ABSTRACT

THE EFFECTS OF GAMIFICATION AND TASTE EXPOSURE ON VEGETABLE CONSUMPTION IN CHILDREN

In 2013, it was reported that 42 million children around the world were considered overweight or obese (Centers for Disease Control [CDC], 2015). This is a major problem considering childhood eating patterns are predictive of adult eating patterns (Lake, Mathers, Rugg-Gunn, & Adamson, 2006). Therefore, the purpose of the current study was to increase healthy eating in school-aged children using gamification via the FIT Game and repeated taste exposure of non-preferred vegetables. Previous research has demonstrated a significant increase in fruit and vegetable consumption using the FIT Game, but these effects have not always been maintained (Joyner et al., 2015). Therefore, it is important to investigate additional strategies, such as taste exposure, that may help sustain healthy eating. The current study conducted a 10-week version of the FIT Game that targeted vegetable consumption with third-fifth graders. Taste exposure sessions were run concurrently with 13 students who demonstrated low preference and consumption of vegetables. Results of this study demonstrated that while FIT Game students consumed more vegetables than the control group, the addition of taste exposure sessions resulted in greater increases in consumption and increased preference even for non-targeted vegetables.

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THE EFFECTS OF GAMIFICATION AND TASTE EXPOSURE ON VEGETABLE CONSUMPTION IN CHILDREN

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CHAPTER 1: INTRODUCTION

According to the World Health Organization, one-third of the United States population is considered obese. Obesity is defined as a disproportionate amount of fat accumulated in the body that may impair health (World Health Organization [WHO], 2016). Obesity can lead to an increased risk of various health conditions such as high blood pressure, Type 2 diabetes, heart conditions, and even death (Centers for Disease Control and Prevention [CDC], 2015).

Considering the implications obesity may have, it is important to understand the variables that may contribute to this epidemic. Specifically, it is presumed that an individual's genetics and behaviors influence whether he or she may become overweight or obese (CDC, 2015). However, while genetics plays a role, genetic changes occur too slowly to be the sole explanation for the obesity epidemic. As such, obesity is likely to be a combination of genetic variation, patterns of physical activity, and eating behavior (CDC, 2015). With respect to eating behavior, it is important to note that childhood eating patterns are predictive of adult eating patterns (Lake, Mathers, Rugg-Gunn, & Adamson, 2006). As such, high obesity rates in children are particularly concerning. Indeed, in 2013 it was reported that 42 million children around the world were considered overweight or obese (CDC, 2015).

There have been attempts by the government and other agencies to address this epidemic, specifically in the school system. The USDA's National School Lunch Program Guidelines are designed to provide free, nutritionally-balanced meals each day to low-income children. While the program makes healthy food available, research indicates that simply making healthy food available is not enough (Hanks, Just, Smith, & Wansink, 2012). In particular,

especially in the United States, individuals are not eating the recommended daily amounts of fruits and vegetables (FV) (Centers for Disease Control and Prevention [CDC], 2013). Specifically, the CDC found that between 2007-2010, 60% of children did not eat enough fruit and 93% of children did not eat enough vegetables. In addition, many individuals consume high-density caloric, low-nutrient foods rather than foods high in nutrients—such as FV. If children engage in these types of consumption behaviors, they may lead to similar patterns in adulthood. As a result, it is pertinent to intervene in unhealthy eating behaviors at an early age.

There is a large body of literature attempting to improve eating behavior, but unfortunately, much of it emphasizes the knowledge and verbal behavior surrounding healthy eating (Bartlett, 1981; Knai, Pomerleau, Lock, & McKee, 2006). While this is important, it does not actually change FV consumption. Therefore, finding interventions for schools that are low-cost, low response effort, and result in sustained outcomes is necessary to changing the trajectory of the obesity epidemic.

CHAPTER 2: LITERATURE REVIEW

School-Based Interventions

Traditional Approaches

According to Bartlett (1981), while the traditional approaches concerning health education in schools have demonstrated an increase in the knowledge and positive attitudes associated with healthy eating, they have yet to demonstrate a corresponding change in eating behavior. Since Bartlett's study, a number of researchers have attempted to find effective methods to promote healthy eating in school-aged children (Knai et al., 2006; Nicklas, Johnson, Myers, Farris, & Cunningham, 1998; Perry, Lytle, & Feldman, 1998). Common approaches to increasing healthy eating behavior in school-aged children include homework, worksheets, parental involvement, exercise plans, and The Knowledge, Attitudes and Practices questionnaire (Nicklas et al., 1998; Perry et al., 1998). However, while these additional studies have altered student's verbal behavior about healthy eating, they have also been unsuccessful in producing any significant change in healthy eating behavior (Bartlett, 1981).

Approaches that have demonstrated a significant increase in healthy eating behavior in children are multi-component interventions. Knai et al. (2006) conducted a meta-analysis that assessed 15 studies attempting to increase healthy eating in children. However, of the 15 studies, only the 10 that were multi-component studies were considered socially significant. One multi-component study that demonstrated a significant increase in healthy food consumption was the Food Dudes program. This program utilizes intervention strategies based on behavior analytic principles (Lowe, Horne, Tapper, Bowdery, & Egerton, 2004).

Food Dudes

The aim of the Food Dudes program is to increase selection and consumption of FV by school-aged children. The program utilizes three intervention strategies, which include taste exposure, modeling, and reinforcement. Students are initially shown a series of 16 videos each day for 16 days involving superheroes who eat healthy food and villains who consume junk food. Following the presentation of each video, teachers read a letter from the Food Dudes program, which contains a message encouraging the children to eat their fruits and vegetables. Next, teachers offer the children healthy food to eat. If a child tries the food item, his or her tasting behavior is reinforced with a sticker; if the child actually eats the allotted portion, he or she is given a small toy. After this phase is completed, the videos are no longer presented, and the letters are now read to the students intermittently.

Tapper, Horne, and Fergus (2002) implemented the Food Dudes program and demonstrated a significant increase in FV consumption in grams for the entire school. Follow-up probes, conducted 4 months following the intervention, indicated that FV consumption remained above baseline levels. Despite the increase, the authors noted several limitations. First, the response effort required by the teachers was notably high. Second, maintaining the program long-term may not be feasible due to the cost.

Other studies have also demonstrated the effectiveness of the Food Dudes program (Horne et al., 2004; Tapper et al., 2002), however, these studies failed to demonstrate increased levels of consumption at follow-up. In fact, a systematic review conducted by Upton, Upton, and Taylor (2012) suggested that while the Food Dudes Program *does* increase FV intake during the intervention, the effects are short-lived and the behaviors do not sustain over time. Lowe (2013)

suggested that these contrasting results, specifically between Horne et al. (2004) and Upton et al. (2012), might be due to fidelity of implementation on behalf of the teachers.

One study added additional measures to assess program fidelity. Morrill, Madden, Wengreen, Fargo, and Aguilar (2015) assessed the implementation of the Food Dudes program, its sustainability, and the effects of utilizing tangible reinforcers as a consequence for tasting the target food. The experimental procedures were identical to prior research with the exception of the following modifications. First, the authors evaluated program fidelity by recording each time the teachers logged onto the website to access the scripts and stories. In addition to frequency, they also collected duration of each login. Second, three different conditions were assessed: tangible, praise, and a control. In each experimental condition, the specified consequence was delivered contingent upon the students consuming the target food. The participants in the control group did not receive any feedback. As an additional program fidelity check, the researchers evaluated the delivery of prizes in the tangible group on a weekly basis to ensure the specified consequence was being administered correctly. Follow-up data were collected over a span of 3 days approximately 6 months after the study was completed.

The results of the Morrill et al. (2015) study indicated a significantly higher consumption of vegetables in the tangible group in comparison to the praise and control groups. However, during the follow-up probes, only a small increase of fruits and vegetables sustained and not at a level considered significant. The results of the treatment integrity measures ruled-out procedural fidelity as a likely explanation for this lack of maintenance. The authors speculated that it may have been due to the delay between the student's eating

behavior and consequence delivery. This delay may have decreased the value of the reinforcer. Additionally, the quality of the reinforcers was not assessed. Finally, although the use of tangible reinforcers demonstrated the highest increase in FV consumption, the cost of purchasing the reinforcers may outweigh their benefits.

As such, other researchers have attempted to address some of these limitations. For example, a newly designed program called the FIT Game (Jones, Madden, Wengreen, Aguilar, & Desjardins, 2014) was created to decrease the response effort of school personnel and to offset the costs associated with the implementation of the program. One factor that contributes to the success of the FIT Game is the gamification component. Gamification eliminates the need for tangible reinforcers and automatizes program delivery. As such, it increases the immediacy of reinforcer delivery, decreases the monetary cost, and lowers the response effort of implementing the intervention significantly.

Gamification

Gamification is defined as a process of engaging individuals to attend to stimuli presented on a screen by using game-like techniques (Burnes, Butchko, Patrick, Wells, & Williams, 2015). The essential components of gamification include creating a convincing story for the audience, earning in-game currency, and making the game interactive in such a way the story line changes as the user's behavior increases or decreases. The techniques that gamification utilizes may be so compelling that it masks the contingencies arranged by the researcher. As a result, many individuals may remain unaware of the changes in their behavior that occur as a result of the gamified contingency.

Gamification has been used in a wide variety of areas, including education (Dominguez et al., 2013), finance, health, sustainability, and many others (Deterding, Dixon, Khaled, & Nacke, 2011). In these settings, gamification has demonstrated an increase in academic behavior, work behavior, and health-related behavior respectively (Morford, Witts, Killingsworth, & Alavosius, 2014). One of the new and interesting areas gamification is being applied to is healthy eating in school-aged children. An example of utilizing gamification to promote healthy eating in children is through a program called the FIT Game (Jones, Madden, & Wengreen, 2014).

FIT Game

The FIT Game targets real-world healthy eating behavior using a virtual gaming system. Jones, Madden, and Wengreen (2014) used an alternating treatments design to assess the effects of this low-cost, game-based intervention in an elementary school over a period of 29 days. During baseline, which lasted 15 days, both FV consumption were calculated daily. Before the FIT Game was displayed, an assembly was held to introduce the children to the game. The program used a false "competition" where students were told they were superheroes (FITs) trying to save the galaxy from the vegetation annihilation team (VATs). The competition phase included three elimination rounds and was held on the first 7 days of the study. During this phase, the students were told they were competing with other schools, but the schools were imaginary and the students were actually competing against themselves, according to their own FV consumption. If the children consumed more food than the 60th percentile of the last 10 days they "beat" the other school. After winning the elimination rounds, the school received a medal, which was placed on the FIT game display board.

Following the competition phase, the mission phase began. In this phase, the teachers read 3-minute scripts and told the students the heroes needed their help by eating either a fruit or vegetable. If the students met criterion, which was determined based on the last 10 days of FV consumption, they moved on. If they did not meet the daily goal, they were instructed to eat more FV and the video was not shown that day. Students were not informed of the specific goal, but were simply told to eat more FV. The students were also given a virtual coin for every gram they exceeded the goal. For example, if the goal was to eat 60 grams and the students consumed 62 grams, the students earned two gold coins. After earning four coins, the students collectively voted on how to use the currency to help the FITs. This was repeated until all episodes were completed. Although the results indicated a significant increase in FV consumption, similar to the Food Dudes program, consumption returned to baseline levels once the intervention was withdrawn.

A follow-up study conducted by Jones, Madden, and Wengreen (2014) utilized similar procedures, with the exception that Jones, Madden, and Wengreen did not include an initial "competition" between the schools; instead, they added seven FV tasting stations. If the students consumed six of the seven FV, they earned a small prize, such as a temporary tattoo; if they consumed all seven of the FV they received a larger prize, such as a mechanical pencil or Frisbee. The authors speculated that the virtual reinforcers alone would be insufficient to increase consumption of FV that were usually avoided. This is noteworthy, because it's necessary to present new or non-preferred FV to the students and assess their current consumption behavior. However, the students were only exposed to the FV one time. Based on previous research, this may not be sufficient to shift a child's preference due to the limited exposures (Lakkakula,

Geaghan, Zanovec, Pierce, & Tuuri, 2010). Similar to other Food Dudes and FIT Game research (Horne et al., 2004; Jones, Madden, & Wengreen, 2014; Tapper et al., 2002) results demonstrated a significant increase in the consumption of fruit, but only a moderate increase in vegetable consumption. The authors noted several limitations, including the brevity of the intervention, the lack of behavioral maintenance, and the high level of teacher response effort.

Joyner et al. (2015) expanded upon the previous research using an A-B-A-B reversal design. They used similar procedures to Jones, Madden, and Wengreen (2014); however, the researchers manipulated the response effort of the intervention and only targeted vegetable consumption. Specifically, the episodes were in a comic book form and were displayed on a projection screen in the cafeteria. This eliminated the need for teacher involvement. The results demonstrated a significant increase in vegetable consumption during the intervention phase. Following the withdrawal of the intervention, the vegetable consumption returned to baseline levels. While this does demonstrate experimental control, the ultimate goal of the FIT Game is to maintain healthy eating once the intervention is withdrawn. The author's speculated that the brief duration of the game may be responsible. Indeed, a possible reason the FIT Game does not maintain healthy eating behavior once the intervention is withdrawn may be attributed to the limited number of taste exposures to any given vegetable during the intervention

Taste Exposure

Research has shown that a child's differential selection of food, also known as preference, is related to subsequent consumption (Birch, 1999). Some children may not consume enough vegetables due to specific stimulus

characteristics or history with respect to vegetables. As such, the Food Dudes and FIT Game research relies on tangible or virtual reinforcers to increase selection and consumption. However, when these reinforcers are removed, FV consumption returns to baseline levels. In order for these interventions to have a sustained effect, we must further evaluate the variables that maintain FV consumption. Previous research has suggested that exposing children repeatedly to a vegetable, by requiring them to consume or taste the vegetable, increases the likelihood that they come in contact with the natural reinforcers that follow consumption, such as the taste. In fact, research has demonstrated that non-preferred foods may become preferred foods after repeated tastings or exposures (Lakkakula et al., 2010).

Lakkakula et al. (2010) conducted a study to examine whether repeated exposures to non-preferred vegetables would shift taste preferences in children. In this study, 360 fourth- and fifth-grade students participated in a 10-week intervention. The intervention was comprised of weekly tasting sessions, where the students received four freshly prepared vegetables. They were then given the instructions, "You were given two cups that contain four different vegetables. One at a time, please taste each of the four vegetables. You do not have to swallow them; you may spit them out into your napkin after tasting" (Lakkakula et al., 2010, p. 227). Following the taste exposure intervention, the students were instructed to fill out a survey. The survey had the names of the vegetables being tasted and included a column for the students to rate their preferences. This preference assessment was an adaptation from a previous study that had been validated by a panel of experts in child nutrition (Cullen et al., 2003). The results demonstrated an increase in the children's preference for previously disliked foods. This shift occurred after approximately eight taste exposure sessions.

Unfortunately, the study did not provide follow-up data to assess if preferences were maintained.

Anzman-Frasca, Savage, Marini, Fisher, and Birch (2012) conducted a study to assess children's preferences, consumption, and maintenance after repeated taste exposures to non-preferred vegetables. The authors' procedure was similar to Lakkakula et al. (2010), except that the current study evaluated a change in preference for vegetables that were presented alone versus those that were presented with a dip. During the first experiment, the researchers used a between-groups design. The children were assigned to either a vegetable alone or vegetable with dip group and were exposed to each vegetable nine times. During the experiment, the researchers administered a series of preference assessments that were conducted before, after, and during the test trials. These trials consisted of a self-report preference assessment and a vegetable intake (consumption) assessment. The authors also conducted a follow-up study, in which they utilized a within-subjects group design. In this study, each child was presented with a non-preferred vegetable alone and a different non-preferred vegetable with a dip.

Both experiments demonstrated an increase in the amount of vegetables consumed. Results also indicated that that the children's preferences for the vegetables shifted after approximately six tastings. This demonstrates that a small number of tastings can be used to improve a child's preference for non-preferred food. The studies also included a 1-month follow-up probe, which showed that the preference shift had maintained. However, at the follow-up, the vegetables that were introduced with a dip did not maintain when presented alone. In fact, the amount consumed did not differ compared to baseline levels.

This indicates that dip is not necessary, and indeed may be detrimental in establishing and maintaining taste preference for vegetables.

Hausner, Olsen, and Moller (2012) also evaluated the lasting effects of taste exposure on vegetable preferences. The vegetables used were unmodified artichoke puree, artichoke puree with added sweeteners, and an energy dense artichoke puree with added fats. The children were exposed approximately two to three times per week to each vegetable, over a span of 4 weeks. Contrary to the aforementioned study, the results indicated that a preference shift was demonstrated after five exposures. However, of all three preparation choices, the most significant increase in consumption was demonstrated in the unmodified puree. Similar to Anzman-Frasca et al. (2012), these findings indicate that no additional flavors or additives are necessary to change preference. Furthermore, a 6-month follow-up probe demonstrated a significant increase in the children's consumption of the unmodified puree. As such, one may conclude that contacting the natural reinforcers following consumption, such as taste, is sufficient to maintain healthy eating.

However, if a child engages in behaviors such as food refusal (Williams, Field, & Seiverling, 2010), there are alternative methods to assist with these deficits. Previous research has shown that using tangibles may increase the probability of a target behavior, such as vegetable consumption (Cooke et al., 2011; Remington, Anez, Croker, Wardle, & Cooke, 2012). For example, a method used by Remington et al. demonstrated a significant increase in children's intake and preference for a target vegetable. The authors randomly assigned children to either an exposure plus tangible condition, exposure plus praise condition, or a control group. In the exposure plus tangible group, the children were asked to try the target food and were told they would get a sticker if they did so. The

exposure plus praise condition was identical, except the children received praise instead of the tangible. Children in the control condition were not exposed to vegetables. Results of the study demonstrated that the children in the exposure plus tangible condition significantly increased their intake and liking of the target vegetable. The results of children assigned to the praise condition did not differ significantly from children assigned to the control group. Increased intake and liking for children in the exposure plus tangible condition also maintained at the 1- and 3-month follow-up probes.

Therefore, the purpose of the present study is to evaluate how the addition of repeated vegetable taste exposures affects the outcome of the FIT Game intervention (Jones, Madden, & Wengreen, 2014). As noted previously, children's vegetable consumption tends to return to baseline levels once the FIT Game intervention is withdrawn. This suggests that virtual reinforcers alone were maintaining healthy eating behavior. For this reason, adding taste exposure may result in more sustained effects by virtue of transferring control of these behaviors from virtual reinforcers to automatic reinforcers (i.e., taste). To further assess this, the FIT Game was evaluated in two ways. First, the FIT Game's duration was increased from 29 days to 10 weeks. Currently, Joyner et al. (2016) are also conducting a study that evaluates an extended version of the FIT Game. Second, a more systematic taste exposure condition was utilized for a small subset of children. This condition was to determine if additional exposures had an additive effect on the results of the FIT Game. Maintenance effects of the FIT Game and the taste exposure intervention were then measured.

CHAPTER 3: METHODOLOGY

Participants and Setting

All children who attended a public central California elementary school in third through fifth grade participated in the FIT Game portion of the study (N=400). Additionally, kindergarten through second-grade students were utilized as a control group. Approximate age range of the children was 6-12 years old. The school is part of the National School Lunch Program (NSLP), and as such, the FV were portioned out as per program guidelines. An opt-out consent procedure approved by the California State University, Fresno Institutional Review Board (FSU IRB) was utilized (see Appendix A). Therefore, all students participated if their legal guardian did not return a consent form indicating otherwise.

In addition, 13 students from the third, fourth, and fifth grade were selected to participate in the taste exposure intervention. These students had selective eating behaviors per parent report and had at least three non-preferred vegetables from the school cafeteria. For these participants, an opt-in consent procedure was used as approved by the FSU IRB and signed parental or guardian consent was required for all participants (see Appendices B and C).

Procedures

Procedures varied based on whether children were exposed to the FIT Game alone or the FIT Game plus taste exposure.

Pre-Baseline Assessments

Prior to baseline, a preference assessment, modified from Lakkakula et al. (2010) (see Appendix D), was given to the 15 students who would be potentially

participating in the taste exposure intervention. The participants were asked to rate their preference for the vegetables that are served in the cafeteria. They were given the instruction "Please place an "X" by the picture that tells me how much you like these vegetables." There were three emoji icons and underneath the specified icon it said, "I like it," "I don't like this, but I'll eat it," and "I don't' like this." The three vegetables ranked the lowest were utilized for the taste exposure intervention. This same preference assessment was also administered at the end of each taste exposure session and at the end of the study.

Following the initial preference assessment, the researcher also delivered a food intake assessment to measure the amount of vegetables the students were consuming prior to the intervention. The children were served 10 bite-size pieces of all of the vegetables served in the cafeteria 15 to 20 minutes before lunch time. The weight of these vegetables was recorded prior to the assessment. The students were then given the instruction, "Eat as much as you would like." They were given up to 15 minutes to eat the vegetables. All remaining vegetables were then weighed and counted to assess current intake levels. During the pre-baseline assessment, if a student consumed 100% of the portion or indicated a preference for three of the five items, they were disqualified from the taste exposure condition and only participated in the FIT Game component. Two participants were disqualified, leaving 13 remaining participants for the FIT Game plus taste exposure part of the study.

Lastly, the students received a brief survey to identify items that may function as reinforcers for future taste exposure sessions. Some of these items included pens with feathers, Slinkies, and emoji erasers.

FIT Game Baseline

During baseline of the FIT Game, FV consumption was recorded throughout lunchtime. Again, all students in third through fifth grade, including those in the taste exposure group participated. The students were instructed to place their leftover vegetables and other materials in specified bins. For example, all vegetable waste was disposed of in a green bin with the label "VEGETABLES," all fruit waste was disposed of in a gray bin labeled "FRUIT," and all other waste was thrown in a trashcan. During this phase, the researcher or research assistants provided praise for accurate sorting behavior and corrected students if they made a mistake. No feedback was provided on how much fruit or vegetables the students consumed.

FIT Game Intervention

On the first day of the FIT Game phase, all students participated in an assembly, where they were introduced to the heroes and the villains of the game (see Appendix E). The students were then instructed on how eating vegetables would help the heroes accomplish various missions. During the rest of the FIT Game phase, all instructions were provided by the game directly and not via the researcher or school personnel. An additional sign saying, "Take your FIT Food" with characters from the game was hung near the area that the students took their FV.

The FIT Game utilized an A-B-C-D research design targeting vegetable consumption. Fruit consumption was measured as a control, and as such, was not directly targeted. Daily goals were set and the game advanced as the children met their goals. The goals were calculated by using a percentile schedule of reinforcement. Specifically, daily goals were set using the 60th percentile of the average consumption over the past 10 days of the study. Children were not told

the specific goal, rather, they were only instructed to increase eating their vegetables to advance the game.

Throughout the study, depending on if the students met their goals, the next episode of the FIT Game was projected on a screen in the front of the cafeteria during lunchtime (see Appendix F). Each episode lasted about three minutes, replayed throughout lunch and described the adventures of the heroes and the villains. Every episode or storyline concluded with the heroes encouraging the students to eat more vegetables. However, if the students did not meet their goal, no new episode was projected and they were encouraged to eat more vegetables by the characters, researcher, and/or research assistant. For example, upon the first goal being met, the first villain was caught on the planet the children chose, meaning contingent upon consuming the target food the storyline changed. Subsequent villains were caught as additional goals were met.

Currency was awarded to the children contingent upon exceeding the daily goal. For every 1% the children surpassed the daily goal, one gold coin was given to the school. For example, if the goal was to eat 60 grams of vegetables and the students consumed 62, the students were awarded two gold coins. These coins were used to purchase items that aided the FIT heroes in defeating the villains. The storyline then changed according to the students' choice. In addition, unlike Jones, Madden, and Wengreen (2014), which only lasted 29 days, this version of the FIT Game lasted for approximately 10 weeks. As noted earlier, this is similar to a study Joyner et al. (2016) are currently conducting to evaluate if an extended game results in better maintenance of effects.

Baseline lasted for 10 days. Following baseline, the FIT Game (Condition B) was introduced (as described above). Given the lack of effect on consumption, a picture prompt was then added (Condition C). Specifically, a picture of the

vegetables available that day was hung below the FIT Food sign to indicate which vegetables could help achieve FIT points. This condition lasted 12 days, but unfortunately did not significantly shift responding. During this condition, the researcher spoke with the cafeteria staff and the principal to stress the importance of having enough vegetables available for the students. The cafeteria staff agreed to do their best to ensure that enough vegetables were available by saving the leftovers from the previous day for the FIT Game group. In addition, verbal prompts, increased sitting time and a fruit-slushie sign were added (Condition D). Verbal prompts consisted of a research assistant standing next to the FV stand and encouraging the students to take a vegetable. Prior to this condition, the participants could also throw away their food at any time during lunch. During Condition D, the students were to remain seated until instructed by the vice-principal to throw their items away. This increased their seated time for eating to approximately 18-20 minutes. The final addition was a fruit slushie sign that was bright yellow and said, "Even if you take a fruit slushie, remember to still take your FIT Food!" This condition lasted 18 days. See Appendix G for a visual display of the experimental conditions timeline for the FIT Game, FIT + taste exposure, and control groups.

FIT + Taste Exposure

While all students participated in the FIT Game, the taste exposure condition only applied to the 13 students who were selected based on their low-levels of vegetable consumption.

Research Design

For the taste exposure intervention, a multiple baseline across food items research design was utilized. More specifically, all vegetables were presented,

but the intervention only targeted one vegetable, while the other two remained in baseline. After several exposures to vegetable 1, participants were also encouraged to try vegetable 2, and then vegetable 3. Regardless of the number of vegetables consumed, the reinforcer remained the same.

The taste exposure baseline and intervention were introduced once all students had completed the first two episodes of the FIT Game. The participants were asked to taste the target vegetable(s) every Tuesday and Friday for 8 weeks.

Taste Exposure Baseline

Approximately 10-15 minutes before lunch, the 13 participants were escorted to a table outside the cafeteria for the taste exposure condition. They were then given approximately 10 minutes to try a bite-sized piece of the previously identified, non-preferred vegetables. The non-preferred vegetables resembled the vegetables that are given during lunchtime. For example, if carrots were the target vegetable and they were served raw during lunchtime, carrots were also served raw during the intervention. The intervention was conducted in small groups of three to four other participants to mimic lunch time conditions. Once the students chose to either not eat, spit or consume the vegetables, they were given the vegetable preference assessment. Once given the preference assessment, each participant was instructed not to look at other participant's preference assessments.

In conjunction with the tasting, students were also asked if they had any of the vegetables in the study presented to them (e.g., while at home, in the cafeteria) since the last session. If they were presented, the students were asked if they ate or just tasted and spit-out the vegetable. Additionally, each day a photograph of their lunch tray was taken before and after their lunch period to

assess the number of presentations, and potential consumptions, the student was coming into contact with.

Taste Exposure Intervention

Once baseline was complete for each vegetable, contingent upon students consuming or spitting the bite-sized portion of the target vegetable(s), they were given a slip with their name on it. This slip of paper was then traded for a tangible item. In addition to the immediate tangible, the slip was also put in a drawing for a prize at the end of the 10 weeks (i.e., science kits, fidget spinners, mermaid tail blankets, toys, etc.). After the students turned in their slip, they were given the vegetable preference assessment to complete.

If the student did not try the vegetable, they were asked to try it twice more. If the child failed to try the vegetable following the third presentation, the student was asked to complete the preference assessment and then was dismissed from the session.

Upon completion of all sessions of the taste exposure intervention, a post-food intake assessment was conducted similarly to the assessment conducted in pre-baseline. In addition to the food intake assessment, the students also completed the preference assessment one final time.

Maintenance Probes

Upon completion of the FIT Game and the taste exposure interventions, a 3-month follow-up probe was conducted for all students in the FIT Game, FIT Game and taste exposure, and control conditions at the school. Specifically, while the study took place in the spring, this maintenance probe took place when students returned for the fall and was conducted for 2 weeks in the school cafeteria.

Social Validity

A social validity survey was administered to school personnel (see Appendix H) at the end of the study (in the spring) but prior to the follow-up probes in the fall. This survey assessed how acceptable and easy the FIT Game intervention was to implement. All children were also asked to rate whether they liked the FIT Game or not (see Appendix I).

Participants in the taste exposure study were asked to complete a self-report survey indicating their preference for the intervention (see Appendix J). Furthermore, a survey was given to the parents of the children participating in the taste exposure intervention (see Appendix K). This survey asked parents to indicate if they saw a change in vegetable eating behavior and preference for previously non-preferred vegetables.

Data Collection

For the FIT Game, daily vegetable consumption was recorded. This was calculated using a weight-based measure:

$$\text{Consumption} = \frac{(P_v - U_v - W_v)}{N}$$

where P_v was the total weight of the vegetables prepared for serving that day, U_v was the weight of the unserved vegetable, W_v was the vegetable waste from the bin, and N was the number of students in attendance that day (Jones, Madden, & Wengreen, 2014). The same equation was utilized to calculate fruit consumption as well, which served as a control measure.

For the taste exposure intervention, each bite sized vegetable that was consumed was recorded as a "+", if the vegetable was chewed for more than

three seconds then spit out it was recorded as "/", if the vegetable was in the participants mouth for less than three seconds it was recorded as a "*" and a "-" if no attempt occurred. Data were also collected on preference per the preference assessment administered at each session. Finally, as mentioned previously, photographs of the participant's lunch trays and self-reports regarding exposure to and consumption of vegetables outside of the experimental setting were solicited.

Data Analysis

An independent samples t-test was conducted by separating the baseline and the comparison condition (i.e., B, C, and/or D) and comparing the two sets of differences in scores. This was conducted by subtracting one group's daily average in grams (i.e., FIT Game, control or FIT+Taste) from the comparison group's average in grams, then the differences in scores was used to compare the conditions. In other words, the test was comparing the differences in scores in baseline and during the intervention to assess whether the difference was larger or was reduced once the intervention was introduced.

Data for the FIT Game, FIT+Taste group, and the control across all conditions for consumption, was evaluated using a visual analysis across an A-B-C-D design. Consumption was analyzed to assess if the intervention had an effect on their consumption of FV. Additionally, comparisons were conducted for across all groups (i.e., FIT Game vs. Control, FIT Game vs. FIT+ Taste, and FIT+Taste vs. Control). Furthermore, for the FIT+Taste participants, data were evaluated using a visual analysis to assess if the intervention had an effect on their consumption and preference.

Interobserver Agreement (IOA)

For the FIT Game, two observers independently recorded the weight of the FV on 33% of sessions. In addition, while one researcher weighed the FV, another researcher or research assistant observed to make sure the items were weighed correctly. Disagreements resulted in repeating the measurement to ensure accuracy.

For the FIT + Taste, IOA was collected on 33% of sessions and was calculated on a trial-by-trial basis by dividing the total number of agreements by the number of agreements plus disagreements and converting the result into a percentage.

CHAPTER 4: RESULTS

FIT Game, Control, and FIT Game + Taste Exposure: Lunchtime Measure

Vegetable Consumption

Average vegetable and fruit consumption in grams per child for the FIT Game experimental and control participants, across baseline (BL), FIT Game (B), FIT Game plus picture prompts (C), FIT Game plus verbal prompting (D), and maintenance sessions are displayed in Figure 1. During baseline, the experimental participants consumed an average of 10.2 grams of vegetables (*SD*=7). This decreased by 5% to an average of 9.7 grams (*SD*= 5.6) when the FIT Game was first introduced (Condition B), maintained at 9.5 average grams per child (*SD*=7.2) after introduction of the picture prompts (Condition C), but increased when verbal prompts were added (Condition D) to 11.4 grams on average (*SD*=6.5). An independent samples t-test was conducted by separating the baseline and the comparison condition (i.e., B, C, and/or D) and comparing the two sets of differences in scores. In other words, the test was comparing the differences in scores in baseline and during the intervention to assess whether the difference was larger once the intervention was introduced. Thus, an independent samples t-test was conducted comparing vegetable consumption during baseline (Condition A) (M=10.24, *SD*= 6.9) and FIT Game plus verbal prompts (Condition D) (M=11.44, *SD*= 6.4), however, and the change was not statistically significant; $t(26)= .04$, $p= 0.32$.

Throughout baseline, the control participants consumed an average of 9.5 grams of vegetables (*SD*= 5). Similar to the experimental participants, the average consumption of vegetables decreased to 8.6 grams per child (*SD*= 6.1) during the

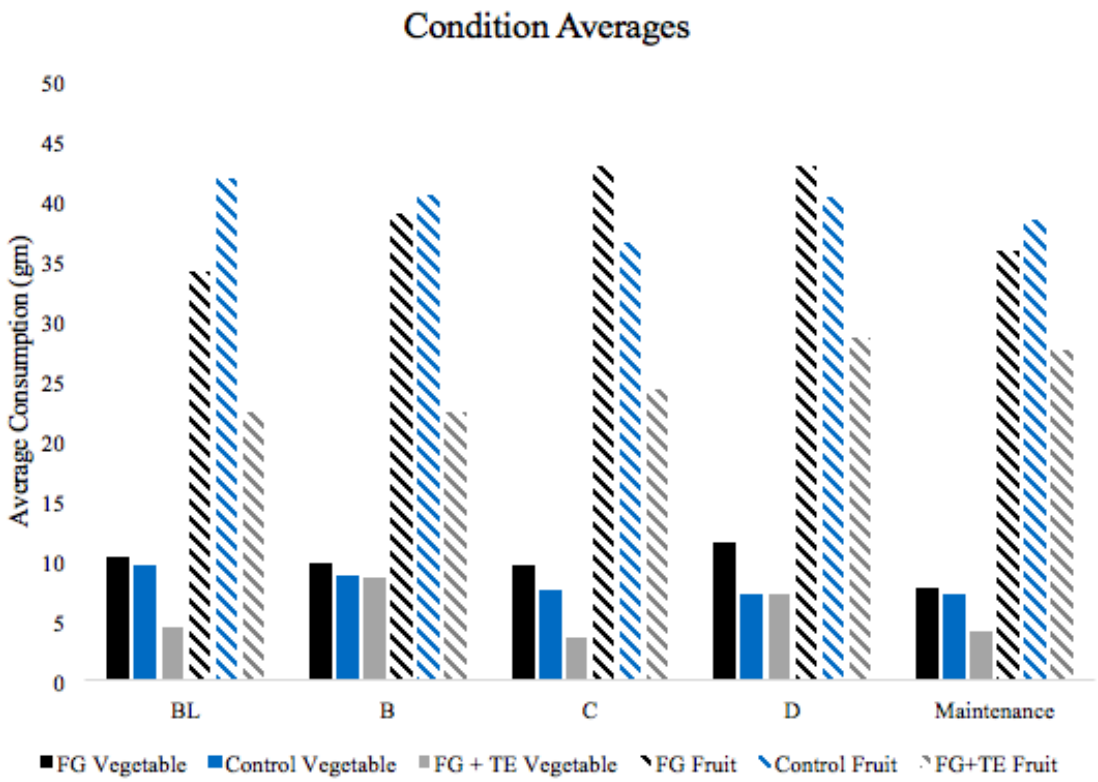

Figure 1. The average FV consumption for the FIT Game (FG) group, and control group, FIT Game plus Taste Exposure (FG+TE).
Notes: Consumption data are shown for baseline (BL), FIT Game (B), FIT Game plus picture prompts (C), FIT Game plus verbal prompts (D), and follow-up (maintenance) for the FG and FG+TE groups, and comparable data for the same time periods for the control group. Fruit consumption (a secondary control measure) for all three groups is shown in the lined columns.

same time as Condition B (see Figure 2). When Condition C was being run for the experimental group, the average consumption of vegetables further decreased to 7.4 grams (*SD*=5.2) and maintained at an average of 7.1 grams during Condition D. An independent samples t-test was conducted comparing the difference in vegetable consumption between FIT Game and the control group between the baseline (M=0.7, *SD*= 10.03) and Condition D (M=4.36, *SD*= 9.22), but the difference was not found to be statistically significant, $t(26) = .07$, $p = 0.16$.

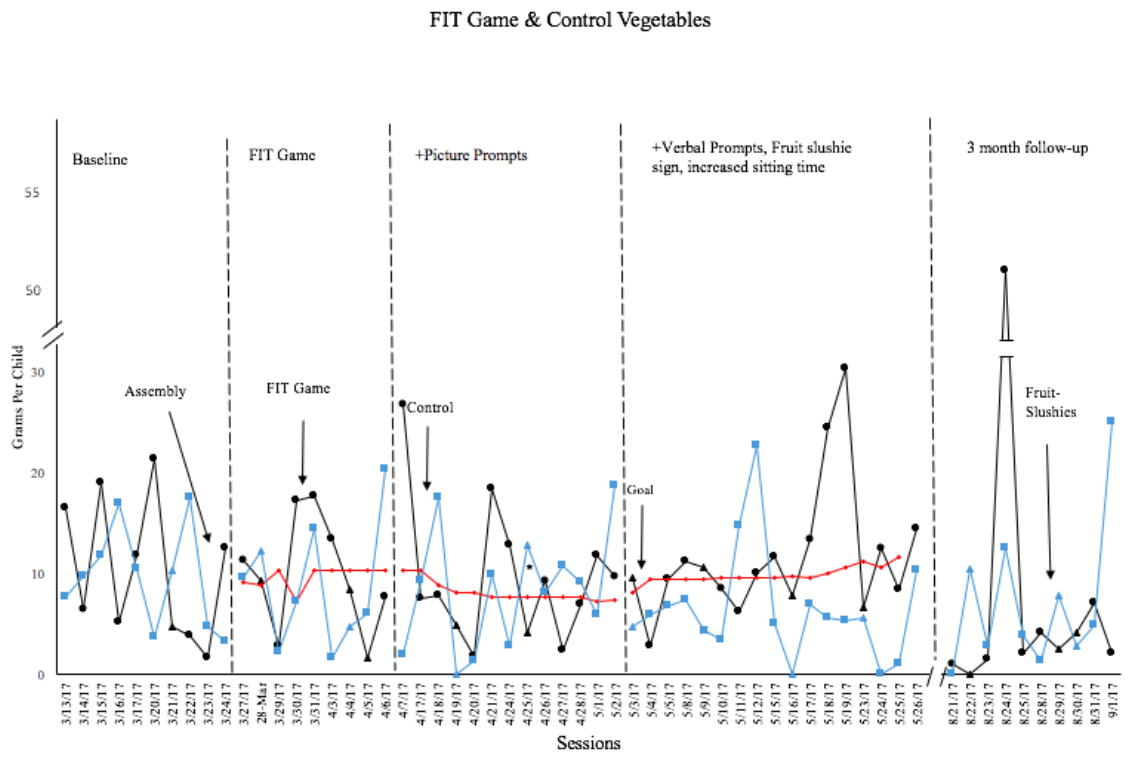

Figure 2. Vegetable consumption for the FIT Game (FG) and Control group across baseline (BL), FIT Game (FG), FIT Game plus picture prompts(C), FIT Game plus verbal prompts (D), and follow-up (maintenance).

During baseline, the FIT Game plus taste exposure participants (FG+TE), consumed on average 4.4 grams of vegetables per child (*SD*=4). Unlike the FIT Game and control groups, the average consumption increased to 8.6 grams (*SD*= 8.9) during the introduction of the FIT Game and decreased to 3.5 grams (*SD*=4.7) after the introduction of the picture prompts (Condition C), but increased to 7.3 grams (*SD*=7.8) when verbal prompts were added (Condition D). During the 3-month follow-up, the average consumption of vegetables returned to baseline levels of 4.1 grams (*SD*=4.7). An independent samples t-test was conducted comparing vegetable consumption during baseline (M=4.44, *SD*= 4), and Condition D (M=7.27, *SD*= 7.8), but was not found to be statistically significant; t*(48)*= 1.06, *p*= 0.14. However, when comparing the difference in vegetable

consumption between the FG+TE and experimental during baseline (M=5.8, *SD*= 7) versus the difference during Condition D (M=11.44, *SD*= 7.1), the results were statistically significant; t*(26)*= 2.15, *p*= 0.02. The FG+TE and the control group was also compared during baseline (M=5.1, *SD*= 5.9) versus the difference during Condition D (M=.18, *SD*= 7.5), the results were statistically significant; *t(26)= 1.9, p*=.02.

Fruit Consumption and FV Combined

As an additional control measure, fruit consumption was also tracked for the FIT Game, control, and FIT + TE groups. During baseline, the experimental (FIT Game) participants consumed fruit an average of 34.1 grams (*SD*= 13.7) per day. Following the introduction of the FIT Game (Condition B), it increased to 39 grams per child (*SD*= 11.8), and increased slightly to 42.8 grams on average (*SD*=22) after the introduction of picture prompts (Condition C) and maintained at 43 grams on average (*SD*= 16.4), following the introduction of verbal prompts (Condition D). An independent samples t-test was conducted between the difference in baseline (M=34.11, *SD*= 13.7) to Condition D (M=43.04, *SD*= 16.4), but despite the increase, the difference was not statistically significant; *t*(26)= 1.5, *p*= 0.07.

In contrast, the control group's fruit consumption did not increase. During baseline, the control participants consumed 41.97 grams of fruit per day on average (*SD*=16.1). When the FIT Game (Condition B) was introduced to the experimental group, consumption maintained at 40.5 grams of fruit (*SD*=22.5), and decreased to 36.6 grams (*SD*=16.9) after the introduction of picture prompts (Condition C) before increasing slightly to 40.3 grams of fruit (*SD*=19.5) following the introduction of verbal prompts for the experimental group (Condition D). An

additional independent samples t-test was conducted to compare the difference in fruit consumption for the FIT Game group and the control group during baseline (M=-7.86, *SD*= 12.5) and Condition D (M=2.71, *SD*= 18.5). The reason for this comparison is that the control group consumed considerably more fruit during baseline than the FIT Game group. So it is worth seeing whether the relatively large difference between the two groups during baseline was reduced by the intervention. As it turns out, this comparison also approached, but was not quite statistically significant; t(26)= 1.6, *p*=.06.

Throughout baseline, children in the FG+TE group consumed an average of 22.4 grams of fruit per day (*SD*=17) which maintained at 22.4 grams (*SD*=17.5) following the introduction of the FIT Game (Condition B), increased slightly to 24.3 grams (*SD*=16.5) when picture prompts were added (Condition C), and increased to 28.6 grams (*SD*= 15.3) after the introduction of the verbal prompts. Moreover, at the follow-up, consumption maintained above baseline levels at 27.5 grams per child (*SD*=15.7). An independent samples t-test was conducted to compare baseline (M=21.7, *SD*= 25.3) to the increase in Condition D (M=28.5, *SD*= 15.3), but was found to be statistically nonsignificant; t*(26)= 0.84, p*= 0.20.

Several additional independent samples t-tests were conducted to compare the difference between groups during baseline to differences between groups during all treatment conditions (i.e., B, C, & D). All comparisons were nonsignificant, except for the comparison between the FIT Game group (M=-7.86, *SD*= 12.5) and the control group (M=2.81, *SD*= 19.9) for fruit; t*(48)= 1.6, p*= .05 and when comparing the FIT Game group (M=-7.17, *SD*= 19.9) and the control group (M=5.74, *SD*= 22.3) FV combined; t(48)= -1.66, *p*=.05. The results suggest that the FIT Game had an effect on fruit consumption in the FIT Game group over the course of all three treatment conditions, and not just during Condition D.

However, when comparing the FIT Game and control groups, the difference for FV combined was also found to be significant for baseline (M=-7.17, *SD*= 19.9) versus Condition D alone (M=-7.06, *SD*= 20.5); t(26)= -1.77, *p*=.04. Additional t-tests comparing the FIT Game, control group, and FIT+Taste consumption from baseline to treatment and baseline to Condition D across vegetables, fruit, and FV combined were conducted. No other comparisons yielded statistically significant results (see Appendix L).

Interobserver Agreement (IOA)

Interobserver Agreement (IOA) was completed for 65% of sessions for the control group and 52% of sessions for the experimental (FIT Game) group. For both groups, IOA was 100% for weight. Additionally, treatment integrity data were taken on at least 53% of the control sessions and 51% of the FIT Game, treatment integrity for the control sessions was between 99%-100% and was 100% for all experimental sessions.

Social Validity

A social validity questionnaire (see Appendix H) was collected from school personnel. Ten surveys were given and five were returned. Results of the questionnaire suggests that all school personnel who returned the questionnaire either "strongly agree" or "agree" that teaching children to eat vegetables is important and that the children seemed to enjoy the study. The school personnel also rated "strongly agree" or "agree" that they believe this study could encourage the children at other schools to eat more vegetables and that the project looks feasible for other schools to implement. Furthermore, they also rated "strongly agree" or "agree" that they would recommend this study to other schools and they were happy to be a part of the study. Lastly, one school

personnel wrote, "they did a fantastic job with the students and I observed the students eating more fruits and vegetables."

Social validity results for the participants suggested that 100% think that it is important to eat vegetables. Additionally, 57% stated they enjoyed watching the FIT Game, while 29% indicated they did not enjoy watching it, and 14% answered "I don't know" to the question. 71% indicated that they consumed vegetables before the FIT Game, 21% recorded that they did not eat vegetables before the FIT Game and 7% indicated "I don't know". Self-report of vegetable consumption increased slightly as 79% of participants indicated that they like vegetables now, 7% said they don't like vegetables now, and 14% indicated "I don't know."

FIT+ Taste

During the study, two measures were taken to identify preference shifts. The first measure utilized a self-report preference assessment and the second measure was a vegetable intake assessment. First, we will discuss the self-report measure for the individual vegetables. One participant did not swallow any of the targeted vegetables more than seven times; therefore, their data will be omitted from the analysis due to not coming in contact with the tasting contingency. Thus, an analysis of preference shifts was conducted for 12 participants and 36 vegetables. Overall, 44% of vegetables were reported as highly preferred during the pre-probe and this preference maintained throughout the study. Of the remaining vegetables with low to moderate preferences, 85% shifted to moderate or highly preferred, and 15% of preferences did not shift. To further assess preference shifts, an analysis of the individual vegetables was conducted (see Table 1).

Table 1

Preference Shifts Between the Pre-Probe and the Post-Probe Across the Individual Vegetables

Vegetable	Preference	Pre-	Post-
Broccoli	High	4/10	9/10
	Moderate	5/10	1/10
	Low	1/10	0/10
Carrots	High	2/3	3/3
	Moderate	1/3	0/3
	Low	0/3	0/3
Salad	High	5/10	9/10
	Moderate	3/10	1/10
	Low	2/10	0/10
Cucumber	High	1/1	1/1
	Moderate	0/1	0/1
	Low	0/1	0/1
Celery	High	4/12	9/12
	Moderate	4/12	3/12
	Low	4/12	0/12

Notes: The two columns on the right are the pre-post measures of self-reported preference of the individual targeted vegetables. An "H" indicates a self-reported high preference for the vegetable, an "M" indicates a neutral preference and an "L" indicates a low/no preference. Due to one participant being omitted, the total number is 36 vegetables instead of 39.

The results suggest that high preferences shifted from four to nine for broccoli, five to one for moderately preferred, and one to zero low/no preference. For carrots, one preference shifted from moderate to highly preferred and two preferences maintained as highly preferred. For salad, results suggest that high preferences shifted from five to nine, moderate from three to one, and low preference from two to zero. For cucumber, one preference maintained as highly preferred, and zero preferences were reported for moderate or low/ no preference. Lastly, for celery, four preferences were recorded as highly preferred

in the pre-probe and in the post-probe nine preferences were record as highly preferred, three were moderately preferred, and there were zero remained at a low preference.

As previously stated, an additional vegetable intake (consumption) assessment was conducted. 16% of vegetables were consumed at a high level during the pre-probe and maintained throughout the study. Of the remaining vegetables with low to moderate consumption, 83% were consumed at a higher level during the post-probe. Consumption levels did not increase or consumption levels decreased for 17% of vegetables during the post-consumption probe. To further assess consumption levels, an analysis of the individual vegetables was conducted (see Table 2).

The results demonstrated high broccoli consumption increased from three to seven during the post probe, one consumption level increased to a moderate level, and two consumption levels remained low. For carrots, one remained and two additional consumption levels were recorded as high, and zero individuals consumed at moderate or low levels during the post-probe. For salad, high consumption levels increased from one to five, two were moderate, and two remained low. For cucumbers, one consumption was recorded and it shifted from low to high. Lastly, for celery, high consumption increased from one to seven, moderate increased from zero to two, and three remained low. Overall shifts in preference and consumption levels were observed for a majority of the participants (see Table 3).

These results demonstrate several main trends. First, the participants (i.e., 6, 7, 8, & 13) who self-reported a low or neutral preference for one or more vegetables that shifted to moderate or high following the intervention, saw a corresponding increase in consumption levels (see Appendix M, green color). It's

Table 2

Consumption Shifts Between the Pre-Probe and the Post-Probe Across the Individual Vegetables

Vegetable	Consumption	Pre-	Post-
Broccoli	High	3/10	7/10
	Moderate	0/10	1/10
	Low	7/10	2/10
Carrots	High	1/3	3/3
	Moderate	0/3	0/3
	Low	2/3	0/3
Salad	High	1/10	6/10
	Moderate	2/10	2/10
	Low	7/10	2/10
Cucumber	High	0/1	1/1
	Moderate	0/1	0/1
	Low	1/1	0/1
Celery	High	1/12	7/12
	Moderate	0/12	2/12
	Low	11/12	3/12

Notes. The two columns on the right are the pre-post measures of consumption of the individual vegetables. An "H" for consumption, indicates the participant consumed 6-10 pieces of the vegetable, an "M" indicates the participant consumed 3-5 pieces of the vegetable and an "L" indicates the participant consumed 0-2 pieces of the vegetable. Due to one participant being omitted, the total number is 36 vegetables instead of 39.

Table 3

Overall Shifts in Preference and Consumption

Vegetable	Consumption/Preference Level	Preference	Consumption
Broccoli	Shifted/Increased	5/10	7/10
	Remained High	4/10	0/10
	No shift/Decrease	1/10	3/10
Carrots	Shifted/Increased	1/3	2/3
	Remained High	2/3	1/3
	No shift/Decrease	0/3	0/3
Salad	Shifted/Increased	4/10	7/10
	Remained High	5/10	1/10
	No shift/Decrease	1/10	2/10
Cucumber	Shifted/Increased	0/1	1/1
	Remained High	1/1	0/1
	No shift/Decrease	0/1	0/1
Celery	Shifted/Increased	7/12	8/12
	Remained High	4/12	1/12
	No shift/Decrease	1/12	3/12

Notes: The two columns on the right are the preference and consumption measures of the individual vegetables. A "shift" or "increase" indicates that the preference went from low or moderate to moderately or highly preferred. "Maintained" indicates that the preference or the consumption was already recorded as high during the pre-probe and remained high during the post-probe. A "no shift" or "decrease" indicates that there was no shift in preference and for consumption means it maintained at low levels and consumption remained low or decreased. Due to one participant being omitted, the total number is out of 36 instead of 39.

worth noting that out of 36 possible vegetables, only six preferences and consumptions demonstrated this correspondence. As further evidence of this lack of correspondence, prior to intervention some participants (i.e., 1, 2, 3, 4, & 5) reported a preference for certain vegetables, however, these participants emitted low consumption levels at pre-consumption. Following the intervention, the participants emitted higher levels of consumption (see Appendix M, yellow color). Conversely, some participants (i.e., 6, 9, 10, & 12) had one of more vegetables with high consumption and low preference prior to the intervention, and their preferences increased (see Appendix M, orange color). Finally, several participants (i.e., 6, 9, 12, 8, 10, & 13) had at least one vegetable whose preference or consumption did not improve (see Appendix M, no color). Interestingly, the only participant whose preferences and consumption did not shift was 11, who was also the participant that tasted but did not actually swallow any of the vegetables.

During the pre-preference and pre-consumption probes, five vegetables were tested to determine the three vegetables to be used for the intervention (see Appendix N). The post-consumption and post-preference probes were identical to the pre-probe, meaning that all five vegetables were presented to the participant. They were instructed to rate the vegetables and to eat as much as they wanted and they could stop at any time. As such, there were 24 non-targeted vegetables, of which, 75% of preferences were reported as highly preferred during the pre-probe and maintained throughout the post probe. Interestingly, of the remaining non-targeted vegetables with low-to moderate preferences, 83% shifted to moderate or highly preferred, and 16% of preferences did not shift. For consumption, 10 of the 24 vegetables were consumed at a high level during the pre-probe. Of the 14 remaining, 100% of consumption levels

increased from low or moderate to moderate or highly preferred. This finding is important because it suggests that taste exposure to the three targeted vegetables may result in generalization to non-targeted vegetables. Overall then, including non-targeted vegetables, there were 22 shifts in self-reported preference for vegetables from low or moderate to moderate or high. Moreover, 39 shifts occurred for consumption from low or moderate to moderate or high for targeted and non-targeted vegetables. These results suggest that repeated taste exposure with a tangible is effective at shifting preferences and increasing consumption of non-preferred vegetables that are both targeted and non-targeted.

As mentioned previously, the FIT+Taste group's consumption of vegetables was also measured during lunch time (see Figure 3). This was to assess for generalization. Overall, the FIT+Taste participants consumed lower levels of vegetables when compared to the FIT Game only group during baseline. This is not surprising given that children with vegetable selectivity were specifically targeted for the intervention. However, they generally followed the same trend as the FIT Game group, which indicates that the gamification intervention had similar effects. This may also indicate that the taste exposure did not generalize to the cafeteria. However, it should be noted that not all vegetables used in the taste exposure condition were presented every day in the cafeteria, therefore, there were days the participants did not have the opportunity to select a targeted vegetable. In addition, effects of TE were delayed until session 35 to session 46 of the FIT Game. At session 35, all participants had at least eight taste exposure sessions, meaning they had sufficient time to taste one targeted vegetable and for preferences to shift, therefore, an upward trend in data during the D condition may have also been due to the taste exposure. However, as previously mentioned, results of the independent samples t-test

comparing baseline to Condition D was nonsignificant (p=.14). However, the FIT+ Taste group and the control group's difference in consumption were compared across baseline and Condition D, and this was found to be statistically significant (p= .03) as was the difference from the overall FIT Game group (p=.02).

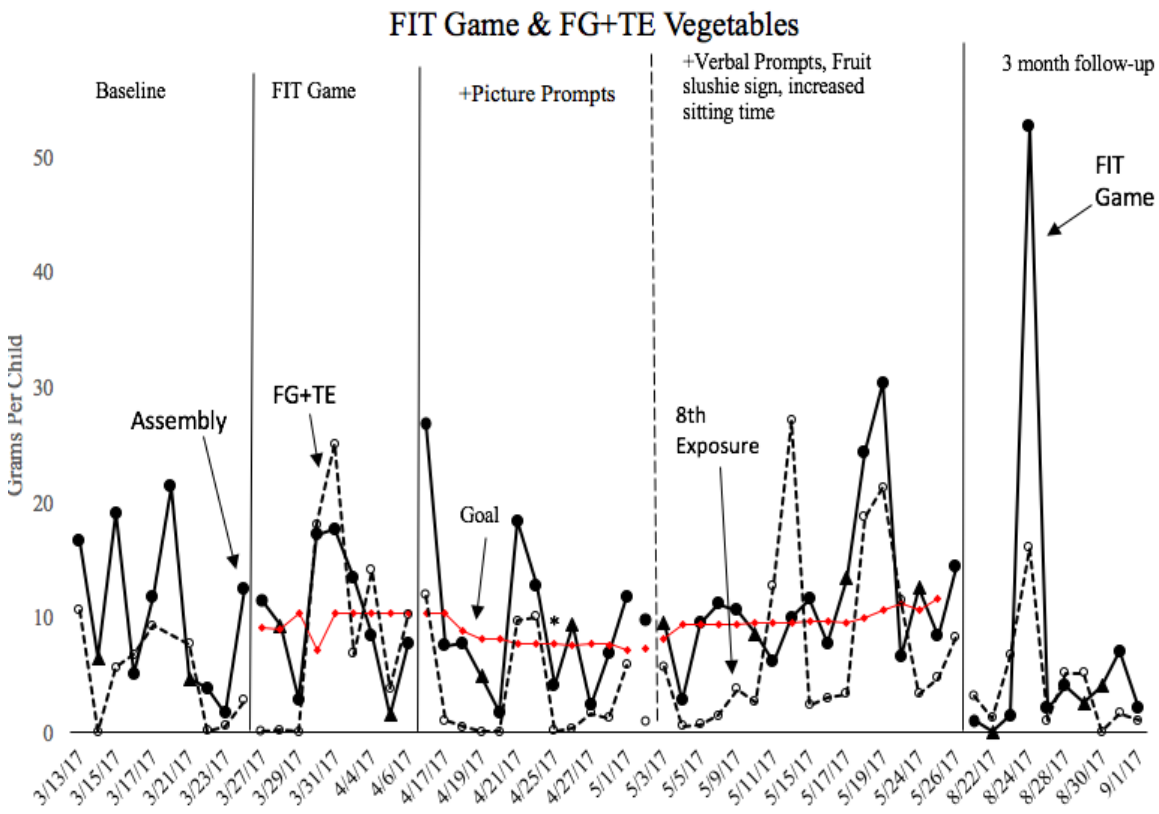

Figure 3. Vegetable consumption for the FIT Game (FG) and FIT+ Taste group across baseline (BL), FIT Game (FG), FIT Game plus picture prompts(C), FIT Game plus verbal prompts (D), and follow-up (maintenance).

Interobserver Agreement (IOA)

Interobserver Agreement (IOA) was collected on 74% of sessions and was calculated on a trial-by-trial basis by dividing the total number of agreements by the number of agreements plus disagreements and converting the result into a percentage. The total number of agreements was 97%.

Social Validity

A social validity questionnaire (see Appendix K) was administered to the participants' parents at the end of the study. Sixty-nine percent of participants' caregivers returned the social validity questionnaire. All caregivers recorded "strongly agree" or "agree" that teaching children to eat vegetables is important and that their child(ren) seemed to enjoy participating in the study. Furthermore, all the caregivers recorded "strongly agree" or "agree" that they were happy their child could participate in the study and that they would be willing to implement similar methods at home. Lastly, three of the caregivers indicated a "neither agree nor disagree" that they observed changes in their child's consumption of vegetables in the home setting. This may indicate the lack of generalization to alternative settings. On the questionnaire, one caregiver wrote, "This program helped a lot with my daughter trying new vegetables."

For the participants, 13 social validity questionnaires were returned. 12 of the 13 participants indicated they think it is important to eat vegetables, they enjoyed being part of the study, and that they now like vegetables. Anecdotally, when the researchers went back to collect maintenance data, several participants asked, "When are we going to start again?" Furthermore, 10 out of the 13 participants indicated that they would like to keep trying new vegetables, that they would eat vegetables before the intervention, and they would like their parents to use these methods at home.

CHAPTER 5: DISCUSSION

Compared to baseline, the FIT Game participants' vegetable consumption slightly increased over the course of the FIT Game. Upon first introducing the FIT Game, vegetable consumption decreased slightly, however, this decrease may be due to limited availability and variety of vegetables present during this condition. This is supported by evidence from the control group, whose consumption also dropped. Due to the decrease in consumption and lack of effect from the intervention, picture prompts were added (Condition C). Data suggest that these prompts may have slightly increased consumption, but were mostly ineffective. As such, verbal prompts, increased sitting time, and a fruit-slushie sign were added (Condition D). During this condition, consumption levels increased and there were very few low consumption days (i.e., only consuming one to two grams) when compared to previous conditions. Most notably, when comparing individual days between the control group and the FIT Game group during the D condition, the FIT Game group had higher vegetable consumption on 74% of sessions, an increase from 50% when compared to baseline. Therefore, the most effective component of the FIT Game was Condition D, when the FIT Game, picture prompts, verbal prompts, increased sitting time, and fruit-slushie sign were all present.

It is important to note that the present study only targeted vegetables, however, fruit consumption was also recorded and the data demonstrated an increasing trend as well. In other words, although fruit was not directly targeted, the participants began selecting and consuming more fruit throughout the study. Since fruit and vegetables are served in the same area this could have led to the students responding to them as if they were in the same stimulus class, therefore leading them to select fruits and vegetables as "FIT foods." As such, picture

prompts were added to facilitate this discrimination, however, these attempts failed, as evidenced by the continued increases in fruit consumption throughout the study. When compared to the control group, this increase was statistically significant (p=.04). These results suggest that the FIT Game had an effect on increasing the participant fruit and vegetable consumption. Specifically because the control group's fruit consumption did not increase but remained somewhat variable. In addition, there were always three or more fruits available to select from during the study. This availability and variety of fruit, when combined with limited availability and variety of vegetables, may have influenced vegetable consumption.

FIT Game Variety and Availability

The school not having a sufficient amount of vegetables available for each student to select from may have suppressed consumption. With limited options, it is unclear whether the participants did not eat vegetables because they chose not to or if they did not eat vegetables because there were not any to choose from. For example, one of the days there was only 26 salads available for the FIT Game group of approximately 150 students. Following this day, the researcher discussed with the cafeteria staff the importance of having at least 75 servings available for the participants and they attempted to have enough available for students for the remainder of the study.

In addition to the limited availability, variety was also a contributing factor to the results. For example, during the 3-month follow-up, the data suggests that vegetable consumption did not maintain. However, this may be due to the lack of variety, as carrots were served almost every day. Previous research suggests that when presented repeatedly with the same food, the

participants behavior is more likely to habituate to the food item (Ernest & Epstein, 2002), which may result in the participants selecting alternative items such as fruit. This is further supported by one outlying data point, which was a session in which the students were presented with carrots and a new stimulus (e.g., chili powder) and vegetable consumption increased by approximately 500%, thus suggesting desensitization may have occurred (see Figure 2, p. 27).

To assess the effect of variety, an analysis was conducted on the number of different vegetables available and the average consumption, which shows that Condition D had the highest consumption average (15.4 grams per child) when four vegetables were served (see Table 4). This suggests that the more variety of vegetables the greater the consumption. However, it should be noted that high consumption also occurred in other conditions (e.g., baseline with one vegetable or maintenance with two vegetables), this could be due to highly preferred vegetables being available such as the carrots with chili powder. Also, in some instances when four vegetables were available, low consumption was observed (e.g., Condition C-4), this could be due to four non-preferred vegetables being available such a coleslaw, corn, celery, and salad. In sum, assessing variety and availability prior to implementing a behavior-change program in schools is essential for the success of the intervention.

Due to having a lack of variety and availability in the beginning of the study, the participants were not meeting goal and this could have contributed to why consumption did not increase when availability and variety improved in Condition D. After discussing the issue with the cafeteria staff, they agreed to save more vegetables for the FIT Game group. The participant's behavior may have gone through extinction in the beginning of the study due to consistently not meeting goal, therefore, when the opportunity was presented the students

Table 4

Overall Averages Based on Number of Vegetables Served in Grams

Condition	1	2	3	4
BL	12.5	7.1	12.9	11.7
B	2.8	8.7	13.1	7.6
C	7.5	6.7	14.8	6.8
D	7.2	9.6	11.8	15.4
Follow-up	2.1	13.2	2	N/A
Overall Average	6.4	9	11	10

Notes. The column on left hand side represents the different FIT Game conditions. The numbers at the top (1-4) represent the number of vegetables available. The numbers in the boxes represent the average number in grams when the number vegetables were available in the different conditions.

did not behave due to a history of non-reinforcement. In addition to the low variety and availability, one competing option was also problematic on some days. The school served "Fruit-Slushies" at least once a week during the intervention (see Appendix O). These slushies were served at the same stand as the FV, therefore, the participants may have selected this item thinking it was an actual fruit. Due to the school rule (i.e., each student must select one item from the FV stand), students may have selected this item in place of real fruit and vegetables, thus contributing to the results. Furthermore, even with the additional prompt in Condition D saying, "Even if you pick a fruit-slushie, remember to grab your FIT Food" high selection levels of slushies maintained throughout the study. Thus, despite the students selecting more vegetables in conjunction with the fruit-slushie, they may have consumed the fruit-slushie instead of the vegetables, even though they selected it. In the current study, we did not assess consumption of the fruit-slushie, we only recorded the selection. Future studies should assess whether the consumption changed by recording the

waste data. As such, prior to implementing the FIT Game, future studies should ensure that there is a variety of vegetables for the participants to select from, there are enough vegetables that each participant has the choice to select several vegetables, and competing high sugar/low nutrition options are not included with other fruits and vegetables (e.g., fruit-slushies, juice, etc.).

FIT Game Response Effort

In addition to the primary intervention, it became necessary to add picture prompts, verbal prompts, rearrange the schedule so students sat longer, and design the cafeteria in a way that makes the FIT Game run effectively and efficiently. Making these changes may be very time-consuming, as a result, this may increase the response effort for the staff when implementing the FIT Game. This is particularly problematic since prior studies (Joyner et al., 2015) have suggested that utilizing the projector and projector screen will reduce the response effort for teachers and increase treatment fidelity. While it may increase the treatment fidelity and reduce response effort for teachers, it may increase the response effort for the cafeteria staff. During the current study, the cafeteria staff had to rearrange cafeteria trash lines, the cafeteria tables, the direction of the trash lines, and set up and take down of the projector to be able to conduct the study. In combination, the steps needed may prove to be too great for cafeteria staff to implement on their own, while still needing to attend to their daily duties. Thus, simpler (reduced response effort) processes or methods need to be explored to ensure continued procedural fidelity of the FIT Game.

FIT +Taste

The results of this study indicated that repeated taste exposure plus a tangible is effective at shifting preferences and increasing consumption of

previously non-preferred vegetables. While a tangible reward was used during the study, consumption increased during the post-consumption probe in the absence of reinforcement, meaning that taste alone may have maintained consumption behavior. In addition to consuming the targeted vegetables while in the absence of reinforcement, the preferences and consumption for non-targeted vegetables also increased. This suggests that generalization may have occurred to non-targeted vegetables. This is important when considering that the intervention was conducted under non-choice conditions (i.e., only vegetables available), and that participants did not have a choice between other preferred vegetables, fruit, or other food items. In the current study, the participants were given the vegetables and instructed to taste the vegetables and if they did not comply, they did not receive a tangible reward. However, in real-life scenarios such as the cafeteria, they will have a choice whether to select a vegetable in the presence of other items. Therefore, assessing whether these preference shifts maintain in the presence of other preferred vegetables and fruits will be necessary. Future research may be able to do this by providing choice conditions with vegetables and other items and reinforcing the selection and consumption of the non-preferred vegetables with a tangible reward and then assessing in different environments. Thus, programming for generalization and maintenance of the non-preferred vegetable consumption behavior.

This is a critical feature when assessing if the preferences and consumption behavior will maintain in other environments, such as during lunch time. Visual analysis of the FIT+Taste condition in comparison to the FIT Game condition indicates that repeated taste exposure increased around the eighth exposure during lunch time. This increase during lunch time suggests that the taste of the vegetables generalized to lunch time selection and consumption.

These results may be due to the taste; however, other possible variables may have been responsible. For example, this increase also occurred when all components of the FIT Game were in place, and as such, may have been partially responsible for the increase. In addition, the researchers being present during lunch time and taking a photograph of their lunch-tray may have influenced these results.

Social contingencies may have also influenced tasting behavior during the taste exposure sessions. Specifically, while the researcher programmed for the students to receive tangible rewards, there may have been additional contingencies maintaining the tasting behavior of the participants. To match the taste exposure conditions to lunch time behavior, the tasting sessions were conducted in groups. On one occasion, the researcher observed one participant tell another participant, "You don't like celery?", the following session, the participant began swallowing the celery. Additionally, on multiple occasions several participants solicited praise from the researcher or research assistants. Therefore, while a tangible reward was given contingent on tasting or consuming the vegetable, other social contingencies may have been present that increased and maintained tasting behavior. While a limitation for this study, if they are effective, future studies should look at deliberately programing social components, whether by peers or adults.

While overall consumption increased and preferences shifted, there were several participants whose vegetable preference and consumption did not shift. This may have been due to several factors, including the programmed consequences not functioning as reinforcers, the length of the study (number of exposures), or level of non-preference for the vegetables. First, the researcher provided a "reinforcer menu" to identify possible reinforcers, however, their

selection does not guarantee that they will function as reinforcers. Second, the study lasted 8 weeks and sessions occurred two times per week, therefore, some vegetables remained in baseline longer than others. This limited timeframe may not have given the opportunity for several vegetables to shift preferences. Extending the study may have led to shifts in preferences and increases in consumption. Lastly, the level of non-preference for the vegetables was not considered when implementing the repeated taste exposure. In the current study, the vegetables were presented randomly and this may have contributed to the results. It is also possible that the participant's history with the vegetables may have affected their consumption behavior (i.e., only tasting and not swallowing the vegetable), and consequently the opportunity for the preference to shift. Thus, future researchers may want to examine the method in which we quantify non-preferred vegetables. For example, instead of grouping vegetables as non-preferred or preferred, possibly doing a paired preference assessment with the actual vegetable and ranking each vegetable. This method may be able to more accurately predict their level of preference and better indicate which vegetables to intervene on first. Specifically, in the current methodology, presenting the least preferred vegetable first would have allowed for more taste exposures relative to less non-preferred vegetables.

Conclusion and Future Research

In conclusion, while the FIT Game was only somewhat effective in this study, it had several implications for future research. First, a visual analysis of graphic data suggests that several vegetables were selected more often throughout the study (i.e., broccoli and carrots), while other vegetables (i.e., celery, salad, coleslaw, and cucumbers) selection remained relatively low. Thus,

without the selection of the vegetable the participants do not have the opportunity to taste it, as a result, preferences do not shift and there may not be an increase in future selection behavior. So, it is essential for the participants to encounter the repeated taste exposure contingencies. The FIT Game portion of the current study only prompted selection behavior and did not directly reinforce tasting behavior. Therefore, in conjunction with prompting the selection behavior during the FIT Game, future researchers should assess whether directly reinforcing repeated taste exposure in a cafeteria would increase consumption behavior for non-preferred vegetables.

In combination with the low selection of non-preferred vegetables, the FIT Game was also high in response effort to implement. Therefore, finding alternative methods to simplify the FIT Game while still utilizing the element of gamification in the cafeteria is essential. One example would be setting up an interdependent group contingency with each table and contingent on consuming vegetables the team's player/rocket/team moves up on a scoreboard until they reach a goal and earn a prize. The reward can be a tangible if the funds are available or access to a preferred activity such as more recess time. This intervention would reduce the intervention steps while also directly reinforcing tasting and consumption, rather than just the selection behavior. The results from the current study suggest that repeatedly tasting behavior is sufficient to shift preferences, increase consumption and may generalize to non-targeted vegetables. Thus, future research should include these components while in the cafeteria and assess the effects on the targeted and the non-targeted vegetables. A similar procedure was effective on a smaller scale in previous studies (Casey, Washio, & Hantula, 2016), and may be applicable in a cafeteria setting. It is also necessary for the school to address opportunity to consume, specifically by

providing a variety of vegetables, in adequate quantities, and with enough time (at least 25 minutes) to eat them.

The current study demonstrated that while effective to some degree, there are many components that need to be in place in order for the FIT Game to truly be effective. In addition, similar to prior research, results of the FIT Game did not maintain despite an extended intervention period of 10 weeks. However, results from the FIT+Taste portion of the study suggest that repeated taste exposure, with a tangible and in a group, is effective at shifting preferences, increasing consumption, generalizing to non-targeted vegetables, and may generalize to lunch time consumption. Thus, future research should find ways to conduct taste exposure on a bigger scale. This alone may be sufficient to increase lunch time vegetable consumption, as well as generalize to other vegetables and fruit without direct intervention. Given the importance of consuming vegetables, future studies should continue to investigate the necessary variables that would maintain vegetable consumption behavior, not only with children in schools, but in other settings and with other individuals as well.

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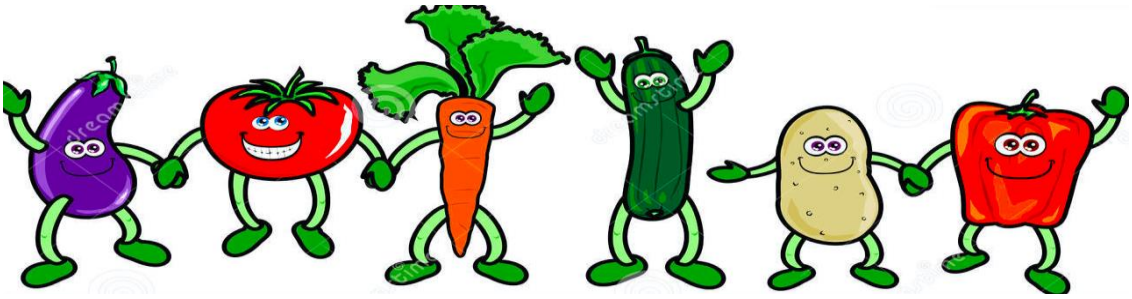
APPENDICES

APPENDIX A: OPT-OUT CONSENT FORM

Opt-Out Consent Form



Dear Parents -

On (date) our school will be participating in a healthy eating project. Our school is working to increase the amount of vegetables eaten by our students. This project will kick off with an introductory school assembly, and then, each day during lunch, our students will watch an episode of our heroes and villains exploring and discovering the galaxy. The heroes (FITs) are trying to save the galaxy from the villains (VATs) and our students will be helping the FITs. During the project they will be encouraged to eat more vegetables and earn virtual tokens to help buy care packages for the FITs to accomplish their mission. It will take our students approximately 10 weeks to help the FITs save the galaxy!

We are making the program available to all students, however, if you do NOT want your child to participate, please sign and return this form. Again, it's only necessary to return the form if you do not want your child to participate.

Thank you,

(Principal's Name)

_____No, my child cannot participate in the healthy eating project.

Child's Name_____ Teacher _____

Parent's signature_____ Date _____

APPENDIX B: INFORMATIONAL FLYER, PARENTAL INFORMED CONSENT FORM, AND STUDENT ASSENT FORM

Do you have a difficult time getting your child to eat vegetables?

Your child may be eligible to participate in a healthy eating project! This project will encourage students to try new vegetables.

- **Participation Criteria:**
  - 4th or 5th grade student
  - Dislikes 3-5 different vegetables served in school cafeteria

- **By participating your child will:**
  - Try new vegetables
  - Receive small prizes
  - Be entered into a drawing for larger prizes at the end of the project

Want more information or want your child to participate?

Contact Amanda Chavira at (559) 664-2536 or achavira42@mail.fresnostate.edu for further information.

Parental Informed Consent Form

Your child is invited to participate in a study conducted by Dr. Sharlet Rafacz and Amanda Chavira in affiliation with California State University, Fresno. The purpose of this research is to teach your child to prefer vegetables by asking him or her to taste them multiple times.

Prior to the implementation of the project, a few assessments will be conducted. First, your child will fill out a survey letting us know what vegetables they do or do not like. Second, bite-size pieces will be presented to your child to taste. If your child indicates a preference for the vegetables or eats 90% of the vegetables presented, they won't be eligible for the study, and you will be notified via email or phone. However, if they indicate that they dislike the vegetable or do not consume more than 50%, they will continue in the project.

This study will occur in the cafeteria, or a nearby room, right before lunch begins. The entire study will last approximately two and a half months and vegetable tasting will be 2 times per week for 5-15 minutes. During the sessions your child will be exposed to several disliked vegetables typically served during school lunch. Your child will then be asked to taste a bite-sized piece. Your child can choose to eat the vegetable, taste it and spit it out, or choose not to eat the vegetable. You, or your child, may choose to stop participating in the study at any time. Each time your child does eat or taste a disliked vegetable they will receive a small prize and be entered in a drawing for a larger prize awarded at the end of the study.

Any information obtained throughout this study will remain confidential. Your child's identity will only by addressed by a number assigned to them. All forms and data will be kept secured.

This study will not put your child at more risk than they would typically experience when a non-preferred vegetable is presented to them. There is a possibility that your child might become upset when asked to try the vegetable, however if this occurs, the child will be given additional time to try the vegetable or they can leave whenever they choose.

If the intervention is successful, it may teach your child to prefer vegetables they had previously disliked. Your child may also continue to eat these vegetables once the project has finished. This may lead to healthier choices and an increase in eating vegetables.

If you decide to allow your child to participate, you are free to withdraw your consent and discontinue your child's participation at any time without penalty. The Committee for the Protection of Human Participants at California State University, Fresno has reviewed and approved the present research.

If you have any questions, please contact Dr. Sharlet Rafacz by email (srafacz@csufresno.edu) or by phone (559-278-2479), or Amanda Chavira by email (achavira42@mail.fresnostate.edu) or by phone (559-664-2536). Questions regarding the rights of research participants may be directed to the Fresno State Committee for the Protection of Human Participants: Dr. Kris Clarke at (559) 278-2985.

You will be given a copy of this form to keep.

YOU ARE MAKING A DECISION WHETHER OR NOT TO HAVE YOUR CHILD PARTICIPATE IN THIS STUDY. YOUR SIGNATUTE INDICATES THAT YOU HAVE DECIDED TO ALLOW YOUR CHILD TO PARTICIPATE, HAVING READ THE INFORMATION PROVIDED ABOVE.

Name of Child: _____

Name of Parent/Guardian (PRINT): _____

Parent/Guardian Signature: _____

Date: _____

Student Assent Form

I am Amanda Chavira from Fresno State. I am doing a study to figure out how to make it easier for children to like vegetables. We are asking you to participate because your parents recommended you for this project.

For this research, we will ask you to try the vegetables you see in the school cafeteria. We will keep all your decisions about eating the vegetables and answers to questions about eating vegetables private. Only the people from Fresno State who are working on the study will know your individual responses.

We don't think any big problems will happen to you while participating in this study, however, you might feel uncomfortable when we ask you to try a new vegetable. But if you don't want to try the vegetables, you may tell us.

You should know that:

- You do not have to be in this study if you do not want to.
- You won't get into any trouble with Fresno State or Howard, if you say no.
- You may stop being in the study at any time.
- Your parent(s)/guardian(s) were asked if it is okay for you to be in this study. Even if they say it's okay, it is still ***your choice*** whether or not to take part.
- You can ask any questions you have, now or later.
- If you think of a question later, you or your parents can contact me at *(559) 664-2536 or achavira42@mail.fresnostate.edu*.

Sign this form only if you:

- have understood what you will be doing for this study
- have had all your questions answered
- have talked to your parent(s)/legal guardian about this project
- agree to take part in this research

_____

Your Signature Printed Name Date

_____

Name of Parent(s) or Legal Guardian(s)

_____

Researcher explaining study

Signature Printed Name Date

APPENDIX C: ALLERGY SCREENING FORM

Allergy Screening Form

To ensure the safety of your child, we are requesting that you complete this allergy screening form. This form allows you to disclose any known allergies to the food items we will be asking your child to taste. Please complete the questionnaire to the best of your ability.

Child's Name:_____

Please check if your child is allergic to any of the following:

- ☐ Cucumber Slices
- ☐ Carrots
- ☐ Broccoli
- ☐ Celery Sticks
- ☐ Green Salad
- ☐ My child is NOT allergic to any of the vegetables above

Are there any other food allergies that your child has been diagnosed with by a physician?

- ☐ Yes
- ☐ No

If yes, please explain:

_____

_____

_____

_____

My signature indicates that I have listed any known allergies and I understand that my child may not be able to participate if they have existing food allergies.

APPENDIX D: PREFERENCE ASSESSMENT

PREFERENCE ASSESSMENT

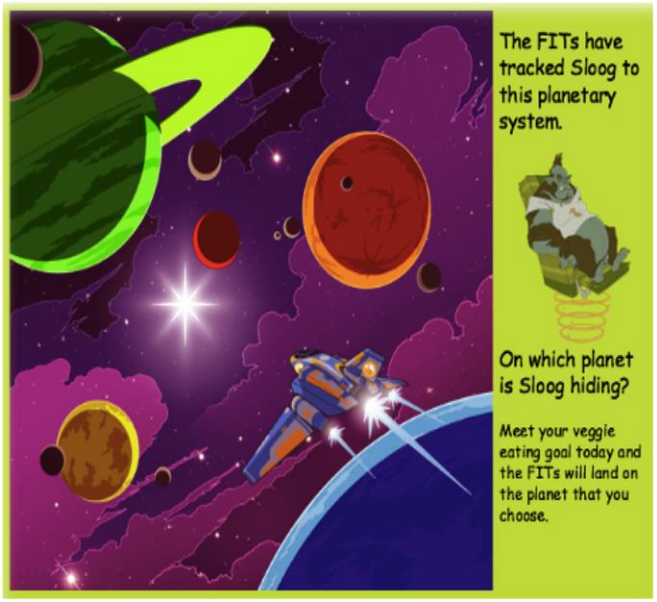
Please place an "X" underneath the picture that describes how you feel about the vegetable.	I spit on the napkin 	I swallowed it 	I did not put it in my mouth 	I like it! 	I don't know what this is. 	I don't like this! 
Broccoli						
Carrots						
Cucumbers						

APPENDIX E: DEPICTION OF THE FITS AND THE VATS FROM THE FIT GAME

DEPICTION OF THE FITS AND THE VATS FROM THE FIT GAME EPISODE

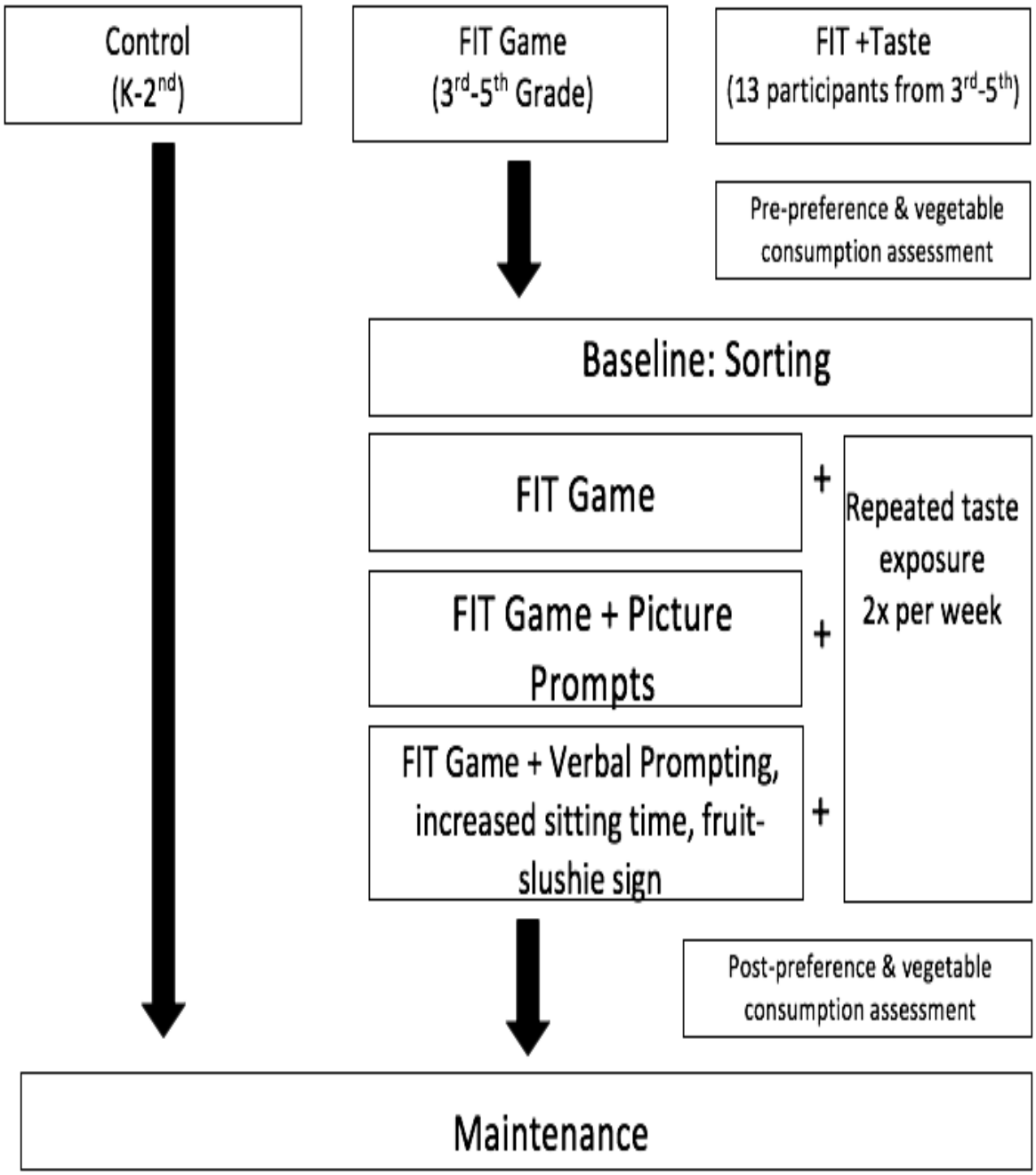
APPENDIX F: EXAMPLE OF A FIT GAME EPISODE

AN EXAMPLE OF AN EPISODE THAT WILL BE DISPLAYED IN THE CAFETERIA



APPENDIX G: METHODOLGY TIMELINE

Timeline of the interventions



APPENDIX H: SOCIAL VALIDITY: SCHOOL PERSONNEL

SOCIAL VALIDITY QUESTIONNAIRE- SCHOOL PERSONNEL

Job Title: _____

1 – strongly disagree

2 – disagree

3 – neither disagree nor agree

4 – agree

5 – strongly agree

1. Teaching children to eat vegetables is important.

1 2 3 4 5

2. The children seemed to enjoy participating in the study.

1 2 3 4 5

3. I observed an increase in the whole school's consumption of vegetables.

1 2 3 4 5

4. I believe the methods in this study may be used to encourage other schools to teach their students to eat more vegetables.

1 2 3 4 5

5. I am happy that my school was able to participate in this study.

1 2 3 4 5

6. This project looks feasible for other schools to implement.

1 2 3 4 5

7. I would recommend this project to other schools.

1 2 3 4 5

Additional comments:

_____

_____

_____

APPENDIX I: SOCIAL VALIDITY: FIT GAME

SOCIAL VALIDITY QUESTIONNAIRE – FIT GAME

1. Do you think it is important to eat vegetables?

   Yes No I don’t know

2. Did you enjoy watching the FIT Game?

   Yes No I don’t know

3. Before the FIT Game, did you eat vegetables?

   Yes No I don’t know

4. Do you like vegetables now?

   Yes No I don’t know

APPENDIX J: SOCIAL VALIDITY: FIT + TASTE CHILDREN

SOCIAL VALIDITY QUESTIONNAIRE – FIT + TASTE CHILDREN

1. Did you think it is important to eat vegetables?

Yes No I don’t know

2. Did you enjoy being involved in this project?

Yes No I don’t know

2. Before this project, did you eat vegetables?

Yes No I don’t know

3. Do you like vegetables now?

Yes No I don’t know

4. Would you like to keep trying new vegetables?

Yes No I don’t know

5. Would you like it if your parents used these methods at home?

Yes No I don’t know

APPENDIX K: SOCIAL VALIDITY: FIT + TASTE CAREGIVERS

SOCIAL VALIDITY QUESTIONNAIRE- CAREGIVERS

Child Initials: _____ Parent Initials: _____ Relation: _____

1 – strongly disagree

2 – disagree

3 – neither disagree nor agree

4 – agree

5 – strongly agree

1. Teaching children to eat vegetables is important.

1 2 3 4 5

2. My child seemed to enjoy participating in the study.

1 2 3 4 5

3. I observed changes in my child's consumption of vegetables.

1 2 3 4 5

4. I believe the methods in this study may be used to encourage other families to teach their children to eat more vegetables.

1 2 3 4 5

5. I am happy that my child was able to participate in this study.

1 2 3 4 5

6. I would be willing to continue to implement similar methods at home.

1 2 3 4 5

Additional comments:

_____

_____

_____

APPENDIX L: STATISTICS FOR THE FIT GAME, FIT+TASTE, AND CONTROL GROUP

INDEPENDENT SAMPLES T-TEST COMPARING FIT GAME, CONTROL AND FIT GAME PLUS TASTE EXPSOURE

Difference from BL to Condition D	Fruit/Veg/FV	Df	*t*	P-value (*sig)
FG vs FIT+TE	Veg	26	-2.15	.02*
FG vs FIT+TE	Fruit	26	-0.29	.38
FG vs FIT+TE	FV combined	26	-.05	.47
FG vs Control	Veg	26	-.097	.16
FG vs Control	Fruit	26	1.6	.06
FG vs Control	FV combined	26	1.77	.04*
FIT+TE vs. Control	Veg	26	1.9	.03*
FIT+TE vs. Control	Fruit	26	0.93	.17
FIT+TE vs. Control	FV combined	26	1.3	.09
FIT+TE only	Veg	26	-1.06	.14
FIT+TE only	Fruit	26	0.84	.20
FIT+TE only	FV combined	26	-1.1	.13
FIT Game only	Veg	26	0.46	.32
FIT Game only	Fruit	26	-1.4	.07
FIT Game only	FV combined	26	-1.5	.07

Difference from BL to Treatment (Cond. B, C, & D)	Fruit/Veg/FV	Df	*t*	P-value (*sig)
FG vs FIT+TE	Veg	47	0.77	0.22
FG vs FIT+TE	Fruit	47	-0.64	.26
FG vs FIT+TE	FV combined	47	-.031	.37
FG vs Control	Veg	47	-.068	.24
FG vs Control	Fruit	47	1.66	.05*
FG vs Control	FV combined	47	1.66	.05*
FIT+TE vs. Control	Veg	47	1.4	.07
FIT+TE vs. Control	Fruit	47	0.84	.20
FIT+TE vs. Control	FV combined	47	1.21	.11
FIT+TE only	Veg	47	-0.81	.20
FIT+TE only	Fruit	47	0.61	.27
FIT+TE only	FV combined	47	-0.83	.20
FIT Game only	Veg	47	-0.09	.46
FIT Game only	Fruit	47	-1.35	.09
FIT Game only	FV combined	47	-1.2	.10

APPENDIX M: NUMBER OF TASTES AND SWALLOWS FOR ALL NON-PREFERRED VEGETABLES

Number of Tastes and swallows for all non-preferred vegetables

Participant	Vegetables	Tastes	Swallows	Pre-Preferen	Post Perefer	Pre-Consum	Post Consum
6	Broccoli	0	16	M	M	H	L
6	Celery	0	16	M	H	H	H
6	Salad	0	16	L	H	L	H
7	Broccoli	0	7	M	H	L	H
7	Carrots	0	16	H	H	L	H
7	Celery	0	7	L	H	L	H
8	Broccoli	0	15	M	H	L	L
8	Celery	4	7	L	M	L	L
8	Salad	0	11	M	H	L	M
13	Broccoli	0	13	M	H	L	M
13	Celery	0	14	L	H	L	M
13	Salad	0	15	L	H	M	L
1	Carrots	0	16	H	H	L	H
1	Celery	0	16	H	H	L	H
1	Salad	0	16	H	H	L	L
2	Broccoli	0	15	H	H	L	H
2	Celery	0	15	H	H	L	H
2	Salad	0	15	H	H	L	H
3	Broccoli	0	16	H	H	L	H
3	Celery	0	16	H	H	L	H
3	Salad	0	16	H	H	L	H
4	Broccoli	0	16	H	H	L	H
4	Celery	0	16	H	H	L	H
4	Salad	0	16	H	H	L	H
5	Celery	0	14	H	H	L	M
5	Cucumbers	0	14	H	H	L	H
5	Salad	0	14	H	H	L	M
9	Broccoli	0	16	M	H	H	H
9	Celery	0	16	M	M	L	H
9	Salad	0	16	M	M	M	H
10	Broccoli	0	15	L	H	H	H
10	Carrots	0	15	M	H	H	H
10	Celery	0	15	L	M	L	L
12	Broccoli	0	16	H	H	L	H
12	Celery	0	16	M	H	L	L
12	Salad	0	16	M	H	H	H
11	Broccoli	8	0	L	L	L	L
11	Carrots	5	0	L	L	L	L
11	Celery	9	1	L	L	L	L

Note. A swallow is defined as consuming the entire piece of the non-preferred vegetable. A taste is defined as the participant placing the non-preferred vegetable in their mouth for more than three seconds. An "H" for preference indicates a self-reported preference for the vegetable, and for consumption, indicates the participant consumed 6-10 pieces of the vegetable. An "M" indicates a neutral preference and indicates the participant consumed 3-5 pieces of the vegetable. An "L" indicates a low/no preference and indicates the participant consumed 0-2 pieces of the vegetable. The green indicates the vegetable shifted in preference and consumption. The yellow indicates an increase in consumption only, due to preference already being high, orange indicates a shift in preference only, due to consumption already being high, and white indicates no shift occurred in preference and/or consumption remained low or decreased.

APPENDIX N: FIT+TASTE GRAPHS FOR PRE-POST-PREFERENCES, CONSUMPTION, AND INTERVENION

Participant 1

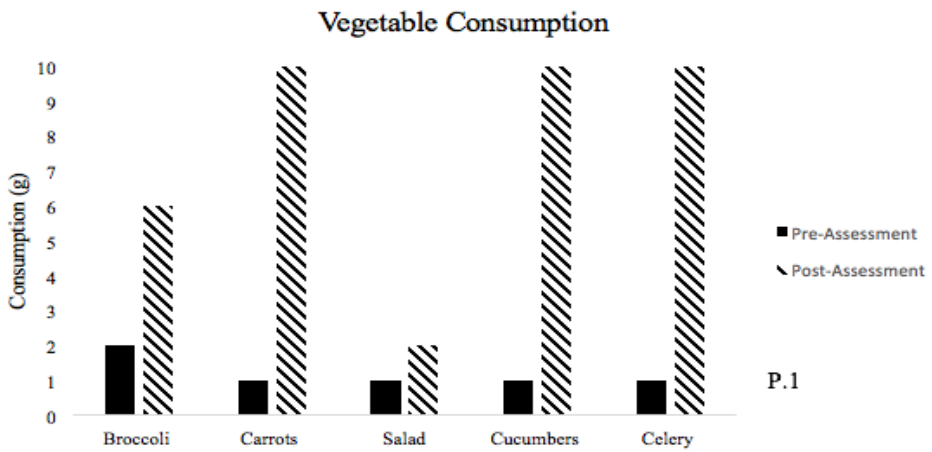


Figure 4. Graph depicting Participant 1's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

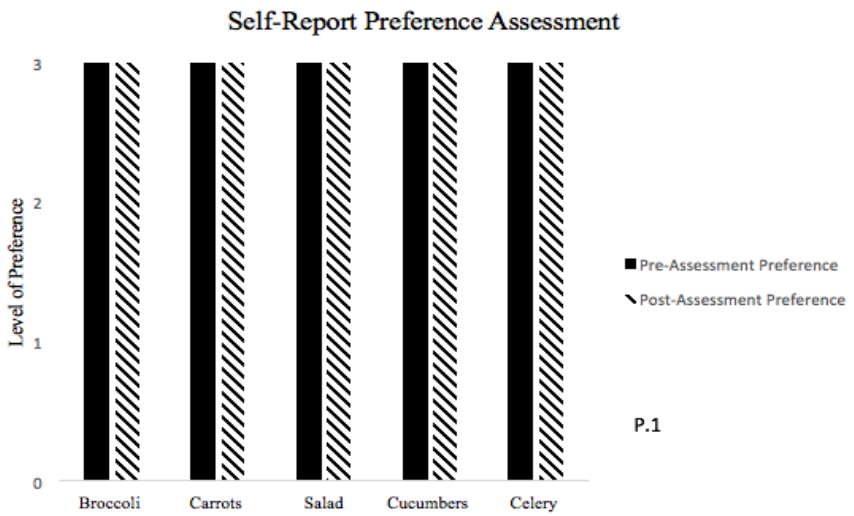


Figure 5. Graph depicting Participant 1's pre-post-self-reported preference level. "1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

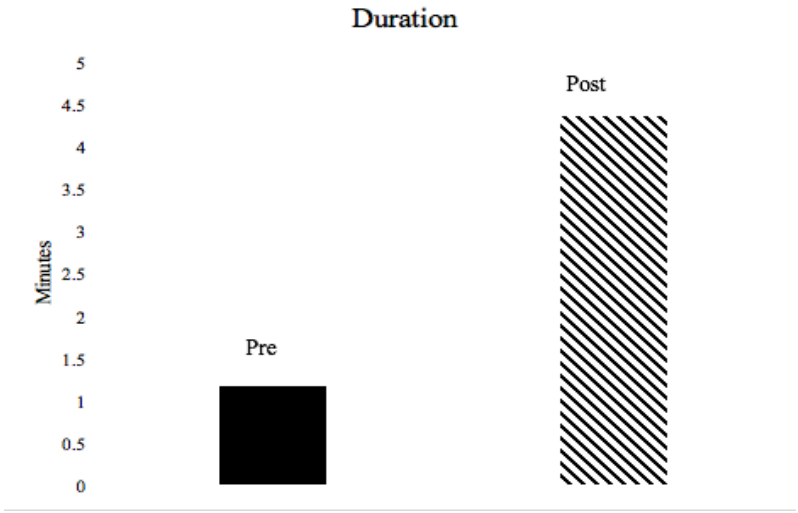


Figure 6. Graph depicting Participant 1's pre-post time in minutes.

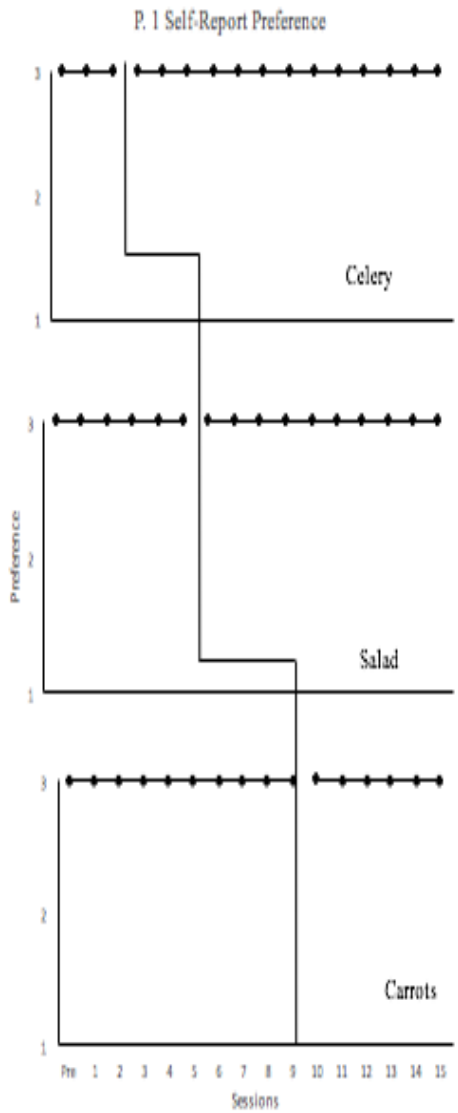


Figure 7. Graph depicting Participant 1's self-report preference assessment for targeted vegetables.

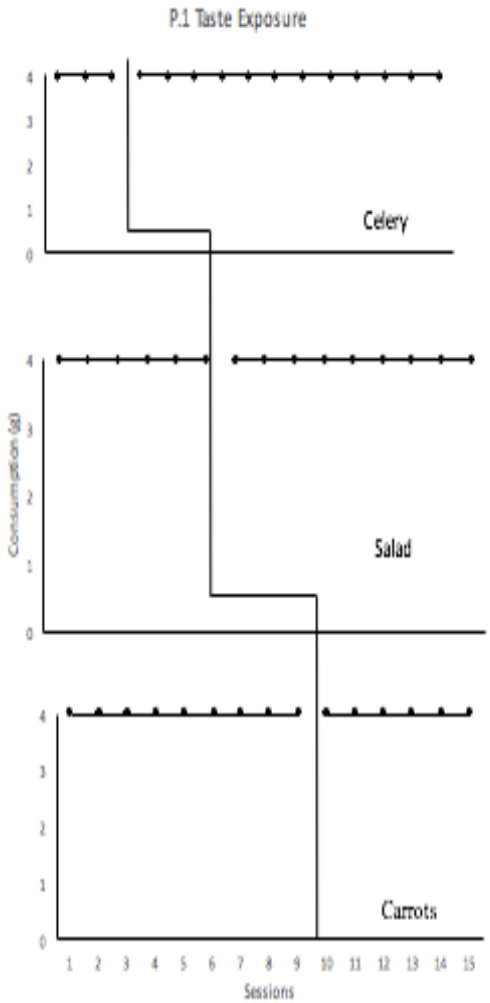


Figure 8. Graph depicting Participant 1's consumption for targeted vegetables.

Participant 2

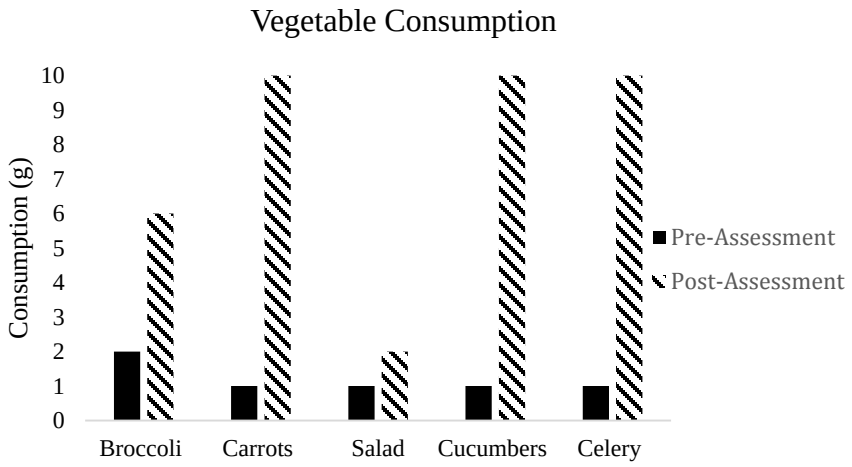


Figure 9. Graph depicting Participant 2's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

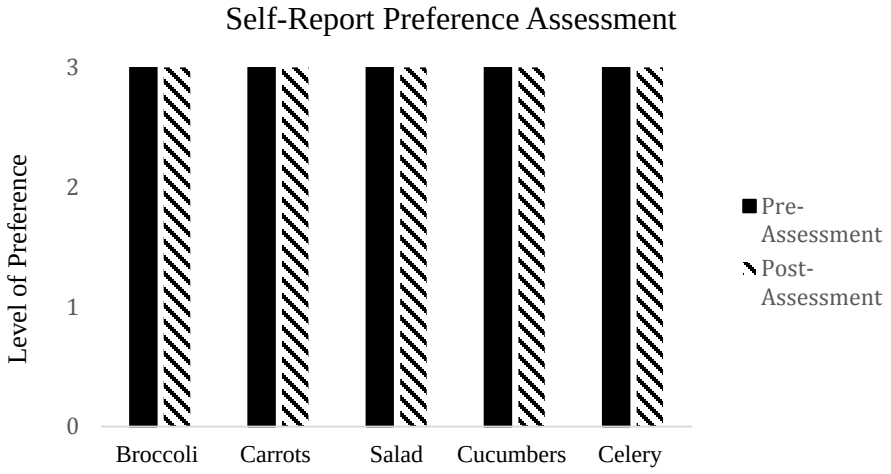


Figure 10. Graph depicting Participant 2's pre-post-self-reported preference level. "1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

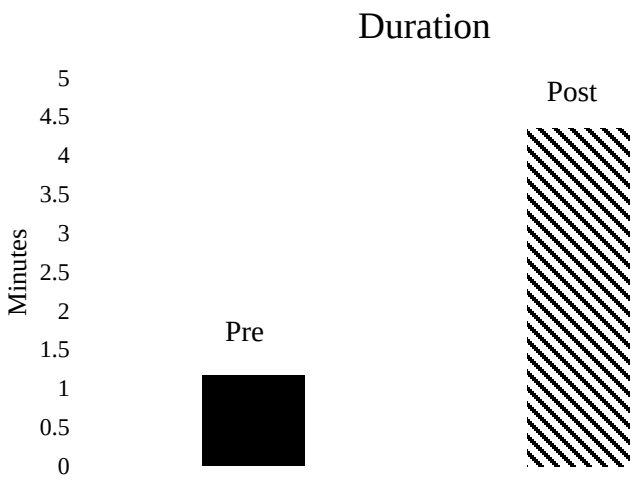
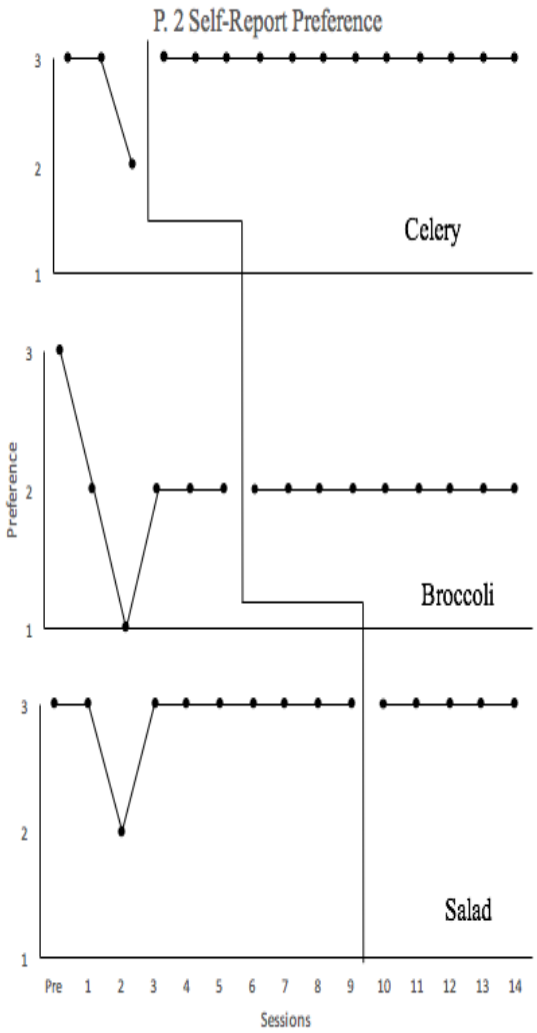


Figure 11. Graph depicting Participant 2's pre-post time in minutes.



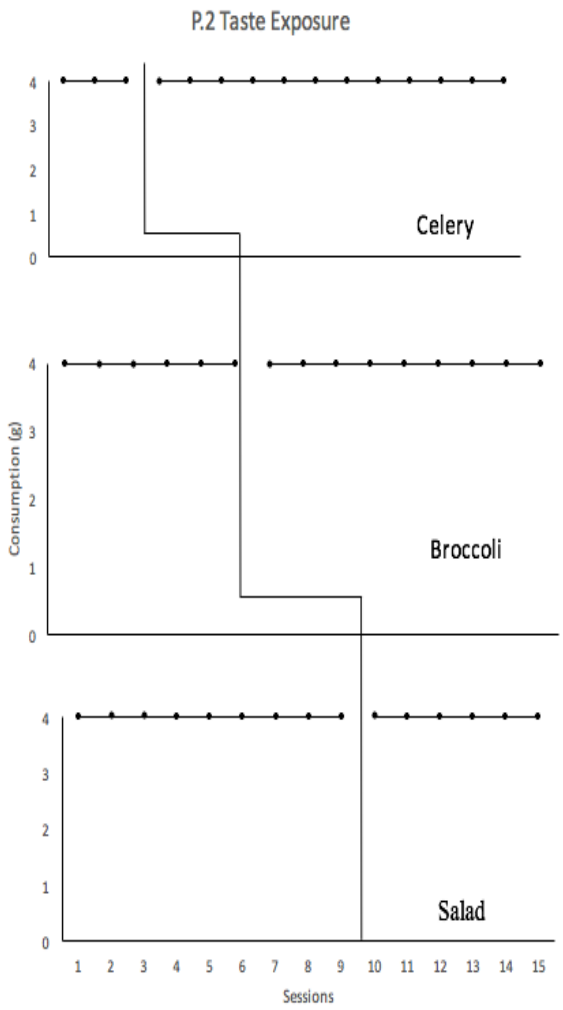


Figure 12. Graph depicting Participant 2's self-report preference assessment for targeted vegetables.

Figure 13. Graph depicting Participant 2's consumption for targeted vegetables.

Participant 3

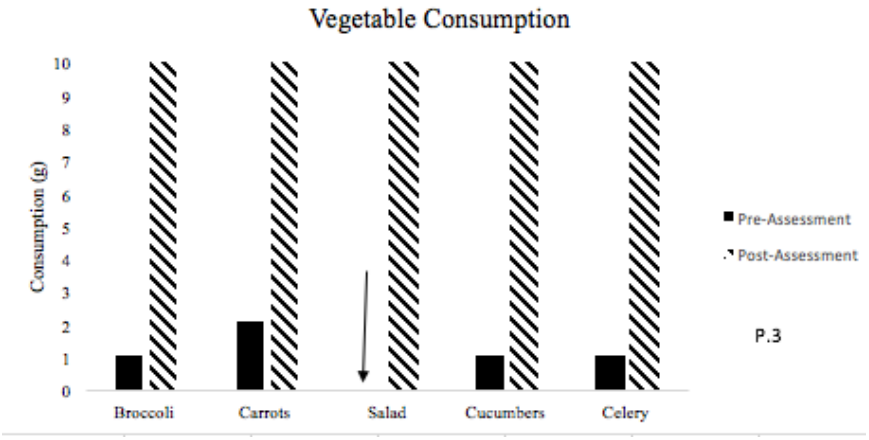


Figure 14. Graph depicting Participant 3's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

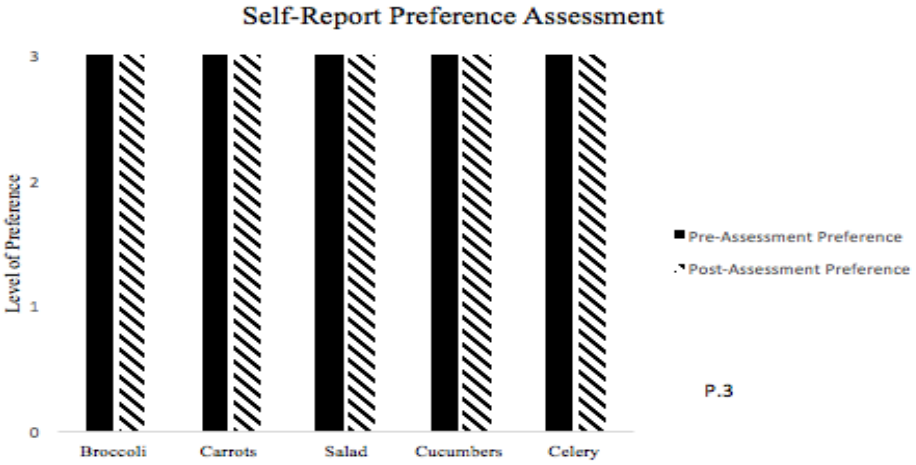


Figure 15. Graph depicting Participant 3's pre-post-self-reported preference level. "1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

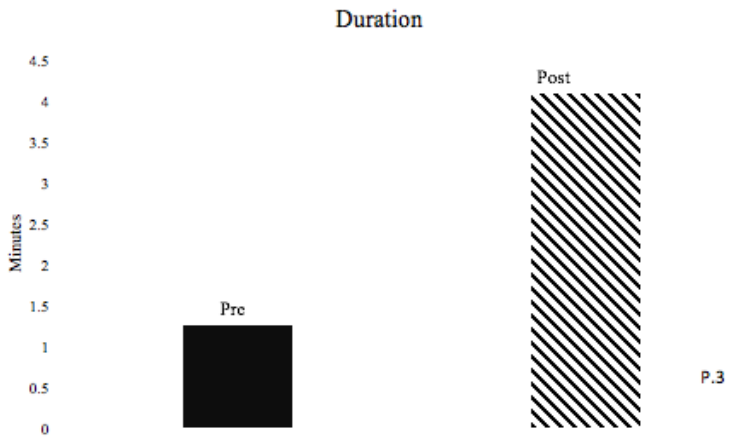


Figure 16. Graph depicting Participant 3's pre-post time in minutes.

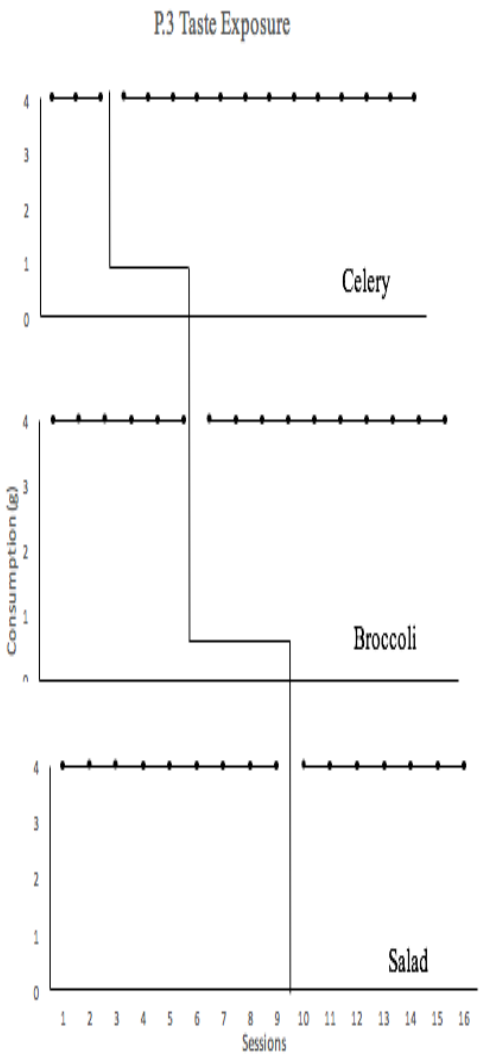


Figure 17. Graph depicting Participant 3's consumption for targeted vegetables.

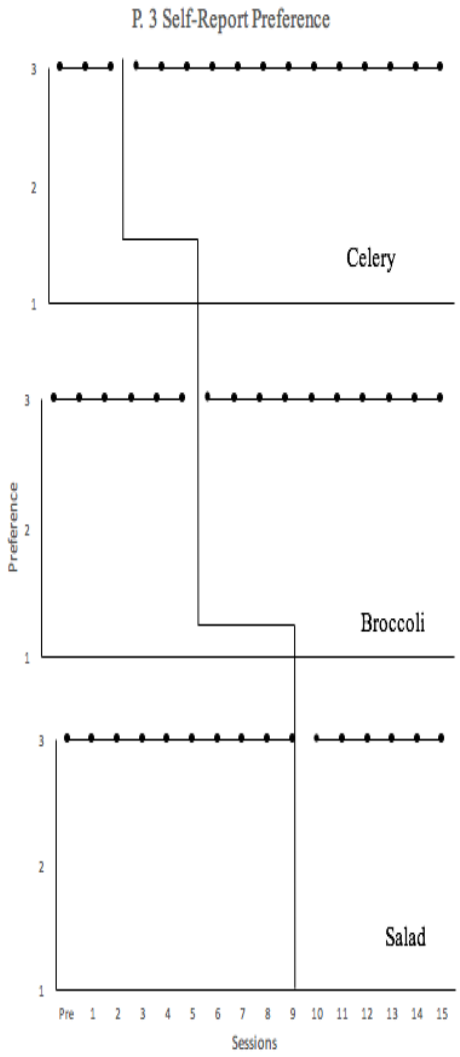


Figure 18. Graph depicting Participant 3's self-report preference assessment for targeted vegetables.

Participant 4

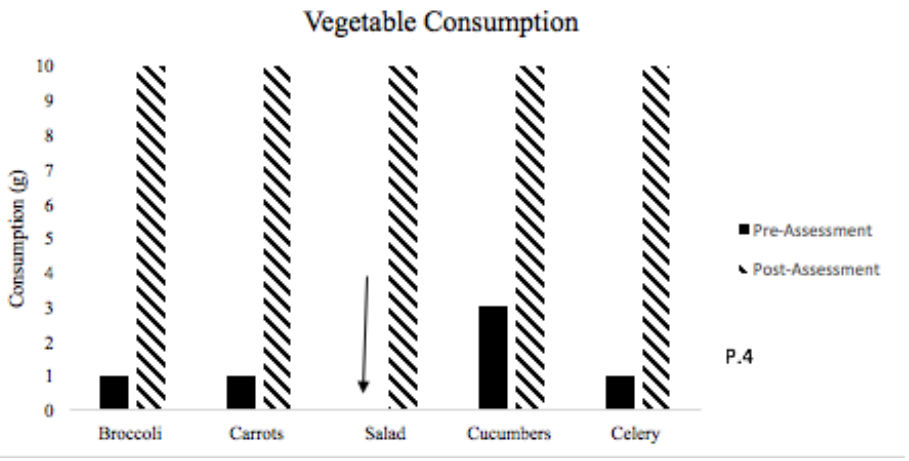


Figure 19. Graph depicting Participant 4's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

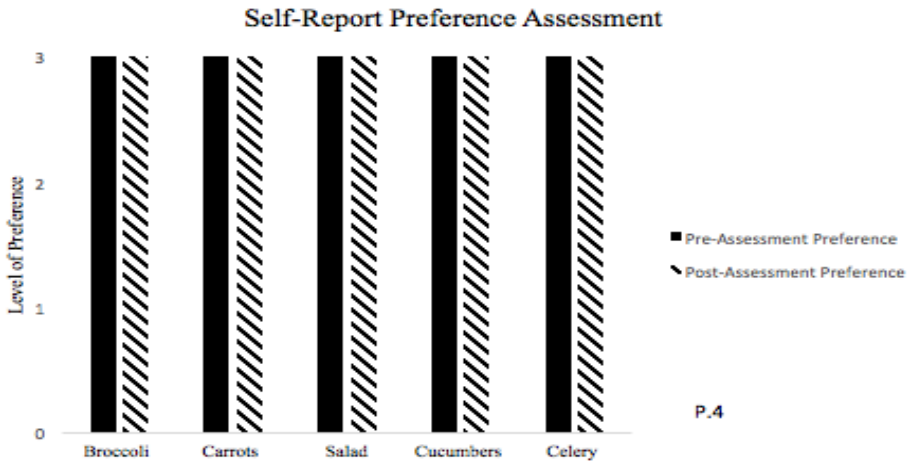


Figure 20. Graph depicting Participant 4's pre-post-self-reported preference level. "1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

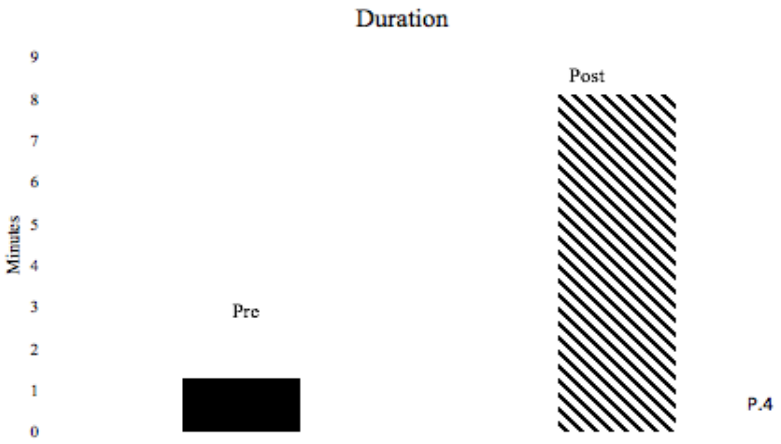


Figure 21. Graph depicting Participant 4's pre-post time in minutes.

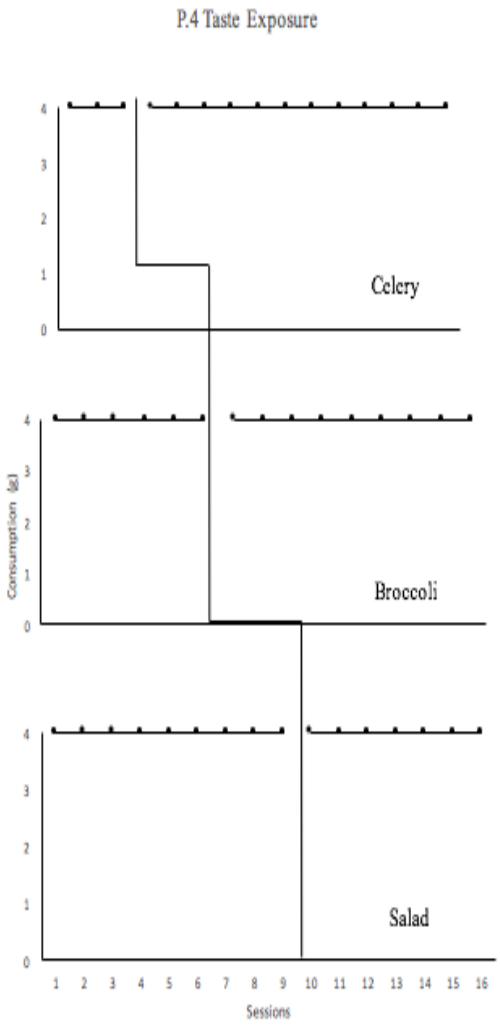


Figure 22. Graph depicting Participant 4's consumption for targeted vegetables.

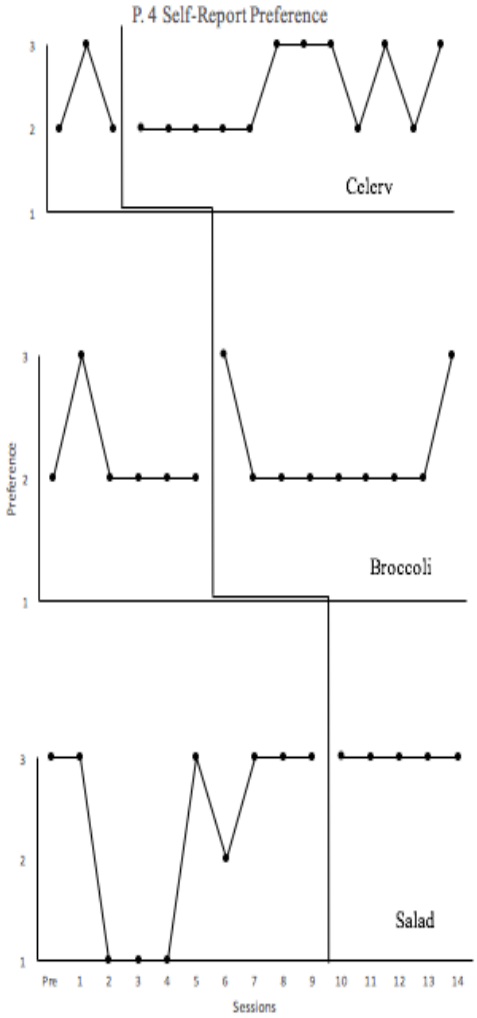


Figure 23. Graph depicting Participant 4's self-report preference assessment for targeted vegetables.

Participant 5

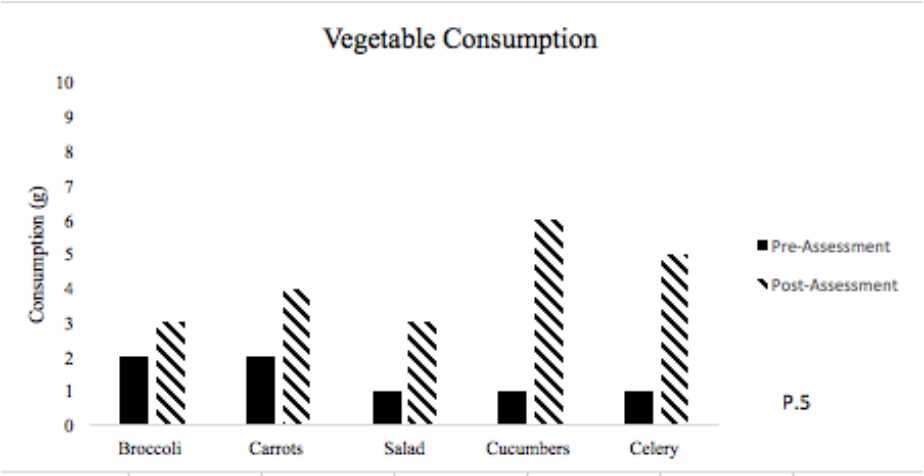


Figure 24. Graph depicting Participant 5's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

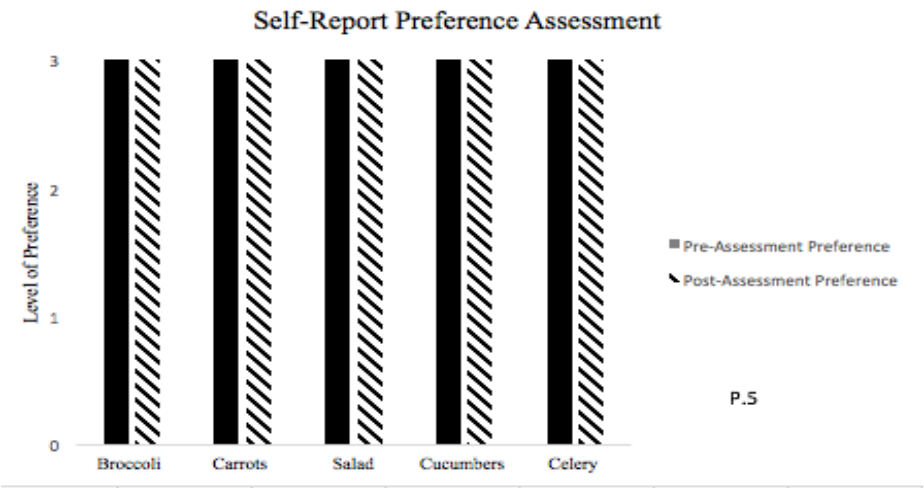


Figure 25. Graph depicting Participant 5's pre-post-self-reported preference level. "1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

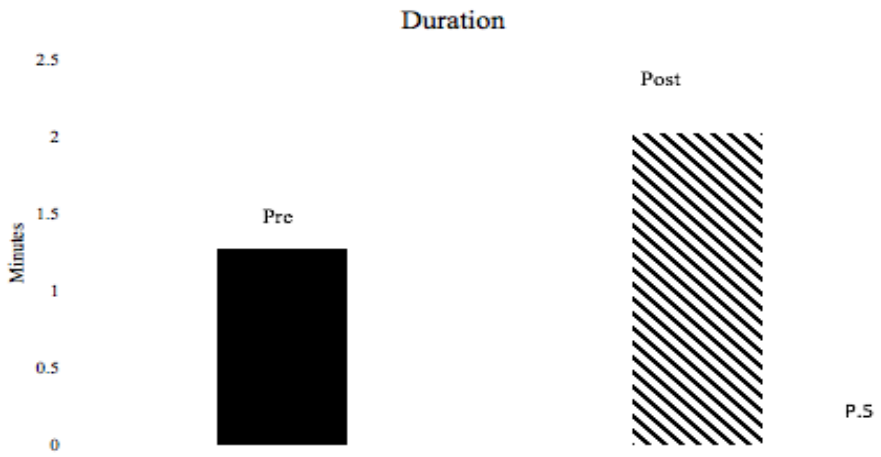


Figure 26. Graph depicting Participant 5's pre-post time in minutes.

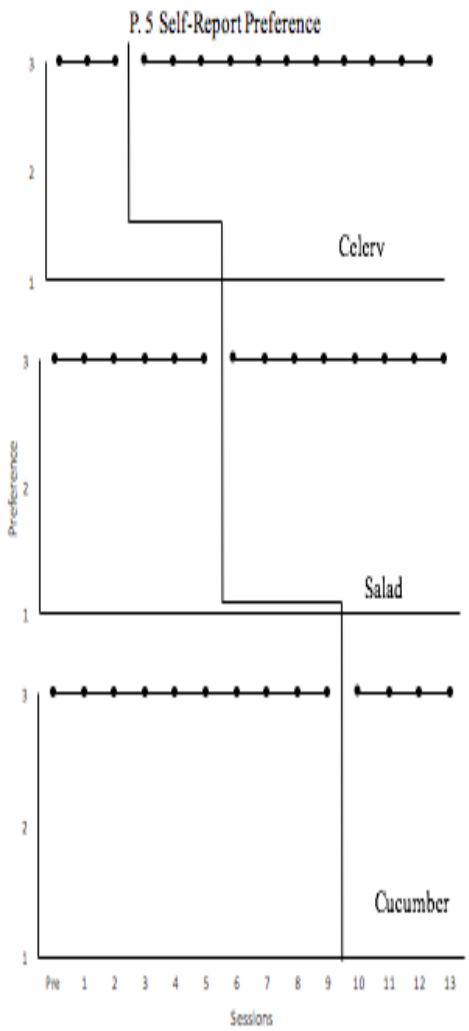


Figure 27. Graph depicting Participant 5's self-report preference assessment for targeted vegetables.

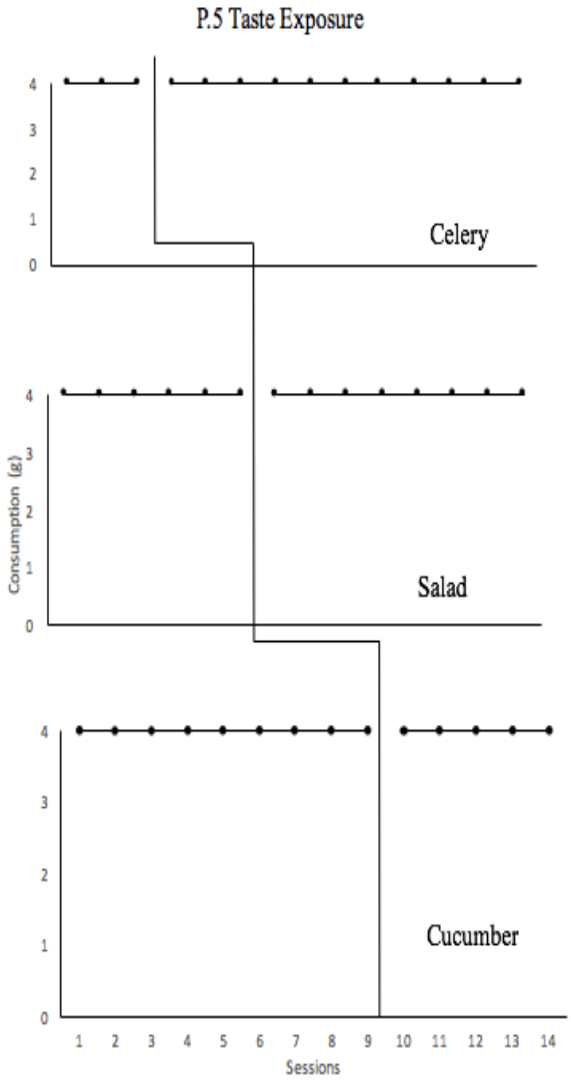


Figure 28. Graph depicting Participant 5's consumption for targeted vegetables.

Participant 6

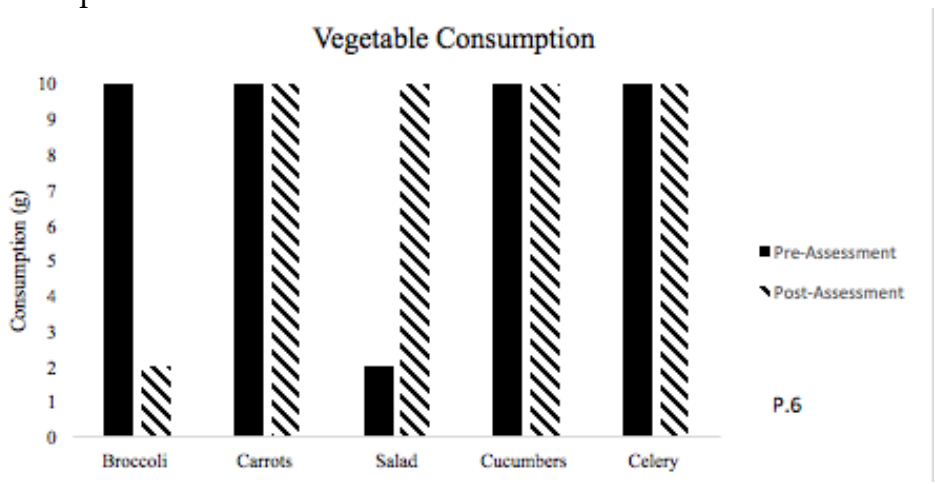


Figure 29. Graph depicting Participant 6's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

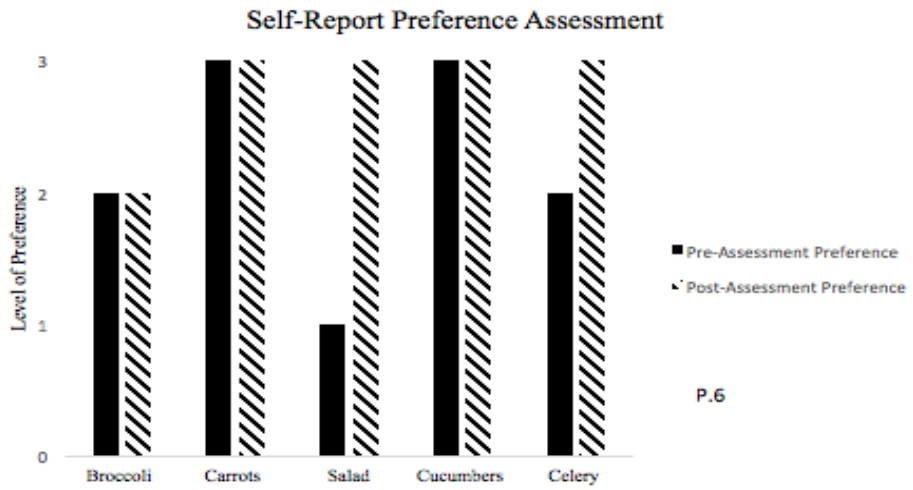


Figure 30. Graph depicting Participant 6's pre-post-self-reported preference level. "1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

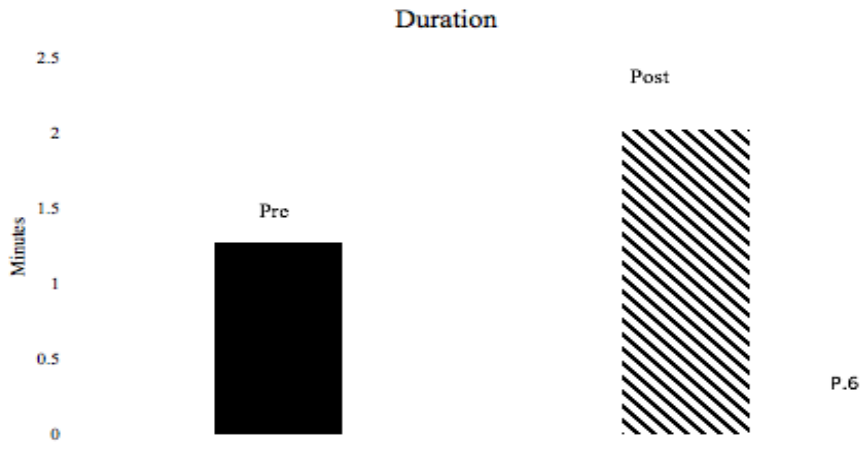
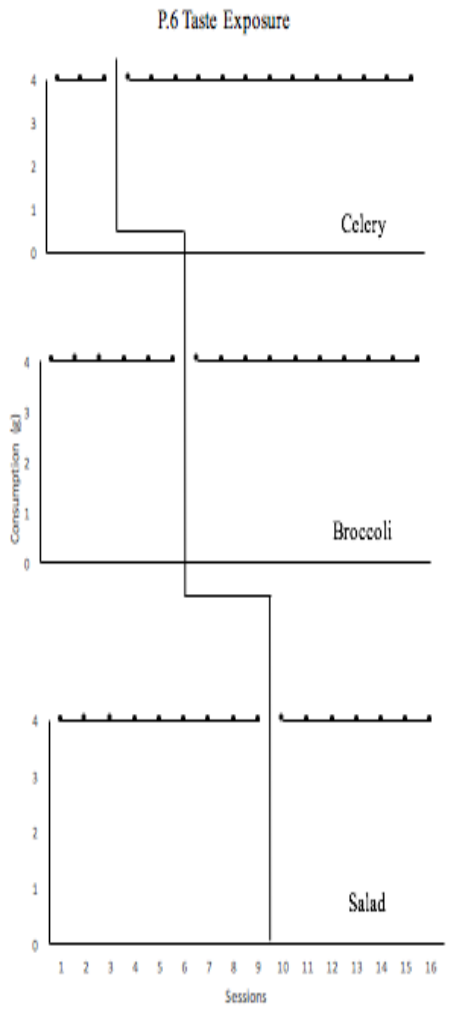


Figure 31. Graph depicting Participant 6's pre-post time in minutes.



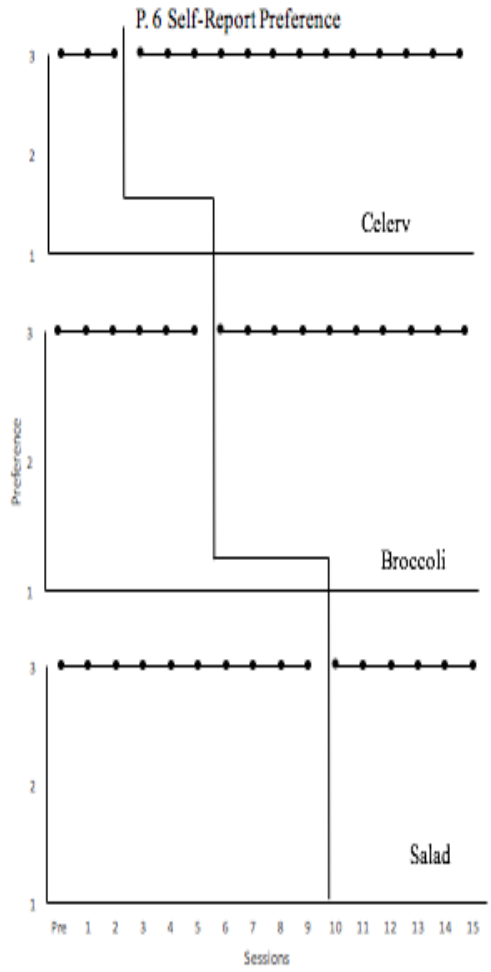


Figure 32. Graph depicting Participant 6's consumption for targeted vegetables.

Figure 33. Graph depicting Participant 6's self-report preference assessment for targeted vegetables.

Participant 7

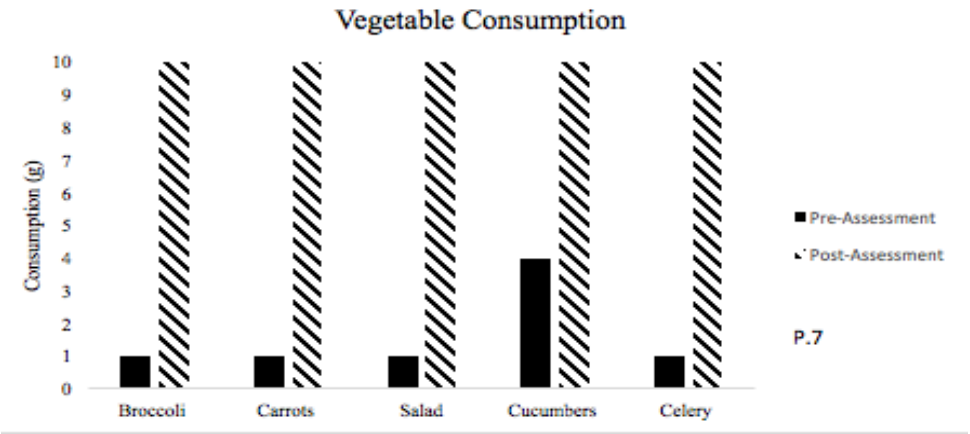


Figure 34. Graph depicting Participant 7's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

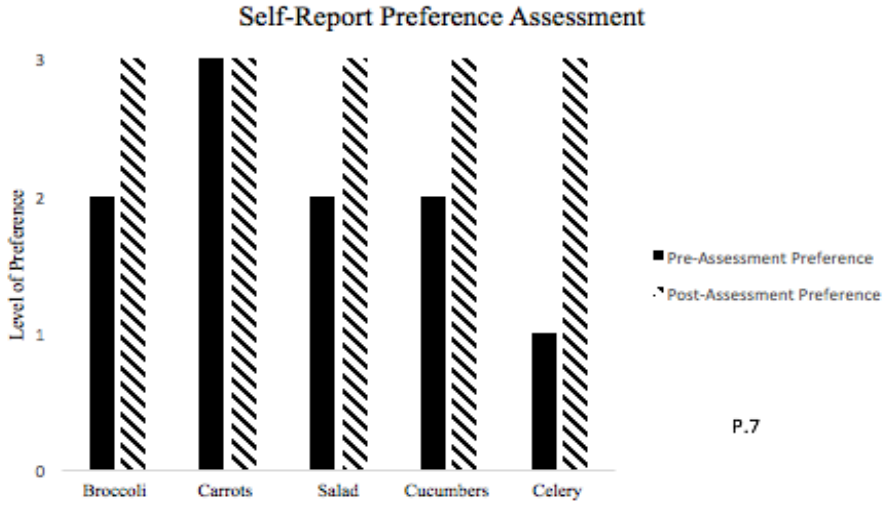


Figure 35. Graph depicting Participant 7's pre-post-self-reported preference level. "1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

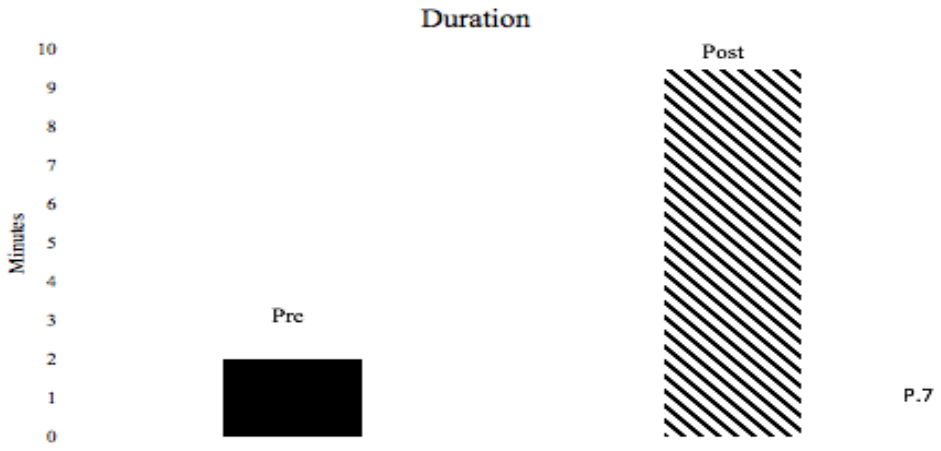
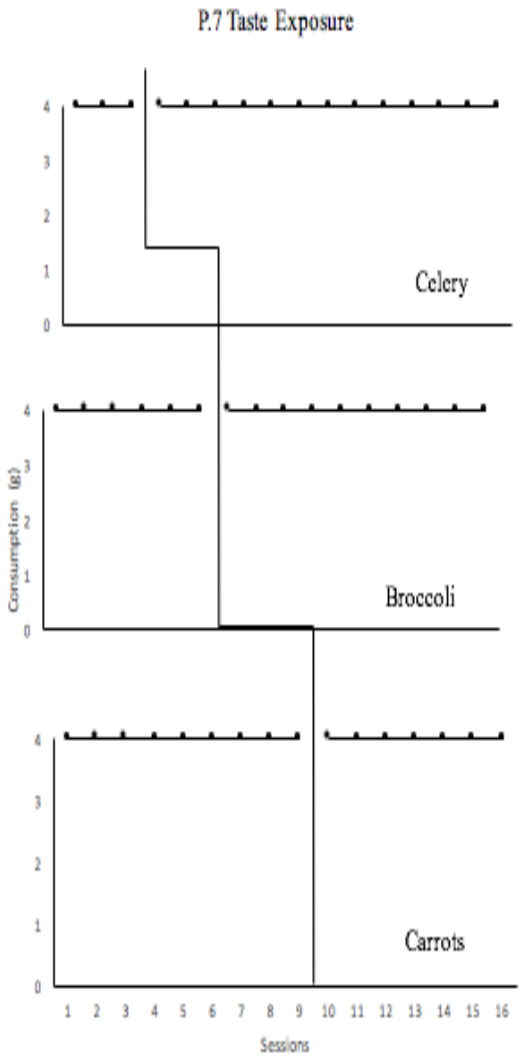


Figure 36. Graph depicting Participant 7's pre-post time in minutes.



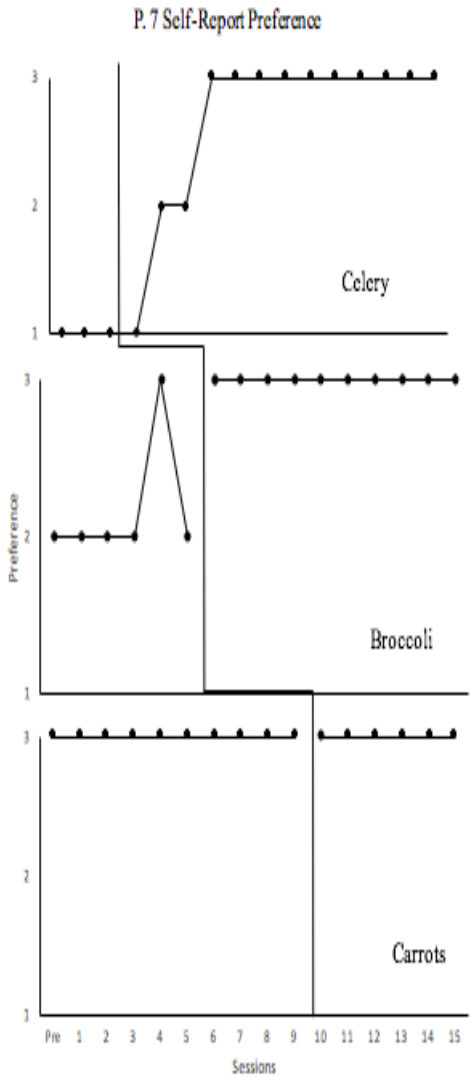


Figure 37. Graph depicting Participant 7's consumption for targeted vegetables

Figure 38. Graph depicting Participant 7's self-report preference assessment for targeted vegetables.

Participant 8

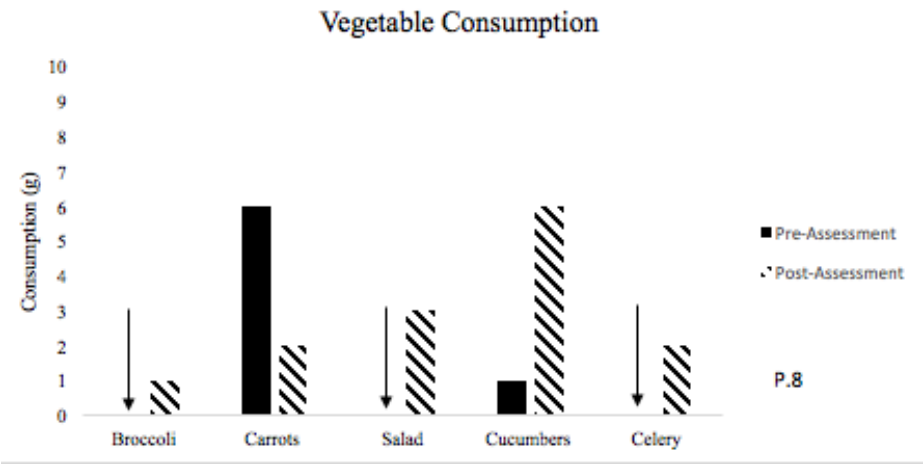


Figure 39. Graph depicting Participant 8's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

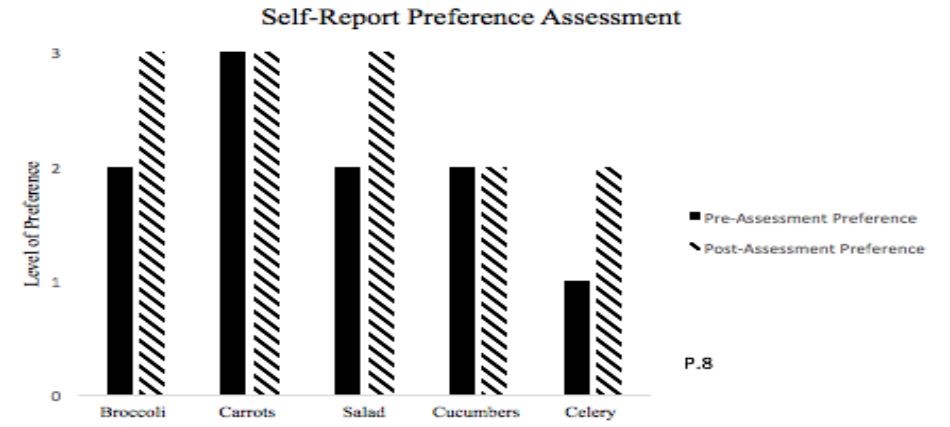


Figure 40. Graph depicting Participant 8's pre-post-self-reported preference level. "1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

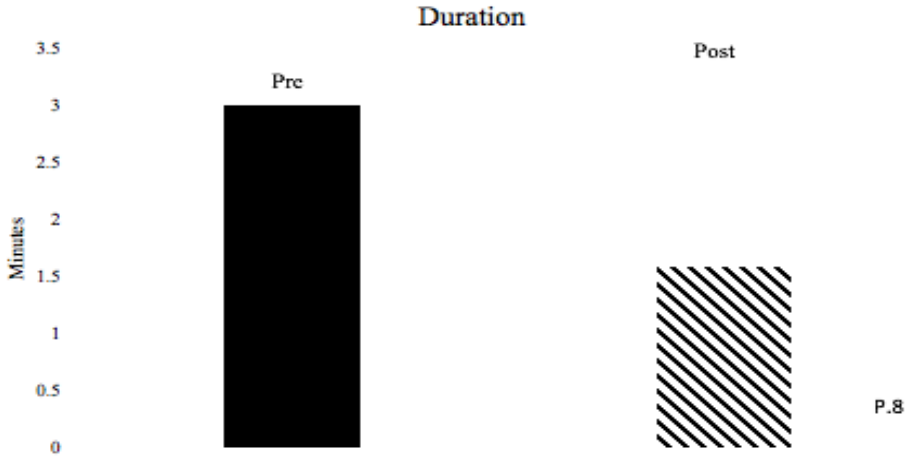
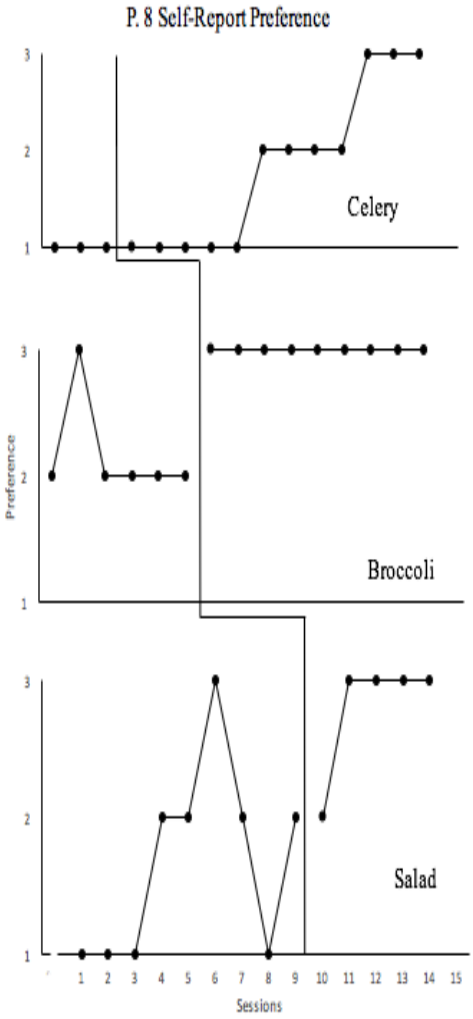


Figure 41. Graph depicting Participant 8's pre-post time in minutes.



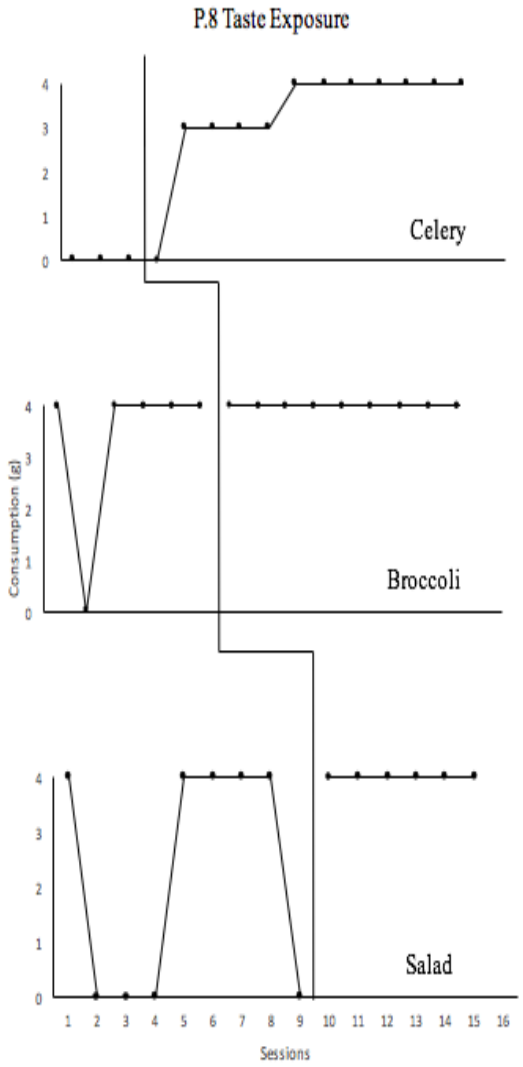


Figure 42. Graph depicting Participant 8's self-report preference assessment for targeted vegetables.

Figure 43. Graph depicting Participant 8's consumption for targeted vegetables

Participant 9

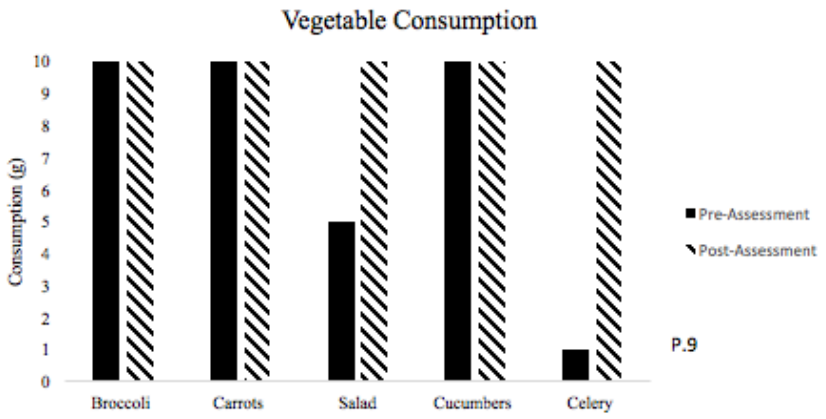


Figure 44. Graph depicting Participant 9's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

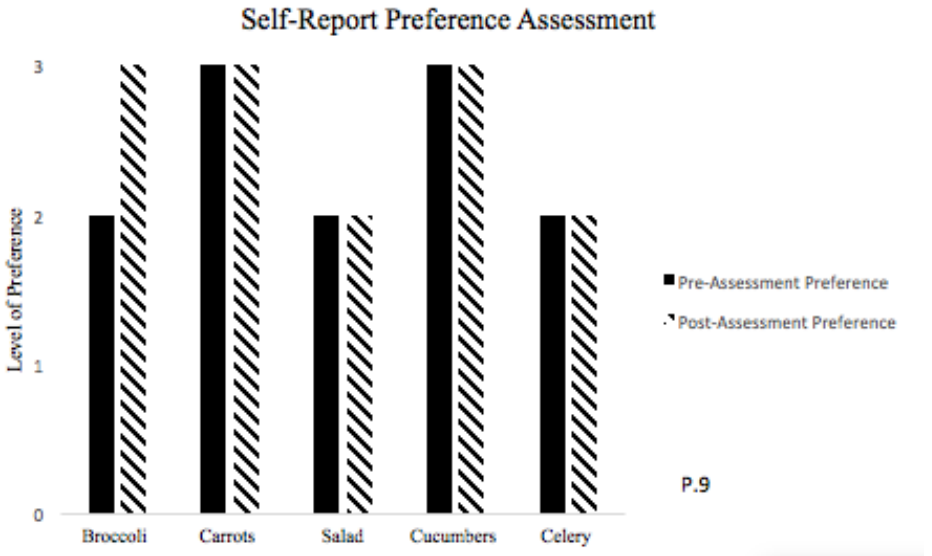


Figure 45. Graph depicting Participant 9's pre-post-self-reported preference level. "1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

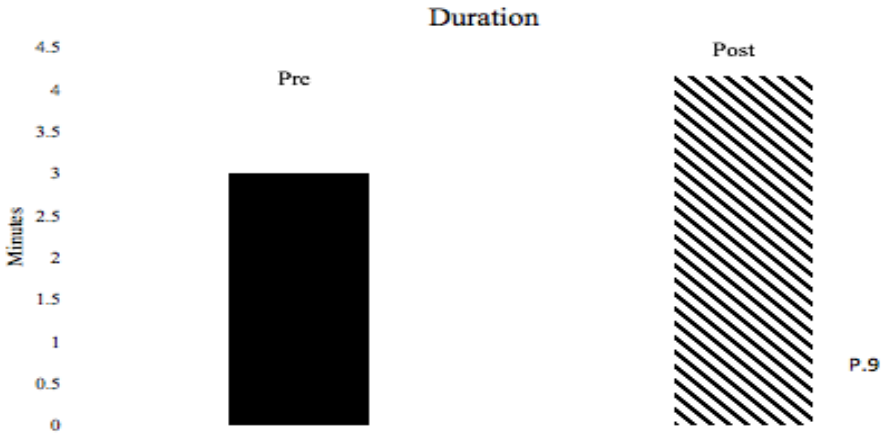
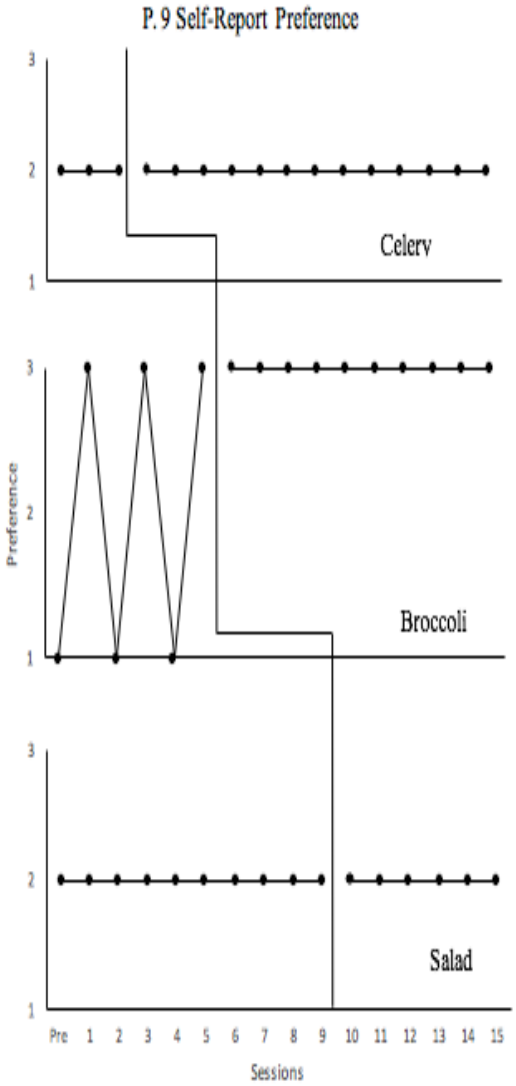


Figure 46. Graph depicting Participant 9's pre-post time in minutes.



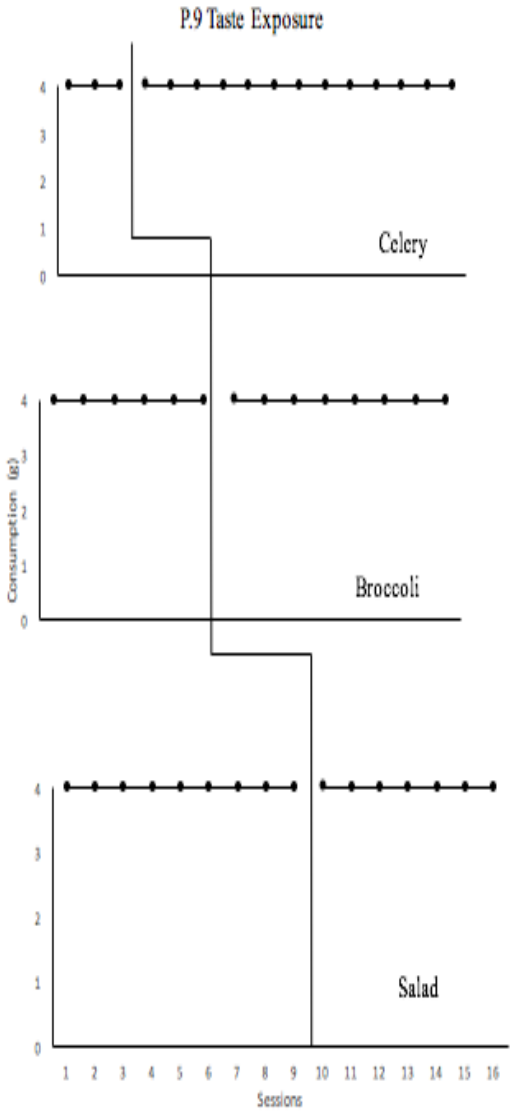


Figure 47. Graph depicting Participant 9's self-report preference assessment for targeted vegetables.

Figure 48. Graph depicting Participant 9's consumption for targeted vegetables.

Participant 10

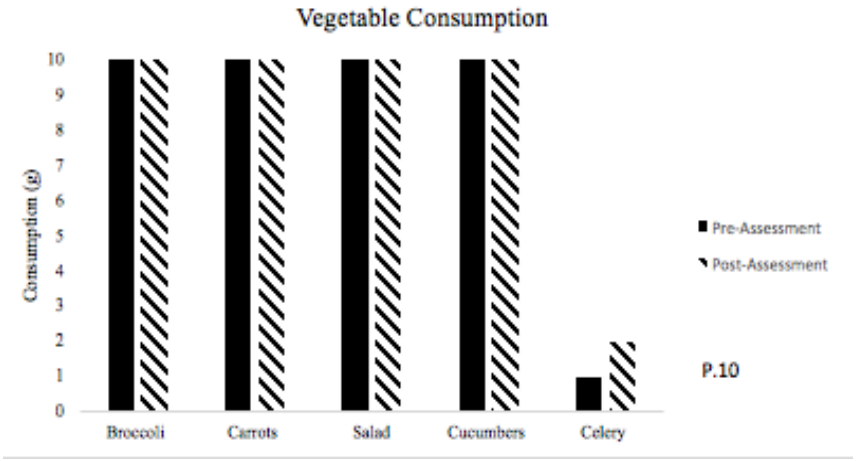


Figure 49. Graph depicting Participant 10's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

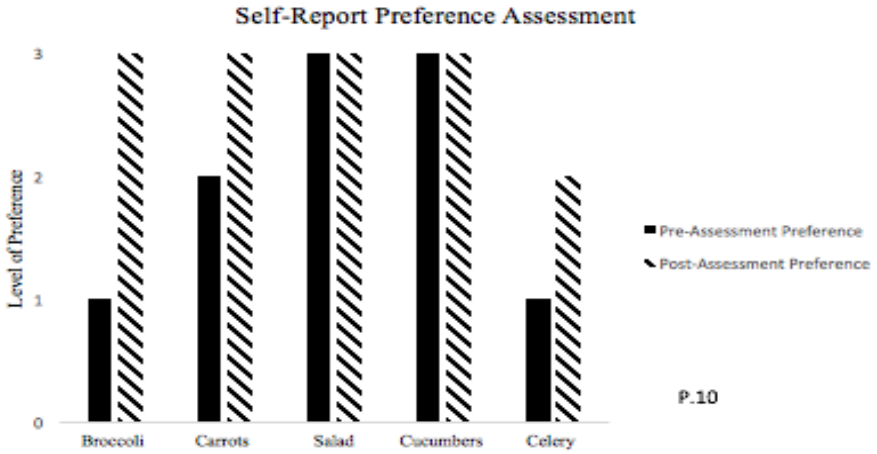


Figure 50. Graph depicting Participant 10's pre-post-self-reported preference level.
"1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

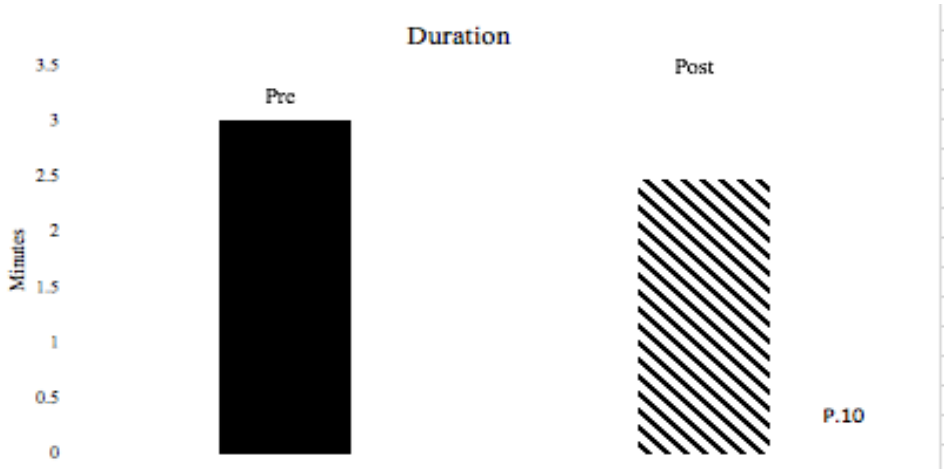


Figure 51. Graph depicting Participant 10's pre-post time in minutes.

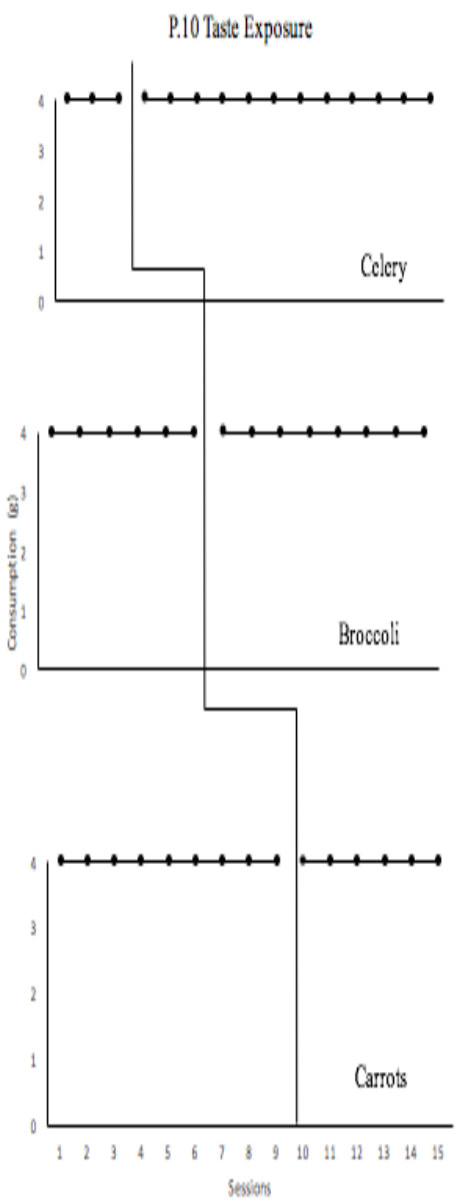


Figure 52. Graph depicting Participant 10's consumption for targeted vegetables.

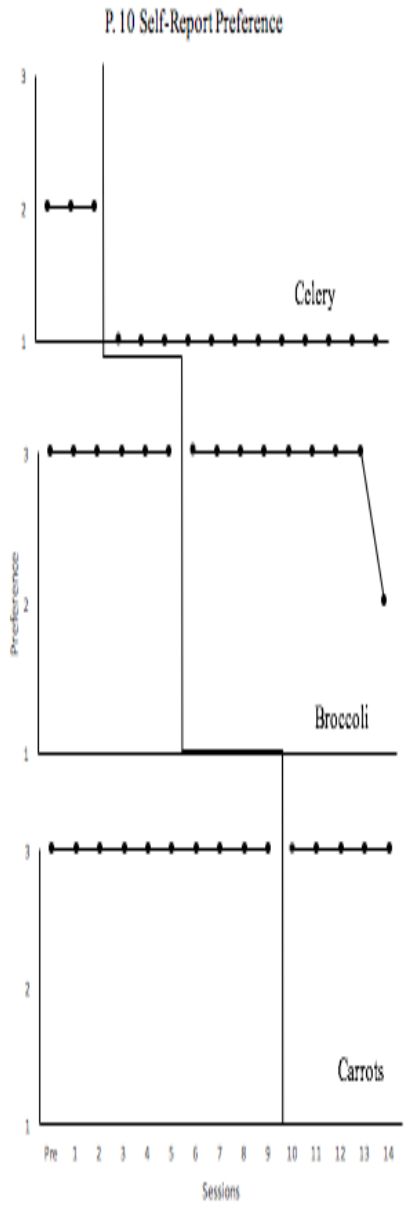


Figure 53. Graph depicting Participant 10's self-report for targeted vegetables.

Participant 11

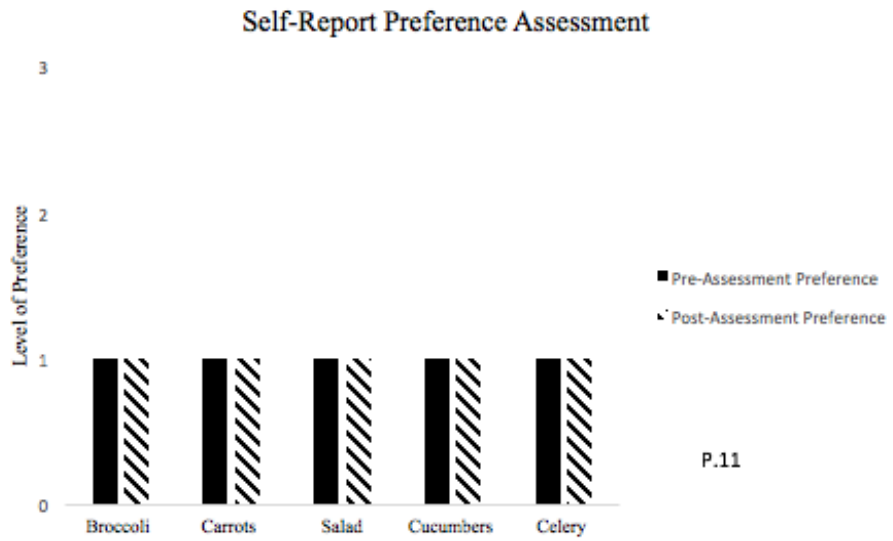


Figure 54. Graph depicting Participant 11's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

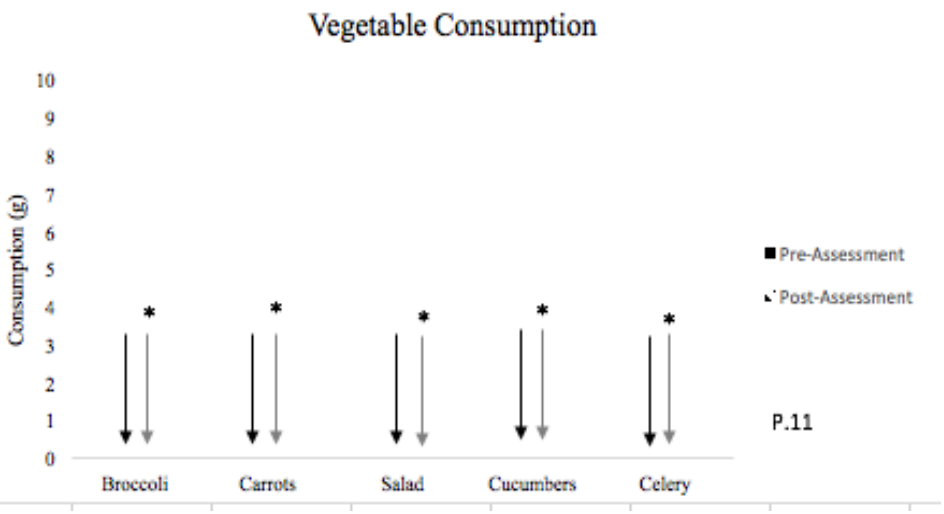


Figure 55. Graph depicting Participant 11's pre-post-self-reported preference level.
"1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

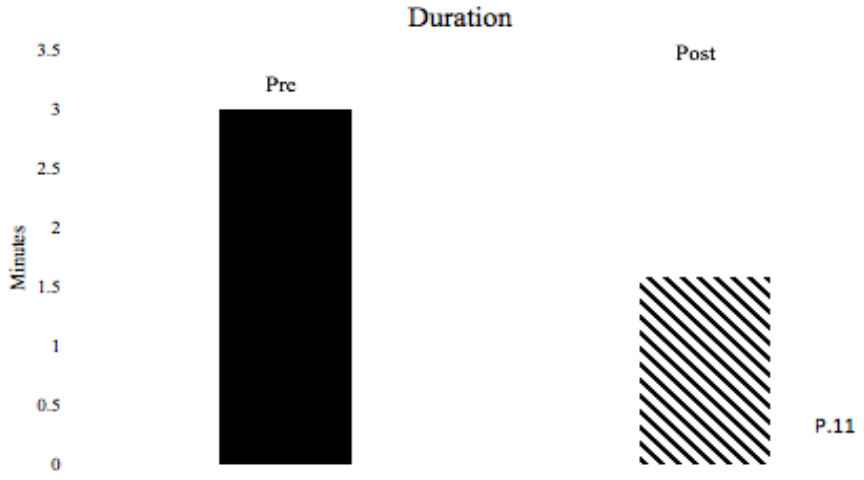


Figure 56. Graph depicting Participant 11's pre-post time in minutes.

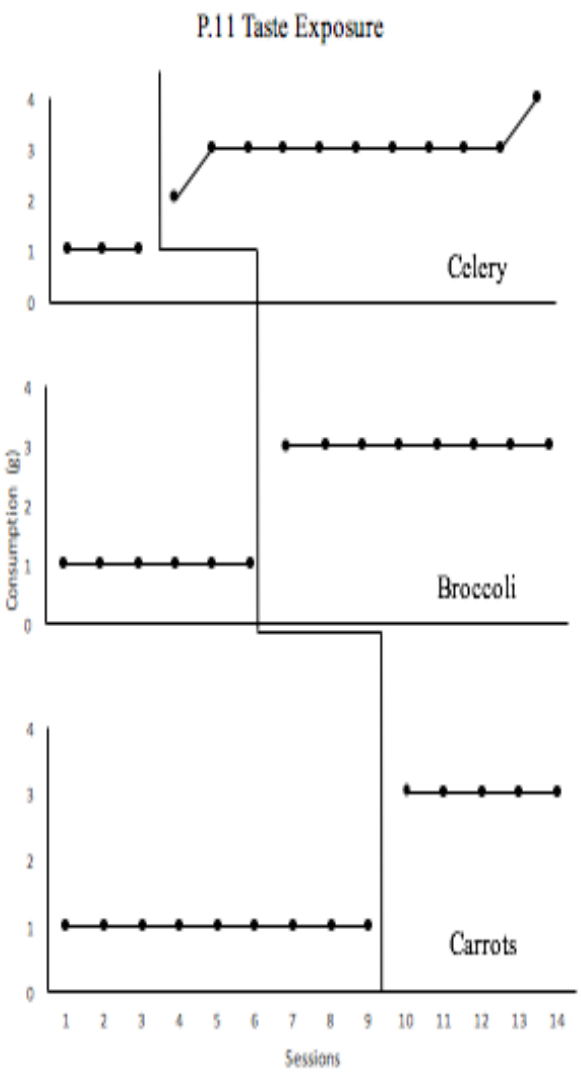


Figure 57. Graph depicting Participant 11's consumption for targeted vegetables.

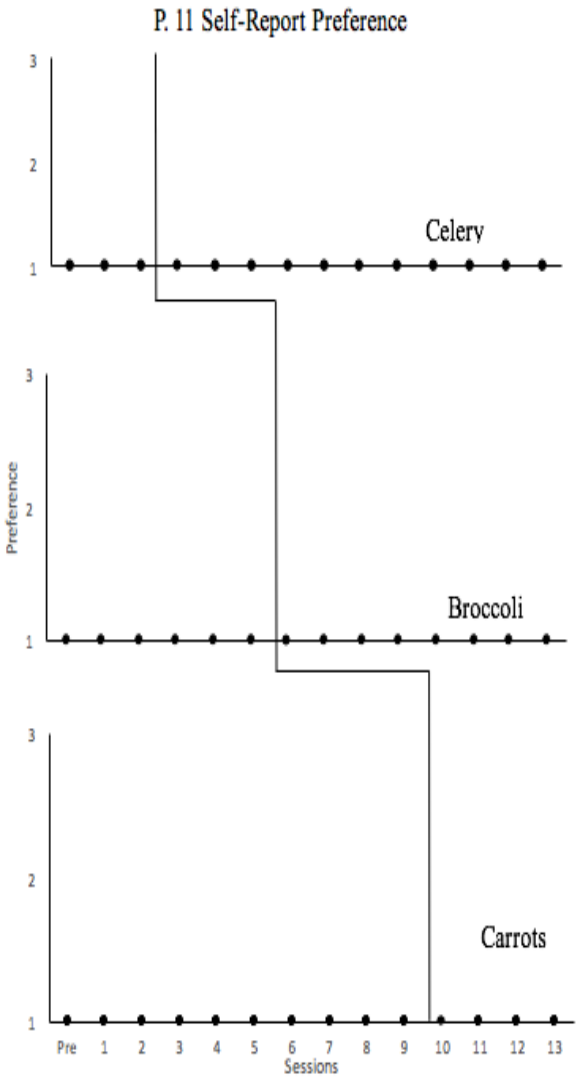


Figure 58. Graph depicting Participant 11's self-report preference assessment for targeted vegetables.

Participant 12

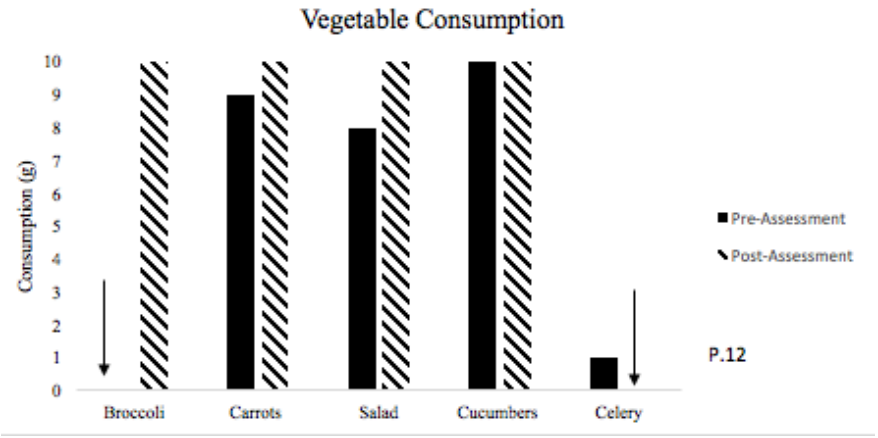


Figure 59. Graph depicting Participant 12's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

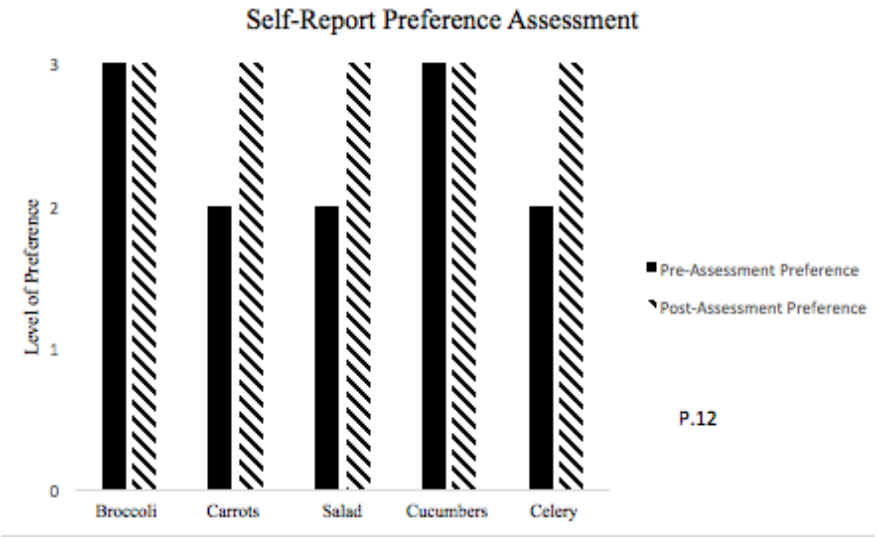


Figure 60. Graph depicting Participant 12's pre-post-self-reported preference level.
"1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

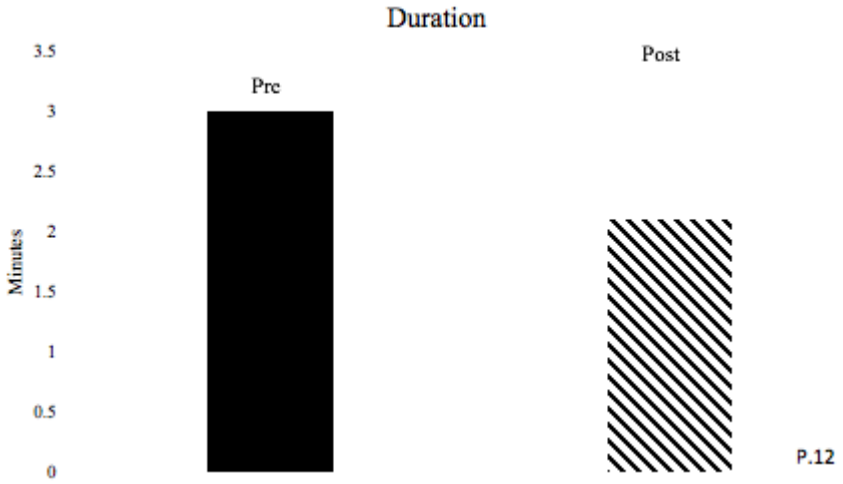
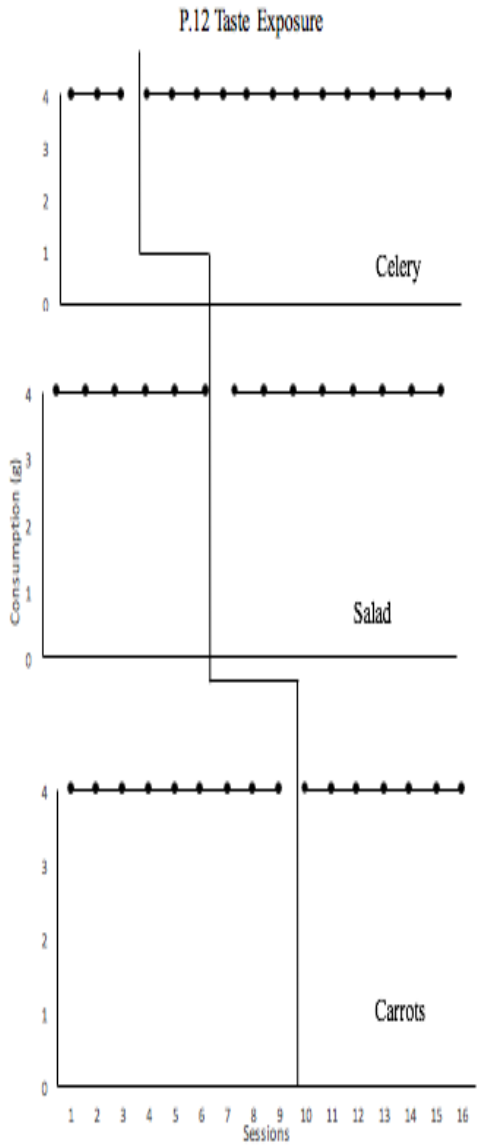


Figure 61. Graph depicting Participant 12's pre-post time in minutes.



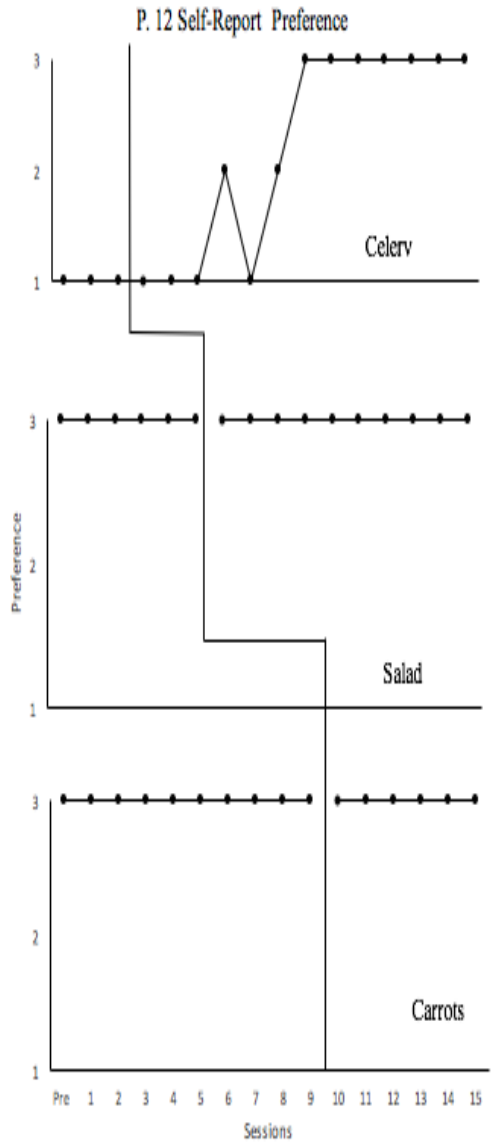


Figure 62. Graph depicting Participant 12's consumption for targeted vegetables.

Figure 63. Graph depicting Participant 12's self-report preference assessment for targeted vegetables.

Participant 13

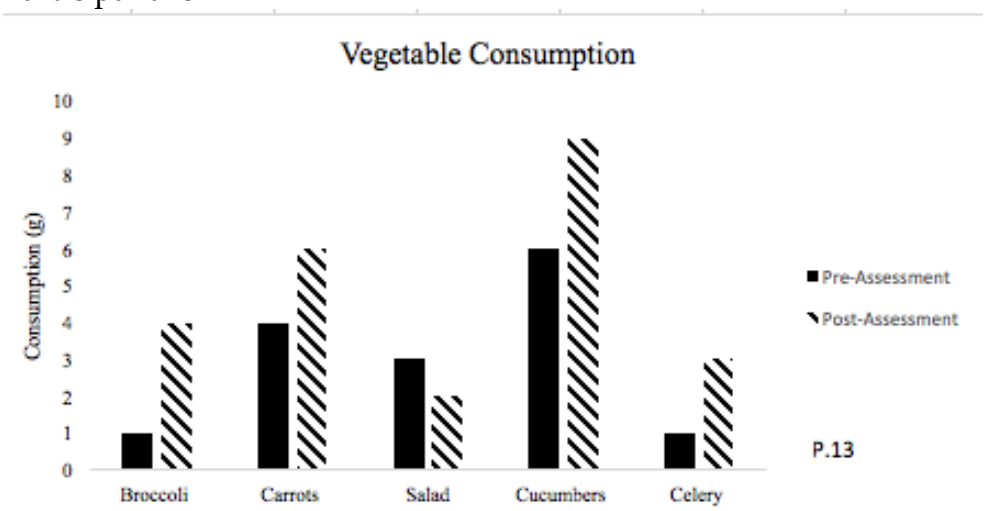


Figure 64. Graph depicting Participant 13's pre-post consumption levels for targeted vegetables and non-targeted vegetables.

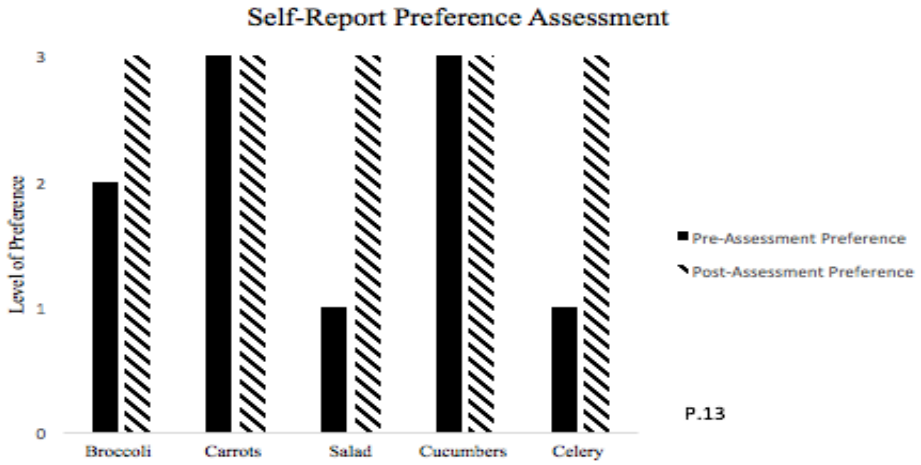


Figure 65. Graph depicting Participant 13's pre-post-self-reported preference level.
"1" indicates no/low preference, "2' indicates moderately preferred, and "3' indicates highly preferred.

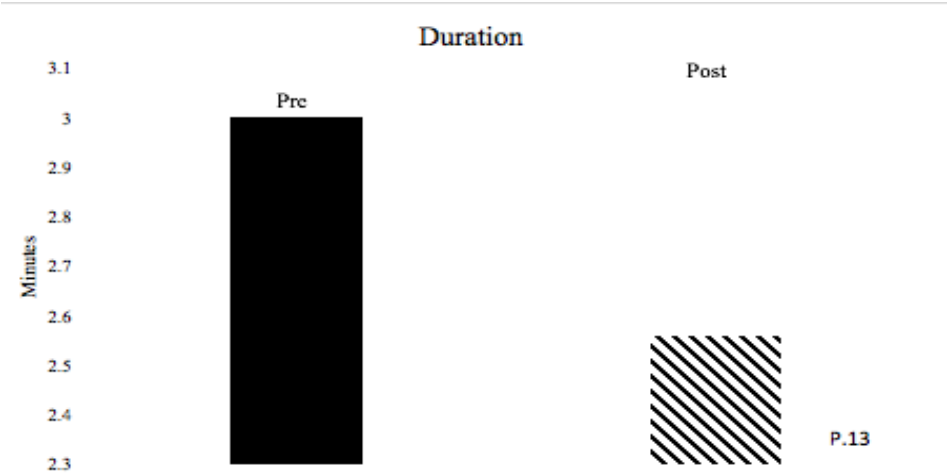
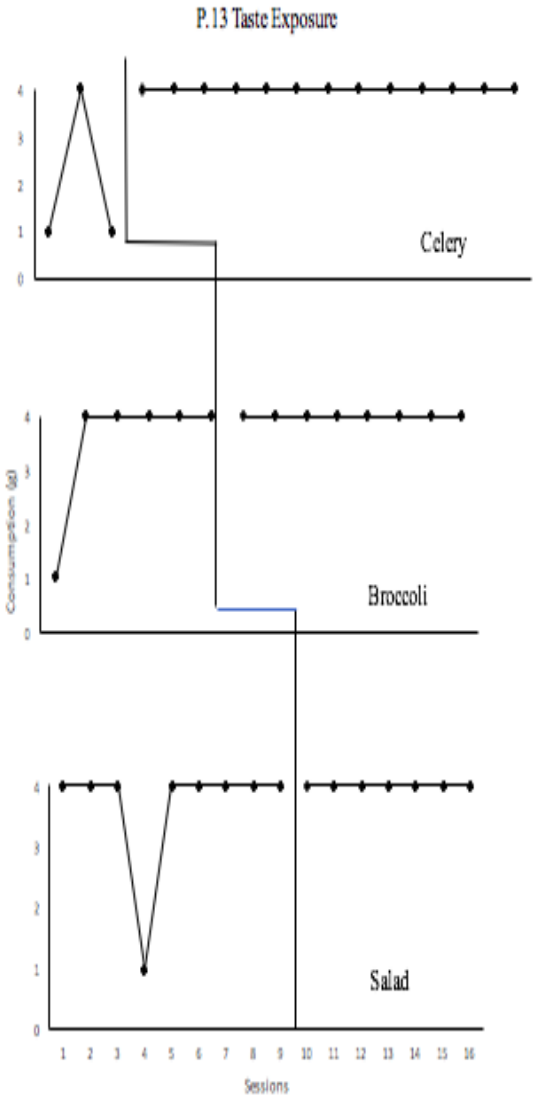


Figure 66. Graph depicting Participant 13's pre-post time in minutes.



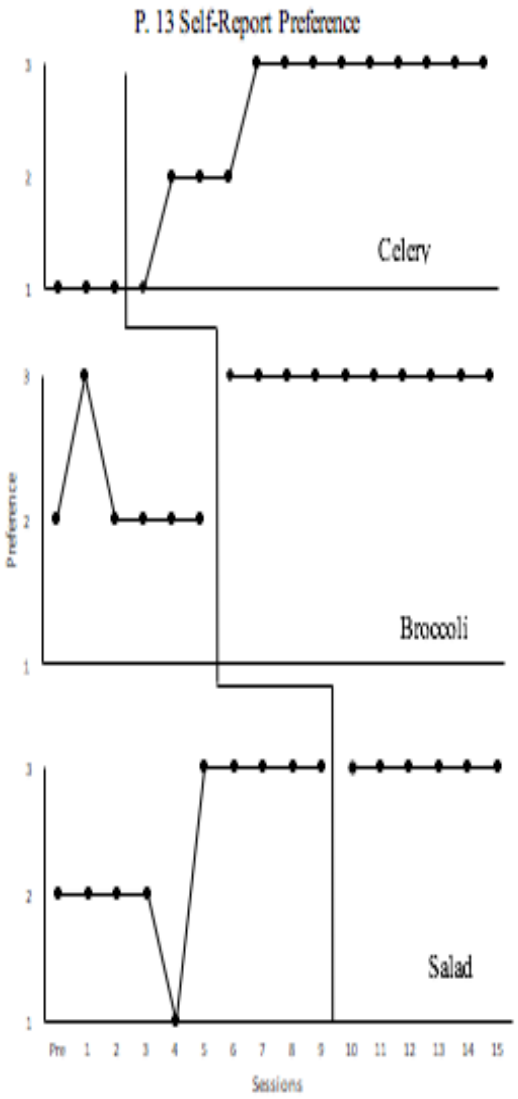


Figure 67. Graph depicting Participant 13's consumption for targeted vegetables.

Figure 68. Graph depicting Participant 13's self-report preference assessment for targeted vegetables.

APPENDIX O: FIT GAME FRUIT GRAPH WITH FRUIT-SLUSHIES

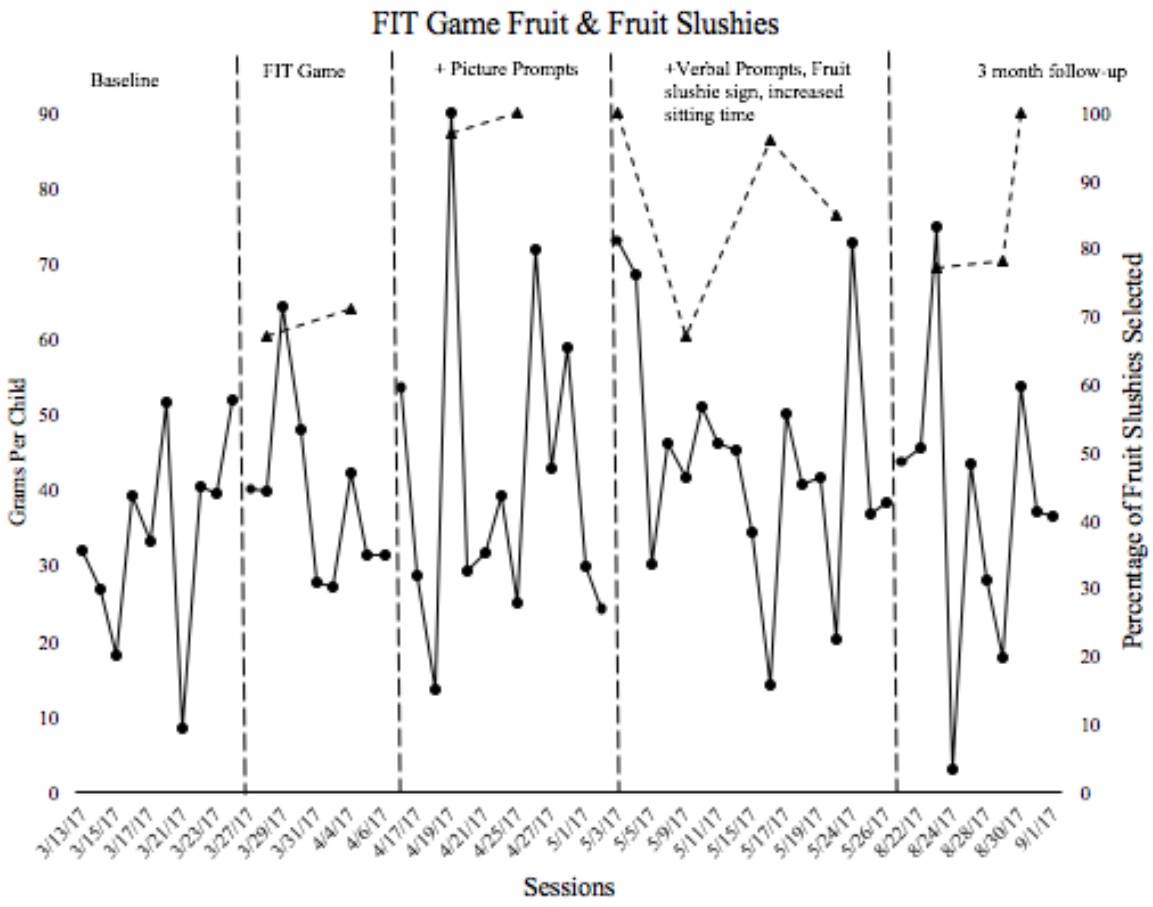


Figure 69. Graph depicting fruit consumption and fruit slushie selection for the FIT Game (FG) and FIT+ Taste group across baseline (BL), FIT Game (FG), FIT Game plus picture prompts(C), FIT Game plus verbal prompts (D), and follow-up (maintenance)