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Decreasing Resistance to Change in the Form of Food Selectivity for Children with Autism

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Decreasing Resistance to Change in the Form of Food Selectivity for Children with Autism

by

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Decreasing Resistance to Change in the Form of Food Selectivity for

Children with Autism

Jaime Crowley, Ph.D.

University of Nebraska, 2019

Supervisor: Kathryn M. Peterson, Ph.D.

Repetitive and restricted response patterns are a core symptom of autism spectrum disorder, and resistance to change is a behavioral subcategory of these symptoms. Food selectivity, consumption of a limited variety of foods and liquids or rigidity during mealtime routines, is a common change-resistant behavior of children with autism that may increase the child's risk for severe health problems such as obesity and additional learning and behavior problems (Freedman, Dietz, Srinivasan, & Berenson, 1999). Unexpected changes in routines or in the environment can cause behavioral outbursts that are disruptive or potentially dangerous to the child, caregiver, or property and increase caregiver stress. In the current investigation, we used a matching law conceptualization to treat the change-resistant feeding behavior of seven children diagnosed with autism and avoidant/restrictive food intake disorder. We increased consumption of healthy target foods and assessed whether the treatment generalized to nontargeted foods.

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LIST OF ABBREVIATIONS

ABA   applied behavior analysis

AC   asymmetrical-choice condition

FC   free-choice condition

RBS-R   Repetitive Behavior Scale- Revised

SC   single-choice condition

INTRODUCTION

Resistance to Change in Autism

According to recent reports from the Centers for Disease Control and Prevention, 1 in 59 children in the United States is diagnosed currently with autism spectrum disorder. One defining feature of autism is repetitive and restricted response patterns, which can be socially stigmatizing, interfere with the child's learning, cause severe problem behavior if interrupted, and require excessive caregiver time or effort to maintain (Rodriguez, Thompson, Schlichenmeyer, & Stocco, 2012; Scahill et al., 2015). These response patterns occur frequently, across multiple contexts, and persist over time (Neil & Sturmey, 2014; Richler, Huerta, Bishop, & Lord, 2010; Turner, 1999).

Results of factor-analytic studies suggest that repetitive behaviors (e.g., motor stereotypies, lining up toys) are somewhat separate and distinct from response patterns called resistance to change or "insistence on the maintenance of sameness" (Turner, 1999, p. 839). Food selectivity, consumption of a limited variety of foods and liquids, or rigidity during mealtime routines, is a common change-resistant behavior of children with autism. Schreck, Williams, and Smith (2004) found that up to 72% of children with autism displayed food selectivity in which they ate significantly fewer foods from all food groups than children without autism. We observe clinically that these children often replace nutritious foods with processed junk foods that are low in nutritional value, such as cookies and French fries. Children with food selectivity also may engage in inappropriate mealtime behaviors, such as pushing food away, mealtime tantrums, aggression, and self-injury, to avoid eating nonpreferred foods or foods presented in a nonpreferred manner (Volkert, Patel, & Peterson, 2016). Food selectivity is problematic because it increases the child's risk for severe health problems such as obesity, Type II diabetes, hypertension, anemia, and additional learning and behavior problems (Latif, Heinz, & Cook, 2002; Freedman, Dietz, Srinivasan, & Berenson, 1999; Sullivan et al., 2002). Caregivers of a

child with a feeding disorder are likely to experience anxiety, stress, depression, or social stigmatization (Auslander, Netzer, & Arad, 2003; Graves & Ware, 1990). Researchers have found that resistance-to-change behavior either stayed the same or worsened over time without direct treatment, even when other symptoms of autism improved (Neil & Sturmey, 2014; Richler et al., 2010; Turner, 1999). Taken together, these data suggest that treatment of change-resistant feeding behavior is important.

Despite its prevalence and potential negative consequences, few studies have evaluated behavioral treatments for resistance to change (Boyd, McDonough, & Bodfish, 2012). In one notable exception, Fisher et al. (in press) used a generalized matching-law conceptualization (Baum, 1974; Baum, 1979) to treat the change-resistant behavior of four children with autism. Basic research has established that organisms will engage in responding that produces relatively higher value reinforcement when given a choice between responses (Fisher & Mazur, 1997; Neuringer, 1967). Researchers have demonstrated the systematic relation between relative reinforcer value and relative rates of responding in studies on children with autism and hypothesize that the change-resistant behavior of children with autism may be maintained by automatic reinforcement. The rationale for this hypothesis is that children with autism have difficulty predicting and controlling events in their environment. The environment becomes more predictable, however, if the child repeats the same behavior over and over (Christensen et al., 2018). The generalized matching law predicts that children with autism are likely to engage in change-resistant behavior because they prefer predictable outcomes, which function as automatic reinforcement for and bias the child to engage in the change-resistant behavior, and each repetition of the change-resistant behavior increases the length of its reinforcement history. Occurrence of the change-resistant behavior prevents occurrence and reinforcement of alternative behavior, which also increases the value of reinforcement for the change-resistant behavior and the likelihood the change-resistant behavior will persist.

Current Treatments for Resistance to Change

The Fisher et al. (in press) study included a free-choice condition in which the researcher gave the children the choice between the change-resistant or alternative responses when choosing either produced the same programmed consequence. The generalized matching law predicts that these children are biased to engage in the change-resistance response during free choice due to their history and automatic reinforcement; this is what occurred in the study. Next, the study included the asymmetrical-choice condition in which the researcher gave the children the choice between the change-resistant or alternative responses when choosing the change-resistant response produced no programmed consequence and choosing the alternative response produced the participant's most preferred item. One participant chose the change-resistant response, meaning that the increase in reinforcement for the alternative response did not compete with the bias toward the change-resistant response. Another participant chose the alternative response, meaning that the child did respond to the addition of differential reinforcement. In the single-choice condition, researchers presented children with only the alternative response and used three-step prompting to ensure the children selected the alternative response. The children began engaging in the alternative response at high and stable levels without problem behavior. Guiding the children to choose the alternative response exposed them to an alternative to change-resistant behavior. This exposure likely increased the predictability of the alternative response and the reinforcement for that response, which likely increased the value of reinforcement for the alternative response relative to the change-resistant response. One interesting finding was that three of the children continued to engage in the alternative response after the researchers terminated three-step prompting and only differential reinforcement remained, even when the children had a choice between the alternative response and the change-resistant response. The generalized matching law predicts that increasing the value of the reinforcer for the alternative response should shift responding from the change-resistant to the alternative response.

Purpose of the Current Study

The purpose of the current study was to extend the findings of Fisher et al. (in press) to the treatment of the change-resistant feeding behavior of seven children diagnosed with autism. Like Fisher et al., we used a matching law conceptualization to shift children's responding away from their bias of consuming foods lacking in nutrition to increasing their consumption of healthy target foods. We also assessed whether the treatments generalized to nontargeted foods.

CHAPTER 1: METHOD

Participants

We included seven children between 2 and 8 years of age diagnosed with autism who displayed change-resistant feeding behavior and met the criteria for the diagnosis avoidant/restrictive food intake disorder. We used the definition from the Diagnostic Statistical Manual (5th ed.) which defines avoidant/restrictive food intake disorder as failure to maintain nutritional or caloric needs primarily associated with significant nutritional deficiencies (America Psychiatric Association, 2013). The inclusion criteria for the current study were: (a) the caregiver reported the child consumed between three and 20 foods regularly; (b) the child consumed at least 90% of caloric needs by mouth and was not dependent on supplemental nutrition, like a gastrostomy tube; and (c) the child's weight for height was at or greater than the 5th percentile (i.e., the child was not experiencing growth failure, which would have required more immediate intensive treatment). A physician cleared participants as safe oral feeders before the study.

A behavior analyst or licensed psychologist affiliated with our program conducted an initial feeding evaluation before we enrolled participants in the study. During the evaluation, the behavior analyst (a) interviewed the caregiver to determine the child's current and past eating behavior and medical history, (b) measured the child's current height and weight, and (c) conducted direct observations of the caregiver feeding the child both preferred and nonpreferred foods in part to determine whether the child had appropriate chewing skills. We excluded children who did not demonstrate safe and appropriate chewing skills with table-textured foods.

Zachary was a 4-year-old boy. His diet mainly consisted of processed and fast foods, like macaroni and cheese, cereals, French fries, and chicken nuggets, and a few fruits. He engaged in inappropriate mealtime behavior, such as pushing food away and throwing food, and crying, coughing, gagging, and vomiting, when caregivers presented him with novel or nonpreferred foods. Zachary only consumed foods presented in a particular way, such as sliced but not a whole

apple, and of a specific brand, like Kraft but not Aunt Annie's macaroni and cheese. Zachary had rigid play routines, problem behavior with transitions, compulsive behavior (e.g., insistence on closing doors), and a rigid bedtime routine.

Kelsey was a 7-year -old girl. Her diet mainly consisted of processed starches, such as canned spaghetti and cereal, and some fruits. She refused vegetables and healthy proteins and grains. Kelsey engaged in inappropriate mealtime behavior and crying, gagging, flopping out of her chair, and eloping from the table when caregivers presented her with novel or nonpreferred foods. Kelsey had repetitive social interactions, problem behavior with transitions, and rigid play routines.

Micah was a 4-year-old boy. His diet consisted of a few fruits and starches. He inconsistently ate a few proteins and refused vegetables. He picked food apart in a certain way before eating. For example, he picked apart French fries and only ate the middle pieces. Micah engaged in inappropriate mealtime behavior, gagging and aggression when caregivers presented him with novel or nonpreferred foods. Micah had compulsive behavior (e.g., insisting on closing the doors), a rigid bedtime routine, problem behavior with transitions, and rigid play routines.

Alfonzo was a 4-year-old boy. His diet consisted of a few foods across the four food groups, however, his acceptance and consumption of those foods was inconsistent. Caregivers reported that he mainly engaged in passive refusal at home when presented with nonpreferred foods. Alfonzo had repetitive social interactions, rigid play routines, a rigid bedtime routine, and problem behavior with transitions.

Steven was a 7-year-old boy. His diet consisted of a few fruits, proteins, and starches and only when presented in a particular way (i.e., refused foods mixed together). He refused all vegetables. He engaged in inappropriate mealtime behavior, eloping from the table, and gagging when caregivers presented him with novel or nonpreferred foods. Steven had repetitive social

interactions, problem behavior with transitions, compulsive behavior (e.g., touching and counting items), and rigid play routines.

Genevieve was a 2-year-old girl. Her diet consisted of a few fruits, starches, and proteins, but mainly processed foods, such as cookies, macaroni and cheese, and cereal. She refused all vegetables. Genevieve engaged in inappropriate mealtime behavior and self-injury when caregivers presented her with novel or nonpreferred foods. Genevieve had rigid play routines and problem behavior with transitions.

Titus was an 8-year old boy who consumed a few fruits, proteins, and starches but refused all vegetables; however, Titus's diet mainly consisted of processed foods, such as macaroni and cheese, frozen chicken nuggets, and cereal. Titus also had specific meal routines and engaged in problem behavior if caregivers changed those routines (e.g., eating Toaster Strudel before school even if he already ate breakfast). Titus engaged in inappropriate mealtime behavior and coughing, flopping from his chair, elopement from the table, property destruction (e.g., throwing nonfood-related items), and aggression when caregivers presented him with novel or nonpreferred foods. Titus had repetitive social interactions, fascination with one topic, problem behavior with transitions, and rigid play routines.

Setting and Materials

We conducted sessions at the University of Nebraska Medical Center's Munroe-Meyer Institute in one of three locations, a classroom in the Starting Early: Eating and Developmental Skills Program, a session room from the Pediatric Feeding Disorders Program, or an Early Intervention classroom in the Center for Autism Spectrum Disorders. General materials included color-coded stimuli for two separate conditions (e.g., colored tablecloths, colored bowls), highly preferred edibles or tangible items for each child, food scales, timers, computers for data collection, video cameras, video recording computer software, and a table and chairs. Participants used either age-appropriate seating (e.g., booster chair) or seating to maintain the participant's

safety (e.g., Special Tomato Chair) and age-appropriate eating utensils, such as toddler spoons and forks. Before the study, caregivers selected four healthy target foods for each participant. Target foods were chicken, corn, green bean, and lasagna for Zachary; green bean, pea, potato, and yam for Kelsey; baked bean, pea, pineapple, and white rice for Micah; avocado, cauliflower, chicken, and potato for Alfonzo; baked bean, broccoli, sandwich (deli meat, lettuce, bread), and strawberry for Steven; carrot, cheese, pancake, and pear for Genevieve; chicken, green bean, pea, and potato for Titus. We also selected two to four change-resistant foods currently in the child's diet based on 3-day food logs provided by caregivers and the preassessment (described below). We selected hot dog and Cheerio for Zachary; pancake, hot dog, pear, and strawberry for Kelsey; Fruit Loops, Captain Crunch, and waffle for Micah; Fruit Loops, Captain Crunch, tropical fruit, and pancake for Alfonzo; banana and quesadilla for Steven; Fruit Loops, Captain Crunch, and chicken nuggets for Genevieve; and chicken nugget, French fries, Nutella on bread, and apple for Titus. We cut foods into 0.6-cm-by-0.6-cm-by-0.6-cm bites, and each presentation was one bite.

Therapists and Observers

Individuals with Bachelor's or Master's Degrees in psychology, applied behavior analysis (ABA), or a related field, were employees in the Pediatric Feeding Disorders Program, and were trained to implement ABA feeding treatments served as feeders and data collectors.

Response Measurement

Our primary dependent variable was *consumption* of healthy target foods during five-trial sessions in which each trial consisted of presentation of a healthy target food and ended with a mouth check (see general procedures). We scored consumption for each trial when the child (a) placed one 0.6-cm-by-0.6-cm-by-0.6-cm bite inside his or her mouth within 8 s of the feeder placing the bowl with the bite of target food in front of the child (acceptance) and (b) when no food larger than a grain of rice was in the child's mouth 30 s after the bite entered the mouth, not including bites the child spit out (mouth clean). In guided choice, observers scored consumption

using the same definition except the child deposited the bite inside her mouth and removed the empty spoon from her mouth from the point at which the feeder guided her hand with the spoon (described below). We converted occurrences of consumption to a percentage after dividing the number of bites consumed by the number of bites presented.

Reliability and Treatment Integrity

A second observer independently scored 33% (range, 15% to 50%) of sessions across participants, foods, conditions, and sessions for consumption to obtain interobserver agreement. We recorded an agreement either when both observers scored or when both observers did not score an occurrence of the behavior for each trial. We recorded a disagreement when one observer scored and the other observer did not score the occurrence of a behavior for each trial. We calculated trial-by-trial agreement for consumption for the target food by recording whether there was an agreement on each trial and dividing the total number of trials that had an agreement by the total number of trials and multiplying by 100%. We conducted periodic retraining when reliability fell below 80%. Mean interobserver agreement of consumption was 97% (range, 40% to 100%) for Zachary, 100% for Steven, 98% (range, 0% to 100%) for Kelsey, 86% (range, 0% to 100%) for Alfonzo, 97% (range, 80% to 100%) for Micah, 98% (range, 0% to 100%) for Genevieve, 98% (range, 60% to 100%) for Titus.

We defined correct treatment integrity as the feeder completing each of the major steps of the protocol, which changed depending on the condition. Observers scored "yes" if the feeder implemented all steps correctly for that trial or "no" if the feeder made an error during any of the steps on that trial. Observers scored treatment integrity for 47% of sessions across participants. Mean integrity was 100% for Zachary, 99% (range, 80% to 100%) for Steven, 99% (range, 40% to 100%) for Kelsey, 100% for Alfonzo, 98% (range, 75% to 100%) for Micah, 98% (range, 40% to 100%) for Genevieve, and 99% (range, 80% to 100%) for Titus.

General Procedure

The feeding therapist conducted meals with Zachary one time per weekday for 45 min each day (i.e., five, 45-min meals per week). The feeding therapist conducted meals with Kelsey two times per weekday for 40 min each meal (i.e., 10, 40-min meals per week). The feeding therapist conducted meals with Micah two times per weekday for 40 min each meal (i.e., 10, 40-min meals per week). The feeding therapist conducted meals with Alfonzo two times per day on two days per week for 40 min each (i.e., four, 40-min meals per week). The feeding therapist conducted meals with Steven two times per weekday for 40 min each (i.e., 10, 40-min meals per week). The feeding therapist conducted meals with Genevieve two to three times per day on two days per week for 40 min each (i.e., approximately five, 40-min meals per week). The feeding therapist conducted meals with Titus four times per weekday for 40 min each (i.e., 20, 40-min meals per week). Each meal consisted of multiple, five-trial sessions, with each session having a 10-min time cap. The number of sessions depended on the individual child's schedule.

The therapist stated the rules of the current contingencies before each session. The therapist presented bites to the child approximately every 30 s by placing two bowls in front of the child, one contained a 0.6-cm by 0.6-cm by 0.6-cm bite of one of the child's change-resistant foods (e.g., hot dog for Zachary) and the other bowl contained one, 0.6-cm by 0.6-cm by 0.6-cm bite of one the child's healthy target foods (e.g., green bean for Zachary) during the free- and asymmetrical-choice conditions. The therapist presented bites to the child approximately every 30 s by placing one bowl in front of the child which contained one, 0.6-cm by 0.6-cm by 0.6-cm bite of one the child's healthy target foods during the single-choice condition. The therapist paired bite presentations with the verbal instruction, "Take one bite." If the child placed either bite in his or her mouth within 8 s of the bite presentations, the therapist provided praise (e.g., "Good job taking a bite"). The therapist removed the bowls either when the child placed either bite in his or her mouth or when 30 s elapsed from the bite presentations, whichever occurred first. If the child

attempted to bring both bites of food (e.g., one bite of the target food, followed by one bite of the change-resistant food) to his or her mouth, the therapist blocked the child from placing the second bite of food in his or her mouth. If the child placed a bite in his or her mouth at any point, the therapist began a timer for 30 s for the child to chew and swallow. After 30 s, the therapist instructed the child, 'Show me "aah." If no food larger than a grain of rice remained in the child's mouth, the therapist provided praise for swallowing (e.g., "Good job swallowing your bite!"). If food the size of a grain of rice or larger remained in the child's mouth, the therapist instructed the child, "Finish swallowing your bite" and moved on to the next trial. Given that all children were confirmed as safe oral feeders and because the bite size was small, we were confident the children were safe to hold this volume of food inside their mouths at one given time, should packing (food larger than a grain of rice inside the child's mouth 30 s after the bite entered the mouth) occur. If the child did not swallow the last bite of the session within 30 s of bite acceptance, the therapist continued to check the child's mouth for food every 30 s until no food larger than a grain of rice remained or the 10-min session cap expired. We did not observe packing behavior for any of the children in this study. The therapist did not provide any differential consequences for coughing, gagging, vomiting, or negative vocalizations.

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Preassessment

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Preference Assessment

We conducted a paired-stimulus preference assessment (Fisher et al., 1992) to identify the child's most preferred toy or edible item. Edible items used in the preference assessment were snack or candy items (e.g., Hot Cheetos, Skittles) that did not constitute a large portion of the children's daily diets as determined by caregiver-reported 3-day food logs. Zachary's top preferred item was one Hot Cheeto, Kelsey's top preferred item was an iPad, Micah's top preferred item was one Skittle, Alfonzo's top preferred item was one Skittle, Steven's top

preferred item was an iPad, Genevieve's top preferred item was an iPad, and Titus' top preferred item was one Skittle.

Preassessment of Change-resistant Response

We conducted an assessment to determine whether participants reliably consumed the change-resistant foods from the caregiver-reported 3-day food logs. Given that children with food selectivity often eat preferred foods in specific presentation formats or in specific mealtime routines, we wanted to ensure the children would consume change-resistant foods in the clinic with structured conditions. We selected two to four of the caregiver-reported change-resistant foods for this preassessment. First, the therapist presented the change-resistant food to the child in the same manner as the caregivers presented the foods to the child at home. For example, if the caregiver reported that the child ate pancakes cut into 1.5-cm-by-1.5-cm-by-1.5-cm triangles with syrup and butter with his hands, we presented the pancake to the child in that same manner. The therapist presented one change-resistant food in each free-operant meal. Before the meal, the therapist presented one of the foods on a plate (e.g., 1.5-cm-by-1.5-cm-by-1.5-cm pancake triangles with butter and syrup) to the child and told him or her, "It's time for a snack. You can have as much or as little of this snack as you want," and set the timer for 5 to 10 min, depending on the amount of food presented (e.g., 5 min for one chicken nugget; 10 min for a whole pancake) and based on caregiver report of how long the child typically took to consume the change-resistant food. After the time elapsed, the therapist removed the remaining food and recorded whether the child consumed *none*, *some*, *most*, or *all* of each of the foods. We asked the caregivers to identify a different food if the child consumed some or none of the change-resistant food. If the child consumed most or all of a food, we then conducted another assessment to determine if the child would consume the food when we presented it in a structured format.

During each structured session, the therapist presented five, 1.5-cm-by-1.5-cm-by-1.5-cm bites of one change-resistant food and followed the general procedure. If the child consumed all

or most the change-resistant foods, the therapist moved onto a structured session following the general procedure with the next change-resistant food. If the child consumed all or most of between two and four change-resistant foods, the therapist moved onto reducing the bite size of those foods. If the child did not consume any of the change-resistant foods, the therapist selected three other change-resistant foods from the child's 3-day food log and followed the preassessment procedure for the newly selected change-resistant foods.

The therapist gradually reduced the bite size across sessions from 1.5-cm-by-1.5-cm-by-1.5-cm bites to 0.6-cm-by-0.6-cm-by-0.6-cm bites. If the child consumed all or most of a particular bite size for that change-resistant food, the therapist reduced the bite size again in the next session. If the child consumed some or none of a particular bite size for that change-resistant food, the therapist increased the bite size again in the next session. If the child consumed some or none of a particular bite size twice for that change-resistant food, the therapist discontinued the preassessment with that food. If the child consumed all or most of a session of 0.6-cm-by-0.6-cm-by-0.6-cm bites, the therapist used that food as one of the child's change-resistant foods in the treatment evaluation. All children in this study passed through all three preassessment steps for at least two change-resistant foods.

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Treatment Evaluation

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Free Choice

The therapist said, "I'll place both bites in front of you and say, 'Take one bite'. If you take a bite, I'll say, 'Good job'" at the beginning of each session. The therapist followed the general procedure.

Asymmetrical Choice

The therapist said, "I'll place both bites in front of you and say, 'Take one bite'. If you take a bite of (healthy target food), you get (reinforcer)" at the beginning of each session. The

therapist followed the general procedure with the following modifications. We paired each contingency arrangement with different-colored stimuli to aid participants to discriminate the contingencies. For example, we used orange stimuli, such as bowls, spoons, and tablecloths for asymmetrical choice. The therapist held or placed the participant's reinforcer approximately 10 cm behind the bowl with the healthy target food and in the participant's sight. The therapist provided the participant with 30 s access to the reinforcer if the he or she consumed the bite of healthy target food. The therapist removed both bowls and the reinforcer and went on to the next bite presentation if the participant did not accept either bite within 30 s. The therapist said, "Good job taking a bite" and removed the reinforcer from sight if the participant did not consume the bite of healthy target food, but consumed the bite of change-resistant food.

Single Choice

The therapist said, "I'll place one bite in front of you and say, 'Take one bite'. If you take a bite of (healthy target food), you get (reinforcer)" at the beginning of each session. The procedure was identical to the asymmetrical-choice condition with the following modifications. We paired each contingency arrangement with different-colored stimuli to aid participants to discriminate the contingencies. For example, we used blue stimuli, such as bowls, spoons, and tablecloths for single choice. The therapist used nonremoval of the spoon with hand-over-hand guidance to deposit the bite into the participant's mouth if he or she did not accept the bite of healthy target food within 8 s of presentation. That is, the therapist physically guided the participant to touch the spoon to his or her lips and hold the spoon touching the lips until he or she opened his or her mouth such that the therapist could guide the participant to put the bite in his or her mouth or the 10-min time cap expired (Peterson et al., 2016). The therapist held the spoon at the participant's lips until he or she could deposit the bite or until the 10-min time cap expired if the participant released his or her grip from the spoon. The therapist scooped up the bite or quickly retrieved a fresh bite with the spoon and touched the spoon to the participant's lips

until he or she could deposit the bite into the participant's mouth or the 10-min time cap expired if the participant spit the bite out (expelled). If the participant expelled the bite during the mouth check, the therapist re-presented the bite and moved onto the next bite once the participant kept the previous bite in his or her mouth for 3 s. If the participant expelled the bite during the mouth check on the fifth bite presentation, the therapist re-presented the bite until the participant met the criterion for mouth clean or until the 10-min time cap expired.

Guided Choice

We used this treatment with Genevieve because percentage of consumption was low for her during the single-choice condition. Procedures were identical to single choice with the following modifications. We implemented several steps to conduct this treatment. After the therapist presented the bowl with the bite, he or she immediately guided Genevieve to place the bite in her mouth. The therapist provided 30-s access to the reinforcer if the bite entered Genevieve's mouth within 8 s of presentation (i.e., she did not engage in inappropriate mealtime behavior or resist the hand-over-hand prompting to prevent the deposit). The therapist provided another 30 s access to the reinforcer if Genevieve had a mouth clean. If Genevieve engaged in inappropriate mealtime behavior, the therapist used the nonremoval contingencies described above, and the therapist did not provide the reinforcer when the bite entered the mouth. When consumption was 80-100% for five sessions, the therapist provided immediate hand-over-hand guidance to touch the spoon to Genevieve's lips, but not deposit the bite into the mouth; bring the bite on the spoon 2.5 cm from the lips; bring the spoon halfway between the bowl and the lips; bring the spoon 2.5 cm from the bowl; and place Genevieve's hand on the spoon. The criterion for moving to the next level of hand-over-hand guidance was 80-100% consumption for five sessions. The last levels included the therapist providing 30-s access to the reinforcer for acceptance and providing 30-s access to the reinforcer for mouth clean. Then the therapist

provided 30-s access to the reinforcer only for acceptance regardless of mouth clean. Finally, the therapist implemented the single-choice contingencies previously described.

Experimental Design

We used a combination reversal and multiple-baseline-across-foods design. We included four healthy target foods for each participant, and each food represented one leg of the multiple baseline. The multiple-baseline-across-foods design was a control to demonstrate that consumption of healthy target foods did not increase until the therapist exposed the food to at least one of the treatments (i.e., asymmetrical or single choice). The multiple baseline design also allowed us to test for generalization of treatment effects to healthy foods not yet targeted with any treatment. We exposed the four healthy target foods to the free-choice contingencies. When consumption of healthy target foods was stable and low for all healthy target foods the therapist implemented the asymmetrical-choice contingencies with Food 1. The therapist reversed back to the free-choice contingencies to determine whether responding would maintain in the absence of asymmetrical choice if we observed percentage consumption increase to 80% or greater for three consecutive sessions for Food 1. If levels of consumption did not increase under the asymmetrical-choice contingencies after three or more consecutive data points for Food 1, the therapist implemented the single-choice contingencies. If we observed percentage consumption increase to 80% or greater for three consecutive sessions for Food 1, we reversed back to the asymmetrical-choice contingencies to determine whether responding would maintain in the absence of single choice. When we observed that levels of consumption did not increase in single choice for Genevieve's Food 1 after 15 consecutive sessions, we implemented the guided-choice contingencies. We conceptualize the free-choice contingencies as the least intensive treatment, asymmetrical choice as more intensive than free choice but less than the most intensive treatment, the single-choice contingencies. When consumption maintained at 80% or greater in the least intensive treatment condition, we exposed the next healthy target food, Food 2, to the same

treatment sequence and so on, in accordance with the logic of a multiple-baseline design until we had exposed Foods 1 to 4 to the contingencies or consumption increased for a food in the absence of contingencies.

CHAPTER 2: RESULTS

Figures 1 through 7 show that our treatment increased consumption of four healthy target foods for all seven participants. Figure 1 displays percentage of trials with consumption for Zachary for chicken (first), lasagna (second), green bean (third), and corn (fourth). During free choice initially, Zachary almost never consumed the healthy target foods when he could choose between the healthy target foods and the change-resistant foods (i.e., hot dog, Cheerio). Mean percentage of consumption of healthy target foods in free choice was 0%, 0%, 0%, and 4% (range, 0% to 40%) for chicken, lasagna, green bean, and corn, respectively. In asymmetrical-choice for chicken, Zachary never consumed the healthy target food ($M = 0$%). During single choice, Zachary consumed chicken at high, stable levels ($M = 65$%; range, 80% to 100%).When we reversed to asymmetrical choice, Zachary continued to consume chicken at high, stable levels ($M = 93$%; range, 60% to 100%). When we reversed to free-choice contingencies, percentage of chicken consumption decreased ($M = 28$%; range, 0% to 80%). Finally, in asymmetrical choice with chicken, percentage of consumption increased to high, stable levels ($M = 100$%). Next, we implemented the asymmetrical-choice contingencies with lasagna and observed no change in percentage of consumption ($M = 0$%). During the single-choice contingencies with lasagna, we observed an increase in percentage of consumption ($M = 76$%; range, 0% to 100%). Percentage of lasagna consumption was high ($M = 100$%) when we reversed to asymmetrical choice. When we exposed green bean and corn to the asymmetrical-choice contingencies, we observed an increase in percentage of consumption ($M = 95$%; range, 60% to 100% for green bean; $M = 98$%; range, 80% to 100% for corn).
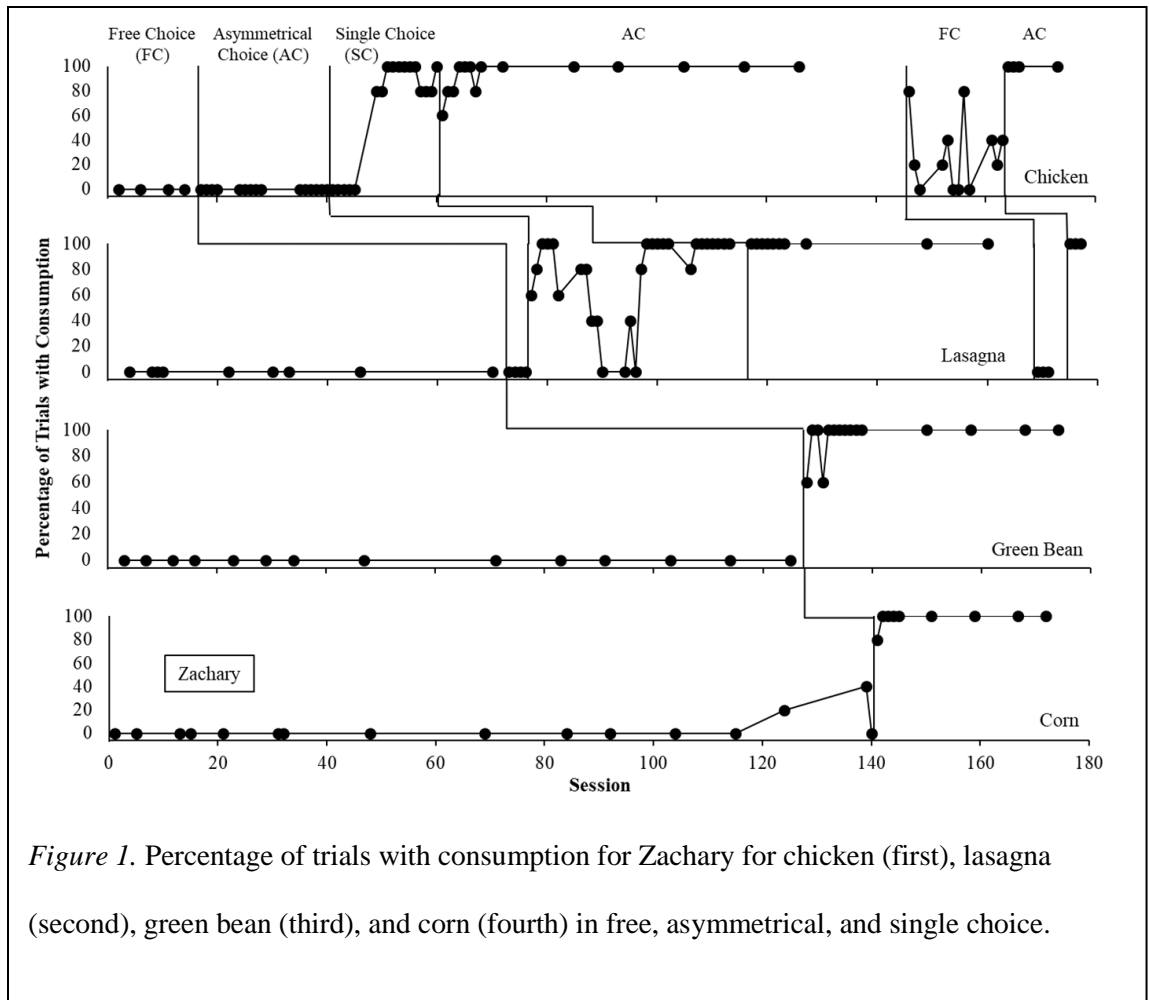
Figure 1. Percentage of trials with consumption for Zachary for chicken (first), lasagna (second), green bean (third), and corn (fourth) in free, asymmetrical, and single choice.

Figure 2 displays percentage of trials with consumption for Kelsey for potato (first), pea (second), green bean (third), and yam (fourth). During free choice initially, mean percentage of consumption of the healthy target foods was 0%, 0%, 0%, and 14% (range, 0% to 100%) for potato, pea, green bean, and yam, respectively. During asymmetrical choice for potato, percentage of consumption was moderate ($M = 50\%$; range, 0% to 80%). During single choice, percentage of potato consumption was high ($M = 91\%$; range, 0% to 100%). When we reversed to the asymmetrical-choice contingencies for potato, Kelsey maintained high levels of consumption ($M = 86\%$; range, 60% to 100%). We observed a moderate but decreasing percentage of pea consumption in asymmetrical choice ($M = 68\%$; range, 20% to 100%); therefore, we implemented the single-choice contingencies, in which we observed high, stable levels ($M = 83\%$; range, 40% to 100%). Percentage of consumption decreased in the first return to

asymmetrical choice ($M = 13\%$; range, 0% to 20%) and increased in the return to single choice

($M = 82\%$; range, 0% to 100%). Percentage of consumption maintained at high, stable levels in a

final return to the asymmetrical-choice contingencies with pea ($M = 97\%$; range, 80% to 100%).

Kelsey never consumed green bean in asymmetrical choice initially ($M = 0\%$). During the single-

choice contingencies, Kelsey consumed green bean at high, stable levels ($M = 84\%$; range, 60%

to 100%) that maintained when we reversed to asymmetrical choice ($M = 100\%$). We observed a

high percentage of consumption for yam during the asymmetrical-choice contingencies ($M =$
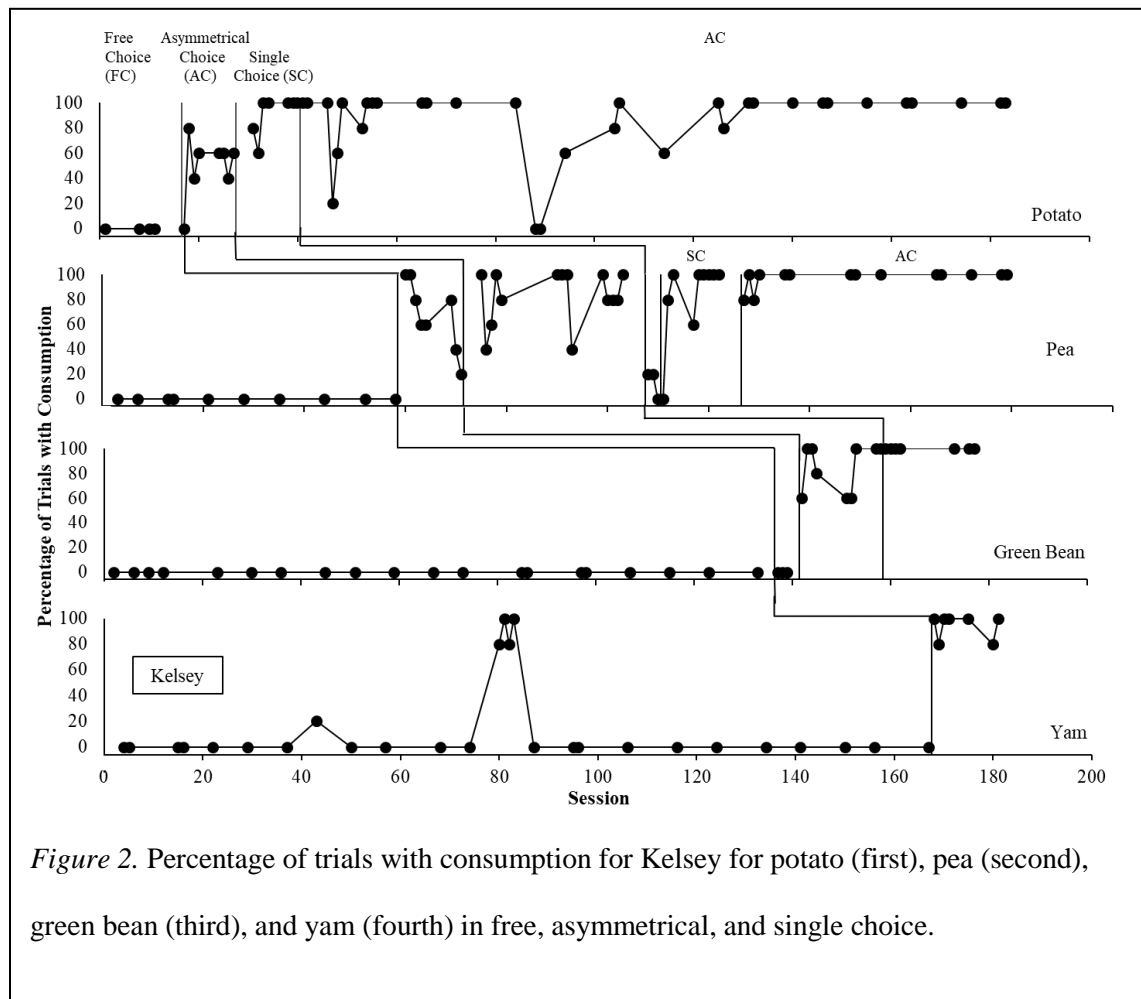
94%; range, 80% to 100%).

Figure 2. Percentage of trials with consumption for Kelsey for potato (first), pea (second),

green bean (third), and yam (fourth) in free, asymmetrical, and single choice.

Figure 3 displays percentage of trials with consumption for Micah for baked bean (first),

pineapple (second), white rice (third) and pea (fourth). During free choice initially, mean

percentage of consumption of the healthy target foods was 0%, 0%, 5% (range, 0% to 20%), and

33% (range, 0% to 80%) for baked bean, pineapple, white rice, and pea, respectively. Micah never consumed baked bean in asymmetrical choice initially ($M = 0\%$). During single choice, percentage of consumption increased ($M = 58\%$; range, 0% to 100%). When we reversed to the asymmetrical-choice contingencies, Micah consumed baked bean at high levels ($M = 80\%$; range, 40% to 100%). When we reversed to free choice with baked bean, percentage of consumption declined ($M = 7\%$; range, 0% to 20%). When we returned to asymmetrical choice, percentage of consumption eventually decreased ($M = 54\%$; range, 0% to 100%); therefore, we returned to the single-choice contingencies with baked bean and observed an increase in percentage of consumption to high, stable levels ($M = 79\%$; range, 40% to 100%). During a return to the asymmetrical-choice contingencies, percentage of consumption for baked bean maintained at high, stable levels ($M = 94\%$; range, 80% to 100%). We observed a high percentage of consumption for pineapple in asymmetrical choice ($M = 92\%$; range, 80% to 100%), followed by a decrease when we reversed to free choice ($M = 44\%$; range, 0% to 100%). Percentage of pineapple consumption returned to high, stable levels in asymmetrical choice ($M = 97\%$; range, 80% to 100%). Next, we observed a high, stable percentage of white rice consumption in asymmetrical choice ($M = 75\%$; range, 40% to 100%). Percentage of consumption for white rice did not maintain in free choice $(M = 0\%)$; therefore, we returned to the asymmetrical-choice contingencies and observed an increase in percentage of consumption to high levels ($M = 79\%$; range, 20% to 100%). Percentage of pea consumption decreased in asymmetrical choice ($M = 0\%$), but increased to high, stable levels ($M = 100\%$) in single choice. Percentage of pea consumption maintained under the asymmetrical-choice contingencies ($M = 88\%$; range, 60% to 100%), but did not maintain in free choice ($M = 13\%$; range, 0% to 20%). Percentage of pea consumption maintained at high, stable levels in asymmetrical choice ($M = 98\%$; range, 80% to 100%).
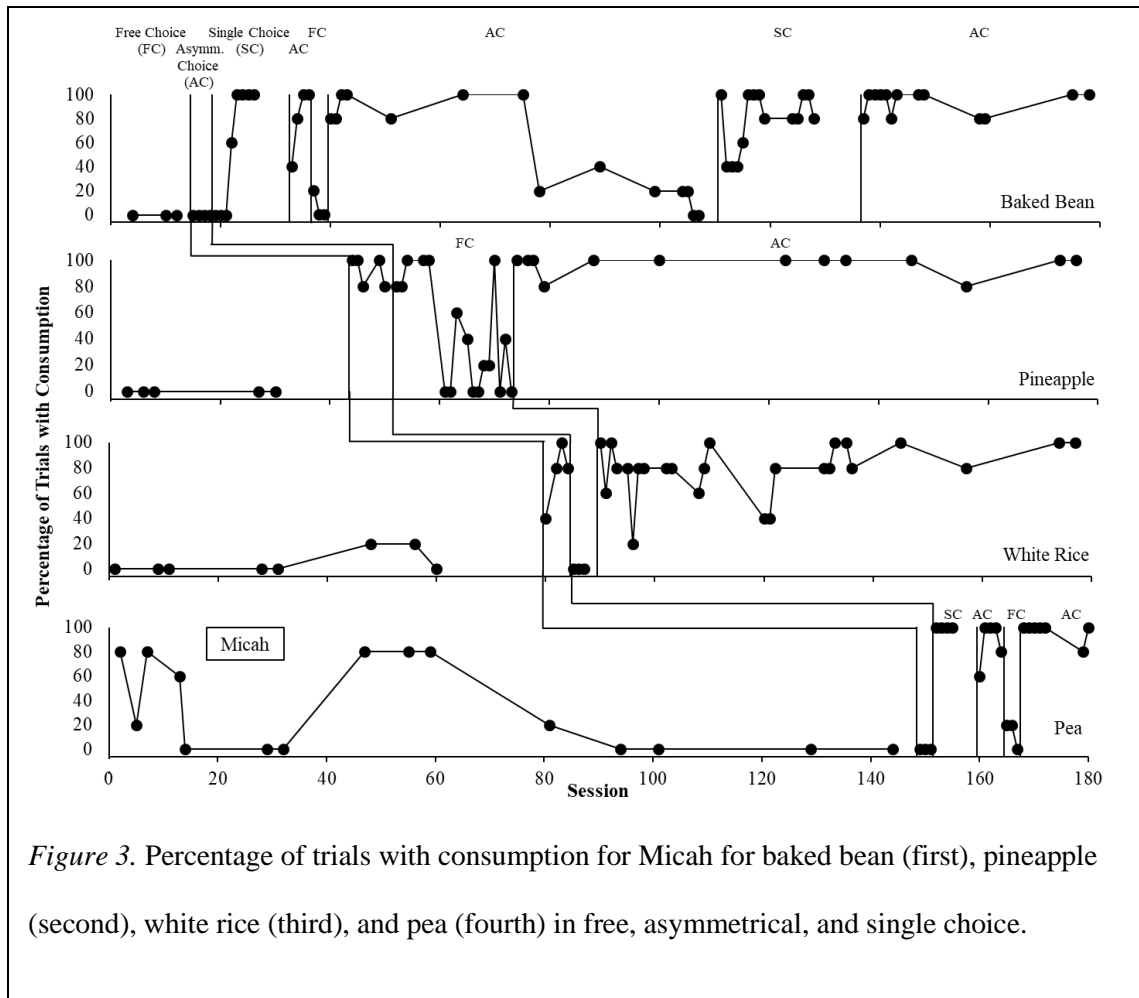
Figure 3. Percentage of trials with consumption for Micah for baked bean (first), pineapple (second), white rice (third), and pea (fourth) in free, asymmetrical, and single choice.

Figure 4 displays percentage of trials with consumption for Alfonzo for potato (first), cauliflower (second), avocado (third), and chicken (fourth). During free choice initially, mean percentage of consumption of the healthy target foods was 0%, 0%, 0%, and 12% (range, 0% to 60%) for potato, cauliflower, avocado, and chicken, respectively. Percentage of consumption increased to moderate levels in asymmetrical choice for potato ($M = 63\%$; range, 0% to 100%). During the single-choice contingencies, percentage of consumption increased to high, stable levels ($M = 98\%$; range, 80% to 100%). When we reversed to asymmetrical choice for potato, Alfonzo maintained a high percentage of consumption ($M = 100\%$). We then reversed to free choice and observed a reduction in percentage of potato consumption ($M = 10\%$; range, 0% to 20%). Finally, we observed percentage of potato consumption increase to high levels in the asymmetrical choice ($M = 90\%$; range, 40% to 100%). We observed an increase in percentage of

cauliflower consumption under the asymmetrical-choice contingencies ($M = 90\%$; range, 80% to 100%), which decreased in free choice ($M = 20\%$; range, 0% to 100%). When we reversed to the asymmetrical-choice contingencies, percentage of cauliflower consumption again increased ($M = 96\%$; range, 80% to 100%). We also observed an increase in percentage of avocado consumption in asymmetrical choice ($M = 100\%$). Percentage of avocado consumption decreased in free choice ($M = 0\%$), but increased to high levels in the return to the asymmetrical-choice contingencies ($M = 97\%$; range, 80% to 100%). Last, we observed an increase in percentage of chicken consumption in asymmetrical choice ($M = 88\%$; range, 60% to 100%) and a reduction in percentage of chicken consumption in free choice ($M = 37\%$; range, 0% to 80%). When we reversed to the asymmetrical-choice contingencies, percentage of chicken consumption returned to high, stable levels ($M = 92\%$; range, 60% to 100%).

Figure 4. Percentage of trials with consumption for Alfonzo for potato (first), cauliflower (second), avocado (third), and chicken (fourth) in free, asymmetrical, and single choice.
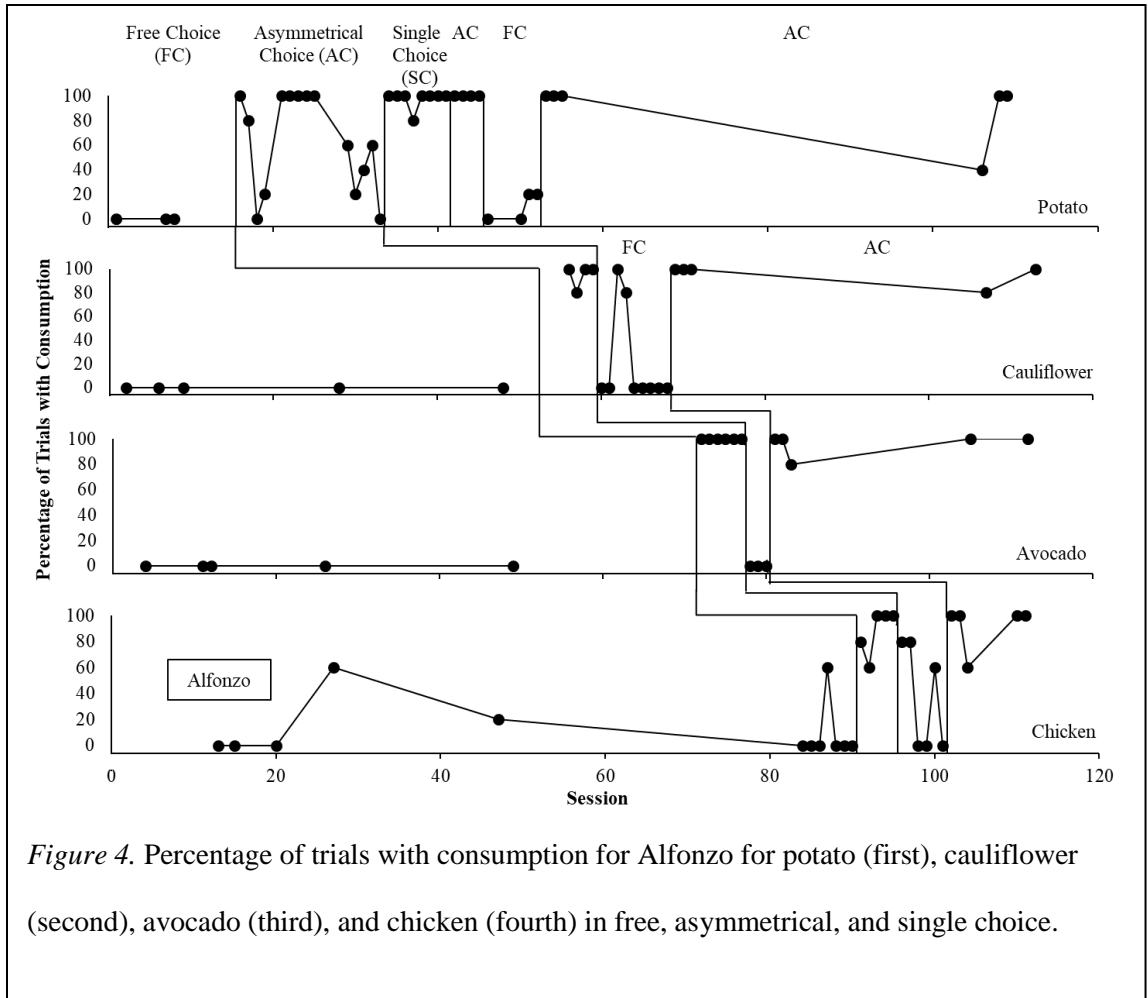
Figure 5 displays percentage of trials with consumption for Steven for baked bean (first), strawberry (second), broccoli (third), and sandwich (fourth). During free choice initially, Steven never consumed the healthy target foods ($M = 0\%$ for all foods). Mean percentage of consumption of the healthy target foods in asymmetrical choice was 100%, 100%, 77% (range, 20% to 100%), and 95% (range, 80% to 100%) for baked bean, strawberry, broccoli, and sandwich, respectively. When we reversed to free choice, percentage of consumption decreased ($M = 0\%$ for all foods). We completed the evaluation with all healthy target foods under the asymmetrical-choice contingencies, during which, percentage of consumption increased to 100%, 98% (range, 80% to 100%), 94% (range, 60% to 100%), and 88% (range, 60% to 100%) for baked bean, strawberry, broccoli, and sandwich, respectively.
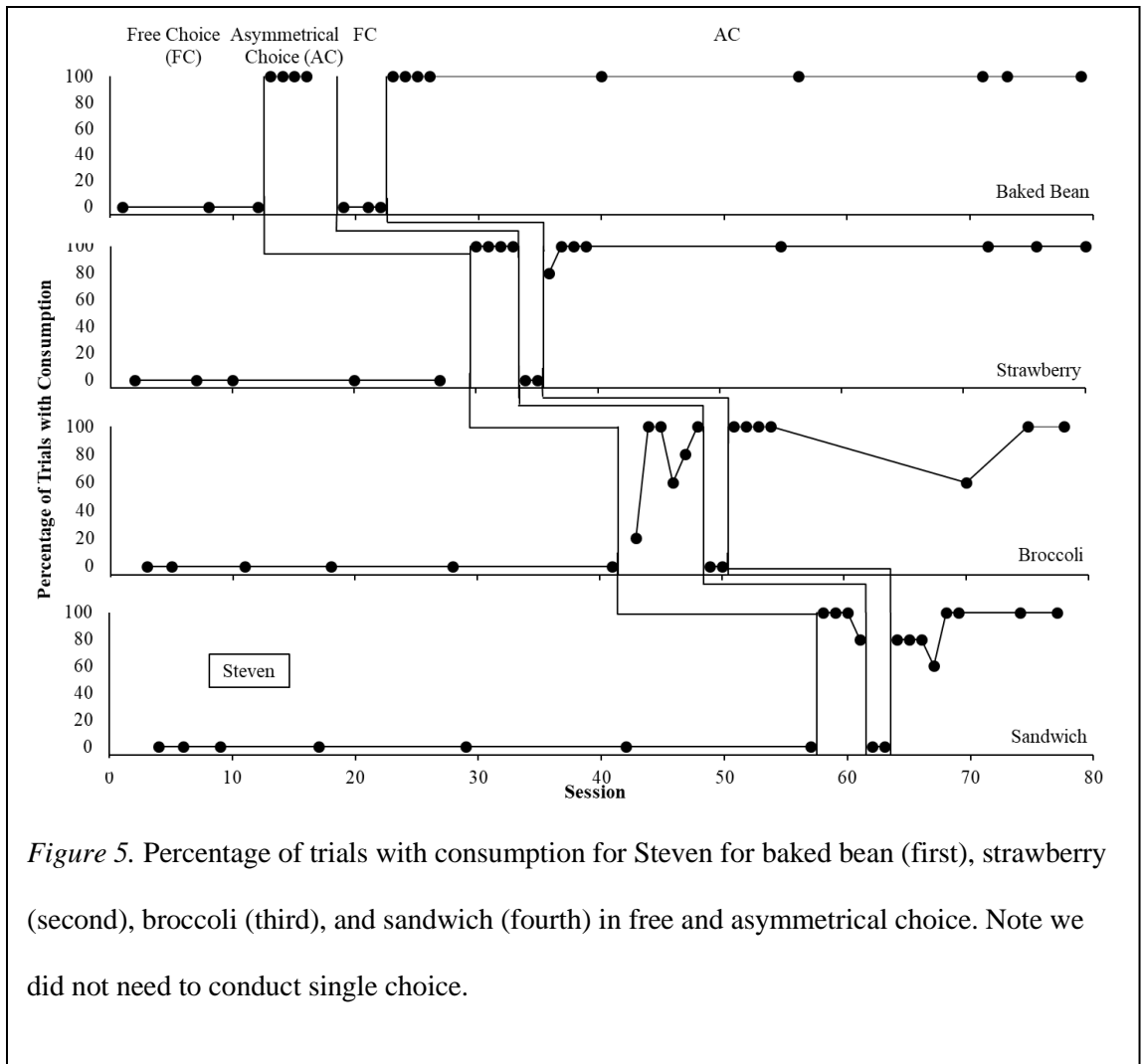
Figure 5. Percentage of trials with consumption for Steven for baked bean (first), strawberry (second), broccoli (third), and sandwich (fourth) in free and asymmetrical choice. Note we did not need to conduct single choice.

Figure 6 displays percentage of trials with consumption for Genevieve for carrot (first), cheese (second), pancake (third), and pear (fourth). During free choice initially, mean percentage of consumption of the healthy target foods was 0%, 0%, 2% (range, 0% to 20%), and 3% (range, 0% to 20%) for carrot, cheese, pancake, and pear, respectively. In asymmetrical choice for carrot, mean percentage of consumption was 0%. During the single-choice contingencies for carrot, Genevieve still did not meet the definition for consumption ($M = 0\%$) because she did not accept bites within 8 s. Next, we implemented the guided-choice contingencies and observed an increase in percentage of carrot consumption ($M = 54\%$; range, 0% to 100%). Percentage of consumption maintained at high, stable levels in single choice ($M = 95\%$; range, 80% to 100%). In the reversal to asymmetrical choice, we observed a decrease in percentage of carrot consumption ($M = 7\%$;

range, 0% to 20%), followed by a gradual increase in percentage of carrot consumption during a return to the single-choice contingencies ($M = 72\%$; range, 0% to 100%). Finally, mean percentage of consumption was high for carrot in asymmetrical choice ($M = 97\%$; range, 80% to 100%).We observed 0% cheese consumption in asymmetrical choice; however, percentage of consumption increased to high, stable levels in guided choice ($M = 87\%$; range, 40% to 100%). Percentage of consumption was high for cheese in single choice ($M = 95\%$; range, 80% to 100%) and in the reversal to the asymmetrical-choice contingencies ($M = 100\%$). Percentage of cheese consumption did not maintain in the reversal to free choice ($M = 40\%$; range, 0% to 60%): however, percentage of cheese consumption increased in the final return to asymmetrical-choice contingencies ($M = 94\%$; range, 80% to 100%). We observed a high percentage of pancake consumption in asymmetrical choice ($M = 80\%$; range, 60% to 100%) and a decrease in percentage of consumption for pancake in a reversal to free choice ($M = 10\%$; range, 0% to 40%). Percentage of consumption was moderate and variable in the return to asymmetrical choice ($M = 72\%$; range, 20% to 100%); therefore, we moved to the single-choice contingencies for pancake and observed an increase in percentage of consumption ($M = 95\%$; range, 80% to 100%). We observed a higher percentage of consumption in a final return to the asymmetrical-choice contingencies for pancake ($M = 77\%$; range, 40% to 100%). Percentage of pear consumption increased in asymmetrical choice ($M = 83\%$; range, 20% to 100%), but did not maintain in the reversal to free choice ($M = 17\%$; range, 0% to 60%). We observed an increase in percentage of pear consumption in a return to the asymmetrical-choice contingencies ($M = 88\%$; range, 40% to 100%).
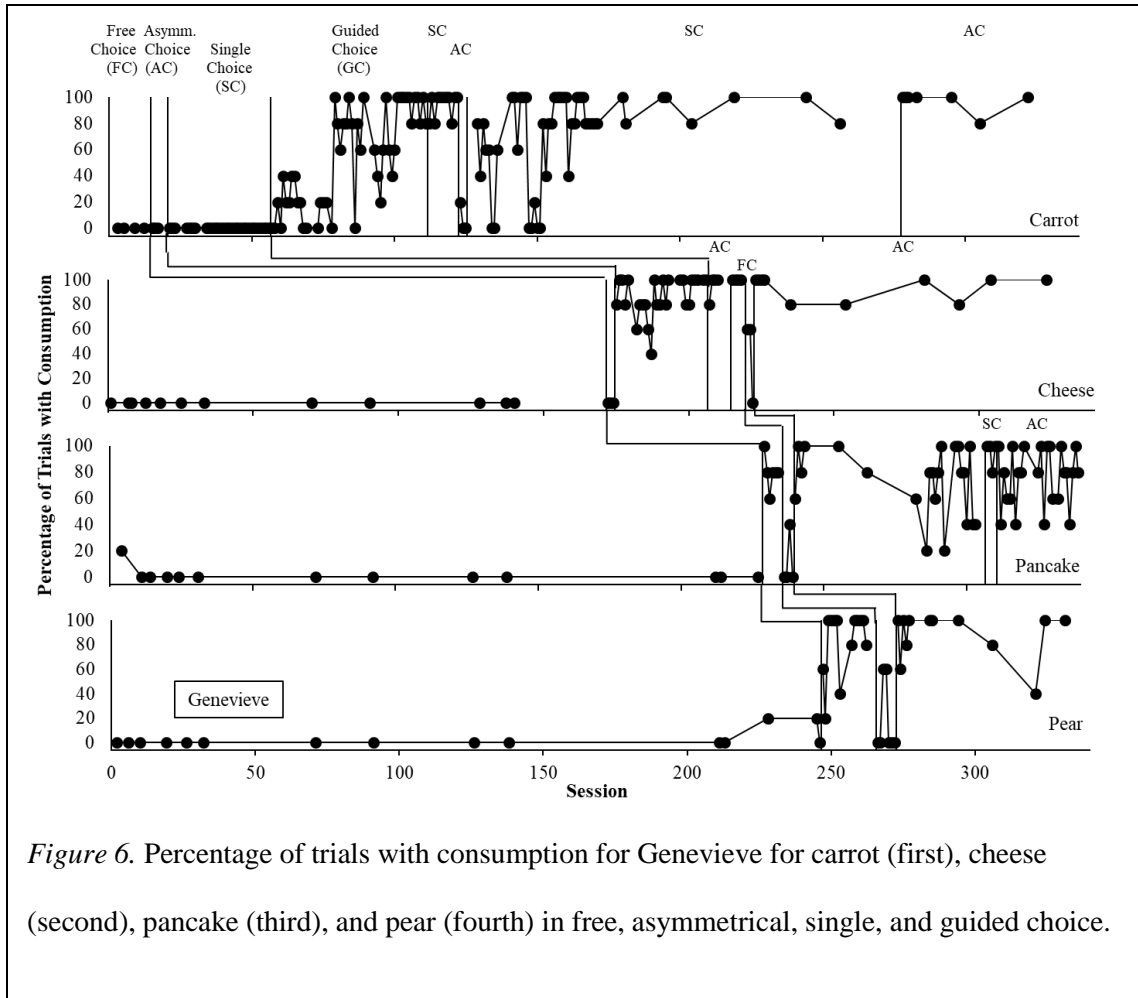
Figure 6. Percentage of trials with consumption for Genevieve for carrot (first), cheese (second), pancake (third), and pear (fourth) in free, asymmetrical, single, and guided choice.

Figure 7 displays percentage of trials with consumption for Titus for green bean (first), chicken (second), potato (third), and pea (fourth). During free choice initially, Titus never consumed green bean or chicken ($M = 0\%$) and rarely consumed potato or pea ($M = 2\%$; range, 0% to 20% for potato; $M = 31\%$; range, 0% to 100% for pea). Mean percentage of consumption increased to 75% (range, 0% to 100%), 85% (range, 20% to 100%), 83% (range, 60% to 100%), and 91% (range, 80% to 100%) for green bean, chicken, potato, and pea, respectively, in asymmetrical choice. When we reversed to free choice, percentage of consumption decreased ($M = 7\%$; range, 0% to 20% for green bean; $M = 0\%$ for chicken; $M = 0\%$ for potato; $M = 0\%$ for pea). In the return to asymmetrical-choice contingencies, mean percentage of consumption increased again to 79% (range, 0% to 100%), 92% (range, 80% to 100%), 94% (range, 0% to 100%), and 94% (range, 80% to 100%) for green bean, chicken, potato, and pea, respectively.
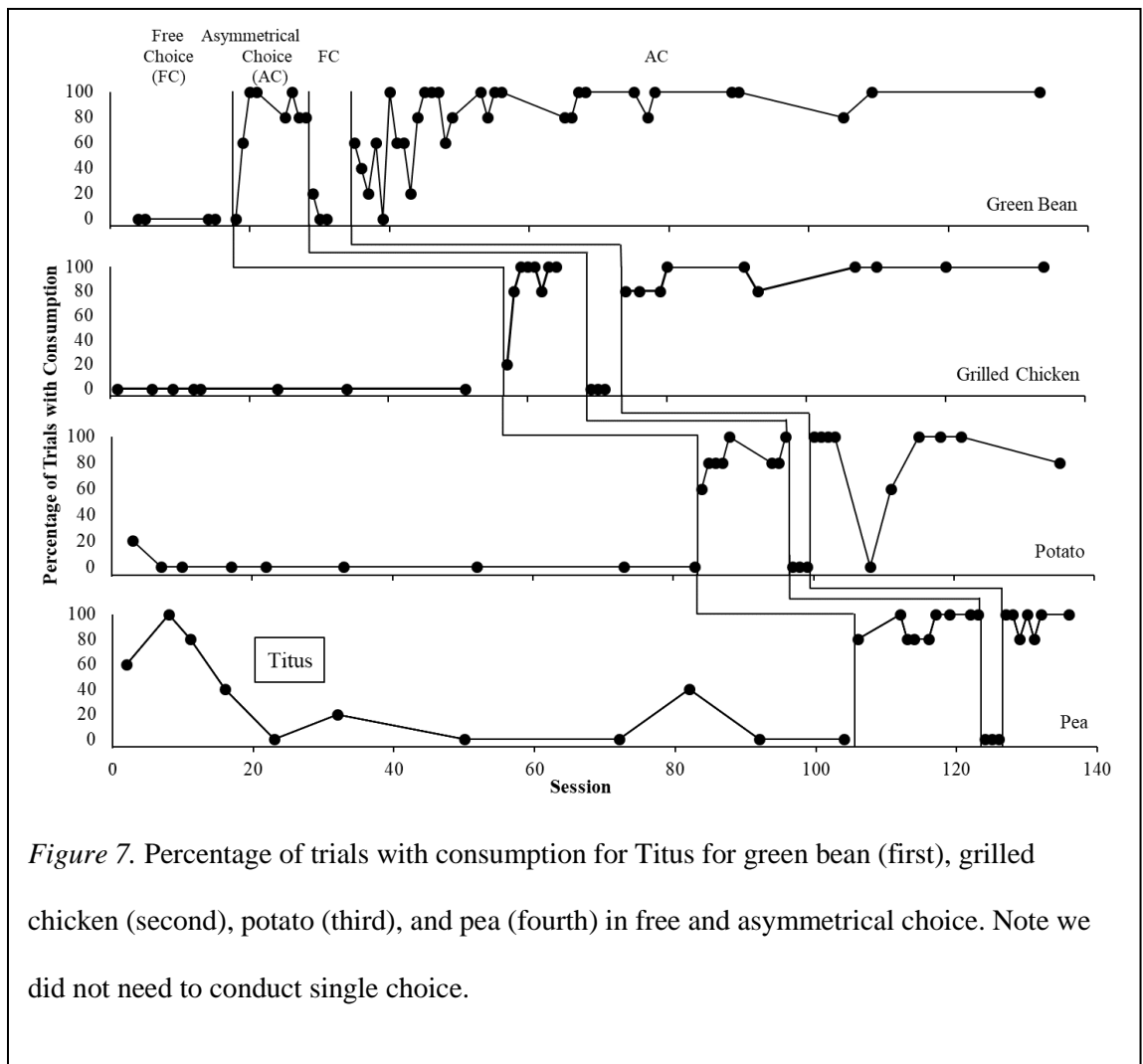
Figure 7. Percentage of trials with consumption for Titus for green bean (first), grilled chicken (second), potato (third), and pea (fourth) in free and asymmetrical choice. Note we did not need to conduct single choice.

CHAPTER 3: DISCUSSION

The preparation we used and the results of the current investigation are novel for several reasons. Many studies on treatment of feeding disorders use an arrangement in which a feeder presents individual bites of target foods (e.g., Patel, Piazza, Martinez, Volkert, & Santana, 2002; LaRue et al., 2011) or multiple bites of target foods simultaneously (e.g., Penrod, Wallace, Reagon, Betz, & Higbee, 2010) to evaluate effects of baseline and treatment conditions. In typical eating situations, however, children often have choices between food options, such as when they eat at the school cafeteria or when searching their pantry for a snack. In these situations, children with food selectivity are likely to select and consume their most preferred food rather than a healthy, novel food. The preparation we used in the current study more closely approximates typical situations in which the child has choices among foods. In fact, we pitted the healthy target food against the participant's change-resistant food(s) in a paired choice-arrangement specifically to teach the participants not just to eat the target food, but to choose the target food and eat it even when the change-resistant food was available concurrently.

We used the matching law as a conceptual framework for hypothesizing how choice responding changes in relation to available reinforcement for concurrent options. Note that we did not use the matching law in its mathematical form. The participants in the current study consistently selected and consumed the change-resistant food when given a choice between a change-resistant food and a target food in the free-choice condition, with a few exceptions. We hypothesize that selection and consumption of the change-resistant food produced several reinforcers, which biased the participant's responding toward the change-resistant food. As noted above, children with autism may experience the world as a confusing, unpredictable place. Thus, change-resistant behavior may produce automatic reinforcement in the form of imposing order on an otherwise unpredictable environment. That is, the consequences of engaging in the change-resistant behavior are predictable, but the consequences of engaging in novel behavior are not.

The change-resistant behavior also may provide the child with control over his or her environment. Even though the child chooses the same foods over and over, research shows that choice making functions as reinforcement even when it produces identical consequences (Fisher, Thompson, Piazza, Crosland, & Gotjen, 2013). Finally, studies on conditioned food preferences show that exposure is one method by which humans develop preferences for foods. Clearly, the participants had a long history of exposure to the change-resistant foods relative to no or minimal exposure to the target foods. In addition, studies on food preferences show that humans prefer tastes that are sweet or salty and are associated with a high fat content (Capaldi, 1996, Chapter 3). Change-resistant foods for most participants were high in fat, such as hot dog, or sweet, such as Cheerios and apples. Change-resistant foods included hot dog and Cheerio for Zachary; pancake, hot dog, pear, and strawberry for Kelsey; Fruit Loops, Captain Crunch, and waffle for Micah; Fruit Loops, Captain Crunch, tropical fruit, and pancake for Alfonzo; banana and quesadilla for Steven; Fruit Loops, Captain Crunch, and chicken nuggets for Genevieve; and chicken nugget, French fries, Nutella on bread, and apple for Titus.

Providing reinforcement in the asymmetrical-choice condition for selecting and consuming the target food was sufficient to switch responding for Steven and Titus to the target foods. Kelsey and Alfonzo contacted reinforcement during asymmetrical choice for selecting and consuming the food in Leg 1 of the multiple baseline, potato. Kelsey's responding maintained at about 50%, which was an improvement from free choice because she never selected or consumed potato in that condition. Alfonzo's consumption was as high as 100% in some sessions of asymmetrical choice, but dropped to 0. Results of some studies have shown that differential reinforcement may be sufficient to increase acceptance of foods for some children with feeding disorders, but not others. The results of the current study are novel because selection and consumption of target foods increased consistently for two participants and inconsistently for two participants even though the participant's change-resistant foods were available, and no negative

consequences occurred if the participant selected and consumed the change-resistant food other than he or she did not gain access to the preferred item.

Percentage of consumption of target foods increased for Zachary, Micah, and Genevieve or increased to clinically acceptable levels for Kelsey and Alfonzo only after exposing at least one food to the single-choice contingencies. These results are consistent with previous literature demonstrating that acceptance does not increase for many participants with a feeding disorder with differential reinforcement alone; these participants require at least some exposure to nonremoval of the spoon (Patel et al., 2002; Piazza, Patel et al., 2003; Reed et al., 2004). The current study added to the literature because we showed that exposure to nonremoval of the spoon during single choice had beneficial effects beyond simply increasing consumption of target foods. After we exposed foods to nonremoval of the spoon in the single-choice condition, we reversed to the asymmetrical-choice condition. Participants continued to consume foods that we had exposed to the single-choice contingencies even when we returned to asymmetrical choice, in which they could consume the change-resistant food. We replicated this finding with every participant for whom we exposed at least one food to the single-choice contingencies and for every food we exposed to the single-choice contingencies.

An additional benefit of the preparation and the treatment was that we observed generalization after we exposed at least one food to the single-choice contingencies, meaning the percentage of consumption increased for some foods during asymmetrical choice without exposing that food(s) to single choice. Increased consumption of foods during asymmetrical-choice without exposure to single-choice contingencies during the multiple baseline occurred for yam in Leg 4 for Kelsey; for cauliflower, avocado, and chicken in Legs 2, 3, and 4, respectively, for Alfonzo; for green bean and corn in Legs 3 and 4, respectively, for Zachary; for pineapple and white rice in Legs 2 and 3, respectively, but not for pea in Leg 4 for Micah; and for pear in Leg 4 for Genevieve. Thus, Kelsey, Alfonzo, Zachary, Micah, and Genevieve required exposures of

three, one, two, one, and three foods, respectively, to nonremoval of the spoon during the single-choice condition before they began consuming other food(s) during asymmetrical choice. Note that Micah's response pattern was different from those of Alfonzo and Zachary. We had to implement the single-choice contingencies for pea in Leg 4 for Micah, but he was consuming the foods in Legs 2 and 3 during asymmetrical choice without exposure to the single-choice contingencies. By contrast, once Alfonzo was consuming the Leg 2 food in asymmetrical choice, he also began consuming the Leg 3 and 4 foods in asymmetrical choice. Once Zachary was consuming the Leg 3 food in asymmetrical choice, he also began consuming the Leg 4 food.

One possible explanation for the finding for Micah is that he did consume pea initially in the free-choice condition, and his pea consumption extinguished in the absence of reinforcement in that condition. A second possibility is that the target foods he consumed during asymmetrical choice, pineapple and white rice, were more like those he consumed typically, which were also grains and fruits. By contrast, he never consumed vegetables historically. This latter explanation is doubtful, however, because he consumed pea in free choice. His consumption of pea in free choice is like that of Titus. Both boys consumed Skittles, and we hypothesize that they consumed pea initially because of its visual similarity with a green Skittle. This hypothesis is speculative, however. Researchers should investigate whether the visual properties of food affect consumption among children with autism.

The increased consumption during asymmetrical choice either during a reversal from single-choice contingencies or after exposing one or more foods to single-choice contingencies is even more impressive considering that we paired each condition with discriminative stimuli. That is, five participants shifted responding from the change-resistant food to the target food after exposing at least one target food to single choice even though discriminative stimuli signaled the contingency arrangement for each condition. There are several possible explanations for this finding. Occurrence of the change-resistant response prevents occurrence and reinforcement of

alternative behavior, which also increases the value of reinforcement for the change-resistant behavior and the likelihood the change-resistant behavior will persist. By contrast, the preparation and contingencies in the single-choice condition eliminates the participant's opportunity to engage in the change-resistant behavior; thus, the reinforcement for the change-resistant behavior does not gain additional value. In addition, the contingencies in the single-choice condition expose the participant to reinforcement for and increases the predictability of consuming the target food. Given that the participant could not engage in the change-resistant response, he or she received repeated practice and exposure consuming the target food and accessing reinforcement. Thus, the consequences of consuming the target food became predictable, which we hypothesize is a reinforcer for children with autism. The single-choice contingencies also exposed the participant to the food, which is a potential mechanism for increasing preferences for foods. Although results of recent studies have shown that exposure does not appear to increase preference for novel foods among children with food refusal (Zeleny et al., in press) and selectivity (Penrod & VanDalen, 2010), participants in Penrod and VanDalen (2010) did consume the novel foods more often than they did in baseline after exposure to those foods. The automatic reinforcement produced by predictable consequences, the contact with the tangible reinforcer, and the exposure to the target foods may have combined to shift responding from the change-resistant to the target food in the asymmetrical-choice condition after exposure of at least one food to single choice. Again, these findings are important because not only did we increase consumption of healthy target foods, we did so in the context of a concurrent-operants schedule, in which the participant had access to the change-resistant food in the asymmetrical-choice condition. This finding suggests that caregivers could continue to expand the child's diet without using single-choice contingencies for every new food (Peterson et al., 2016).

A limitation of this study, however, is that we did not test the children's ability to discriminate the colored stimuli or any biases toward the colors. Children in this study may not

have discriminated between single- and asymmetrical-choice contingencies, particularly because we paired and visibly presented the reinforcer during both conditions. On the other hand, both the target and change-resistant foods were available in the asymmetrical- but not the single-choice conditions, which should have aided discrimination between conditions. In addition, participants periodically selected the change-resistant food during the asymmetrical-choice condition, so they did contact the contingencies for both conditions. Future studies should evaluate participants' ability to discriminate between and preference for colored stimuli.

Clearly, the reinforcement produced by consumption of the target foods was not sufficient to maintain responding when we reversed to the free-choice condition. Participants' responding switched to the change-resistant food during reversals to free choice. The ultimate goal of feeding-disorders treatment is for the participant to select and consume healthy target foods in the absence of a programmed intervention. Although we did not achieve that outcome in the current study, our results could inform future studies that could achieve that goal.

There are many alternative explanations for the different outcomes across participants. For example, Steven and Titus were among the oldest in age (i.e., ages 7 and 8), had the largest verbal repertoires, and displayed more adaptive skills (e.g., toileting, self-dressing) than the other participants, and their behavior might have been rule governed. However, Kelsey was 8 months older than Steven and required exposure to the single-choice contingencies to increase the percentage of consumption for three of four target foods. Alfonzo and Micah were twins and demonstrated dissimilar outcomes. Future researchers could assess the effects of rules on feeding interventions. Treatment dosage also could have been a contributing factor. For example, Genevieve had appointments that were more spaced apart across the week. Research in other areas of ABA suggests that more intense and consistent exposure to ABA results in more immediate and robust outcomes (Lovaas, 1987; McEachin, Smith, & Lovaas, 1993); treatment dosage is beginning to become an area of research in pediatric feeding as well (Peterson, Piazza,

Ibañez & Fisher, in press). Carry-over effects between the different contingencies implemented in the legs of the multiple baseline might have affected the results. We always randomly alternated between foods during meals to minimize the likelihood of order effects and to ensure each food had equal exposure to the contingencies.

A limitation of this study is that we do not know the effects of the preassessment used to determine whether the participant would consume the change-resistant foods. During the preassessment, we manipulated stimulus properties of the participant's change-resistant foods by changing the size of the bites and the presentation format (i.e., we placed the food on a specific spoon, in a specific bowl). We included the preassessment to prevent satiation too early in the meal and to avoid further biasing responding toward the change-resistant food due to other features (e.g., bite size). Although we conducted this preassessment without any differential consequences, the assessment itself may have increased the participant's tolerance of trying novel foods or novel stimulus properties in general. If the preassessment led to a decrease in the aversiveness of novel foods, then participants who consumed more in the preassessment may have demonstrated a more rapid increase in consumption of the novel target foods. Future researchers should conduct baselines with target foods alone prior to and following the preassessment to rule out the possibility that this exposure increased the likelihood that the child would consume novel foods.

Another limitation of the current investigation is that we did not conduct a preference assessment with the change-resistant foods. We selected the change-resistant foods from the 3-day food log thus assuming those foods were at least moderately preferred. The relative preference of the change-resistant foods is important because it could affect the value of consuming that food. Future researchers should consider conducting a preference assessment with the change-resistant foods to evaluate whether the relative preference of the change-resistant foods results in differential responding in free and asymmetrical choice.

Although we hypothesize that children with autism often display resistance to change in the form of food selectivity, we did not assess whether our treatment impacted resistance to change or simply increased the likelihood the participants would consume the target foods. If food selectivity for children with autism is a symptom of resistance to change, it may be that by intervening on food targets first, we could observe generalization to nonfood targets (e.g., daily living routines such as wearing different clothing or taking a new route to school). To assess this, future researchers should conduct formal assessments, such as the Repetitive Behavior Scale-Revised (RBS-R) as well as conduct free-choice baselines of nonfood related targets both prior to and following treatment with food.

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