The Effects of a Visually Appealing and Interactive Snack Activity on Fruit and Vegetable Intake of Preschool-Aged Children

A Thesis Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

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August 2016

Acknowledgements

Thank you to my advisor, Dr. Marsha Spence for all of her continual support and guidance. Thank you to my thesis committee, Dr. Sarah Colby and Dr. Katie Kavanagh for their feedback on my project. Thank you to the students in the ICAN-GROW lab for all of their assistance on my project. Lastly, thank you to all the other faculty and staff members of the University of Tennessee Nutrition Department who have contributed to my journey to becoming a better public health nutrition professional.

Abstract

Background: Previous research has shown the potential of increasing vegetable intake by incorporating the senses into interventions. However, little to no research has specifically looked at the impact that the use of the senses can have on intake of vegetables among preschool-aged children.

Purpose: The aims of this study were to examine if mean intake of vegetable snacks and/or willingness to try the vegetable snacks would be significantly higher among preschool-age children who participated in a visually appealing and interactive snack activity compared to children who received control vegetable snacks.

Methods*:* Two preschools were selected to participate in the study. Prior to the start of the study, participants colored placemats that contained heart-, star-, and flower-shapes. Parents were surveyed to establish the target vegetable, which was determined to be green pepper. The vegetable was served three times. The control group received the vegetable cut into strips served on white paper plates. The experimental group received the vegetable cut into hearts, stars, and flowers and served on the placemats that children colored at the beginning of the study. The vegetable was weighed before and after each snack time.

Results: There were no significant differences found in intake of the vegetable snack between the control and the intervention group. However there were significant differences in willingness to try and between the genders.

Conclusion: Although there were no significant differences in consumption between the groups, the significant findings between the boys and girls highlights a potential area that needs further investigating.

Table of Contents

Chapter I: Literature Review 1
Introduction 1
Current Nutrition Guidelines and Diet Quality of Preschoolers 1
Factors that may affect proper intake 2
Past Interventions 4
Incorporating the Senses into Interventions 8
Visual Appeal 10
Touch and Interaction with Foods 12
Cooking with a Chef 16
Theoretical Framework 17
Discussion 18
Conclusion 19
Chapter 2: Manuscript 20
Chapter 3: Expanded Methods 32
Recruitment and Participants 32
Study Design 32
Selection of Target Fruits and Vegetables 33
Randomize into Two Groups 33
The Snack Activity 34
Evaluating Intake Across the Two Groups 35
Statistical Analysis 35
Strengths and Limitations 36
References 37
Appendices 43
Appendix A 45
Appendix B 49
Appendix C 52
Appendix D 54
Appendix E 55
Appendix F 56
Appendix G 57
Vita 58

List of Tables

Table 1. Demographic Characteristics of Experimental and Control Groups.....25
Table 2. Mean Consumption Difference Within Groups by Time Point...……..……..25
Table 3. Mean Difference in Consumption Between Groups by Time Point……...…….26
Table 4. Mean Difference in Consumption Between Groups by Genders and Time Point...……26
Table 5. Chi-Square Analysis of Willingness to Try by Time Point..……...…27
Table 6. Study Arms……..33
Table 7. Classroom Randomization...…….34
Table 8. Snack Schedule. ……..35
Table 9. Independent and Dependent Variables…….....…….36
Table 10. Mean Fruit Intake Difference Within Groups by Time Point……57
Table 11. Mean Difference in Consumption of Fruit Snack Between Groups by Time Point.....57

Chapter I: Literature Review

Introduction

Based on the Life Course Theory (LCT), factors that can influence an individual's health in adulthood can start as early as in the womb.[1] The National Institute for Health Care Management calls public health professionals to focus on "upstream" determinants, which may have detrimental effects on children as they get older.[1] Also by improving "upstream" determinants, a person's health trajectory may improve as well.[1] To raise the next generation as a healthier generation, healthy habits should be instilled in children at a very young age. The early stages of life (birth to six years) are the most crucial for the development of a person and can have long-term effects; and therefore, the earlier these healthy habits are started, the better.[2] According to Healthy People 2020, chronic diseases and cancers may start developing in this early stage of life if optimal health is not being met.[2] Nutrition experts are currently concerned with the lack of variety and quality of children's diets.[3] A component of healthy eating is an intake of a variety of fruits and vegetables (F&Vs) daily. The purpose of this project was to review the literature on fruit and vegetable (F&V) intake in preschool-aged children (two- to five-year-olds) and to add to the literature on what may be a better approach in increasing intake of F&Vs.

Current Nutrition Guidelines and Diet Quality of Preschoolers

According to the 2015 Dietary Guidelines for Americans, preschool-aged children should consume one to one and half cups of fruits and one to two cups of vegetables per day.[4] Currently, preschoolers are not meeting or are barely meeting these recommendations.[4,5] Research shows that 50% of children aged two to five years do not meet daily fruit recommendations, and 78% do not meet daily vegetable intake.[5] Secondly, it is important to examine the types of F&Vs children routinely eat. According to the 2015 Dietary Guidelines, potatoes made up 21% of the

most commonly consumed vegetable and tomatoes made up 18% of the most commonly consumer vegetables.[4] Additionally, 100% fruit juice made up 47% of total fruit intake for one to three year olds.[4]

Factors that may affect proper intake

The two major influences on children's eating behavior are parents and childcare providers.[6,7,9] It is important to include childcare providers because a large portion of young children spend the majority of their time in someone's care other than their parents.[6,7] This results in children eating a majority of their meals away from their parents and in preschool or childcare settings.[7] The ways parents and preschool and/or childcare providers can influence a child include access to foods, feeding practices, modeling, and food socialization.[6,7,9]

First, parents and childcare providers can affect a child's eating behavior through their control over the access and availability of foods in the environment.[6] Parents are the ones who grocery shop and cook meals, and thus, act as the gatekeepers of foods available at home. If parents do not prepare F&Vs at home, it is unlikely that children can consume them. The Child and Adult Care Food Program (CACFP) provides guidelines for childcare providers to follow during meals and snacks.[8] The CACFP guidelines ensure children have access to nutritious meals and snacks when in childcare centers. The current CACFP snack guidelines for two- to five-year-olds are to select two of the following components: milk, fruit or vegetable, grain, or protein.[8] For those that do not follow the CACFP guidelines, the childcare providers often only prepare foods they believe the children will like and consume, which may result in the childcare centers underserving, and children who may not meeting daily nutrition requirements.[6,7]

Secondly, parents and childcare providers can influence F&V intake through various feeding practices.[6,7,9] One common feeding practice is bribing. For example, parents sometimes

think that bribing children to eat disliked foods by saying that they will receive a liked food or be able to participate in a fun activity, will result in children eating more of the disliked food. However, research shows that this technique often causes the liked foods to be desired more and the disliked food to be disliked even more.[6,9] Another feeding practice is simply to force children to eat the disliked foods, which also may result in the child disliking the food even more.[6,9] Childcare providers' behaviors may have very similar effects. In addition, sometimes parents and/or childcare providers encourage children to clean their plates, which may cause overeating and may affect children's ability to learn to stop eating when full.[7]

Another influence that has an effect on children's eating behaviors and dietary intakes is modeling. Often children learn eating behaviors by watching their parents, other family members, and/or childcare providers.[6] If children's parents consume F&Vs, many children are likely to follow the examples and consume F&Vs as well. However, it should be noted that some studies have found a weak correlation between the two.[9] Research suggests that modeling F&V consumption by childcare providers may have similar effects on children and their intake of F&Vs. Though oftentimes, this does not happen, best practices suggest that childcare providers should sit with children and eat the same meal that is served to the children.[7]

Lastly, food socialization from parents and childcare providers can have an effect on F&V intake.[6] Food socialization is the idea that the meal is an important time for both parents and childcare providers to talk about the kinds of foods on children's plates and the nutritional aspects of those foods. Also, part of food socialization theorizes that parents' feelings towards certain foods or eating behaviors may be transferred to children's eating behaviors. Research shows that even after one meal, a child may associate the experience with food preferences. For

example, if a child had a negative experience at a particular meal, the child may negatively associate the food that was served and may begin to dislike it.

Interventions to Increase Fruit and Vegetable Intake

Past interventions that target home and childcare center feeding practices and focused on increasing F&V intake were examined for effectiveness. Several strategies have been studied for increasing F&V intake in children. Because fruit intake is believed to be easier to increase due to their sweet taste, most interventions specifically targeted increasing vegetable intake. Some of these strategies include repeated exposure, flavor-flavor learning, flavor-nutrient learning, increased portion sizes, family meals, offering a dip with a vegetable, and offering a choice of vegetables to consume. Repeated exposure is when the vegetable is given to the child repeatedly over a period of time so that they can become familiar with it.[10] Flavor-flavor learning is when an additional flavor component is added to a vegetable such as sweetness. In flavor-nutrient learning, the vegetable is made more energy dense by adding a fat such as sunflower oil, based on the theory that children prefer foods with higher energy densities.[10]

Past Interventions

In the United Kingdom, researchers specifically looked at increasing the intake of a novel or unfamiliar vegetable through three ways: repeated exposure, flavor-flavor learning, and flavor-nutrient learning.[10] The research team implemented the study in a preschool using a disliked vegetable, puréed artichoke, and a control vegetable, puréed carrot. For repeated exposure the children were exposed to both vegetables 10 times, for the flavor-flavor manipulation sweetness was added, and for the flavor-nutrient component sunflower oil was added. Overall, the results concluded repeated exposure was just as successful as flavor-flavor and flavor-nutrient learning. Also of importance, the researchers found intake did not

significantly increase after more than five exposures; thus, concluding that only five exposures might be needed to increase intake. However, this study had two major limitations. First, the research team conducted the study themselves, which could have caused a bias. Secondly, the use of pureed vegetable rather than the solid form could have affected intake.[10]

Another study on repeated exposure was conducted in the United States.[11] This study was different than the previous study because the researchers were not a part of the intervention at the preschool and only gathered the data after children ate. The vegetables used were cauliflower, snow peas, and green pepper. The purpose of this study was to examine the efficacy of repeated exposure in a natural setting. However, results of the study did not find a significant difference in intake after 10 exposures, but a limitation of the study could have affected intake; the intervention vegetables were served at lunch along with the vegetables the preschool was required to serve with the meal. This may have caused the children to make a choice between eating one or the other, rather than both.

In addition to repeated exposure the study looked at peer modeling, parent influences, and variability in intake.[11] The study found a slight positive correlation between the amount consumed by peers and the amount consumed by the subjects. This led to the conclusion that it might be beneficial to sit children who eat well with children who do not eat well in hopes that the latter will follow the others' intake. The research team did not find a relationship between parent feeding practices and intake. However, it should also be noted that the research team found a wide variation of intake within each participant; meaning one child would eat a vegetable one day and not the next, but then eat it again a week later. The researchers pointed out the fact that parents often stop serving a certain vegetable after a child refuses it only once, assuming that they do not like it. The researchers suggested that the variability may mean it is

important to continue exposing a vegetable to a child more than 10 times before the intake becomes consistent.

Another intervention looked at serving larger portions of F&Vs at meals.[12] The results found that doubling portions of F&Vs at a meal increased intakes. This study also found that children ate less of the more energy-dense main course and more of the F&Vs, which resulted in less overall calories consumed. Limitations of this study included a small sample size of 30 children, a majority of the sample started with a high preference for F&Vs, and the study was conducted in a research facility.

In London, a study was conducted on the relationship between parent involvement in meals and F&V intake of preschool children.[13] Positive correlations were found between family meals and intake as well as increased consumption when parents cut up F&Vs. Children who had family meals were likely to eat at least 1.5 servings more per day than children who did not ($p<.001$). A strength of the study was a large sample size of over 1,000. However, the results were limited by the use of a take home survey, which may have been subject to bias.

Additionally, research shows that offering a low-fat dip or herb-flavored dip with a disliked vegetable can increase intake.[14] A study used celery and squash and two types of dip. The study compared three groups, vegetables alone, the vegetables with plain low-fat dip, and the vegetables with herb-flavored dip. The results found that herb flavored dip decreased rejection three-fold over serving the vegetables alone. However, with this type of intervention comes the concern of increasing an energy-dense food. Parents do not typically serve a small amount of dip or what might be considered an appropriate serving size, which may cause the children to consume more calories than intended or needed.

In the Netherlands, researchers tested whether or not allowing the child to choose a vegetable would increase consumption.[15] Children were divided into three groups, no choice, pre-meal choice, and at-meal choice. The children in the no-choice group were presented with two vegetables and told that they were not allowed to pick which one they wanted. The children in the pre-meal choice group were asked to choose between two vegetables to be served at dinner. The children in the at-meal choice group were served two vegetables at dinner and told that they could eat either or both. The results of the study found that the pre-meal choice group of children liked getting a choice; however, it did not result in increased vegetable consumption. Strengths of the study included a large sample size and that the study was conducted in a restaurant setting. Although the restaurant would be more natural than a laboratory, it is less natural than the home. Overall, this study was the first to evaluate choice and consumption, and more research should be conducted before deciding its effectiveness.

In Minnesota, a research team tried altering the timing of when F&V were served at mealtime.[16] The researchers compared three different styles of serving food in a preschool. The control group ate lunch normally, in a family style. The children were allowed to serve themselves, but were required to get some of every food served that day. The second group was given pre-portioned plates of all menu items. Lastly, the third group was given F&Vs first to serve themselves, in a family style. The children were told they could go ahead and begin eating, and after five minutes the rest of the menu items were given to them. The results found the third group, served the F&Vs first, significantly increased fruit intake, but not vegetable intake. A limitation of the study was that it was conducted in only one preschool with a sample size of only 53 children.

Incorporating the Senses into Interventions

In recent years, the use of the senses has become a popular avenue to explore in nutrition interventions. Since preschoolers are at a stage where it is difficult to get them to eat new foods and even more so, to eat new F&Vs, techniques that make the initial intake a pleasant experience and to familiarize them with the F&Vs tend to work best.[17] The Ellyn Satter Institue also emphasizes the need for eating experiences to be enjoyable ones in order to have a positive impact on intake of healthy foods such as fruits and vegetables.[18] In 2012, Dazeley and colleagues looked at the importance of incorporating the senses into healthy eating interventions.[17] The research team reviewed the research and the benefits of each sense, including touch, sight, smell, and taste, and the benefits each could have on increasing intake. All of these components increased exposure and familiarization of F&Vs to children. The researchers concluded that there is a gap in the research of interventions that are sense-based for younger children.

Another study in Finland explored the impact all five senses could have on increasing kindergartner's willingness to try F&Vs.[19] The researchers conducted five weeks of activities focusing on different strategies to familiarize the participants with F&Vs. Taste was explored by allowing children to taste diluted solutions of salty, bitter, sweet, and sour. Touch was explored by allowing the participants to touch food samples in a bag. Smell was explored by using bottles that contained the odor of foods. Sound was explored by the children listening to the food being chewed. Each week focused on different activities so that the children could become more familiar with the foods through their senses. The researchers were comparing willingness to try by whether or not the participants completely refused, took a bite, ate half the sample, or ate the entire sample. The intervention group significantly increased their willingness to try the F&Vs ($p < .001$), but the control group did not. The researchers also conducted a parent survey that

covered questions about parents' beliefs about how much their child liked or disliked certain F&Vs. Interestingly, often the parents' answers did not match how the child reacted to the foods. For example, a parent said that their child did not like a food and then the child was willing to try the food during the study. The researchers highlighted that this was why it was important to not put a large emphasis on parent surveys during child F&V interventions.

Another study conducted in 2015 also utilized four senses (sound, smell, touch, and sight) in a willingness to taste intervention.[20] The study included one- to three-year olds in primary care facilities. Sweet potatoes, green peppers, rhubarb, dried figs, butternut squash, beans, dried prunes and pomegranates were divided into two groups; Set A and Set B foods. Each group had two fruits and two vegetables. The classrooms of the primary care facilities were either exposed to the Set A foods or Set B foods during sensor activities or did not receive sensory activities at all. Each week the experimental classrooms focused on one sense for four weeks using their assigned set of foods, A or B. After four weeks, all participants were individually served both Set A foods and Set B foods. Children were presented with a plate with one Set A food and one Set B food and asked if they would like to try either. Which food the participant chose first was noted. If the child ate the entire sample, they were offered more and then asked if they would like to try the other food. All foods were served to each participant. The results showed that the experimental groups significantly touched and tasted more foods than the control group ($p=.046$). Additionally, those that had been exposed to Set A foods during the sensory activities, significantly touched and tasted more Set A foods before set B foods; those exposed to the Set B foods touched and tasted those foods first significantly more the Set A foods. Although these studies mentioned above focused on all of the sense, two of the five senses of particular interest for this project are sight and touch.

Visual Appeal

Sight might be the first sense that can impact a child's perception of a food, which can further influence whether the child eats the food and the amount consumed.[21] Studies have shown that the size and shape of a food not only changes perception, but also how food feels in the mouth when being chewed.[22] A vast amount of research has explored how visual appearance relates to perceptions and preferences of F&Vs in children.[21,23,24] The assumption is if they like the way it looks, they will eat it.[23] However, there is limited research on visual appeal and subsequent intakes.

Olsen and colleagues looked at the ways children wanted to be served fresh vegetables.[24] The sample consisted of children aged 9- to 12-years-old. They were presented vegetables in two sizes, medium and small, as four different shapes, chunks, slices, sticks, and stars. The children were then asked to choose which of the eight versions they preferred. The results showed that the children highly preferred raw vegetables cut in the shape of stars rather than sticks or chunks. Although this study did not measure the effects on intake, this shows that children may rather be served vegetables cut into shapes rather than sticks or chunks.

Jansen and colleagues looked at food appearance versus restriction and their effects on fruit intake of four- to seven-year-olds.[25] The children were offered fruit in two different ways, "visually appealing" and plain. The "visually appealing" fruit presentation was fruit in a bowl made out of watermelon and pierced with flagged toothpicks. The regular presentation was fruit served on a plain white plate and pierced with plain toothpicks. Three groups of children were served both versions of the fruit at the same time. Children were tested alone, one at a time. One group of children was told they could only eat the visually appealing fruit, the second group was told they could only eat the regular fruit, and the third group was told they could eat both presentations. A few minutes later the children from all groups were then presented with both

presentations and allowed to eat from either of them. The study found no effects from restriction on intake. However, they did find that intake of the visually appealing fruit was almost double of the regular presentation from the group of children that was not restricted to consuming one particular presentation (p=.001).

The few studies that have been conducted on visual appearance of foods among preschool-aged children examined snack foods, but not specifically F&Vs. One study looked at different shapes (heart or animal) to regular shapes of high fiber pancakes, banana bread, and sandwiches.[26] The children were first acclimated to the new foods for three weeks and then served each snack both ways for a total of four times. The study did not find a significant difference between intake among the shaped snack and regular snack. However, the limitations of this study, a small sample size of 21 and only including two races, could have affected the outcomes. A strength of the study was the acclimation period.

Another study looked at "cute" snacks such as bagel basketballs (bagel and cream cheese), porcupine salad (tuna salad with pretzels quills), and dominos (cereal bars with frosting) versus the foods being served in no special way.[27] Children were served both the regular snack and the "cute" snack on 12 different occasions. The research team looked at amount consumed and the time it took to consume. No significant difference was found between the "cute" snack and the regular snack. The study did find that the children consumed more of certain snacks than others and took significant more time to consume some of the "cute" snacks than the regular snacks. A limitation of this study was a small sample size of 40 children, and the presence of researchers during the snacks. Strengths of the study included it being conducted in preschools and using CACFP guidelines when developing the portion sizes.

Touch and Interaction with Foods

Touch and interaction with foods is another avenue being explored in relationship to the senses. Dazeley and colleague found that allowing hands on activities provided children another way to become familiar with new foods.[17] Avenues such as gardening, interactive play, and meal preparation have been explored with young children.

A popular way to get preschool-aged children to interact with F&Vs is gardening.[17,28] The children help plant, water, and then eventually harvest the F&Vs. Once harvested, the children are encouraged to try the foods. Dazeley and colleagues noted several studies, revealing that this type of intervention may increase F&V intake.[17] A study was conducted on the effectiveness of gardening at preschools on F&V intake.[28] Preschool classroom teachers were asked to plant a garden and were given a curriculum to teach each week. The preschoolers helped with the gardening and were allowed to eat the F&Vs that they picked. The results demonstrated that the children ate significantly higher portions of vegetables, but not fruit.

Another avenue for interaction with foods is incorporating interaction into a structured nutrition education curriculum. One such program was Color Me Healthy, a nutrition education program administered for 12 weeks.[29] It specifically focused on fruits, vegetables, and physical activity. The preschool children were introduced to F&Vs using their different senses to familiarize them with the new foods and then were allowed to eat the foods. Pre- and post-assessments found that the program significantly increased the children's F&V intake immediately after, and intake was still increased three months post-intervention. However, the program's long-term effects were not known. A strength of the study was a large sample of 17 preschools with over 200 child participants. Although gardening and a nutrition education program with interactive components have been successful in increasing F&V intake, little

research has been conducted related to how an interactive component alone could affect F&V intake of preschool-aged children.

Another component of interaction with foods is cooking and meal preparation. Cooking and meal preparation are important to incorporate into interventions as each involve skills children can use for the rest of their lives.[30] Specifically for preschool-aged children, these skills can assist in developing their fine motor development.[30] Additionally, Anliker and colleagues found that preschool-aged children who were more involved in food preparation activities were more nutritionally aware than those who were less involved in meal preparation.[31] There is a growing body of literature with positive outcomes related to cooking and meal preparation with adolescents. Although, a majority of the following studies targeted elementary school-aged children and adolescents, one can deduce that including preschool-aged children in food preparation may also have a positive impact on their intake as well.

The theory behind why meal preparation has a positive impact on intake is that people tend to take greater pride in foods they help prepare.[32] Outside of the nutrition literature, this has been regarded as the "Ikea Effect."[32] Participants of a study were told to build a storage box and then were asked to bid on their box and a box with the same design that someone else built. The results found that people were willing to pay more money for the box that they built over the other, even though the boxes were the same. The same study had participants and experienced origami folders create the same figures. Then the participants were asked to bid on their own origami and the experienced folders' figures. Participants were willing to pay significantly more money for their own origami figures than the others. This suggests that they highly valued their own creations even if they were not as well made as the ones created by the experienced folders. To further test this, bystanders were asked to bid on the two groups' figures. The bystanders

were willing to pay more for the experienced folders' origami figures over the participants', which may further illustrate that participants were willing to pay more for their own figures simply because they made them. The same idea can be applied to cooking and meal preparation.[33] College students were asked to make a milkshake and then asked to taste their milkshake and a milkshake made by someone else with the same ingredients. The study found that the students preferred and consumed more of their own milkshakes over the others. The researchers deemed this the "I-cooked-it-myself" effect. The idea that people takes more pride and enjoyment in their own creations may explain why interventions that include meal preparation and cooking can have a positive impact on intake.

One study examined the effects of preparing a meal with a parent on vegetable intake among a group of six- to ten-year-old children.[34] The experimental group consisted of a group of children who cooked meals with one of their parents. The control group consisted of a group of children who sat in the room as their parents cooked the meals. The research team found that the children that helped prepare the meals ate significantly more vegetables than the children that did not help. Limitations of the study were a small sample size of 47, and that it was conducted in a research facility. A strength of this study was that it looked at the effects of cooking as the sole intervention.

Another study that examined cooking as the sole intervention offered several cooking classes.[35] The intervention was adapted for children and adults. The average age of the children was 12 years. The cooking classes covered different ways of preparing and cooking F&Vs and food safety. After the cooking classes, the adolescents that participated reported a significant increase in the number F&V servings they consumed. At post intervention, the children also reported trying new F&Vs in new ways. A limitation of the intervention was that the authors did

not provide much information in their results about the average number of classes attended by the children or how much involvement the children were allowed to have in the cooking demonstrations. A strength of the intervention was a large sample size of over 200 child participants.

One study that included cooking as part of a multi-level intervention was the Cookshop Program, which was conducted in the classrooms of elementary schools.[36] First, targeted fruits, vegetables, and whole grains were served more often in the cafeteria. Next, 10 cooking lessons and 10 nutrition lessons were conducted in the classrooms. Thirdly, parents were encouraged to be involved in both the nutrition and cooking lessons. Lastly, community members were involved through newsletters and other partnerships. The study design compared the effects of the different components on intake by comparing four groups: cooking and nutrition lessons, cooking lessons alone, nutrition lessons alone, and increasing the amount of F&Vs served in the cafeteria (control). All groups received the newsletters for parents and the cafeteria component. The results showed that cooking and nutrition lessons combined had the greatest impact on intake followed by the cooking lessons. The research team emphasized that increased exposure of the foods alone did not have an impact on vegetable intake in the control group. However, increased exposure along with the cooking lessons improved vegetable intake. Strengths of the study include: the intervention involved several levels and a large sample size with a total of almost 600 children. A limitation of the study is that it was quite labor intensive, as it required parents, teachers, and other community members to conduct the cooking classes.

One study involving preschool-aged children and meal preparation was found during the review of the literature.[37] This study involved lessons directed towards the children, their parents, and children and parents. Of those lessons, two lessons involved the child and the parent cooking

or preparing a healthy snack. Overall, the intervention positively affected F&V consumption. Although the results did not separate the impact each lesson might have had on the child's eating behavior, one can see that an intervention with a meal preparation component has been successfully conducted in the preschool population. A strength of the study is that it was conducted in a preschool setting, a more natural setting compared to a laboratory or research facility.

Cooking with a Chef

Another interesting way cooking and meal preparation interventions are implemented is through the addition of a chef. Several interventions include a chef conducting a cooking demonstration and assisting the children in preparing a meal or dish.[38,39] Research has shown that children recognize chefs as people who know how to cook.[40] A qualitative study in the United Kingdom asked children to draw a picture for an alien explaining how people on earth cook. Children often drew pictures of celebrity chefs cooking.[40]

One study had a chef come teach two classes in London primary schools, one on food safety and healthy eating and then another on cooking and preparation techniques.[38] After the classes, the intervention group reported significantly higher intake of vegetables. When asked about the classes and the presence of the chef, the majority of the children said they wanted another class and liked the chef teaching the classes. The researchers recognized only having one cooking class as a limitation of their study, as one class may not have as great of an effect as multiple classes might have. Also, because only one class was conducted, not every child had one-on-one time with the chef. The authors encouraged future studies to increase the number of classes a chef conducted to increase the impact the intervention could have.

Another study involving a chef included five cooking classes during a summer program for low socioeconomic children aged eight- to twelve-years old.[39] Before each cooking demonstration, a nutritionist would provide a quick nutrition lesson and then the chef would assist the children with cooking. Emphasis was put on the fact that the children were involved in the process and not just watching. The authors noted that the children were more willing to consume F&Vs when they were cut into shapes. Overall, the study found that children enjoyed the classes and reported selecting healthier foods at the store with their parents. An intervention delivered by a chef, who children might revere as a cooking expert, may be more impactful than a teacher or a researcher.

Theoretical Framework

The theoretical foundation for the project that was conducted used the Social Cognitive Theory (SCT) as its foundation.[41,42] This theory postulates that the social environment can affect cognitive processes and both work together to induce behavior changes. The SCT states that there is a triadic bidirectional relationship between a person, his or her environment, and his or her behaviors.[41] This means people are not only a product of their environment and behaviors, but producers of their environment and behaviors as well. One major focus of the SCT is self-efficacy, which is one's perception of his or her own ability to perform a certain behavior. If one does not believe that he/she can perform said behavior, the likelihood that he or she can or will perform the behavior is decreased dramatically. Self-efficacy is established through four modes: mastery experience, peer modeling, verbal persuasion, and physical and emotional arousal.[42] Individually, these modes have been shown to minimally effect self-efficacy. However, all together, the four modes are believed to increase behavior change.

In conjunction with the SCT, many nutrition interventions utilize the Cognitive Development Theory (CDT) as well.[43] According to the CDT, based on a child's developmental stage, he or she learns skills through different methods. Preschool-aged children are in the preoperational stage. During this preoperational stage children learn skills through hands-on activities such as imaginary play or art.[43]

Discussion

Although several interventions have been examined, there is still a need to determine the best method to increase F&V consumption among preschool-age children. A major weakness of several of these studies includes altering the natural taste of vegetables to make them more appealing. The fear is that children will only want to consume vegetables the way in which they were introduced.[14] For example, a child might not want to eat artichokes unless the sweetness flavor is added to them. It is important to stick with introducing vegetables in their natural form so children are more willing to eat them in a variety of ways. Also, many of the mentioned studies lacked a diverse population. Samples consisted of similar race/ethnicity, socioeconomic status, and/or parents with a high education levels. More research seems to be needed to see if these interventions are useful for lower income children and other races/ethnicities. Additionally, many studies were conducted in a controlled setting with researchers present.

Little research has been conducted on the visual and interactive aspects of increasing F&V intake. Preliminary research shows each could have a positive impact on F&V intake. Thus, the research team conducted a study to address this gap through this thesis project. This project included a diverse population and aimed to increase F&V intake without altering the taste of the study foods. Additionally, this project was conducted in a preschool, a natural setting for the participants, and a "chef" delivered the intervention, which has been shown to be effective.

Conclusion

In conclusion, to positively impact individuals' life course, it is important to improve dietary habits as early as possible. Current preschool-aged children's diets do not meet recommendations for F&V intake. It is critical that young children's diets improve to help prevent obesity and other chronic diseases. In order to do this, the two components of developing a healthy lifestyle must be examined, the home and childcare centers. As more children spend more time in childcare centers, it is important to create interventions for both the home and for preschool/childcare programs. Within the research literature, there is a lack of consistency on what works best for diverse populations. There is a need for more research to explore ways to increase both F&V intake that result in life-long healthy habits. Overall, by improving children's diets the likelihood of improving their health in adulthood will increase as well.

Chapter II: Manuscript

Background

Based on the Life Course Theory, factors that can influence an individual's health in adulthood can start as early as in the womb.[1] The National Institute for Health Care Management calls public health professionals to focus on "upstream" determinants, which may have detrimental effects on children as they get older.[1] Also by improving "upstream" determinants, a person's health trajectory may improve as well.[1] To raise the next generation as a healthier generation, healthy habits should be instilled in children at a very young age. The early stages of life (birth to six years) are the most crucial for the development of a person and can have long-term effects; and therefore, the earlier these healthy habits are started, the better.[2] According to Healthy People 2020, chronic diseases and cancers may start developing in this early stage of life if optimal health is not being met.[2] Nutrition experts are currently concerned with the lack of variety and quality of children's diets.[3] A component of healthy eating is an intake of a variety of vegetables daily.

According to the 2015 Dietary Guidelines for Americans, approximately 78% of preschool-aged children (two- to five-year-olds), do not meet the recommendations for daily vegetable intake.[4,5] Potatoes made up 21% of the most commonly consumed vegetable and tomatoes made up 8%.[4] Although several strategies based on the incorporation of the sense of taste have been explored to increase young children's vegetable intake (such as repeated exposure, flavor-flavor learning, increased portion sizes, family meals, offering a dip with a vegetable, and offering a choice of vegetables to consume) it is still unclear on what is the best way to increase young children's vegetable intake. In recent years the idea of increasing intake by increasing familiarization of vegetables through non-taste sensory properties (through sight, smell, sound, and touch) has become increasingly popular.[17-29]

The Social Cognitive Theory (SCT) has been widely used to develop interventions to increase fruit and vegetable consumption.[41,42] One major focus of the SCT is establishing self-efficacy through four modes: mastery experience, peer modeling, verbal persuasion, and physical and emotional arousal.[41,42] Individually, these modes have been shown to minimally effect self-efficacy.[42] However all together, the four modes are believed to increase behavior change.[42]

In conjunction with the SCT, many nutrition interventions utilize the Cognitive Development Theory (CDT) as well.[43] According to the CDT, based on a child's developmental stage, he or she learns skills through different methods. Preschool-aged children are in the preoperational stage. During this preoperational stage children learn skills through hands-on activities such as imaginary play or art.[43]

In addition to decisions of intervention focus (taste vs. non-taste sensory properties) and basis of theoretical model, location needs to be considered when developing interventions to increase children's vegetable intake. A large portion of young children spend the majority of their time in someone's care other than their parents.[6,7] This results in children eating a majority of their meals away from their parents and in preschool or childcare settings.[7] Therefore, it is important to develop interventions that can be conducted in the childcare setting.

This study targeted all four modes of the SCT and utilized a hands-on activity to increase vegetable intake, included a focus on non-taste sensory properties, and was designed to be implemented in a childcare center. The aims of this study were to examine if mean intake of vegetable snacks and/or willingness to try the vegetable snacks would be significantly higher among preschool-age children in a childcare center who participated in a visually appealing and interactive snack activity (incorporated non-taste sensory properties) compared to children who

received control vegetable snacks. A secondary aim of this study was to ascertain if there were gender differences in mean intake of the vegetable snacks between groups.

Methods

This project used a quasi-experimental design with two groups randomized to control and experimental with between and within subject factors study design. The University of Tennessee Institution Review Board approved this study (IRB-15-02413-XP) and consent was obtained from parents prior to program implementation.

Participants

Two preschools in East Tennessee were recruited to participate. Three classrooms at each school were randomized into two groups, control and experimental (interactive + visual appeal). Participants were recruited as parents picked up their children from the preschool and by placing consent forms and surveys in children's boxes. Informed consent was obtained from all parents of participants, and they were given the option of whether they wanted to complete a survey with demographic questions and questions about their children's intake of vegetables. The latter questions were used for identification of the target vegetable, as described below. While most parents completed both, some opted only to provide consent for their child to participate in the study. Program directors were also surveyed to collect baseline information to help identify the target vegetable.

Identification of the Target Vegetable

The director survey included a list of several vegetables with questions regarding how often each vegetable was served (never/hardly ever, once a month, once a week, more than once a week), what foods the preschools had difficulty serving, and serving style. The parent survey included demographic questions and the same list of vegetables as the director survey with questions regarding how often each vegetable was served to their children. To determine which vegetable would be used in the study the degree of exposure, indicated by the parents and

preschool directors on the surveys, was rated on a scale of one to four, one being never/hardly ever and four being more than once a week. The mean score for each vegetable was calculated. A vegetable that was relatively familiar to the children, but reported by the childcare providers and parents as not served frequently, was used. Unfamiliar vegetables were not used, as introducing these new foods may have contributed to increased refusal and decreased intake, thus biasing results. The target vegetable was determined to be green pepper. The snacks were prepared based on the Child and Adult Care Food Program guidelines for snacks; each consisted of the proper serving size of a vegetable and a dairy product.[8] All children in both groups received the same snack.

Procedure

To help control for time spent interacting with the research team, the week prior to beginning the snack intervention, all children in both groups colored a placemat, which contained flower, heart, star, and circle shapes, which were then laminated so they could be used multiple times and taken home after the intervention. Each vegetable snack was served three times, once a week every other week. The snacks were served on the same day of the week and always as an afternoon snack. The same two research team members served the snacks to each group dressed as chefs throughout the project because previous research has shown that children have positive attitudes towards chefs and recognize them as people who make food.[38-40] The control group was served the vegetable snack in strips on a plain white paper plate. The experimental group (interactive + visual appeal) was served the vegetable cut into flowers, hearts, stars, and circles and the children were allowed to place the vegetable on the various shapes on their placemat. Although the control group did not use the placemats during the intervention, they were given to the children in both groups upon completion of the intervention.

Prior to each snack time, the vegetable was weighed offsite at the research facility to obtain the pre-snack weight using Ohaus Scout Pro scales. The snack was weighed twice and if the two weights were different a third weight was taken, and an average of the three weights were used. A researched team member manually entered weights into the computer. After the snack, the uneaten vegetables were collected from each participant, labeled with an identification number, and taken back to the research facility to be weighed. The same weighing protocol for the pre-snack weight was used for obtaining the post-snack weight. Intake was found by subtracting the post-weight from the pre-weight.

Analysis

Data analysis was conducted using IBM's Statistical Package for the Social Sciences (SPSS) Version 22.0. Appropriate descriptive statistics were calculated for demographic data and chi-square and independent t-tests were used to test for baseline differences; a Shapiro-Wilk test was used to ascertain if the dependent variables were normally distributed. An independent t-test was conducted to find mean change difference in intake from the first snack to the third snack between the groups and paired t-tests for within the groups. Additionally, the research team evaluated willingness to try using chi-square and differences in consumption between genders using independent t-tests.

Results

There were no statistical baseline demographic differences between the groups at either school; therefore the control group and the experimental group from each school were combined. A total of 67 participants out of 120 students enrolled in the preschools were recruited, 36 in the control and 31 in the experimental group. Of those recruited, 32 parents of participants in the control group and 24 parents of participants in the experimental group completed parent surveys. Demographic information of participants collected from the surveys is reflected in Table 1.

Table 1. Demographic Characteristics of Experimental and Control Groups

Characteristic	Control (n=32) Mean	Experimental (n=24) Mean
Age, y	3.7 ± .55	4.0 ± .36
	Control (n=32) N (%)	Experimental (n=24) N (%)
Gender		
Male	15 (46.9)	11 (45.8)
Female	17 (53.1)	13 (54.2)
Race		
White	3 (9.4)	3 (12.5)
Black/African American	26 (81.3)	18 (75.0)
Other	0	1 (4.2)
More than one	3 (9.4)	2 (8.3)

Intake of the Vegetable Snacks

Data were normally distributed according to the Shapiro-Wilk test. Table 2 illustrates the mean difference in consumption within groups by time point; as shown, there were no significant differences in the mean number of grams consumed of the vegetable by time point within groups. Table 3 illustrates the mean difference in consumption by time point between groups; there were no significant differences in the mean grams consumed of the vegetable snacks between groups.

Table 2. Mean Consumption Difference Within Groups by Time Point

Time Point	Control Mean Change (Std Dev)	*p* value	Experimental Mean Change (Std Dev)	*p* value
First to Second Vegetable Snack	.99g (8.67)	.56	2.63g (5.71)	.07
Second to Third Vegetable Snack	1.15 (6.70)	.35	.61 (6.76)	.72
First Snack to Third Vegetable Snack	1.72g (7.79)	.25	-.53g (6.86)	.74

Table 3. Mean Difference in Consumption Between Groups by Time Point

Time Point	Mean Difference (SE)	*p* value
First Vegetable Snack	.606g (2.20)	.78
Second Vegetable Snack	-.56g (2.16)	.80
Third Vegetable Snack	.83g (2.33)	.72

Intake between Genders

The research team examined differences in consumption by gender. Boys in the experimental group consumed a significant higher amount of the vegetable snack at the second time point (p=.05), as seen in Table 4. There were no other significant differences in consumption by gender.

Table 4. Mean Difference in Consumption Between Groups by Genders and Time Point

Time Point	Boys Mean Difference (SE)	*p* Value	Girls Mean Difference (SE)	*p* value
First Vegetable Snack	2.41g (4.55)	.60	-2.42g (2.72)	.38
Second Vegetable Snack	-8.85g (4.25)	.05	-2.25g (3.08)	.47
Third Vegetable Snack	.76g (3.78)	.84	-.43g (3.60)	.91

Willingness to Try

During the first snack, the control group was significantly more willing to try the vegetable compared to the experimental group (p=.03). During the second snack the experimental group was significantly more willing to try the snack than the control (p=.01). There were no significant differences at the third snack. Table 5 illustrates the results from the chi-square analysis.

Table 5. Chi-Square Analysis of Willingness to Try by Time Point

Time Point	Percent of Children Willing to Try the Snack		*p* value
	Control	Experimental	
First Vegetable Snack	96.7%	77.3%	.03
Second Vegetable Snack	63.8%	70.6%	.02
Third Vegetable Snack	97%	87.5%	.17

Discussion

Although this study did not find a significant difference in vegetable intake between the control and the experimental groups, this differed from other studies that evaluated intake in interventions that focused on non-sensory taste properties.[28,29] Namenek and collegeagues found a significant increase in fruit and vegetable consumption immediately following and three-months after the conclusion of a gardening program for preschoolers.[28] Witt and Dunn found a group of preschoolers consumed almost twice as much of a fruit that was served to them in a visually appealing way over the control group that were served the fruit in a plain way.[29]

Additionally, it remains unclear if an intervention needs to incorporate all of the senses or if only including one or two may be sufficient, similar to this study. Some studies have found a significant impact by manipulating the sense of sight.[24,25] Two studies offered "visually appealing" fruits or vegetables and found significantly increased willingness to try or intake in the intervention groups. However, other studies have found contradicting results when manipulating visual appeal.[26,27] These studies also offered "visually appealing" snacks but did not find a significant difference. However, these snacks were not solely made of vegetables.

The interventions that included all of the non-taste properties through structured lessons or gardening seem to be the most successful.[19,20,28,29] These interventions create more

opportunities for a child to explore vegetables through each sense and as a result increase a child's familiarization with that particular vegetable. This supports the Ellyn Satter Institute's theory that proper familiarization of foods is more likely to result in high consumption of that food.[18] It seems that increasing familiarization is an important component when increasing intake or willingness to try in young children.[18] Although it seems that repeated exposure of a vegetable should be adequate to increase intake the exact number it takes for a child to be willing to consume a vegetable is still unknown.[10,11] Thus, allowing a child to explore new foods through their senses may decrease the number of times a child needs to be exposed to a new food. However, most of the studies mentioned above did not evaluate the impact senses had on intake in preschool-aged children.

In addition to intake, the research team analyzed the data for willingness to try. Willingness to try is what other studies have utilized to evaluate the effectiveness of focusing on non-taste sensory properties in internvetions.[19,20,24] Since the control group was significantly more willing to try the snack over the experimental group, this could indicate perhaps that the experimental group was more interested in playing with their food rather than consuming it. It was noted during all three snacks, that the experimental group placed the shaped vegetable on the corresponding shape on the placemat without being prompted. During the second snack, however, the experimental group was significantly more willing to try the snack than the control. Thus, signifying that maybe the experimental group did not feel the need to play with the food as much because they had been sufficiently exposed to the vegetable. On the other hand, during the third snack willingness to try was not significantly different between the groups

Evaluating the differences between the genders, boys in the experimental group significantly consumed more during the second snack. This brings forth an interesting finding. It

has been established that boys are likely to have a lower intake of vegetables.[44,45] It has also been established that boys do not prefer fruits and vegetables as much as girls.[45] This results in boys being vulnerable to poorer diets, with higher intake of energy dense foods over fruits and vegetables. Additionally it has been established that boys tend to learn better through hands-on activities and kinesthetic learning rather than in a traditional classroom settings.[46-48] This theory of incorporating kinesthetic activities into nutrition interventions to target boys is not a novel idea.[49,50] Lineberger and Zajicek used a gardening program based intervention and evaluated preference and intake of third through fifth graders using a survey.[49] Jaenke and colleagues used a curriculum-based intervention with cooking and gardening components and evaluated preference and intake of fourth and fifth graders using a survey and a 24-hour recall.[50] However, both studies did not find a significant increase in boys intake or preference compared to girls and actually saw significant increases in preferences in the girls in the experimental groups.[49,50] The findings from this study contradicts the mentioned above studies, however, this may be due to a difference in evaluation tools, since this study used a plate waste study to evaluate intake and age differences in study populations. Taking in consideration the developmental stage boys are in during preschool years compared to late elementary years may be the reason why the mentioned above studies did not find a significant increase in consumption. Based on this study's results, kinesthetic learning-based nutrition interventions might have a greater impact on the vegetable intake of preschool-aged boys compared to late elementary-aged boys.

Strengths and Limitations

There were several strengths of the study. One included that this study is one of the few studies that actually looked at how intake of vegetables in preschoolers was impacted using two senses. In addition, this study used a plate waste method, which is currently the gold standard for

evaluating intake. Additionally, this study was conducted in a preschool setting, a natural environment where preschoolers are spending a lot of their time rather than in a lab and was incorporated into their normal routine. Another strength of the study was having the research team dress as chefs. Studies have found that preschool-aged children recognize chefs as the experts of food and have found that when chefs were involved in projects it positively impacted fruit and vegetable intake.[38-40]

There were a few limitations that could have impacted the results. One of the limitations was the small sample size. Ideally, more participants and even more preschools would have been recruited. Additionally, it was difficult to keep participants in the study as a few participants who were originally recruited changed classrooms and had to be excluded from the data analysis. Another limitation was the time constraint. This also contributed to not being able to recruit more participants.

Implications for Future Research

It may be an important point to consider that successful studies have been conducted using all of the senses (sight, smell, touch, and sound) and not just two senses such as this study.[19,20,28,29] This maybe indicative of the important role all of the senses play in increasing vegetable intake in young children. Also most studies have not measured intake but only willingness to try or preference.[19-21,24] The Ellyn Satter Institute also emphasizes using all of the senses during the first exposures of new food.[18] Perhaps it is more important to further investigate how the senses impact willingness to try foods rather than how much of these food will a child eat. It would be important to further examine the long-term impact of using all of the senses in an intervention. Furthermore, it would be important to consider how this type of intervention translates into the home setting and if it is successful in all settings a child might be

exposed to vegetables. Along with these considerations, further research should be conducted to investigate the impact of non-taste properties on young boys' intake over girls to further support or refute the idea that boys would better benefit from kinesthetic based learning in nutrition interventions.

Chapter III: Expanded Methods

Recruitment and Participants

The Infant, Child, and Adolescent Nutrition's Graduate Research and Outreach for Wellness (ICAN-GROW) research team worked with Health Happens!, a grant-funded project in collaboration with East Tennessee Children's Hospital to recruit eligible preschools. Preschool directors were informed of the study via email and asked if they would like to participate. Due to time constraints recruitment continued until two sites with a sufficient amount of students at the appropriate age (three- to five-year-olds) agreed to participate. Three classrooms were selected that contained at least 15 children. After the classrooms were selected, consent forms were sent out via the child's take-home folder or passed out as parents picked up their children (See Appendix A). Along with the consent forms, parents were given a questionnaire about their personal education level, income level, demographic information, the child's allergies, and feeding practices (See Appendix B). Parents were offered a $5 gift card for completing both the consent form and the survey.

Study Design

The study design of this project was a two group, quasi, control experimental study with between and within subject factors (See Table 6). Changes in F&V intake were the dependent variables. The independent variables were the treatment groups and the number of times each snack was served. Though children were not randomly assigned to treatment groups, the preschool classrooms were randomized to groups.

Table 6. Study Arms

Group	**Intervention**
Control	F&V served in plain chunks on white paper plate
Interactive+ Visual Appeal	F&V served in shapes and child allowed to place on placemat

Selection of Target Fruits and Vegetables

Once preschools were recruited, surveys were provided to preschool directors to complete (see Appendix C). The director survey included a list of several F&V with questions regarding how often each were served (never/hardly ever, once a month, once a week, more than once a week), what foods the preschools had difficulty serving, and serving style. Results from the parent survey were also used to determine the target F&V using the same list of F&V as the director survey with questions regarding how often each F&V was served to their children. To determine which F&V would be used in the study the degree of exposure, indicated by the parents and preschool directors on the surveys, was rated on a scale of one to four, one being never/hardly ever and four being more than once a week. The mean score for each F&V was calculated. A F&V that was relatively familiar to the children, but reported by the childcare providers and parents as not served all the time, was used. Unfamiliar F&Vs were not used, as introducing these new foods may have contributed to increased refusal and decreased intake, thus biasing results. The target vegetable was determined to be green pepper and the target fruit was determined to be cantaloupe. The snacks were prepared based on the Child and Adult Care Food Program (CACFP) guidelines for snacks; each consisted of the proper serving size of a fruit/vegetable and a dairy product.[8] All children in both groups received the same snack.

Randomize into Two Groups

Three classrooms in the recruited preschools were randomized into two groups: control group and interactive + visual appeal group (See Table 7).

Table 7. Classroom Randomization

	Preschool 1	***Preschool 3***
Classroom 1	Control	Control
Classroom 2	Interactive + Visual Appeal	Control
Classroom 3	Interactive + Visual Appeal	Interactive + Visual Appeal

The Snack Activity

Prior to the beginning of the snack activities, the graduate student created a placemat that contained flowers, hearts, stars, and circles (See Appendix D). All students in both groups (even those who had not consented to the study) were provided the placemat and asked to color however they saw fit. The placemats were taken back up and laminated. The placemats were returned to all students after the completion of the study.

Fruits and vegetables were washed and prepared by the research team prior to the snack at the research lab due to limited space at the preschool sites. Each groups' F&V were cut into their respective forms prior to serving as well.

Control Group

The control group was served the fruit or vegetable cut into chunks or strips on a plain white paper plate.

Interactive + Visual Appeal Group

The fruit or vegetable snack were cut into flowers, hearts, stars, and circles with metal cookie cutters. The participants were served each snack on the placemat mentioned above. The participants were allowed to place the F&Vs on the various shapes on their placemat.

Each F&V snack were served three times, once a week alternating weeks (See Table 8). The snacks were served on the same day of the week every time and always as an afternoon

snack. Also, two research team members served each group dressed as chefs. The script for the "chef" can be found in Appendix E.

Table 8. Snack Schedule

Week 1	Fruit Snack
Week 2	Vegetable Snack
Week 3	Fruit Snack
Week 4	Vegetable Snack
Week 5	Fruit Snack
Week 6	Vegetable Snack

Evaluating intake across the two groups

Fruit and vegetable intake were evaluated by weighing the F&V component of the snacks to the nearest gram before and after the children ate. Intake was determined by subtracting post-snack weight from pre-snack weight. Due to limited space available at the childcare site, waste was gathered after the snack was completed and taken back to the ICAN-GROW lab for weighing. See Appendix F for plate waste protocol.

Statistical Analysis

Data analysis was conducted using IBM's Statistical Package for the Social Sciences (SPSS) Version 22.0. Appropriate descriptive statistics were calculated for demographic data and chi-square and independent t-tests were used to test for baseline differences; a Shapiro-Wilk test was used to ascertain if the dependent variables were normally distributed. An independent t-test was conducted to find mean change difference in intake from the first snack to the third snack between the groups and paired t-tests for within the groups. Additionally, the research team

evaluated willingness to try using chi-square and differences in consumption between genders using an independent t-test. See Table 9 for independent and dependent variables. Additional analysis of the difference in fruit snack consumption can be found in Appendix G.

Table 9. Dependent and Independent Variables

Variables	
Independent Variables	F&V snack presentation group: plain and Interactive + Visual Appeal component and time (each time fruit or vegetable is served)
Dependent Variables	Differences in gram amount of snack consumed for intake

Strengths and Limitations

A strength of this project was the novelty of the approach. Research suggests that the use of the senses could increase F&V intake. The research team hypothesized that combining the sense of vision and touch would have a positive effect on F&V intake. Limited research on F&V intake among preschool-age children has been conducted in a natural setting; thus, this is another strength of the project.

Due to time constraints preschool recruitment was limited which led to only recruiting two preschools rather than three, which was originally planned. Additionally, it was difficult to get parents to sign consent forms and complete the survey, which lead to a smaller sample size than desired as well. Another limitation is that since the F&V were cut into shapes, what F&Vs that that could be used for the study were limited.

References

1. Halfon N. Life course health development: A new approach for addressing upstream determinants of health and spending. Expert Voices, National Institute for Health Care Management Foundation. 2009. http://www.nihcm.org/pdf/ExpertVoices_Halfon_FINAL.pdf.Accessed November 25, 2014.

2. US Department of Health and Human Services Office of Disease Prevention and Health Promotion. Healthy People 2020. http://www.healthypeople.gov/2020/topics-objectives/topic/early-and-middle-childhood. Accessed November 25, 2014.

3. Ogata BN, Hayes D. Position of the Academy of Nutrition and Dietetics: nutrition guidance for healthy children ages 2 to 11 years. *J Acad Nutr Diet.* 2014. Aug;114(8):1257-76.

4. US Department of Health and Human Services and US Department of Agriculture. 2015-2020 Dietary Guidelines for Americans, 8th Edition. December 2015. http://health.gov/dietaryguidelines/2015/guidelines/. Accessed March 1, 2016.

5. Lorson BA, Melgar-Quinonez HR, Taylor CA. Correlates of fruit and vegetable intakes in US children. *J Acad Nutr Diet*. 2009 Mar;109(3):474-8.

6. Nicklas TA, Baranowski T, Baranowski JC, Cullen K, Rittenberry L, Olvera N. Family and child-care provider influences on preschool children's fruit, juice, and vegetable consumption. *Nutr Rev*. 2001 Jul;59(7):224-35.

7. Larson N, Ward DS, Neelon SB, Story M. What role can child-care settings play in obesity prevention? A review of the evidence and call for research efforts. *J Am Diet Assoc.* 2011 Sep;111(9):1343-62.

8. United States Department of Agriculture Food and Nutrition Service. Child and Adult Care Food Program. http://www.fns.usda.gov/cacfp/child-and-adult-care-food-program. Accessed April 18, 2015.
9. Hill AJ. Developmental issues in attitudes to food and diet. *Proc Nutr Soc*. 2002 May;61(2):259-66.
10. Caton SJ, Ahern SM, Remy E, Nicklaus S, Blundell P, Hetherington MM. Repetition counts: repeated exposure increases intake of a novel vegetable in UK pre-school children compared to flavour-flavour and flavour-nutrient learning. *Br J Nutr*. 2013 Jun;109(11):2089-97.
11. O'Connell ML, Henderson KE, Luedicke J, Schwartz MB. Repeated exposure in a natural setting: a preschool intervention to increase vegetable consumption. *J Acad Nutr Diet*. 2012 Feb;112(2):230-4.
12. Mathias KC. Serving Larger Portions of Fruits and Vegetables together at Dinner Promotes Intake of Both Foods among Young Children. *J Acad Nutr Diet*. 2012;112(2):266-70.
13. Christian MS, Evans CE, Hancock N, Nykjaer C, Cade JE. Family meals can help children reach their 5 a day: a cross-sectional survey of children's dietary intake from London primary schools. *J Epidemiol Community Health*. 2013 Apr;67(4):332-8.
14. Savage JS, Peterson J, Marini M, Bordi PL, Jr., Birch LL. The addition of a plain or herb-flavored reduced-fat dip is associated with improved preschoolers' intake of vegetables. *J Acad Nutr Diet*. 2013 Aug;113(8):1090-5.

15. Zeinstra GG, Renes RJ, Koelen MA, Kok FJ, de Graaf C. Offering choice and its effect on Dutch children's liking and consumption of vegetables: a randomized controlled trial. The *Am J Clin Nutr*. 2010 Feb;91(2):349-56.
16. Harnack LJ, Oakes JM, French SA, Rydell SA, Farah FM, Taylor GL. Results from an experimental trial at a Head Start center to evaluate two meal service approaches to increase fruit and vegetable intake of preschool aged children. *Int J Behav Nutr Phys Act*. 2012;9:51.
17. Dazeley P, Houston-Price C, Hill C. Should healthy eating programmes incorporate interaction with foods in different sensory modalities? A review of the evidence. *Br J Nutr*. 2012 Sep;108(5):769-77.
18. Satter E. Eating competence: definition and evidence for the Satter Eating Competence model. *J Nutr Educ Behav*. 2007 Sep-Oct;39(5):S142-53.
19. Hoppu U, Prinz M, Ojansivu P, Laaksonen O, Sandell MA. Impact of sensory-based food education in kindergarten on willingness to eat vegetables and berries. *Food Nutr Res*. 2015;59:2
20. Dazeley P, Houston-Price C. Exposure to foods' non-taste sensory properties. A nursery intervention to increase children's willingness to try fruit and vegetables. *Appetite*. 2015 Jan;84:1-6.8795.
21. Wadhera D, Capaldi-Phillips ED. A review of visual cues associated with food on food acceptance and consumption. *Eat Behav*. 2014 Jan;15(1):132-43.
22. Rolls BJ, Rowe EA, Rolls ET. How sensory properties of foods affect human feeding behavior. *Physiol Behav*. 1982 Sep;29(3):409-17.
23. Birch LL. Development of food preferences. *Annu Rev Nutr.* 1999;19:41-62.

24. Olsen A, Ritz C, Kramer L, Møller P. Serving styles of raw snack vegetables. What do children want? *Appetite*. 2012;59(2):556-62.

25. Jansen E, Mulkens S, Jansen A. How to promote fruit consumption in children. Visual appeal versus restriction. *Appetite*. 2010 Jun;54(3):599-602.

26. Boyer LE, Laurentz S, McCabe GP, Kranz S. Shape of snack foods does not predict snack intake in a sample of preschoolers: a cross-over study. *Int J Behav Nutr Phys Act*. 2012;9:94.

27. Branen L, Fletcher J, Hilbert L. Snack Consumption and Waste by Preschool Children Served "Cute" versus Regular Snacks. *J Nutr Educ Behav*. 2002;34(5):279-82.

28. Namenek Brouwer RJ, Benjamin Neelon SE. Watch me grow: a garden-based pilot intervention to increase vegetable and fruit intake in preschoolers. *BMC Public Health*. 2013;13:363.

29. Witt KE, Dunn C. Increasing fruit and vegetable consumption among preschoolers: evaluation of color me healthy. *J Nutr Educ Behav*. 2012 Mar-Apr;44(2):107-13.

30. Hertzler AA. Preschoolers' food handling skills — Motor development. *J Nutr Educ.* 1989;21(2):100B-101B

31. Anliker JA, Laus MJ, Samonds KW, Beal VA. Mothers' reports of their three-year-old children's control over foods and involvement in food-related activities. *J Nutr Educ.* 1992;24(6):285-291.

32. Norton MI, Mochon D, Ariely D. The IKEA effect: When labor leads to love. *J Consum Psychol*. 2012;22(3):453-60.

33. Dohle S, Rall S, Siegrist M. I cooked it myself: Preparing food increases liking and consumption. *Food Qual Prefer*. 2014;33:14-6.

34. van der Horst K, Ferrage A, Rytz A. Involving children in meal preparation. Effects on food intake. *Appetite*. 2014 Aug;79:18-24.

35. Brown BJ, Hermann JR. Cooking classes increase fruit and vegetable intake and food safety behaviors in youth and adults. *J Nutr Educ Behav.* 2005;37(2):104-105.

36. Liquori T, Koch PD, Ruth Contento I, Castle J. The Cookshop program: outcome evaluation of a nutrition education program linking lunchroom food experiences with classroom cooking experiences. *J Nutr Educ.* 1998;30(5):302-313.

37. De Bock F, Breitenstein L, Fischer JE. Positive impact of a pre-school-based nutritional intervention on children's fruit and vegetable intake: results of a cluster-randomized trial. *Public Health Nutr.* 2012;15(3):466-475.

38. Caraher M, Seeley A, Wu M, Lloyd S. When chefs adopt a school? An evaluation of a cooking intervention in English primary schools. *Appetite.* 2013;62:50-59.

39. Dougherty K, Silver C. Chef-nutritionist teams spark enjoyment and learning in cooking education series for 8- to 12-year-olds. *J Nutr Educ Behav.* 2007;39(4):237-238.

40. Caraher M, Baker H, Burns M. Children's views of cooking and food preparation. *British Food Journal.* 2004;106(4):255-273.

41. Bandura A. Self-efficacy: Toward a unifying theory of behavioral change. Psychol Rev. 1977;84(2):191-215.

42. Stajkovic AD, Luthans F. Social cognitive theory and self-efficacy: Going beyond traditional motivational and behavioral approaches. *Organ Dyn.* 1998;26(4):62-74.

43. Herr, J. Child Development Principles and Theories. In: *Working with Young Children*. 6th ed. Goodheart-Willcox Publisher; 2008;68-87.

44. Rasmussen M, Krolner R, Klepp KI, et al. Determinants of fruit and vegetable

consumption among children and adolescents: a review of the literature. Part I: Quantitative studies. The international journal of behavioral nutrition and physical activity. *Int J Behav Nutr Phys Act.* 2006;3:22.

45. Bere E, Brug J, Klepp KI. Why do boys eat less fruit and vegetables than girls? *Public Health Nutr*. 2008 Mar;11(3):321-5.
46. King K, Gurian M. Teaching to the minds of boys. *Educ Leadersh*. 2006;64(1):56.
47. Taylor D, Lorimer M. Helping boys succeed. *Educ Leadersh*. 2002;60(4):68-70.
48. Carrier SJ. Environmental Education in the Schoolyard: Learning Styles and Gender. *J Environ Educ*. 2009;40(3):2-12.
49. Lineberger SE, Zajicek JM. School gardens: Can a hands-on teaching tool affect students' attitudes and behaviors regarding fruit and vegetables? *Horttechnology.* 2000 Jul 1;10(3):593-7.
50. Jaenke RL, Collins CE, Morgan PJ, Lubans DR, Saunders KL, Warren JM. The impact of a school garden and cooking program on boys' and girls' fruit and vegetable preferences, taste rating, and intake. *Health Educ Behav*. 2012 Apr;39(2):131-4.

Appendices

Appendix A Parent Consent Forms

Parental Consent for Interactive + Visual Appeal

Dear Parent or Guardian

Your child is invited to participate in a research study conducted by a graduate student from the Department of Nutrition at the University of Tennessee. The purpose of this study is to see if cutting fruits and vegetable into different shapes and allowing your child to place the foods on a placemat that they will color will increase their fruits and vegetables intake. To see if this is successful, we would like your permission to allow your child to take part in this project. Your child is being asked to take part in this study because he/she attends _____ school and between the age 3-5 years old.

INFORMATION ABOUT PARTICIPANTS' INVOLVEMENT IN THE STUDY

If you agree to allow your child to take part in this project, beginning in October 2015 your preschool director will answer a survey on how often certain fruits and vegetables are served at the childcare center and fruits and vegetables the children do not seem to like. One fruit and one vegetable will be chosen and snacks for each will be developed.

Beginning in October 2015, the graduate student will come to your child's classroom and help the children make a placemat with shapes on it. Your child will be allowed to color the placemat however he/she likes. The graduate student will take the placemats to be laminated and return it to your child. Once the placemats are laminated and returned, your child will receive the fruit snack once a week, three times over a six-week period and the vegetable snack once a week three times over the same six-week period. These snacks will take the place of your childcare centers regular afternoon snack. The fruits and vegetables will be cut into shapes prior to snack. Shapes include: hearts, stars, flowers and circles. Your child will be served each shape and be allowed to place the shaped fruit or vegetable on the corresponding shapes on their placemat.

Also, we would like you to please fill out the attached form to provide us with some information about you and your child. This information will be used only for group descriptions and no reference to you, your child, or others will be made that could link you or your child to this study.

RISKS
Risks associated with this project are minimal and are no more than those encountered in daily life. If your child does not wish to participate in any of the activity related to this project or does not wish to eat the snack, he/she may choose not to.

BENEFITS
Your child may benefit from participating in a fun snack activity and enjoy eating the fruits and vegetables.

CONFIDENTIALITY

All study records will be kept confidential. Each child will be given an identification number for data entry purposes. Only the PI and her faculty adviser will have access to the list of names and identification numbers. Data will be stored securely and will be made available only to persons conducting the study unless participants specifically give permission in writing to do otherwise. No reference will be made in oral or written reports, which could link participants to the study.

_____ Participant's initials (please initial before reading the second page)

PARTICIPATION

Your child's participation in this study is voluntary; he/she may decline to participate without penalty. If your child decides to participate and you agree, he/she may withdraw from the study at anytime without penalty. If your child withdraws from the study before data collection is completed your child's data will be destroyed.

CONSENT

I have read the above information. I have received a copy of this form. I agree to participate in this study.

Child's name (please print)_____
Parent's name (please print) _____
Parent's signature _____ Date _____
Investigator's signature _____ Date _____

Parental Consent for Control Group

Dear Parent or Guardian

Your child is invited to participate in a research study conducted by a graduate student from the Department of Nutrition at the University of Tennessee. The purpose of this study is to see if cutting fruits and vegetable into different shapes and allowing your child to place the foods on a placemat that they will color will increase their fruits and vegetables intake. To see if this is successful, we would like your permission to allow your child to take part in this project. Your child is being asked to take part in this study because he/she attends _____ school and between the age 3-5 years old.

INFORMATION ABOUT PARTICIPANTS' INVOLVEMENT IN THE STUDY

If you agree to allow your child to take part in this project, beginning in October 2015 your preschool director will answer a survey on how often certain fruits and vegetables are served at the childcare center and fruits and vegetables the children do not seem to like. One fruit and one vegetable will be chosen and snacks for each will be developed.

Beginning in October 2015, the graduate student will come to your child's classroom and serve the fruit snack once a week, three times over a six-week period and the vegetable snack once a week three times over the same six-week period. These snacks will take the place of your childcare centers regular afternoon snack. Your child will be served each shape on a plain white paper plate.

Also, we would like you to please fill out the attached form to provide us with some information about you and your child. This information will be used only for group descriptions and no reference to you, your child, or others will be made that could link you or your child to this study.

RISKS
Risks associated with this project are minimal and are no more than those encountered in daily life. If your child does not wish to participate in any of the activity related to this project or does not wish to eat the snack, he/she may choose not to.

BENEFITS
Your child may benefit from participating in a fun snack activity and enjoy eating the fruits and vegetables.

_____ Participant's initials (please initial before reading the second page)

CONFIDENTIALITY

All study records will be kept confidential. Each child will be given an identification number for data entry purposes. Only the PI and her faculty adviser will have access to the list of names and identification numbers. Data will be stored securely and will be made available only to persons conducting the study unless participants specifically give permission in writing to do otherwise. No reference will be made in oral or written reports, which could link participants to the study.

PARTICIPATION

Your child's participation in this study is voluntary; he/she may decline to participate without penalty. If your child decides to participate and you agree, he/she may withdraw from the study at anytime without penalty. If your child withdraws from the study before data collection is completed your child's data will be destroyed.

CONSENT

I have read the above information. I have received a copy of this form. I agree to participate in this study.

Child's name (please print)_____

Parent's name (please print) _____

Parent's signature _____ Date _____

Investigator's signature _____ Date _____

Appendix B Parent Survey

Thank you for agreeing to take part in this study. Please provide information about your child and yourself.

Your child's name: _____

School they are attending: _____

1. What is the highest education you have obtained?
    - ○ Grammar school
    - ○ High school
    - ○ Vocational/ Technical school
    - ○ Some college
    - ○ Bachelor degree
    - ○ Graduate degree

2. What is your income level?
    - ○ Less than $50,000
    - ○ $50,000-$75,000
    - ○ $75,000-$100,000
    - ○ Over $100,000

3. What is your race/ethnicity? (please check all that apply)
    - ○ White
    - ○ Black
    - ○ Hispanic
    - ○ Asian/Pacific Islander
    - ○ Native American
    - ○ Other _____

4. Is your child male or female?
    - ○ Male

- ○ Female
- ○ Prefer to not answer

5. What is your child's age?

- ○ 3
- ○ 4
- ○ 5
- ○ Other _____

6. What is your child's race? (please check all that apply)

- ○ White
- ○ Black/African American
- ○ Asian
- ○ Hawaiian/Pacific Islander
- ○ Native American

Other _____

7. Is your child Hispanic/Latino?

- ○ Yes
- ○ No

8. How often do include your child in any kind of meal preparation at home (setting the table, wash foods, mixing, clear table)?

- ○ Never
- ○ 1-2 times a week
- ○ 3-4 times a week
- ○ More than 4 times a week

8. Please list any food allergies your child has:

_____

_____

9. Please indicate how often you serve your child any of these foods.

	Never/Hardly ever	At least once a month	At least once a week	More than once a week
Apples				
Banana				
Broccoli				
Cantaloupe				
Carrots				
Cauliflower				
Celery				
Cranberry				
Cucumber				
Grapefruit				
Grapes				
Green Pepper				
Honey Dew Melon				
Mango				
Oranges				
Peach				
Pears				
Pineapple				
Red Pepper				
Squash				
Strawberry				
Sweet Potatoes				
Tomatoes				
Watermelon				
Zucchini				

Appendix C Preschool Director Survey

Thank you for agreeing to take part in this study. Please answer a few questions so we can get to know your facility.

What is the name of your childcare center or preschool?_____

1. Please indicate how often you serve each food listed below at your childcare center?

	Never/Hardly ever	At least once a month	At least once a week	More than once a week
Apples				
Banana				
Broccoli				
Cantaloupe				
Carrots				
Cauliflower				
Celery				
Celery				
Cranberry				
Cucumber				
Grapefruit				
Grapes				
Green Pepper				
Honey Dew Melon				
Mango				
Oranges				
Peach				
Pears				
Pineapple				
Red Pepper				
Squash				
Strawberry				
Sweet Potatoes				
Tomatoes				
Watermelon				
Zucchini				

2. Are there specific foods your staff has difficulty serving because the children do not like them? If yes, please list foods?

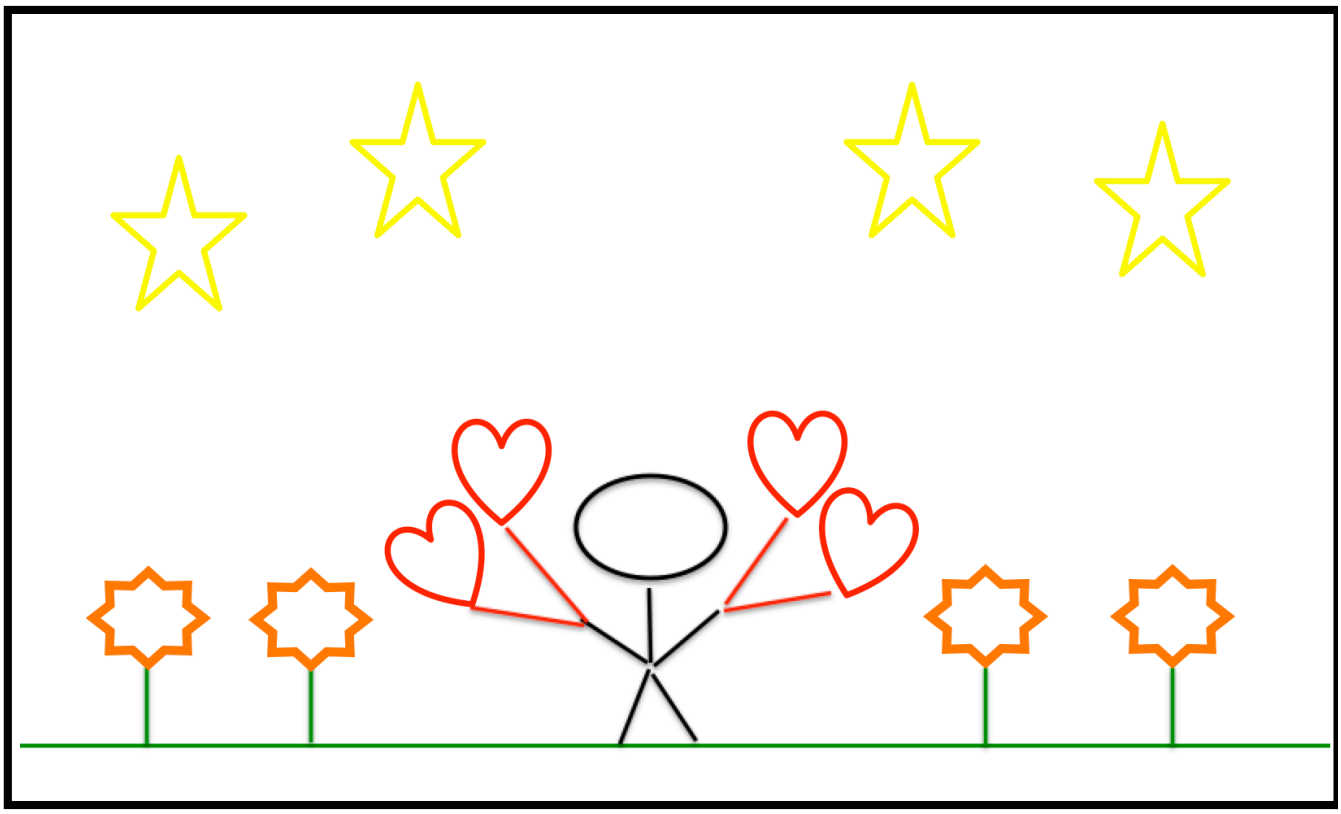
3. How are meals served to the children?

- ○ Plated and then served
- ○ Family Style (where each table of children are given the bowls and serve themselves)
- ○ Other (please specify) _____

4. How are snacks served to the children?

- ○ Plated and then served
- ○ Family Style (where each table of children are given the bowls and serve themselves)
- ○ Other (please specify) _____

Appendix D Placemat



Appendix E Chef Script
Chef 1: main research team member or P.I. will introduce second research team member as friend
Chef 2: research assistant to aid in observing while children consume snack

Chef Script
All three groups will have the same script.

Before Serving:
Chef 1: *Hi boys and girls, my name is Chef (insert name). I am here to serve your snack today! This is my friend Chef (insert name of Chef 2), who helped me cut up your snack for you today!*

Chef 1: *For today's snack you are having (insert fruit or vegetable) and (insert other component)!*

While Serving:
Chef: *This looks like a yummy snack!*

After Snack*:*

Chef: *Alright, boys and girls, thank you so much for letting me come to your classroom today! I hope you have a great rest of the day! Bye!*

If children share: Chef will discourage sharing
Chef 1: *Boy and girls lets keep our own food on our own placemat/plate*

Note: If child does share food, that piece of food will be noted and excluded from data.

Additionally, the classroom's teacher will be present to help with supervising the children in case the class becomes disruptive.

Appendix F Plate Waste Protocol

The plate waste protocol was used to determine intake. F&Vs were weighed before each child consumed the snack and then after they consumed the snack. Intake was determined by subtracting weighed post weight from pre weight.

Once F&Vs were cut into their proper forms (chunk/strips, or hearts, stars, flowers, and circles). The F&V were weighed using the Ohaus Scout Pro scale. Weights were manually entered into an Excel spread sheet. Due to technological difficulties after the second fruit week, weights were also hand written in addition to entering the weights into the computer. The original plan was to use WinWedge Standard 3.5, a device data collection software that would send the weights to an excel sheet from the Scout Pro scale. However, the updated software was unavailable to the research team. After the snack time was completed, the foods were gathered and weighed again using the same scale. Each individual's intake was be tracked throughout each snack using identification (I.D.) numbers given to the children at the beginning of the study.

During the snack time, the two researchers that were dressed as the chefs observed the participants. Children were discouraged from sharing foods, and it was noted if a child shared their food. If a child shared their food, their intake for that piece of food was excluded. If a child dropped a piece of food, the dropped piece was collected and excluded from the pre and post weight. Each participants' I.D. number were used when taking notes during the snack.

Appendix G Fruit Consumption Results

There were no significant differences found between or within the groups for fruit consumption. Tables 10 and 11 illustrate the results from the independent t-test and paired t-test.

Table 10. Mean Fruit Intake Difference Within Groups by Time Point

Time Point	Control Mean Change (Std Dev)	*p* value	Experimental Mean Change (Std Dev)	*p* value
First Snack to Third Fruit Snack	1.87g (21.46)	.68	1.96g (12.18)	.52

Table 11. Mean Difference in Consumption of Fruit Snack Between Groups by Time Point

Time Point	Mean Difference (SE)	*p* value
First Fruit Snack	2.70g (5.92)	.65
Third Fruit Snack	5.05g (6.77)	.46

Vita

Kristen Clay grew up in Nashville, Tennessee. She attended Lipscomb University where she received a Bachelor's of Science with a concentration in Dietetics in December 2013. Kristen was accepted into the Public Health Nutrition Master's program and Dietetic Internship at the University of Tennessee, Knoxville. She began pursing her Master's in August 2014. During her Master's work, Kristen worked with East Tennessee Children's Hospital and the Tennessee Childhood Obesity Coalition as a Healthy Kids Club Instructor. She was also actively involved in the ICAN-GROW lab's work with Cardiac Club, an afterschool nutrition education and physical activity program for fourth and fifth graders in Knox County. Kristen is expected to graduate August 2016.