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**FRUIT AND VEGETABLE CONSUMPTION AT BEAR RIVER
CHARTER SCHOOL; A DEMAND CURVE ANALYSIS**

by

McKelle Tobey

**Thesis submitted in partial fulfillment
of the requirements for the degree**

of

**HONORS IN UNIVERSITY STUDIES
WITH DEPARTMENTAL HONORS**

in

**Psychology
in the Department of Psychology**

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Abstract

Many variables contribute to the rising prevalence of children being overweight and obese, one being poor nutrition and the lack of a balanced diet. Proper nutrition helps children to grow and develop normally, as well as lowers the risk of developing chronic problems such as cardiovascular disease, coronary heart disease, and certain cancers later in life. Conducted alongside an applied behavioral intervention to increase consumption of fruits and vegetables, a behavioral economic evaluation of demand curves was administered to students in the fifth through eighth grades. Findings suggest that the intervention had no significant effect on the elasticity of the different commodities studied. However, there was a significant difference found between commodities, with the results showing that children value fruits the most.

Acknowledgments

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Introduction

“Childhood obesity is a growing epidemic in America. An estimated 23 million children and teenagers ages 2-19 are obese or overweight. That rate has tripled in the past 30 years. For the first time in history, children have shorter lifespan expectancies than their parents” (Kennai, 2010; Brownell & Horgen, 2004). Problems with weight are hitting children earlier with each generation, and the consequences are becoming more severe as it hits sooner in life. The Center for Disease Control and Prevention has classified a child that is equal to or greater than the 95th percentile of the age and gender specific body mass index as being obese, while those that are equal to or greater than the 85th percentile are considered overweight. While the adult population currently has even higher rates, childhood obesity levels are the highest they’ve ever been (Center for Disease Control and Prevention, 2011). Over the past 30 years the number of overweight children has doubled while the number of overweight teenagers has tripled, with an 80% chance of obese children becoming obese adults (Schroeder & Gordon, 2002).

The complications that come from childhood obesity are very severe and lead to life-long problems. If current trends and lifestyles continue, it is predicted that one third of all children will develop diabetes during their lifetime. Other problems like asthma, gallstones, hernias, dysfunctional organs, hypertension, and risk of coronary disease are serious medical conditions that can also result from obesity later on in life (Daniels, 2006; Onis & Lobstein, 2010).

Many different factors are causing the rise in childhood obesity rates. Increased time in front of electronic devices, lack of exercise, and poor nutrition are generally credited as the largest factors (Koplan et al., 2005). When dealing with childhood obesity, it is important to look at the school environment and the changes that could be made there. In the current school system, children are not taught proper nutrition, nor are they provided with adequate physical

education time. Schools are currently considered a “negative exercise zone” where the situation “is not reinforcing to teachers or students who want to exercise”, and does not provide a “stimulus to students who need encouragement to exercise” (Schumacher & Queen, 2006). As standardized test score requirements have risen in states, the school districts are cutting back the time spent in physical education.

The health and wellness of a child has an impact on their academic achievement as well as their social-emotional development. It has been shown that a child that is receiving proper nutrition and exercise does better in school due to an increase in energy and greater self-confidence (Satcher, 2004). When children are obese there are different things that interfere with their opportunity to learn: low self-esteem, peer discrimination, teacher prejudice, and non-acceptance are but a few. Schools can be a foundation for a change towards healthier lifestyles. Faculties and staff can start by being positive examples for their students. Schools can integrate physical activity into lesson plans, and children can be taught about nutrition so that they can make healthy choices about what they are eating.

Nutrition is one of the key components to health, and weight control. According to the U.S. Department of Health and Human Services, proper nutrition is comprised of “getting the right types and amounts of foods and drinks to supply nutrition and energy for maintaining body cells, tissues, and organs, and for supporting normal growth and development” (2005). Poor nutrition has an actively negative impact on the body, taking energy from the previously mentioned areas as well as impacting the bone and muscle systems. A balanced diet consists of six main food groups: dairy, meat and beans, fruit, vegetables, grains, and oil. Healthy eating habits prevent and control many different health problems, such as heart disease, high blood pressure, high cholesterol, type 2 diabetes, and can even help you handle stress more effectively.

In previous generations junk food has not been as easily available, making it even more important in this day and age to make sure that children are learning proper nutrition. As the age of disease onset becomes lower, it is essential to make sure that proper eating habits are working to decrease the risk of chronic conditions in our youth, as well as lower the number of children reaching adulthood already possessing a predisposition for obesity. Deficits of the nutrients found in fruits and vegetables can cause not only weight gain, but also failure to grow at the correct rate and successful academic performance.

It is recommended by the U.S. Department of Health and Human Services that adults eat four servings (2 cups) of fruits, and five servings (2.5 cups) of vegetables as part of an average 2,000-calorie diet. While recommended intake is lower for children, fruit and vegetable consumption is still a significant portion of their diet, a combined five servings a day. Nutrition as a whole has many health benefits; in addition to this, increased consumption of fruits and vegetables has been shown to lower the risk of Coronary Heart Disease (CHD), Cardiovascular Disease (CVD), Diabetes, as well as certain cancers (Bazzano, Serdula, & Liu 2003, He, Nowson, & MacGregor 2007, Veer, Jansen, Klerk, & Kok 1999).

To increase the consumption of fruits and vegetables in public schools, this pilot study was conducted using gamification as a basis for the behavioral intervention. Gamification is the application of “game design thinking to non-game applications to make [it] more fun and engaging” (Marczewski, 2012). Game designers dedicate a great deal of time to implementing different elements into their games that will increase both the amount of individuals playing their games, as well as the amount of time spent playing. These elements are the ones that are taken and applied to real life situations such as increasing productivity in the workplace, engaging customers online, or increasing the connectedness of a university student body. The effectiveness

of gamification has been credited to the natural desire that we possess as humans to have our achievements recognized, our individuality accurately reflected through representation, and our ability to be motivated by competition.

Reeves and Read (2010) identify ten elements in their book “Total Engagement” that are considered to be the most effective. Each element can be modified to fit the situation, and not all need to be employed to effectively gamify. First is personal representation through the use of avatars. Avatars increase engagement, are able to accurately show others your progression, and they are easy to use. A game space that reflects the physical properties of the world is another. When given a game space in which to move the avatar around—creating memories with different locations as well as an organizational sense—connectedness to the game increases. Narratives also play an important role in the gamification process; they “guide action, and organize character roles, rewards, and group action” (Reeves and Read, 2010). When a good back-story is part of a game, it will increase the excitement an individual feels, the attention they give to the game, and how many details about the game are remembered.

Another key to the success of gamification success is feedback from the game. Games are fun due to the feedback that you, the player, receive about your actions: because of feedback, you change your behavior in different situations, large tasks are broken down into more manageable tasks that you work through based on feedback, and progress through tasks working towards larger goals is facilitated through feedback. When looking at the big picture, feedback is the main source of both primary and secondary reinforcement, as well as intrinsic and extrinsic rewards, one of the most crucial parts of increasing participation and making something more enjoyable. An element that incorporates feedback—as well as the narratives and personal identity—into helping you become more involved in the game is rank/level or reputation. The

way that your character is reflected to others is based upon the level or rank that you have obtained, which is something to which all others involved in the game have access. Your reputation is also important because you want to be an individual that is known for your accomplishments not only as recognition for what you've done, but also because of the social opportunities that it will give you to advance faster.

Once you get into multiplayer games there are a few more elements that become crucial; although these are rather obvious, they are often elements that are not utilized in real life. Adding economies and marketplaces to a game adds a currency that has value only in the game, a currency that all players have access to obtaining, and another way of determining rank between individuals. Teams come into play when there are multiple players, creating a connection between individuals that may not have one otherwise, this can build communities and create relationships that will exist outside of the game. Crucial to teams, and an element often overlooked in games, is communication. Games have the ability to parallel communication as it exists in the real world in ways such as using multiple methods of delivery (text, audio, etc.), having both public and private conversations, and implementing the effects of proximity on communication. The one advantage game communication has over other forms of communication is the ability to easily talk to those that you do not know. Games possess less formal social rules, and everyone engaged in the game automatically has something in common.

The final two elements are aspects that affect almost every game, but they are important to keep in mind when deciding how to implement gamification: time restraints and rules that are explicit and enforced. Time adds another element to the game, adding the question of not only "are you good enough?" but also, "are you good enough to do it in this amount of time?" With this added pressure comes added excitement, and the time crunch can also add to team cohesion

as you battle the clock. Time is an example of a game rule, or something that helps players understand exactly what they need to do in order to advance levels, ultimately winning the game. Rules help the flow of the game, creating a sense of fairness between players as well as a sense of internal control. Overall, the process of gamification is increasingly complicated by the number of elements that the designers choose to implement, but just a few aspects put into place can add an element of fun to any situation.

The goal of this study was to increase fruit and vegetable consumption using a behavioral intervention based on gamification; the measure that was used to determine consumer behavior has a foundation in behavioral economics. Behavioral economics is the study of variables that affect the behavior of consumers (Madden, 2000). These variables consist of the influence of individual social, cognitive, and emotional factors, as well as the factors affecting the state of the economy as a whole, such as inflation, market prices, or resource allocation. When looking at these factors, there are two main areas of focus: consumption and spending. Consumption is a broad field that entails the physical intake of a substance, the use of another's time or resources, or the use of material goods. From a behavior standpoint, anytime a reinforcer is consumed, it is considered a consumer demand. Spending is another broad area that is defined by "the amount of money, work, or time that an individual will allocate toward obtaining a particular reinforcer" (Madden, 2000). While looking at both elements is important, this study focuses on the consumption/demand side.

One way to measure value of a good is through a demand curve, a function used to determine the level of consumption based on the amount of spending required to obtain a reinforcer. Demand curves are primarily used to determine the elasticity of demand. When a good is considered to be elastic, it responds to changes in other parameters; the more elastic a

good is, the smaller the change it responds to. On the opposite side, inelasticity describes a variable that does not respond to changes in other parameters. When plotted on double logarithmic coordinates, one obtains a demand curve. To be considered elastic, the demand “a 1% change in price produces greater than a 1% change in consumption” for a specific reinforcer; when it is inelastic, “a 1% price change produces less than a 1% change in consumption” (Madden, 2000). When looking at the plotted curve, we can determine elasticity based on the slope: a slope equal to or greater than -1 is elastic, and a slope that is less than -1 is inelastic (Hursh and Silberberg, 2008). The plotting of points on a curve will determine if the commodity is elastic or inelastic. “When demand for a good is elastic, a price increase decreases both consumption and spending. When demand for a good is inelastic, however, price increases decrease consumption and increase the amount of money, effort, or both allocated toward obtaining the good” (Madden, 2000).

As the struggle with childhood obesity and poor nutrition continues, researchers continue to find new ways to incentivize healthy eating. It is through this study that we explore the option of evaluating the effectiveness of measuring healthy eating through the use of demand curves.

Method

This study was conducted alongside a larger behavioral intervention based within the school system, with the overall goals of increasing school-wide and individual consumption of fruits and vegetables through repeated exposure and gamification. The intervention was based in a charter school in Logan, UT (n=177). All parents or legal guardians were given a consent form with the option of opting out of the study. Data was collected at the beginning and end of the study in regard to height, weight, and skin carotenoid levels. During baseline, data was collected

on the amount of fruits and vegetables consumed school wide for ten days. Children were limited to two servings of fruit and two servings of vegetables each day; both children with home lunch and school lunch had access. The gamification portion of the study was based in a narrative that the children were read part of each day. Every day they had the goal to eat more fruits and vegetables than they had the previous day. Whether that was just a bite, a whole serving, or a whole serving of each. Consumption was measured based on weight, looking at the number of single servings divided by the amount of students in attendance on any given day. If goals were reached each day, they earned "FIT" points to work towards updating the avatars or choosing the path that the narrative would take. The update of "FIT" points and the narrative were displayed on a large flat screen TV mounted on the wall about 6 feet above the ground.

The behavioral economic facet of this study is based on the research done by Hursh and Silberberg (2008). A measure was administered to the fifth through eighth graders during baseline, and after treatment during the 2013 spring semester. Following microeconomic theory, the consumption of goods was evaluated as a function of price, using Hursh and Silberberg equation (6) using standardized price:

$$\log Q = \log Q_0 + k(e^{-a[Q_0^C]} - 1) \quad (1)$$

Each child was administered a survey stating the amount of money (\$5) they hypothetically had to spend in a given week during school lunch. They were given the option of spending the money on up to 6 servings of fruits, vegetables, or items of lower nutritional value still found in school cafeterias (e.g., potato chips, fries). The only stipulation being that they only had \$5; consequently, near the end the amount of servings possible became lower as the price increased. Throughout the survey, the price of a serving doubles on each question. There were seven

questions, with the price ranging from 0.00 (free) to 0.80 cents. Figure 1 below shows two of the questions from the survey.

Figure 1

Question 1: In the cafeteria this week all of the items below cost \$0 (they are free). Fill in the circle corresponding to the number of servings of each you would eat this week?

	0	1	2	3	4	5	6
Servings of Fruit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Servings of Vegetables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bags of Chips or Servings of French Fries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 5: It is a new week and you just received a new \$5 allowance. In the cafeteria this week all of the items below cost 20-cents. Fill in the circle corresponding to the number of servings of each you would eat this week? Be careful to not spend more than your \$5 allowance.

	0	1	2	3	4	5	6
Servings of Fruit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Servings of Vegetables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bags of Chips or Servings of French Fries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Upon completion the surveys were scanned into Excel and checked for errors. The data was then used to plot demand curves for the entire school using Graph Prism Pad 6. A three by three ANOVA was analyzed using SPSS 2.0.

Results

The final sample size that completed the demand curve surveys was 70. There were seven students that were absent during one of the data collections, making their data exempt. Data were taken to plot demand curves for the three different data sets, as well as the three different commodities, fruit, vegetables, and "junk"- lower nutritional side dishes. The demand curves were plotted on both a linear scale (Appendix 1) and a log 2 scale (Appendix 2).

To analyze the peak consumption data, SPSS 2.0 was used to conduct a within subject repeated measures 3x3 ANOVA. There were three levels of time (baseline 1, baseline 2, & intervention phases), and three levels of food (fruit, vegetable, & junk). A test of sphericity was conducted and it was determined that there was a non-normal distribution for food type. Greenhouse-Geisser corrections were therefore applied to the analysis of the main effect of food,

which was significant, $F(1.6, 108) = 13.6, p < .0001$. Peak consumption was higher for fruit than the other foods. The main effect of time and the time x food interaction were nonsignificant.

Alpha (α) values (see Equation 1) derived from group-average demand curves for fruit, vegetables, and junk foods are shown in Table 1. α -values decreased slightly for fruit and vegetables; thus, demand for these commodities proved less sensitive to price increases over time. Unfortunately, this stronger demand for fruits and vegetables began before the intervention phase, and junk food proved to be more inelastic over time as well. .

Table 1	Fruit	Vegetables	Junk
Baseline 1	0.3253	0.2622	0.2269
Baseline 2	0.1927	0.09284	0.1654
Intervention	0.2397	0.2056	0.1786

Discussion

The major finding of this study was the significant difference in peak consumption between the various commodities. This finding shows that children do not equally value all foods. While there was no significant change over time, the data shows us a consistent food preference among this group of students. Surprisingly students rated fruits as the commodity that they would most prefer, even above “junk food” which would typically be assumed most preferred by a pre-teen age group. This finding should influence caregivers, encouraging them to make a greater effort to have fruit accessible. It should also propel caregivers to be more conscious of the fruits that are in season, and how to prepare them in a manner that the children will be want to consume them. While this finding holds important

implications with fruits, it is also important for improving consumption rates of vegetables. Preparing both fruits and vegetables in multiple ways to discover which way is preferred by individual children, has the ability to improve consumption in the future, as well as helping children discover a new healthy food they enjoy.

Though the majority of the data collected during this study was not statistically significant, the demand curves accurately represented what happened to cafeteria-based consumption of fruits and vegetables during the intervention. The intervention did not increase fruit and vegetable consumption among the 5th-8th graders. The lack of change across time was also present in the demand curves, showing that they could potentially be an accurate way to measure consumption and elasticity. The intervention's implementation of gamification did not seem to appeal to the older children. Things that could be done differently in the future include using individual avatars, working to earn points directly related to their character, a more connected environment (e.g. a school), adding some sort of time constraint, or adding an element of competition (e.g. between grades). Another limitation with the older group was a lack of engagement with the narrative; this is partially due to a lack of teacher engagement in the project. A great deal of effort was put into making the narrative more accessible to teachers—further efforts could include a tangible incentive for the teachers, reading the narrative at lunch, or putting the narrative into multimedia form.

One limitation that the demand curves encountered was due to the time in the school year during which they were administered. Students were more responsive to the demand curves during the week after winter break than they were nearing the end of the school year. They were also asked to complete the surveys during their lunchtime, something that deterred the individuals from taking time to read thoroughly through the questions and thoughtfully answer.

This limitation led to a portion of the individual data not following the economic theory that as the price increases, consumption should decrease. A possible way to work with this limitation would be to select a sample of individuals to work with, rather than the entire student population. Administering the survey orally or using artificial currency could also help to address some parts of the problem.

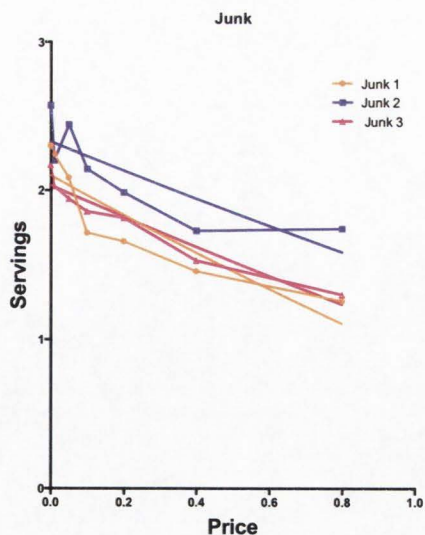
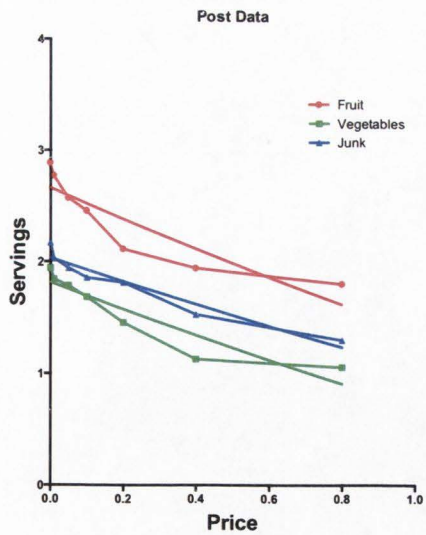
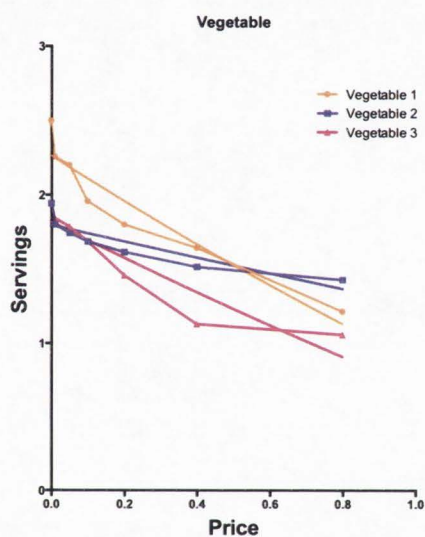
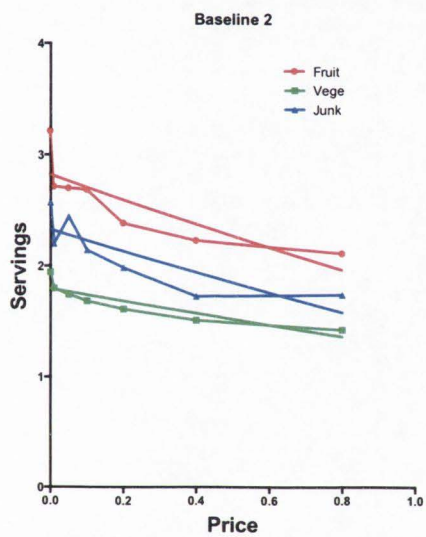
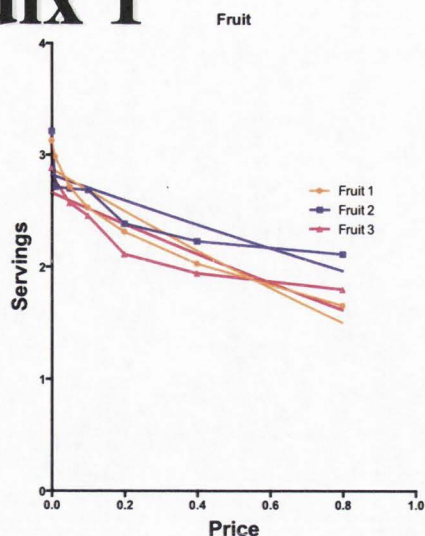
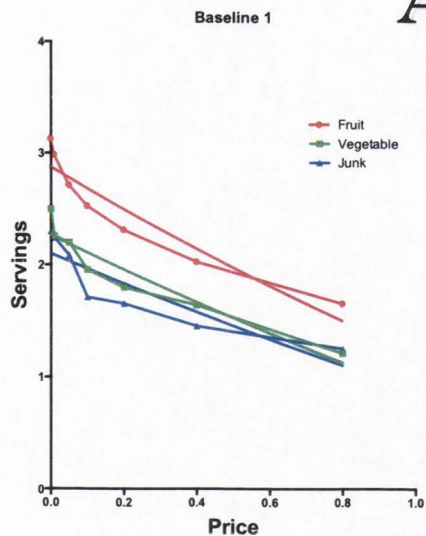
This study can be applied to many different groups, from parents packing school lunches to governmental officials looking to improve health in the public school system. As a pilot study it illustrates that demand curves have the potential to be an accurate measure of consumer behavior with further study.

Resources

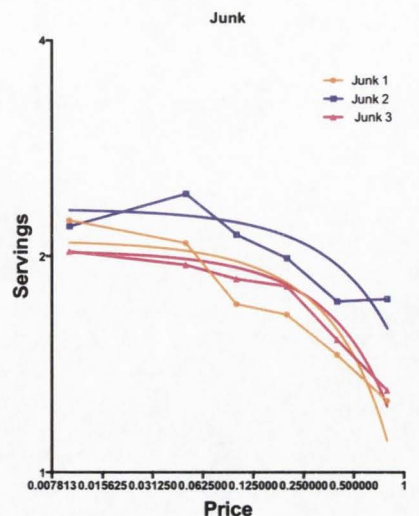
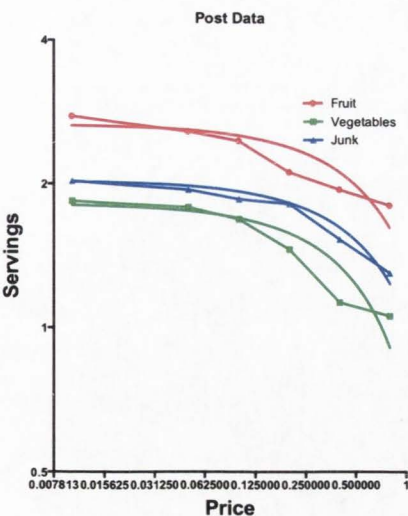
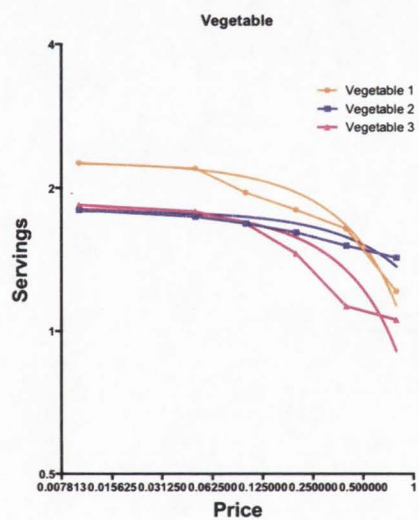
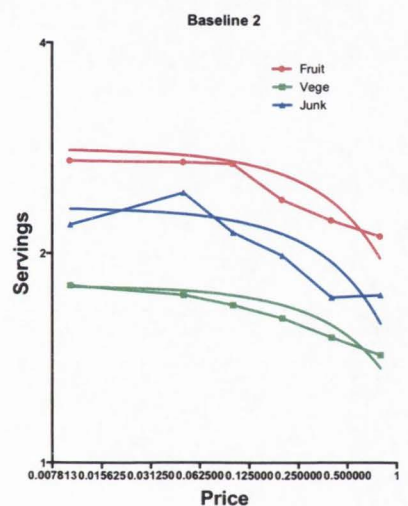
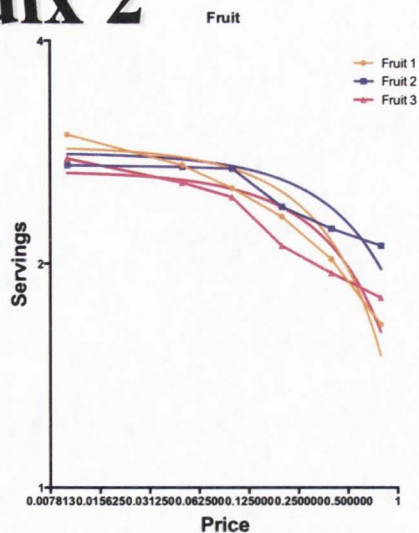
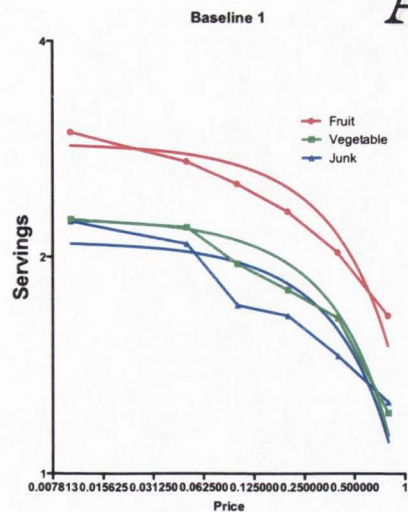
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Appendix 1



Appendix 2



McKelle Tobey was born and raised in Logan, Utah. She graduated from Mountain Crest High School in Hyrum, Utah as part of the class of 2010. She majored in Psychology with emphases in Interpersonal Relations and Behavior Analysis, with a minor in Political Science. While attending Utah State University, McKelle served on the executive council of Psi Chi, the international psychology honors society. She was also a member of the political science honors society, Pi Sigma Alpha. After graduating from Utah State University in May 2013, McKelle will attend graduate school at the University of Kansas to study educational psychology.