the treatment analysis.

Treatment Analysis

Results from the treatment analysis indicate that manipulation of choice responding is possible by altering the delay to the snack food edible for both Harry and Atticus. Results of the treatment analysis are displayed in Figure 5. At a delay of 30 s, Harry's allocation of responding switched from snack foods to fruit. A reversal back to

baseline responding demonstrated that the delay did affect Harry's response and that it was not a result of extraneous factors. In the final phase of Harry's treatment analysis, the phase continued until there were three sessions with 80% or above of the selections being fruit. Atticus followed a similar pattern of responding, however, manipulation of choice responding occurred at a longer delay of 60 s. Due to unforeseen circumstances sessions with Orion were postponed following the 30-s delay phase.

Post-MSWO

Following the treatment analysis, a post-MSWO assessment was conducted with Harry. This assessment followed the same procedure as the pre-assessment for the combined MSWO. Harry demonstrated an increase in preference for the orange edible. It was the highest preferred edible followed by strawberries. The fruit snack, which was included in the treatment analysis, decreased to a moderately preferred edible.

Post-Reinforcer Assessment

Following the post-MSWO assessment, a post-reinforcer assessment was conducted with Harry. This was conducted to evaluate if there was a change in the reinforcing effectiveness of the edibles included in treatment. The orange which had an average breakpoint of four demands during the preassessment showed an increase post-treatment to 11 demands. This demonstrates that the reinforcing effectiveness of the edible increased following treatment. The average breakpoint for the fruit snack decreased from 13 demands to six demands post-treatment.

Discussion

The current study extends research on food selectivity by examining preference for fruit edibles versus snack food edibles. It examined if manipulating delay to

reinforcement would be effective in increasing the selection of healthy foods in comparison to unhealthy foods using a concurrent-operants arrangement. That is, the participants could either choose a healthy food (i.e., fruit) immediately or chose an unhealthy food (i.e., snack food) after a delay. Two participants that completed treatment did have a switch in responding from the snack edible to the fruit edible when a delay was added. One participant, Harry, switched responding to selecting more fruit edibles at the initial delay of 30 s. The second participant, Atticus, switched responding at the 60-s delay. These results indicate that adding a delay for the snack food edible was effective in increasing selection for the fruit edible. This may indicate that the immediacy parameter of reinforcement may play a factor in healthy food selection.

This study extends research from Zonneveld et al. (2019) by evaluating the immediacy of reinforcement. Zonneveld et al. provided the edible following a 1-hr delay. This is an extended period for individuals to wait for an edible which may not be a feasible procedure for clinicians to implement. Additionally, a 1-hr delay may increase the state of food deprivation and increase the aversiveness of the procedure. This study allows an examination of shorter delays and suggests a conclusion that a longer delay is not necessary for individuals to switch responding. This makes this procedure more feasible for clinicians to implement.

A strength of this study was that it did not rely on aversive situations. There were different aversive situations that may be associated with previous treatments such as nonremoval of the spoon or meal (LaRue et al., 2011; Tarbox et al., 2010). An additional aversive situation that arises from the nonremoval of the meal procedure is the possible food deprivation. If the participant did not eat that food, they were not provided anything

else until the next mealtime. This could have continued for many meals in which the child did not consume any food. This study averts that by allowing the participant to select which edible they wished to consume and providing it immediately or following the designated delay. This makes the procedure potentially more reinforcing to the participant.

It is interesting to note that despite previous research by Kronfli et al. (2020) suggesting that snack foods displace the majority of healthy foods, the current study did not replicate those findings. In the current study, the combined MSWO showed that some displacement did occur, however, all participants chose a fruit edible as their second highest preferred edible and two of the four top ranked edibles were fruits in all of the pre-assessment MSWOs across participants. Kronfli et al. discussed that the participants anecdotally seemed to choose fruits over vegetables. It is possible that we would have observed higher displacement if we used vegetables rather than fruit.

It is also interesting to note that adding a delay to the snack food edible made it less reinforcing over time and increased the reinforcing effectiveness of the more immediate edible. This is indicated in the post-treatment reinforcer assessment. The results from Harry's post-treatment reinforcer assessment suggests that the reinforcing effectiveness of the orange increased from the pre-assessment reinforcer assessment and the reinforcing effectiveness of the fruit snack decreased from the pre-assessment to post-treatment. These data are also supported by the decrease in preference for the fruit snack in the post-treatment combined MSWO. The post-treatment combined MSWO showed an increase in preference for fruit edibles which was associated with more immediate reinforcement.

There may be several limitations to the current study. One limitation of the current study is that it only had one participant who demonstrated mild compliance problems. It is possible that the intervention would not have been as effective if the participants demonstrated a higher magnitude of compliance problems. Because the current study required the participant to complete a specified number of demands before the edible is provided, it is possible that noncompliance would have prevented the participant from ever receiving an edible reinforcer and meeting the choice contingency. Additionally, all of these participants had mild problem behaviors. It is unclear if more severe behaviors would affect responding and prevent the consumption of the edibles. More severe problem behaviors may reduce the feasibility of implementation of the intervention, especially in the home environment. If the parent of the child is unable to safely conduct the intervention without the risk of injury, then this procedure would not be appropriate, and alternatives should be sought. Not only would severe problem behavior pose a risk to the parents and clinicians trying to conduct this intervention, but if the child were to start engaging in screaming or displaying tantrum behavior there is an increased risk of chocking on any foods that they may have in their mouth.

Another limitation is that a control edible was not included in the post-treatment reinforcer assessment conducted with Harry. Had a control edible been included the data could have been compared to determine if the control edible also increased in reinforcing effectiveness following treatment. Future researchers should evaluate the reinforcing effectiveness of a control edible pre- and post-treatment analysis. If a control edible were to increase in reinforcing effectiveness, then we conclude that the treatment was not responsible for the change in reinforcing value. It is possible that repeated exposure of

the fruit edible is what influenced the change in reinforcing effectiveness. However, if a control edible maintained the same reinforcing effectiveness post-treatment, we would conclude that the treatment was responsible for the change in reinforcing value of the fruit.

To further evaluate food selectivity treatments in children with ASD, future researchers could examine the manipulation of choice responding for fruit edibles by examining the magnitude of the edible. To do this researchers could increase the magnitude of the immediate fruit edible while maintaining the magnitude of the delayed snack edible. Researchers could also examine the different reinforcer parameter sensitivities of the participants then manipulate that parameter for the fruit or vegetable edible. This would require conducting a sensitivities assessment that would allow experimenters to identify which parameter of reinforcement would have the largest effect on responding for each participant (Kunnavatana et al., 2018). After establishing what parameter of reinforcement, the participant is most sensitive to, experimenters would manipulate this parameter for the treatment analysis.

The manipulation of delay to reinforcement to increase the selection of healthy food options is a relatively new idea for the treatment of food selectivity. This study directly manipulated the immediacy of fruit edibles and snack food edibles to increase the selection of fruits in a concurrent-operants arrangement. The intervention was created in a way to avoid possible aversive situations for the participants that were identified in previous research. Additionally, this study focused on fruit edibles over vegetables because of the natural sugar content associated that may make them less aversive than vegetables. We found that adding a delay to the snack food edible was effective in

switching the allocation of choice responding to the fruit edible. More specifically, one participant switched their choice responding at the 30-s delay (Harry) and another participant switched their choice responding at the 60-s delay (Atticus). While there are many limitations that can be addressed by future researchers, this study provides an additional steppingstone for the treatment of food selectivity in children with ASD.

References

Athens, E. S., & Vollmer, T. R. (2010). An investigation of differential reinforcement of alternative behavior without extinction. *Journal of Applied Behavior Analysis, 43*(4), 569-589. https://doi.org/10.1901/jaba.2010.43-569

Bandini, L. G., Curtin, C., Phillips, S., Anderson, S. E., Maslin, M., & Must, A. (2017). Changes in food selectivity in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *47*(2), 439-446. https://doi.org/10.1007/s10803-016-2963-6

Carroll, R. A., Kodak, T., & Fisher, W. W. (2013). An evaluation of programmed treatment-integrity errors during discrete-trial instruction. *Journal of Applied Behavior Analysis*, *46*(2), 379-394. https://doi.org/10.1002/jaba.49.

Chistol, L. T., Bandini, L. G., Must, A., Phillips, S., Cermak, S. A., & Curtin, C. (2018). Sensory sensitivity and food selectivity in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *48*(2), 583-591. https://doi.org/10.1007/s10803-017-3340-9

Conine, D. E., & Vollmer, T. R. (2019). Relative preferences for edible and leisure stimuli in children with autism. *Journal of Applied Behavior Analysis*, *52*(2), 557-573. https://doi.org/10.1002/jaba.525.

Curtin, C., Hubbard, K., Anderson, S. E., Mick, E., Must, A., & Bandini, L. G. (2015). Food selectivity, mealtime behavior problems, spousal stress, and family food choices in children with and without autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *45*(10), 3308-3315. https://doi.org/10.1007/s10803-015-2490-x

DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29*(4), 519-533. https://doi.org/10.1901/jaba.1996.29-519

Garcia, A. L., McLean, K., & Wright, C. M. (2016). Types of fruits and vegetables used in commercial baby foods and their contribution to sugar content. *Maternal & Child Nutrition, 12*(4), 838–847. https://doi.org/10.1111/mcn.12208

Johnson, C. R., Turner, K., Stewart, P. A., Schmidt, B., Shui, A., Macklin, E., Reynolds, A., James, J., Johnson, S. L., Courtney, P. M., & Hyman, S. L. (2014). Relationships between feeding problems, behavioral characteristics and nutritional quality in children with ASD. *Journal of Autism and Developmental Disorders, 44*(9), 2175-2184. https://doi.org/10.1007/s10803-014-2095-9

Kronfli, F. R., Vollmer, T. R., Fernand, J. K., & Bolívar, H. A. (2020). Evaluating preference for and reinforcing efficacy of fruits and vegetables compared with salty and sweet foods. *Journal of Applied Behavior Analysis, 53*(1), 385-401. https://doi.org/10.1002/jaba.594

Kuchler, F., & Stewart, H. (2008). Price trends are similar for fruits, vegetables, and snack foods. *Economic Research Service, 55,* 1-29.

LaRue, R. H., Stewart, V., Piazza, C. C., Volkert, V. M., Patel, M. R., & Zeleny, J. (2011). Escape as reinforcement and escape extinction in the treatment of feeding problems. *Journal of Applied Behavior Analysis*, *44*(4), 719-735. https://doi.org/10.1901/jaba.2011.44-719

Lerman, D. C., Addison, L. R., & Kodak, T. (2006). A preliminary analysis of self-control with aversive events: The effects of task magnitude and delay on the

choices of children with autism. *Journal of Applied Behavior Analysis, 39*(2), 227-232. https://doi.org/10.1901/jaba.2006.90-05

Ma., N. S., Thompson, C., & Weston, S. (2016). Brief report: Scurvy as a manifestation of food selectivity in children with autism. *Journal of Autism and Developmental Disorders, 46*(4), 1464-1470. https://doi.org/10.1007/s10803-015-2660-x

Penrod, B., Wallace, M. D., Reagon, K., Betz, A., & Higbee, T. S. (2010). A component analysis of a parent conducted multi-component treatment for food selectivity. *Behavioral Interventions, 25*(3), 207-228. https://doi.org/10.1002/bin.307

Penrod, B., Gardella, L., & Fernand, J. (2012). An evaluation of a progressive high-probability instructional sequence combined with low-probability demand fading in the treatment of food selectivity. *Journal of Applied Behavior Analysis, 45*(3), 527-537. https://doi.org/10.1901/jaba.2012.45-527

Porter, A., & Sy, J. R. (2020). Assessment and treatment of self-control with aversive events. *Journal of Applied Behavior Analysis, 53*(1), 508-521. https://doi.org/10.1002/jaba.604

Saini, V., Kadey, H. J., Paszek, K. J., & Roane, H. S. (2019). A systematic review of functional analysis in pediatric feeding disorders. *Journal of Applied Behavior Analysis, 52*(4), 1161-1175. https://doi.org/10.1002/jaba.637

Schreck, K. A., & Williams, K. (2006). Food preferences and factors influencing food selectivity for children with autism spectrum disorders. *Research in Developmental Disabilities, 27*(4), 353-363. https://doi.org/10.1016/j.ridd.2005.03.005

Silbaugh, B. C., & Swinnea, S. (2018). Failure to replicate the effects of the high-probability instructional sequence on feeding in children with autism and food selectivity. *Behavior Modification*, *43*(5), 734-762. https://doi.org/10.1177/0145445518785111

Tarbox, J., Schiff, A., & Nadjowski, A. C. (2010). Parent-implemented procedural modification of escape extinction in the treatment of food selectivity in a young child with autism. *Education and Treatment of Children*, *33*(2), 223-234. https://doi.org/10.1353/etc.0.0089

Zobel-Lachiusa, J., Andrianopoulos, M. V., Mailloux, Z., & Cermak, S. A. (2015). Sensory differences and mealtime behavior in children with autism. *The American Journal of Occupational Therapy : Official Publication of the American Occupational Therapy Association*, *69*(5), 1-8. https://doi.org/10.5014/ajot.2015.016790

Zonneveld, K. L. M., Neidert, P. L., Dozier, C. L., Gureghian, D. L., & Bayles, M. W. (2019). Assessing factors that influence young children's food preferences and choices. *Journal of Applied Behavior Analysis*, *52*(1), 240-257. https://doi.org/10.1002/jaba.521

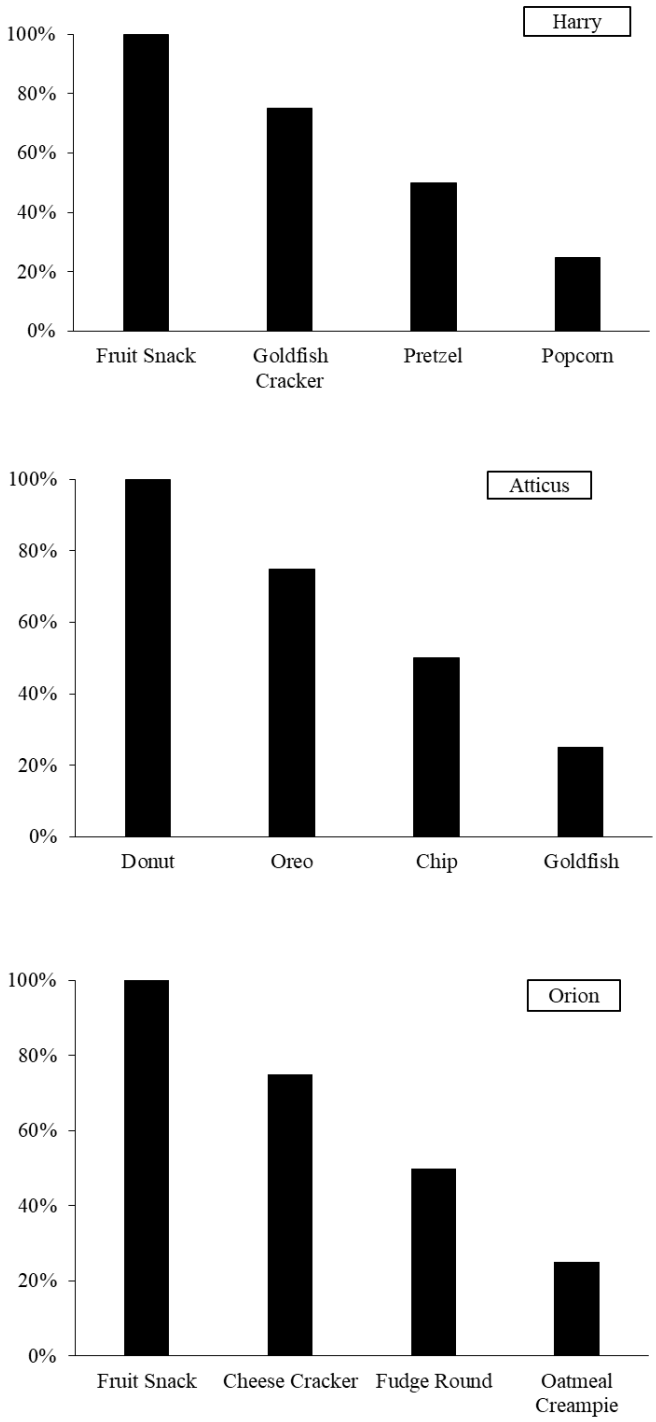

Figure 1. The percentage of selection for snack food edibles in a multiple-stimulus without replacement preference assessment for Harry, Atticus, and Orion.

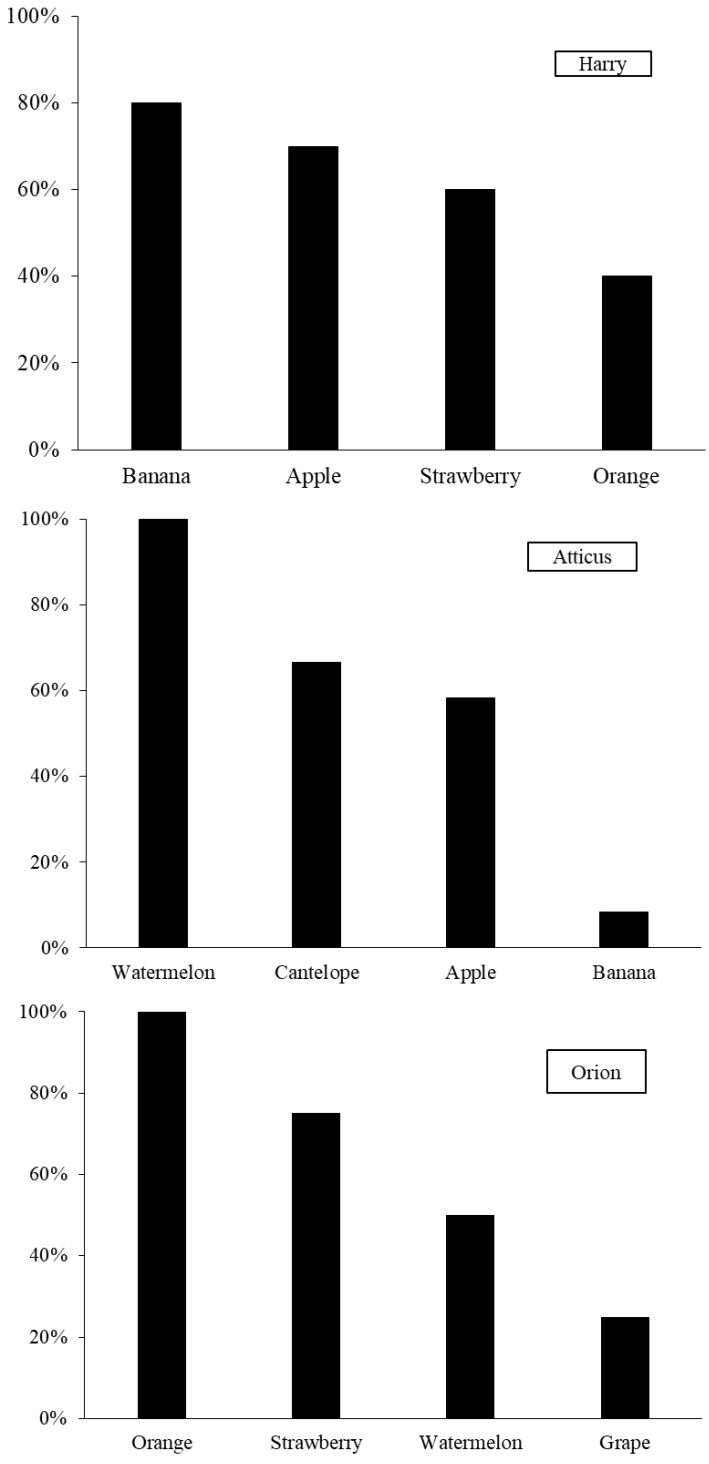

Figure 2. Percentage selected of fruit edibles in a multiple-stimulus without replacement preference assessment for Harry, Atticus, and Orion.

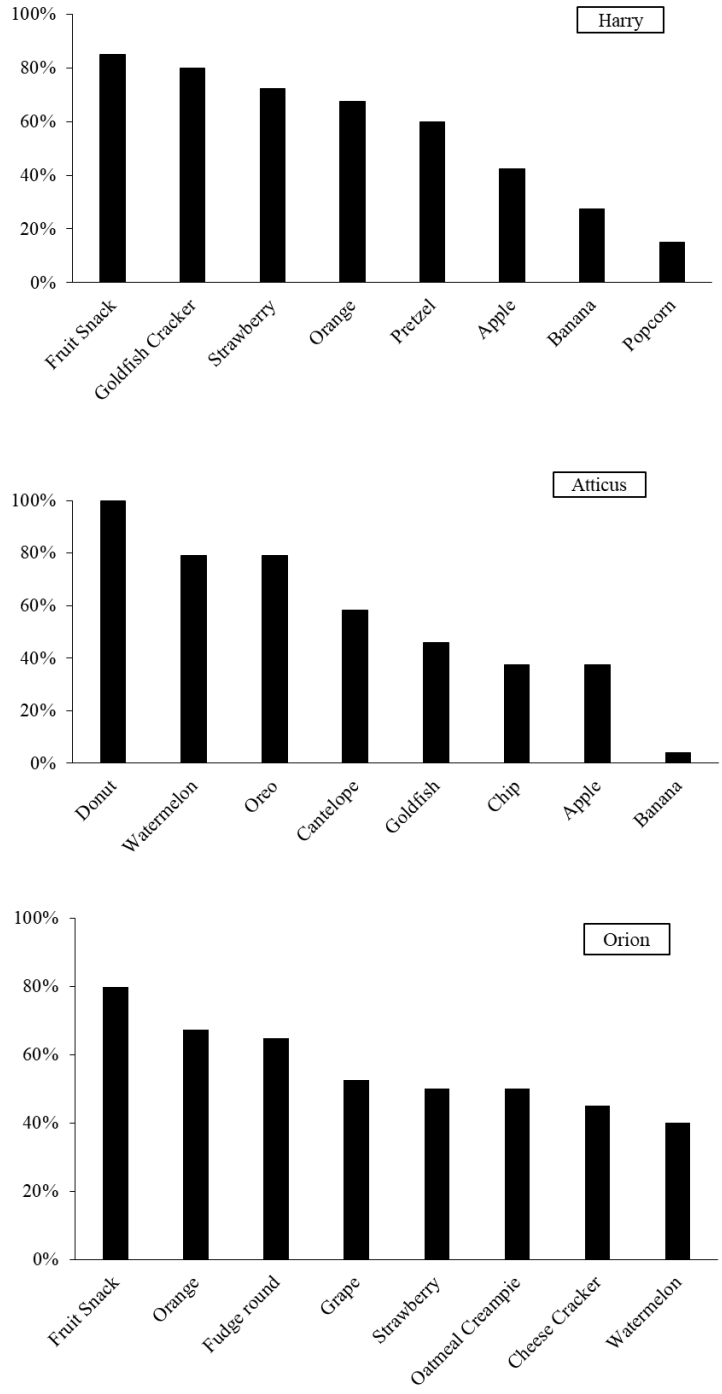

Figure 3. Percentage selected for both fruit and snack food edibles in a multiple-stimulus without replacement preference assessment for Harry, Atticus, and Orion.

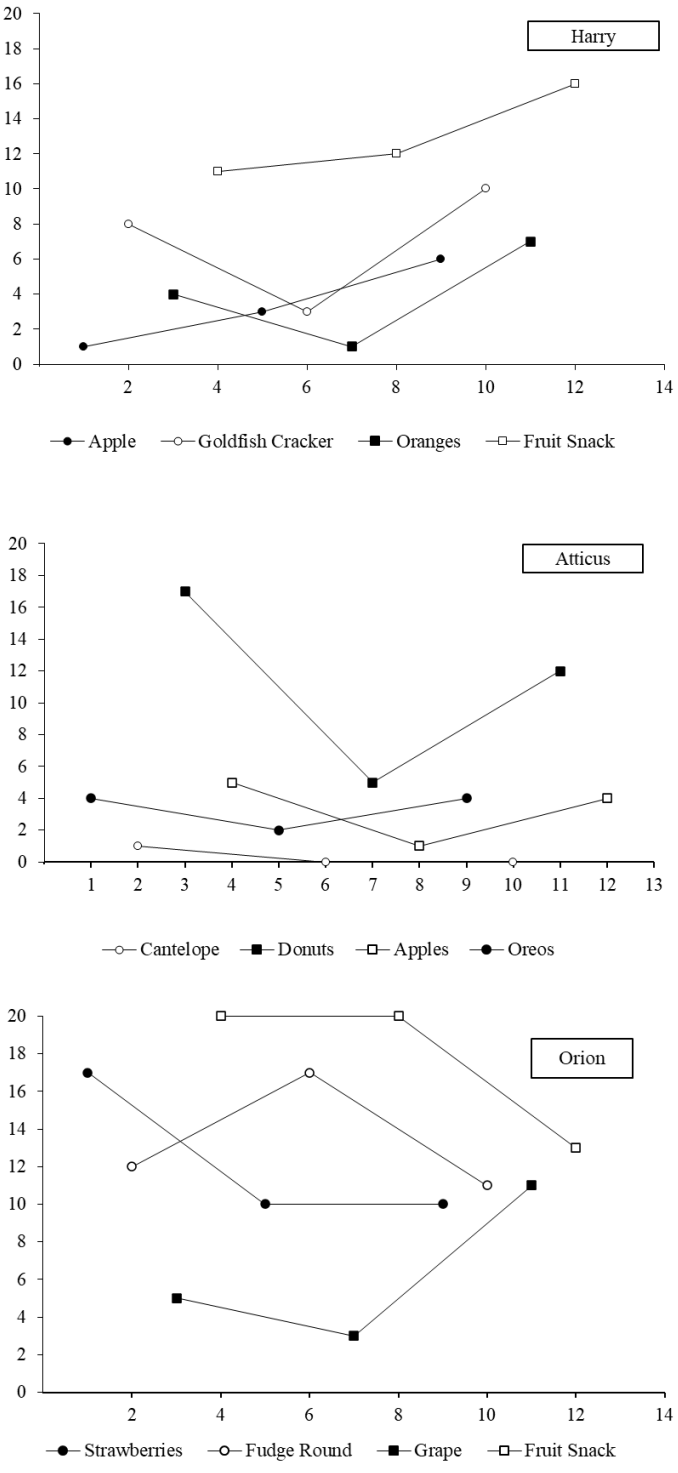

Figure 4. Breakpoints for fruits and snack food edibles in the reinforcer assessment.

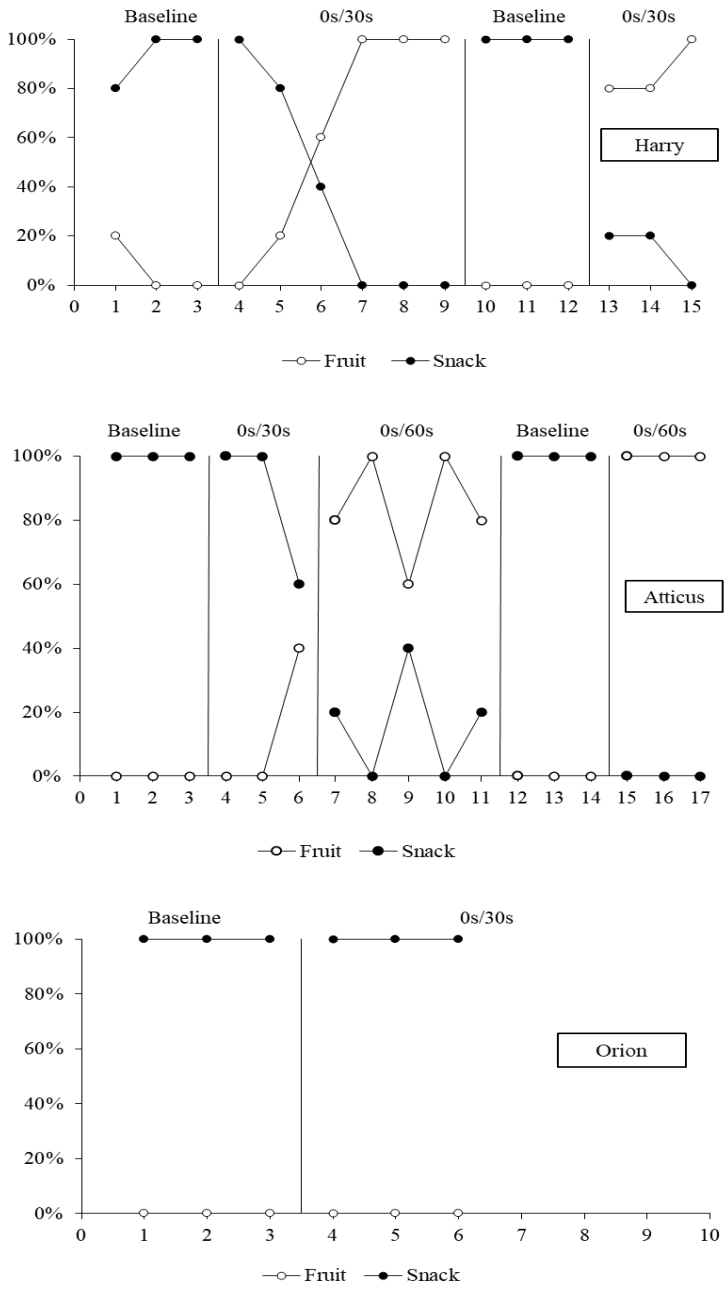

Figure 5. Percentage of trials in which Harry, Atticus, and Orion selected the fruit edible and snack edible for each session. The number depicted before the forward slash, "/", depicts the delay to the fruit edible and the number following the "/"depicts the delay to the snack edible.

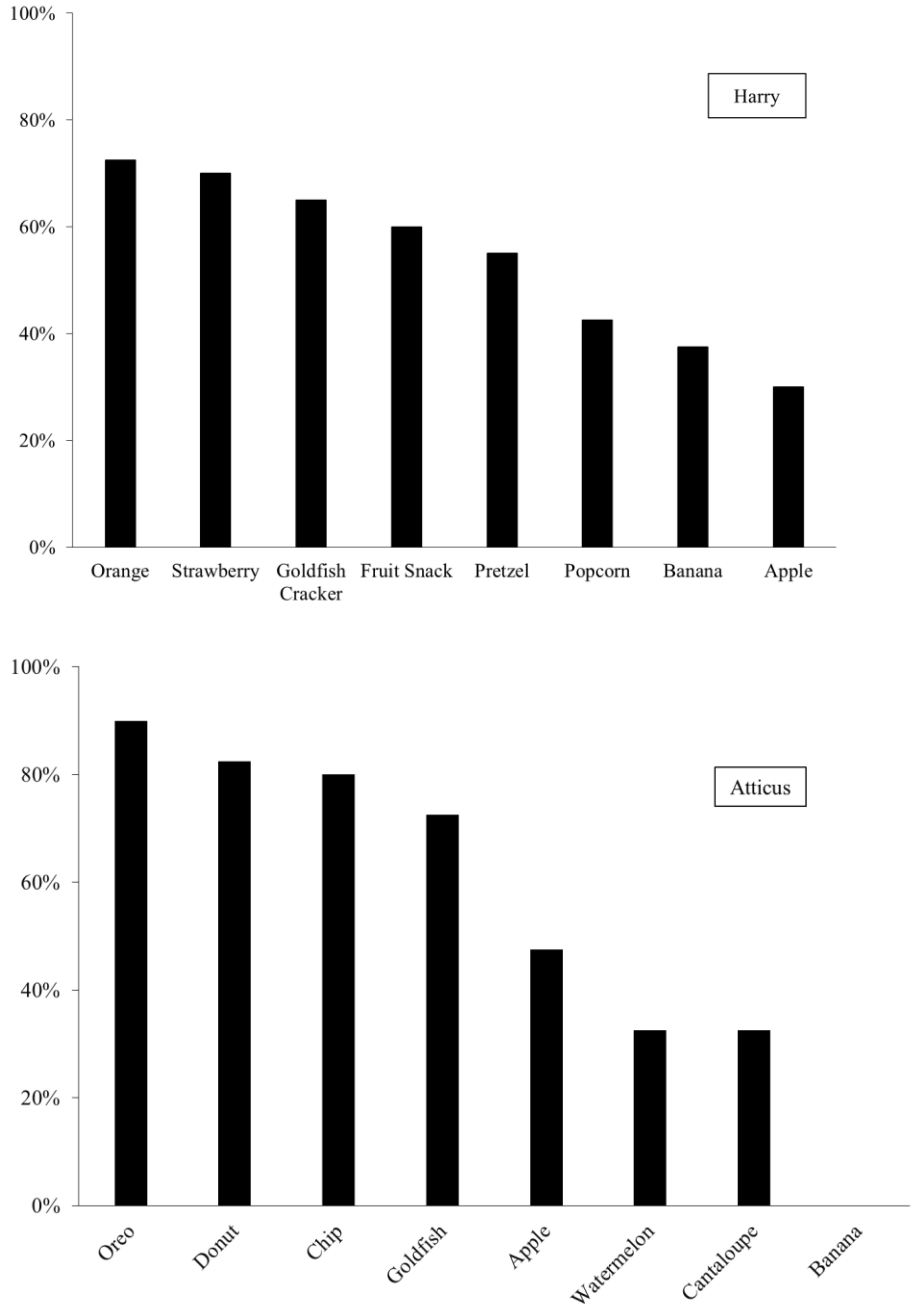

Figure 6. Percentage selected for both fruit and snack food edibles following treatment analysis.

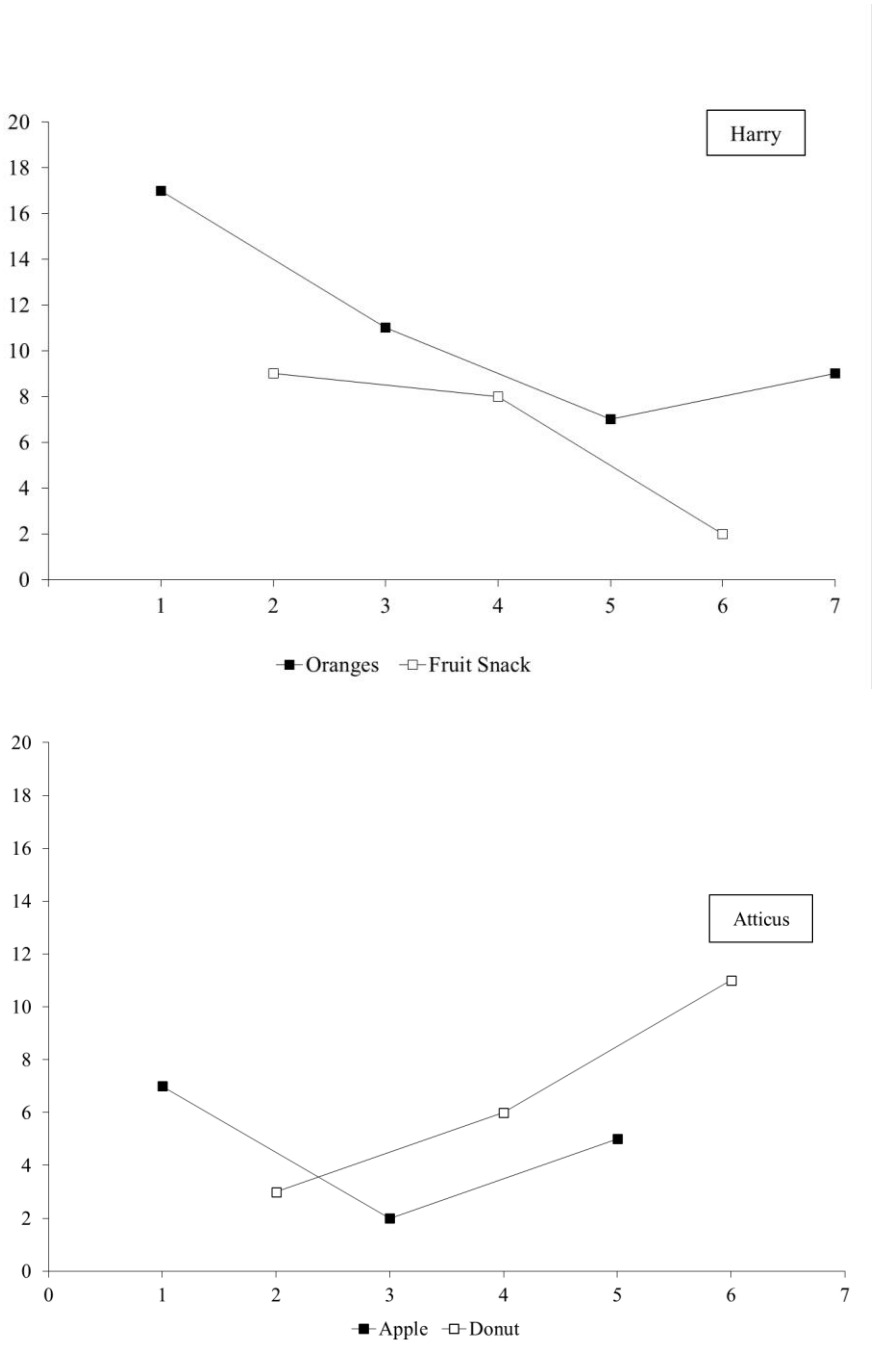

Figure 7. Post-treatment reinforcer assessment evaluating the number of demands completed to obtain edible reinforcer.

Appendix A

Consent Form

I, _____, provide consent for

to participate in the Food Selectivity study on _____(date). I am aware that I may withdraw participation in this study at any time. Below are four fruits that have been consumed at least once before and four snack foods that are often consumed.

Fruits:

1. **_____.**
2. **_____.**
3. **_____.**
4. **_____.**

Snacks:

1. **_____.**
2. **_____.**
3. **_____.**
4. **_____.**

Appendix B

MSWO for 8 items

Item A: _____

Item B: _____

Item C: _____

Item D: _____

Item E: _____

Item F: _____

Item G: _____

Item H: _____

Date:		
Data collector:		
Initial position: **A B C D E F G H**		
Trial #	**Item selected**	**Placement of item selected**
1		X X X X X X X X
2		X X X X X X X
3		X X X X X
4		X X X X
5		X X X
6		X X
7		X
8		

Date:		
Data collector:		
Initial position: **B C D E F G H A**		
Trial #	**Item selected**	**Placement of item selected**
1		X X X X X X X X
2		X X X X X X X
3		X X X X X
4		X X X X
5		X X X
6		X X
7		X
8		

Date:		
Data collector:		
Initial position: **C D E F G H A B**		
Trial #	**Item selected**	**Placement of item selected**
1		X X X X X X X X
2		X X X X X X X
3		X X X X X
4		X X X X
5		X X X
6		X X
7		X
8		

Date:		
Data collector:		
Initial position: **D E F G H A B C**		
Trial #	**Item selected**	**Placement of item selected**
1		X X X X X X X X
2		X X X X X X X
3		X X X X X
4		X X X X
5		X X X
6		X X
7		X
8		

Date:		
Data collector:		
Initial position: **E F G H A B C D**		
Trial #	**Item selected**	**Placement of item selected**
1		X X X X X X X X
2		X X X X X X X
3		X X X X X
4		X X X X
5		X X X
6		X X
7		X
8		

Appendix C

MSWO Integrity

Criteria	Yes	No	N/A
Place edibles in array			
State "Choose your favorite"			
Allow 30 s access following selection			
Remove selected edible from array			
Percentage correct =yes/(yes+no)*100			

Criteria	Yes	No	N/A
Place edibles in array			
State "Choose your favorite"			
Allow 30 s access following selection			
Remove selected edible from array			
Percentage correct =yes/(yes+no)*100			

Appendix D

Reinforcer Assessment

Data collector:_____Date:_____Edible:_____.

Trial	Number of Demands	Completed demands	Earned reinforcement
1		**Yes / No**	**Yes / No**
2		**Yes / No**	**Yes / No**
3		**Yes / No**	**Yes / No**
4		**Yes / No**	**Yes / No**
5		**Yes / No**	**Yes / No**
6		**Yes / No**	**Yes / No**
7		**Yes / No**	**Yes / No**
8		**Yes / No**	**Yes / No**
9		**Yes / No**	**Yes / No**
10		**Yes / No**	**Yes / No**
11		**Yes / No**	**Yes / No**
12		**Yes / No**	**Yes / No**
13		**Yes / No**	**Yes / No**
14		**Yes / No**	**Yes / No**
15		**Yes / No**	**Yes / No**
16		**Yes / No**	**Yes / No**
17		**Yes / No**	**Yes / No**
18		**Yes / No**	**Yes / No**
19		**Yes / No**	**Yes / No**
20		**Yes / No**	**Yes / No**

Notes: _____

_____

Appendix E

Reinforcer Assessment Integrity

Criteria	Yes	No	N/A
Presents continency of "If you press this button, then you can get this____"			
Follows progressive ratio schedule for providing edible			
Ignores all problem behavior			
Terminates session when responding stops for 30 s, property destruction of materials occurs, or problem behavior persists for 30 s, or all edibles have been received			
Percentage correct = yes/(yes+no)*100			

Criteria	Yes	No	N/A
Presents continency of "If you press this button, then you can get this____"			
Follows progressive ratio schedule for providing edible			
Ignores all problem behavior			
Terminates session when responding stops for 30 s, property destruction of materials occurs, or problem behavior persists for 30 s, or all edibles have been received			
Percentage correct = yes/(yes+no)*100			

Appendix F

Treatment Analysis Data Sheet

Data collector:_____(Prim/Reli)

Date: _____

Condition: _____.

Session Number:

Trial	Demand requirement	Delay	Edible selected
1			
2			
3			
4			
5			

Data collector:_____(Prim/Reli)

Date: _____

Condition: _____.

Session Number:

Trial	Demand requirement	Delay	Edible selected
1			
2			
3			
4			
5			

Appendix G

Treatment Analysis Treatment Integrity

Criteria	Yes	No	N/A
Therapist conducted ____ demands for each trial			
Therapist ignored all problem behavior			
Therapist provided the contingency for edibles following completion of tasks			
Least-to-Most prompting implemented for no response			
Error Correction implemented for incorrect responses			
Fruit edible is provided immediately or at its designated delay +/- 3s			
Snack edible is provided at the correct delay time +/- 3 s			
Percentage Yes/(Yes + No) × 100			

Criteria	Yes	No	N/A
Therapist conducted ____ demands for each trial			
Therapist ignored all problem behavior			
Therapist provided the contingency for edibles following completion of tasks			
Least-to-Most prompting implemented for no response			
Error Correction implemented for incorrect responses			
Fruit edible is provided immediately or at its designated delay +/- 3s			
Snack edible is provided at the correct delay time +/- 3 s			
Percentage Yes/(Yes + No) × 100			