

**UNDERSTANDING THE EFFECT OF PRODUCT DISPLAYS ON  
CONSUMER CHOICE AND FOOD WASTE:  
A FIELD EXPERIMENT**

by

Devon P. Meadowcroft

A thesis submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Master of Science in Agricultural and Resource Economics

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## **ABSTRACT**

This study aims to discover the link between product displays, consumer choice, and food waste at the retail level. To discover this connection, field experiments were conducted. The experimental sessions occurred in the fall of 2015 in northern Delaware, and a total sample size of 119 adult participants was gathered. In the study, participants were free to choose one apple from three different product displays, while being filmed in order to observe their behaviors during the selection process. However, no product display was perfect in appearance. One product display (“single”) only had one apple in it that did not have any blemishes or marks. The second display (“blemished”) was organized in appearance and fully stocked, but had blemished apples along with apples with no imperfections. In the blemished display, the apples with imperfections were visible to participants, and were placed on top of the normal apples. The third display (“disorganized”) was fully stocked with only perfect looking apples, although it was disorganized.

Our results showed that the disorganized display was the most popular option, followed by the blemished display and then the single display. These findings indicate that participants are more likely to select an item from a fully filled product display over selecting the last item in a product display. Furthermore, participants rated the apple in the single display as having the lowest quality, even though it was free from any imperfections. When these ratings were analyzed through ordered logit regression models, it was found that participants who agreed on a survey that they would never buy the last item left on a product display were more likely to give the apples in the

disorganized and blemished display a better quality rating – an intuitive outcome. Conditional logit regression models were additionally used to examine what participant characteristics affected what display they chose from. Those participants who identified themselves to be the primary shoppers in their households were more likely to take an apple from the single display over taking an apple from the disorganized or blemished display. Participants who stated that they were against purchasing the last item left on a product display were more likely to select an apple from the disorganized or blemished display, over taking the solitary apple in the single display.

These results obtained from this study can assist in explaining the reasoning behind why retailers keep their product displays fully stocked, and why food waste occurs in the retail sector, particularly with fresh produce. Because the product supply is greater than the consumer demand, all of the items cannot be purchased in time before they become unsellable – and thus they are thrown out and contribute to overall food waste.

## **Chapter 1**

### **INTRODUCTION**

#### **1.1 Food Waste in the United States**

As defined by the United States Department of Agriculture (USDA), “food waste” occurs when edible food items are disposed of instead of being consumed (Buzby et al., 2014). Globally, one third of the food available for human consumption becomes wasted, thus totaling to roughly 1.3 billion tons per year (United Nations, 2011). Even though food waste is a worldwide issue, in North America and Europe food is thrown away at a higher per capita rate than any other region. The Food and Agriculture Organization of the United Nations (FAO) estimates that in Europe and North America, 95 to 115 kilograms (about 209 to 254 pounds) of food is wasted per person, per year (United Nations, 2011).

Food waste has a detrimental impact on both the United States’ economy, and environment. In 2010, it is estimated that \$161 billion was lost due to consumable foods going uneaten in the United States (Buzby et al., 2014). The estimated per capita value of food loss at the consumer level was \$371 (Buzby et al., 2014). Food waste will also have negative impact on the future United States economy. In 2014, 14% of households in the United States were food insecure, meaning that they had a limited access to quality food (Coleman-Jensen et al., 2015). Accompanied with the projection that the United States’ population will increase by about 2.1 million citizens per year until 2060 (Colby and Ortman, 2015), this means that there will be additional pressure on the U.S. to feed its population. Because reducing food waste by 15% would provide

enough food to feed more than 25 million Americans per year, a decrease in waste would supply more food to satisfy the growing population and food insecure homes (Gunders, 2012). With respect to the environment, food waste is a major contributor to the United States' landfills. In 2012, 34.69 million tons out of the 164 million tons of trash in landfills was food waste, making it the largest contributor to landfills (EPA, 2012). When food decomposes in landfills, it transforms into methane. Methane is a greenhouse gas that is 25 times more powerful than carbon dioxide in contributing to global warming (Gunders, 2012).

The issue of food waste has been gaining more attention in recent years in the United States. In 2013, the United States Department of Agriculture (USDA) and the Environmental Protection Agency (EPA), introduced the U.S. Food Waste Challenge. This initiative's aim is to bring together groups from all across the food supply chain to tackle the issue of food waste and take steps to reduce it (USDA, 2013). On September 16, 2015, Agriculture Secretary Tom Vilsack and the Deputy Administrator of the EPA, Stan Meiburg, announced the beginning of the first food waste reduction goal in the United States. The overall objective is a 50% reduction in food waste by the year 2030. Through this new goal, the federal government will be more proactive in combatting food waste, with hopes of creating a more food secure and environmentally sustainable United States (USDA, 2015).

## **1.2 Linking Product Displays, Consumer Choice, and Food Waste**

Food is lost at each stage in the supply chain, from production all the way to household consumption. The focal point of this study was to examine food waste at the retail step of the supply chain. Waste occurs at the retail stage when unsold foods are thrown away by retailing locations, due to a variety of reasons such as damaged

packaging, bruising, misshapen or blemished products, expired use-by and sell-by dates, and overstocked product displays (Buzby and Hyman, 2012; Gunders, 2012; Thyberg and Tonjes, 2016). Gunders (2012) states that retailers overstock their displays, because they presume consumers react more favorably to a fully filled display over a product display that is not entirely filled. However, this action by retailers has negative consequences. Thyberg and Tonjes (2016) note that this overstocking causes retailers to acquire more food products than is demanded by shoppers, and thus the surplus items have to be thrown away.

This study aimed to make the connection between product displays and food waste by proposing that the product displays are instrumental in contributing to waste in the retail sector. Through observing how consumers react and pick from differing setups of product displays, it was determined what structure appeals to shoppers the most, and the least. A main focus of this study was to observe how the quantity of products in a display affects consumer choice. By analyzing consumers' perceptions and choices as they pertain to displays with different quantity amounts, it helped to understand why the overstocking of product displays occurs and tested the assumption that retailers make that consumers only want to select an item from a fully stocked display. If consumers were more prone to pick from a display that was entirely filled with products, even if the quality of those products were compromised, this means that fully stocked displays were more attractive – and thus more food waste would eventually occur.

### **1.3 Objectives**

The objectives of this study were threefold. The first objective was to ascertain what presentation of items in a product display was the most preferred by consumers,

and what assembly was the least preferred. In this study, there were three display organizations that were being utilized. Each display contained apples, however, all three displays had apples shown in differing ways. The main aspect of the displays were that each had one “unfavorable” aspect in its presentation. One display was disorganized, one had blemished apples, and one only had a single apple in it. So, out of three seemingly negative display options – which will consumers choose from the most? Through achieving this objective, it specifies which of the three adverse characteristics was the most detrimental in causing a consumer not to pick from that particular display. In a survey given to participants during the experiment, they were allowed space to write out their opinions concerning the three displays, and why they did (or did not) chose an apple from that display. These explanations were helpful in completing this objective, because it showed more of the participants’ thought processes while making their selection and their perceptions of the apples in the three displays.

The second objective was to observe how consumers act when they make their purchasing decisions, through watching participants’ behaviors when they selected which apple they would like to take. Because this study was conducted through field experiments, it enabled for the opportunity to watch in person, in real time consumers make their apple choice. An important feature of this study is that the experiment sessions were filmed, by two camcorders placed at different angles inside the tent where the choices happened. These videos were made use of by timing how long it took the participants to make their final selection, to see if the amount of time they spent with the displays impacted their choice. The videos were also watched to notice specific actions of the participants. For example, if the participants picked up an apple

to look it over before making their choice or if they moved from display to display before settling on one to pick from. Like with time, these behaviors were analyzed to see if they played a part in influencing what displays the participants chose from.

The third, and final, objective was to determine how consumers perceive issues relating to their purchasing and consumption activities that impact food waste. This objective was accomplished by giving participants a survey at the completion of the experiment and the survey had five Agree/Disagree questions that pertain to food waste. With the help of this survey, it was established if the participants considered themselves to be food wasters in their homes and if they performed behaviors that lead to food waste. When all the survey answers were compiled it was seen if, on a whole, the participants in this study help to contribute to the problem of food waste.

#### **1.4 Organization of Thesis**

Directly after this introduction, Chapter 2 contains a literature review that will assesses previous studies concerning food waste, product displays, and the consequences of product scarcity on consumer choice. Then, Chapter 3 covers the experimental design with a description of the sample used in this study, along with the experimental procedure and an explanation of the surveys given to participants. Chapter 4 goes into the methodology, and begins with descriptive statistics and then progresses into the econometric models used for the data analysis. In Chapter 5, the results derived from the study will be discussed. Chapter 6 concludes the thesis with a summary of the main findings and the implications and limitations of this study.

## **Chapter 2**

### **LITERATURE REVIEW**

#### **2.1 Food Waste at the Retail Level**

In 2010, the United States lost 43 billion pounds of food at the retail step of the supply chain. The top three food products that were wasted were: dairy products (9.3 billion pounds), grain products (7.2 billion pounds), and vegetables (7.0 billion pounds) (Buzby et al., 2014). Thyberg and Tonjes (2016) argue that food is primarily wasted at the retail stage of the supply chain due to management choices relating to food presentation and how much food is kept in the inventory. Mena et al. (2011) broke down that theory even further by identifying three main causes of food waste in the retail sector. The first cause are industry trends, such as the recent surge in consumer demand for fresh products over products containing preservations. The next cause are the natural constraints that affect the freshness of food. The third cause are administrative issues, which can occur when those who do the product ordering order too much or too little and do not satisfy consumer demand. The size of the retailing location could also impact the amount of food that is thrown out. Researchers in the United Kingdom stated that smaller grocery stores produce more food waste than larger stores. This difference in food waste is due to smaller grocery stores not being able to properly predict consumer demand (Parfitt et al., 2010).

In order to prevent retailing locations from throwing out edible food items, a number of measures can be implemented. Employees can be better educated on how to store and handle their products, transportation can be improved so as to minimize the

amount of damage food products undergo, product packaging can be enhanced to minimize spoilage, and retail owners can better manage their stock by purchasing the correct amount of items to meet consumer demand (Thyberg and Tonjes, 2016). Furthermore, retailers can offer promotional sales on food items they would like to sell and provide their customers with recipe ideas that will incorporate any leftovers (Quested et al., 2013). Surplus food items or items that are unsellable (but still edible) can also be donated to charities or food banks for redistribution into food insecure households. Alexander and Smajie (2008) noted that this category of foods that are safe to eat, yet not able to be sold in stores, consists of products that are mislabeled, have damaged packaging, were promotional items that are now out-of-date, or became surplus items do to the retailer over-ordering the item. They also mentioned that fresh food items can fall into this category of food products when they are past their sell-by date, but are still safe to consume if their use-by date has not passed. In the United Kingdom, researchers tracked the food that was gifted to FareShare, a charity whose aim is to reduce food waste while providing food to those in need, and analyzed how successful the organization was in fulfilling its purpose. They found that 80% of the food given to FareShare was delivered to food insecure homes, and that the process was safe and well-organized (Alexander and Smaje, 2008).

However, these actions to reduce food waste at the retail level are not easily carried out. Retailers and suppliers would first have to work closely together in order to ensure that the proper amount of food, and the best quality of food, is being brought into the store at the right time for it to sell (Mena et al., 2011). Additionally, the cost to any food retailer looking to reduce their losses would be high. In order to reduce waste, retail management would have to either have to keep their inventories low and

restock their shelves more frequently, or invest in more resources, like more employees to monitor consumer demand, to combat food waste (Loke and Leung, 2015).

## **2.2 The Power of Product Displays**

Overall, product displays have been found to considerably impact a store. Cornelius et al. (2009) found that the simple presence of a storefront product display is an effective way to positively augment a store's image with customers. In their study, they sent out an online survey where they gave participants images of a store with different storefront displays, and then asked the participants to rate and review the stores. The displays were only found to have positive effects on a store, and even the participants who did not like storefront displays in general felt that an inventive storefront display made the store more modern – thus a positive spillover effect occurred. When Gabrielli and Cavazza (2014) placed items in end-of-aisle product display stands, they found that consumers perceived that item to be valuable and were more inclined to purchase that product. The power of product displays is not just limited to traditional brick and mortar stores. Product displays can also have an impact on internet sales. Researchers recorded a stimulus in sales when in-store displays were present for an online grocery store (Breugelmans and Campo, 2011).

The design and layout of product displays are also influential in effecting consumer choice and total sales. Valenzuela and Raghurir (2009) found that consumers believe that the product located in the center of the product display is the most popular item, and are more likely to select that item over items placed on the ends of a display. van Kleef et al. (2012) conducted a study where they changed the amount of healthy snacks and unhealthy snacks in a display present in a cafeteria in a

Dutch hospital and then observed what types of snacks customers purchased. The results were that if a product display had more healthy snacks in it, then the probability of a customer of selecting that snack improved significantly. In van Herpen et al. (2012), the researchers manipulated displays for fair trade food products. They observed that an increase in the amount of facings that a fair trade product receives in a display will increase that product's sales. When Morales (2005) presented participants in a laboratory experiment with organized, neat product displays, the participants' willingness to pay for the products in those displays increased. That study also observed that participants would be more willing to visit a store with orderly displays. Castro et al. (2013) obtained a similar result. When food products were placed in displays that were both disorganized, and had a limited quantity of products in it, the chance of a customer purchasing those products decreased.

### **2.3 Characterizing Why Consumers Waste**

Consumers additionally play a role in why food is wasted. Individuals who have certain demographic characteristics are prone to produce more waste than others. Through a mail survey in Switzerland, researchers found that females and those who are young in age will yield more food waste than males and those who are older (Visschers et al., 2015). Similarly, the presence of children in a household impacts the amount of waste. Parizeau et al. (2014) observed that homes containing children under 18 will generate more food waste in comparison to homes with no children. A person's income additionally affects the quantity of food they throw away. A 10% increase in per capita income was found to be correlated with a 7% increase in the amount of food they personally waste (Chalak et al., 2015).

How consumers shop for their food is also influential in their food waste generation. In Denmark, Stancu et al. (2016) surveyed 1062 Danish consumers on their attitudes about food waste, and how those views affect their purchasing behaviors. They discovered that planning out food shopping trips, and purchases, in advance is a highly significant characteristic of households who produce a minor amount of food waste. Stefan et al. (2012) found a comparable result when surveying Romanian consumers. Making shopping lists, checking the food already at home, and pre-planning meals were consumer behaviors that negatively effected the amount of food waste created.

Consumers who feel a moral obligation to decrease their food waste are also linked to behaviors that help to reduce overall food waste. While interviewing British consumers, Graham-Rowe et al. (2014) found that people actively tried to minimize their own food waste because they felt it was the ‘right’ thing to do. Those consumers who were concerned about the negative societal repercussions related to waste were strongly motivated to practice behaviors that would not end in food being thrown away. Evans (2012) too conducted interviews in the United Kingdom with consumers. Through those interviews, he learned that his respondents felt anxiety about being wasteful when throwing out food, and would therefore actively take precautions to reduce waste just to alleviate their stress.

#### **2.4 The Question of Quantity**

Since a focal point of this study is the issue of how quantity affects consumer choice, it is important to delve into the past literature concerning this subject. Commodity theory is the proposition that scarcity increases the value of an object that can be owned, and therefore it benefits the owner of that limited item (Brock, 1968).

There are two main reasons presented in the literature as to why scarcity occurs in a market. Either the object's quantity is deficient due to an increase in consumer demand, or a decrease in supply (Worchel et al., 1975; Verhallen and Robben, 1994). van Herpen et al. (2009) conducted a virtual store experiment, where their goal was to assess how consumers react to products that are scarce because other consumers had already purchased that product. They found that participants rated the quality of the product in limited supply to be higher than the product in abundance. It was also observed that participants, in general, chose the scarce product because they inferred from its limited supply that it was the "popular" choice, and thus – external demand increases personal demand.

Parker and Lehman (2011) built on the 2009 van Herpen et al. study by looking into how and why the perceived popularity of a scarce item affects consumer choice. Results showed that popularity assumptions played a more substantial role in guiding consumers to pick a scarce item, rather than inferences about the quality of the products offered. Furthermore, a recent van Herpen et al. (2014) study has explored the difference of how demand caused and supply caused scarcity impacts consumer decisions. When a product's shortage is due to an insufficient supply and consumers have a desire to be "unique", they prefer the scarce product to the product in excess. On the other hand, when a product's shortage is due to a large demand, those consumers who seek to be distinctive show no distaste to selecting the scarce product.

The literature has also studied how the classification of good in question is affected by commodity theory. Specifically, if there's a divergence between how conspicuous and non-conspicuous goods are viewed and chosen after changes in supply and demand. Conspicuous consumption was introduced by Thorstein Veblen in

1899, and conspicuous goods are items that are purchased to indicate an individual's affluence or social standing (Bagwell and Bernheim, 1996; Trigg, 2001). A conspicuous good benefits greatly from evidence that it is scarce because of a short supply, but does not profit as much when its scarcity is due to a growth in consumer demand. For non-conspicuous goods, however, the opposite is true. When the quantity of a non-conspicuous good is lessened as a result of a surge in consumer demand, it benefits considerably (Gierl and Huettl, 2010).

In order to determine if participants in this study chose, or did not choose, the apple in the single display due to their perceptions about the item's popularity, special attention was given to the comment section on the survey given to them after their selection has been made. If participants mentioned that the apple was more attractive to them due to inferences they made about it being a sought-after item, then it will further show that scarcity increases a product's value. Because the item used in this study was a non-conspicuous good (an apple), it was additionally theorized that if participants believed the items in the single bin were more attractive to other participants, that apple in the display would benefit by being chosen and given a higher quality rating.

## **2.5 Contribution to Literature**

Preceding studies have evaluated the topics surrounding food waste, product displays, how scarcity effects product evaluation, and overall consumer choice. However, there has not yet been a comprehensive study that brings together these areas and explores them through a field experiment. This study was noteworthy in that it proposed that the structure of product displays, particularly when they are fully filled with items, contribute to food waste, and then tested that idea. By looking into

how consumers perceive and pick from displays that are fully stocked and not fully stocked, this study again showed that quantity plays a role in choice decisions, Additionally, this study took it one step farther and asked participants to rate the quality of the displays with the different quantity amounts, and provided them with an area to write and express their thoughts about the displays – which captured detailed ideas and perceptions.

Knowing specifically how a decreased quantity of products in a product display effects consumer choice will be useful in understanding why retailers keep their displays completely filled with items. Then, steps can then be taken by those in the retail sector to change consumer behavior, and make shoppers more inclined to purchase an item from a product display that is not fully stocked. For example, retail owners could educate their shoppers about their store’s practices to reduce food waste and that a limited quantity does not imply a compromised quality.

Another distinct contribution to the literature that this study will make is that this study was based off an unique dataset that involves participant behaviors as explanatory variables. Because the participants were filmed throughout the duration of their choice making, it allowed for the videos to be observed and analyzed. The variables collected from the videos were utilized in the econometric models, to determine how they influenced quality ratings of the apples in the displays and how they played a role in the display the participant chose from.

## **Chapter 3**

### **EXPERIMENTAL DESIGN**

The foremost objective of this thesis was to analyze how consumers choose one apple from three product displays that are different in appearance. The second objective was to determine if participants' behaviors affected their decision of what item to take, through recording their selection processes with camcorders. The third and final objective was to see how consumers generally act when deciding what food they would like to buy, and their perceptions about food waste. This objective was achieved by asking participants survey questions related to their shopping and consumption practices that can impact food waste. Field experiments were used to achieve these objectives. Participants were invited to select an apple from three displays, and then were surveyed to find out the association between consumer behaviors and food waste.

#### **3.1 Pilot Study**

This study is an extension of a pilot field experiment which occurred in the spring of 2015. In the experiment, 41 students from the University of Delaware were recruited to pick a food product from one of two product displays. Students were randomly assigned to either select an apple or an individual sized bag of potato chips from a display that was organized or disorganized. The main findings from that study are displayed in Table 3.1. Results showed that overwhelmingly, the students selected food products from the neat display. Out of the 23 participants who were designated to

choose apples, 15 took an apple from the organized display and out of the 18 participants who were designated to choose potato chips, 15 took a bag of potato chips from the organized display. The mean quality ratings for the four product displays are also presented in Table 3.1. The quality ratings for the organized and disorganized display for the apples were found to be statistically different from one another. Additionally, the mean quality ratings for the organized and disorganized display for the chips were found to be statistically different from one another.

**Table 3.1: Results from Pilot Study**

Display Item	Display Type	Participant Choice	Mean Quality Rating
Apples	<i>Organized</i>	15	3.8261
	<i>Disorganized</i>	8	3.3478
Chips	<i>Organized</i>	15	4.2222
	<i>Disorganized</i>	3	2.5556

*\*Quality Ratings are on a 1-5 scale (Poor-Excellent)*

The preliminary results also found that for apples, the most significant variable when the participants made their selection was how they perceived the quality of the apples in the unorganized display. The more highly a participant thought about the quality of food in the disorganized display, the odds of them choosing from the organized display decreased. For the bags of potato chips, the most significant independent variable was the same as it was for the apples: the participant perception of the food products in the disorderly display.

This study built upon the results discovered in the pilot experiments, by having each display presented have one unfavorable aspect to it. Through the pilot study, it was determined that a majority of participants will take a food product from an organized display, rather than a disorganized display. So, it was important in this study to test that idea with three different display structures, and specify if display organization is still important, even if the products in those displays have an imperfect appearance or a low quantity.

### **3.2 Experimental Design Summary**

The field experiments for this study contained three procedural steps. The first step included the participants being invited to take part in the study, and then completing a consent form if they agreed to take part. Then, a survey was given to the participants where they completed basic demographic questions. The next step involved participants selecting one apple from three product displays that were shown to them, while being recorded by two camcorders set up near the displays. The participants were allowed to take the apple they chose with them, and could use it as they saw fit. Once the apple was selected, the third and final step comprised of filling out a survey with questions asking the participants to rate the apples in the three displays. The survey also requested they write out why they did or did not chose an apple from each display. The final section of the post-selection survey gave the participants five statements concerning food waste and food wasting behaviors, that they could either disagree or agree with. After the full completion of the field experiment, the subjects were given a \$2 compensation for their time and involvement. Sections 3.3 through 3.5 explain the experimental design in more detail.

### **3.3 Pre-Selection**

The first segment of the field experiment was where the participants completed a short survey asking them to provide demographic information, and this survey can be found in Appendix C. Statistics regarding the participants' age, gender, race, education, income, and if they were the primary food purchaser in their household were collected. Participants were also asked about how often they purchase fresh produce. This question is indicative of the participants' shopping habits, and if they are regularly encountering product displays that hold fresh produce. As soon as the pre-survey was completed, participants were invited to make their apple selection. Importantly, participants were unable to view the displays until they were finished with their survey.

### **3.4 Apple Selection**

Following the completion of the first survey, participants were asked to select one apple from three different product displays, which were located on a table directly behind where participants filled out the pre-selection survey, inside a tent. During the entirety of this part of the experiment, participants were recorded by two camcorders placed at different angles inside the tent. The participants were informed that they could take as much time as needed to make their choice, and were additionally told that they could pick up to touch and feel any apple in the three bins if they so desired. Once the participant made their final choice of apple, the bin they chose from was marked on their post-selection survey by a researcher, and they proceeded to the final stage of the experiment.

### **3.4.1 Display Descriptions**

All apples used in the field experiment sessions were Gala apples to keep the food products consistent throughout the study. Wooden bins (1 and a half feet wide by 3 feet long) were procured to be the product displays for the apples, and were set at an incline to resemble apple displays that consumers would regularly encounter at grocery stores. The displays were designated by colors: green, orange, and purple. Colored paper labeling the display was placed on the back of the bin, and was not visible to the participants while they made their selection. This action was done to avoid the participants picking an apple from a bin, simply because they liked the color attached to it. The displays were therefore marked so the researchers could easily note which display the subject chose from, and for identification purposes during subsequent data analysis. The bins were moved throughout the study and changed positions (for example: the green display was placed to be on the far left, the middle, and the far right at least once during the study) to stay away from any directional biases participants had.

The green display (hereafter referred to as the “single” display) only had one apple in it. This apple was free from any imperfections or marks, and was placed in the middle of the bin. The single display’s aim was to test the premise that scarcity affects participants’ choices. The orange display (the “blemished” display) was fully supplied with apples and was organized neatly. However, the blemished display contained blemished apples that were placed on top of apples free of any imperfections. Previously blemished apples were obtained directly from a grocery store. The blemished display was used to test the hypothesis that products with imperfections affect consumers’ decisions. And lastly, the purple display (the “disorganized” display) was fully filled with apples and all apples in the disorganized

display were flawless in appearance. Yet, the disorganized display was disorderly and not well-organized. Thus, the disorganized display was there to test the idea that organization (and disorganization) impacts choice.

Consumers shying away from picking food products with cosmetic imperfections and retailers constantly keeping their displays fully stocked with items has been identified to be a source of fresh produce loss and waste in developed countries (Buzby et al., 2015). Also, the disorganization of objects in a food product display has been shown to discourage consumers from selecting those products (Morales, 2005; Castro et al., 2013). Therefore, the treatments in this study were based off of those causes of food items to not be chosen, and later discarded. The varying treatments determined if scarcity, product imperfections, or disorganization is the largest deterrent to product selection and consumer choice.

### **3.4.2 The Videos**

The participants in the field experiment sessions were filmed by two camcorders while they made their apple choice. The participants were aware that they were being recorded, as it was specified in the consent form they signed before the experiment began and was also verbally told to participants. The two camcorders were placed at different angles inside the tent where the display bins were placed, one camcorder was facing the displays and the other camcorder was behind the displays. Videography was used in this study to observe the participants' routines while they made their selection. All of the videos were viewed and the total time it took the participants to pick their apple was recorded. Two additional behaviors were documented: if the participant picked up an apple to look it over before they made their choice and if the participant walked to look at multiple display bins before

settling on one to pick from. The principal purpose of the videos, and the observations gathered from the videos, was to establish if the participants' behaviors affected their choice of apple or the quality ratings they gave to the apples.

### **3.5 Post-Selection**

The final segment of the experiment was where the participants filled out another survey, which can be found in Appendix D. Participants completed this section of the study at a table directly behind the tent where the displays were placed. This survey contained two sections. The first section had the participants rate the quality of the apples in each of the three displays on a 5-point, "Poor" to "Excellent" scale. A photograph of the three displays was included on this part of the survey, for reference. Once the participants rated a display, they were requested to leave a remark about why they did or did not choose an apple from that display. The comment section was included to take a deeper look into the thought processes that the participants went through when they made their choices, and all comments that were made during the experimental sessions are listed in Appendix E.

The second section of the post-selection survey gave the participants five statements related to food waste and purchasing behaviors. The statements are displayed in Table 3.2. The participants selected their level of agreement with those statements, on a "Strongly Disagree" to "Strongly agree" scale. Statement 2 and 5 were used in the data analysis to see if the participant's stated behaviors affected their apple choice. All five statements were used to examine how participants perceive issues associated with food waste.

**Table 3.2: Agree/Disagree Statements on Post-Selection Survey**

Number	Statement
1	I waste too much fresh produce at home because my household can't eat in time before it goes bad
2	I would never buy the last product left on a display of a fresh produce item
3	Supermarkets are responsible for most food waste
4	I am an impulse buyer when it comes to purchasing food
5	I would buy fresh produce with blemishes or marks on them

### **3.6 Session Information**

Two field experiment sessions were held for this study, on October 15<sup>th</sup>, 2015 and on October 17<sup>th</sup>, 2015. A 119 participant sample was gathered from the two sessions, 68 from the first and 51 from the second. Every participant received \$2 as compensation for completing the experiment, and were allowed to take home the apple they picked from the displays. The session on October 15<sup>th</sup> occurred at the University of Delaware, outside the UD Creamery – an ice cream store frequented by both students and community members. The session on October 17<sup>th</sup> took place at Battery Park, a local park in the northern Delaware region with a diverse demographic makeup.

## **Chapter 4**

### **METHODOLOGY**

#### **4.1 Descriptive Statistics for Demographic Variables**

Table 4.1 shows the summary statistics and variable definitions for the demographic variables. Table 4.2 is a contingency table that breaks down those elements even further, and displays the frequency distributions for the variables which were categorical or binary. In the sample, 56.3% of participants were female, which is higher than the percentage of females that census data states is currently in New Castle county, Delaware (51.6%) (DEcensus, 2014). The average age of the subjects in the study was about 35 years old, with a standard deviation of 17.7 years. For race, the sample was 83.2% Caucasian. This percentage is considerably higher than the percentage of Caucasian residents in New Castle county, which is 67.1% (DEcensus, 2014). In terms of education, 70.6% of the sample had at most attended college for an undergraduate degree. Approximately 16% of the sample had attended graduate, or professional school for a higher degree.

The average household income of participants was about \$80,300 per year, with a standard deviation of \$62,300. The average household income of the sample is higher than the median yearly household income in New Castle county, which is \$64,857 (DEcensus, 2014). The last two demographic variables are Primary Shopper and Frequency. In the sample, 55.4% identified themselves as being the primary shopper in the household and 82.3% identified themselves as being frequent fresh produce purchasers.

**Table 4.1: Summary statistics and variable definitions**

Variable	Description	Mean	Standard deviation
<i>Demographics</i>			
Female	1 if participant is female, 0 otherwise	0.5630	0.4981
Age	Participant's age in years	34.9832	17.7363
Caucasian	1 if participant is Caucasian, 0 otherwise	0.8319	0.3755
College	1 if participant has only attended college for an undergraduate degree, 0 otherwise	0.7059	0.4576
Grad	1 if participant has attended graduate or professional school, 0 otherwise	0.1597	0.3678
Income	Midpoint of household income bracket selected (in thousands); 10, 27.5, 42.5, 62.5, 87.5, 125, 175, 250	80.2941	62.3083
Primary Shopper	1 if the participant is the primary food purchaser in their household, 0 otherwise	0.5546	0.4991
Frequency	Frequency of fresh produce purchases; 1: Frequent purchaser, 0: Non-frequent purchaser	0.8235	0.3828

**Table 4.1 continued**

Variable	Description	Mean	Standard deviation
<i>Video variables</i>			
Time	Time in seconds it took participants to make their final choice of apple	12.1950	11.9068
Pickup	1 if the participant picked up to look at an apple before making their selection, 0 otherwise	0.3277	0.4714
Move	1 if the participant moved to look at multiple bins before making their selection, 0 otherwise	0.4790	0.5017
<i>Purchasing habits</i>			
Last	1 if participants agreed that they would never buy the last item left on a display of a fresh produce item, 0 otherwise	0.4622	0.5007
Marked	1 if the participants agreed that they would never buy fresh produce with blemishes or marks on them, 0 otherwise	0.4790	0.5017

**Table 4.2: Contingency table for demographic variables**

Variable		Number of participants	Percentage of participants
Female	Male	52	43.70%
	Female	67	56.30%
Race	Caucasian	99	83.19%
	Non-Caucasian	20	16.81%
College	College	84	70.59%
	Non-College	35	29.41%
Grad	Grad	19	15.97%
	Non-Grad	100	84.03%
Income	10	21	17.65%
	27.5	15	12.61%
	42.5	9	7.56%
	62.5	20	16.81%
	87.5	16	13.45%
	125	24	20.17%
	175	8	6.72%
	250	6	5.04%
Primary Shopper	Primary	66	55.46%
	Non-Primary	53	44.54%
Frequency	Frequent	98	82.35%
	Non-Frequent	21	17.65%

## 4.2 Econometric Models and Hypotheses

Two econometric models were assembled to investigate the objectives of this study. First, ordered logit models were used to examine the quality ratings that participants gave the apples in the single, blemished, and disorganized displays. Conditional logit models were carried out to determine what participant variables affected their choice of apple. For both models, the survey questions provided the independent variables, along with the variables collected from the videos recorded from the experiment sessions. All of the explanatory variables used in the models are listed in Table 4.1.

### 4.2.1 Ordered Logit

In order to analyze the quality ratings that participants gave the apples in the three displays, an ordered logit model was used. The ordered logit model was first introduced in 1975, by McKelvey and Zavoina (1975). In the ordered logit model, the dependent variable is ordinal meaning that it is a categorical variable with ordered groups. However, the distances between the categories is not known (Agresti, 2007). For this study, the ordinal dependent variables are the quality ratings that participants gave the apples in the three displays. The quality rating categories were “Poor”, “Fair”, “Good”, “Very Good”, and “Excellent”, corresponding to values from 1 to 5.

With the ordered logit model, the dependent ordinal variable *QualityRating* is a function of *QualityRating\**. *QualityRating\** is a latent variable which is not measured. *QualityRating* is equal to an ordinal category ( $m$ ) if *QualityRating\** is greater than or equal to and less than the corresponding  $\tau$ 's. The  $\tau$ 's are referred to as “cutpoints” in the ordered logit model and reflect the predicted cumulative probabilities if all the explanatory variables are held at zero. Because there were quality ratings for each of

the displays, the subscript  $i$  represents the single, blemished, or disorganized display. Therefore, three models were carried out. Following Long (1997) this study defines  $QualityRating$  and  $QualityRating^*$  as follows:

$$(1) \quad QualityRating_i = m \text{ if } \tau_{m-1} \leq QualityRating_i^* < \tau_m \text{ for } m = 1 \text{ to } 5$$

$$(2) \quad QualityRating_i = \begin{cases} 1 \rightarrow \text{Poor if } \tau_0 = -\infty \leq QualityRating_i^* < \tau_1 \\ 2 \rightarrow \text{Fair if } \tau_1 \leq QualityRating_i^* < \tau_2 \\ 3 \rightarrow \text{Good if } \tau_2 \leq QualityRating_i^* < \tau_3 \\ 4 \rightarrow \text{Very good if } \tau_3 \leq QualityRating_i^* < \tau_4 \\ 5 \rightarrow \text{Excellent if } \tau_4 \leq QualityRating_i^* < \tau_5 = \infty \end{cases}$$

Including the explanatory variables, the final form of the ordered logit model was:

$$(3) \quad QualityRating_i^* = \beta_0 + \beta_1 Female + \beta_2 Age + \beta_3 Caucasian + \beta_4 College + \beta_5 Grad + \beta_6 Income + \beta_7 PrimaryShopper + \beta_8 Frequency + \beta_9 Time + \beta_{10} Pickup + \beta_{11} Move + \beta_{12} Last + \beta_{13} Marked + \varepsilon_i$$

In this model, the error term ( $\varepsilon_i$ ) has a logistic distribution, with a mean of 0. Its cumulative distribution function is:

$$(4) \quad F(\varepsilon) = \frac{\exp(e)}{1 + \exp(e)}$$

Once the ordered logit models were estimated, the predicted probabilities were determined. The goal was to specify the probability that  $QualityRating_i$  would equal each of the different ordinal categories, “Poor” through “Excellent”, which correspond

to values 1 to 5 and are represented as  $m$  in the equation. The predicted probabilities were calculated given the mean values of the independent variables (the  $x$ 's) and their estimated  $\beta$  coefficients, along with the corresponding cut-points (the  $\tau$ 's) . Again, adhering to Long (1997), the predicted probabilities for the three quality ratings were estimated as follows:

$$(5) \quad \frac{1}{119} \sum_{i=1}^{119} \widehat{Pr} (QualityRating_i = m | x) = F(\hat{\tau}_m - x\hat{\beta}) - F(\hat{\tau}_{m-1} - x\hat{\beta})$$

It was hypothesized that participants would give a higher quality rating to the apples that came from the bin they selected from. Therefore, the apples in the bin that was chosen from the most in the field experiments were anticipated to be given the highest quality ratings in comparison to the apples in the two other bins. The apples from the disorganized display were expected to have the top quality ratings, followed by the single and blemished displays. This reasoning is based off the idea that participants would chose from the disorganized bin the most, due to the display having a high quantity of apples to select from. Additionally, the disorganized bin did not contain any apples with imperfections. The single display apple was expected to have the second highest quality ratings, because it was free from any imperfections. Lastly, the apples in the blemished display were expected to have the lowest quality ratings. Even though those apples were high in quantity, a portion of them did have a comprised quality since some had blemishes or marks.

For the demographic variables, the relationship between quality ratings and gender and race was uncertain. It was unknown if female or male participants and if Caucasian or non-Caucasian participants would give higher quality ratings to the

apples in the displays. Age, College, and Grad were expected to be positively related to the quality ratings for the disorganized and single displays, and negatively related to the ratings for the blemished display. Participants who are older and more educated were generally thought to be more perceptive of the items they purchase, therefore it was believed that they would distinguish the differences in the apples' conditions. The relation between Income and quality ratings was anticipated to be positive, because participants with lower incomes do not have a lot of funds to spend on food, therefore they would be more selective and critical about the quality of the items they purchase. Like with Age, College, and Grad – Primary Shopper and Frequency were expected to be positively linked to the quality ratings for the disorganized and single displays, and negatively linked to the ratings for the blemished display. Those participants who were the primary shoppers in their households, and frequent fresh produce purchasers, come in contact with grocery stores and product displays more often and therefore are thought to be more perceptive .

The video variables Time, Pickup, and Move were also expected to be positively related to the quality ratings for the disorganized and single displays, but negatively related to the quality ratings for the blemished display. It was assumed that if a subject spent a longer period of time making their choice, and also used that time to touch the apples and examine multiple displays, they would become more cognizant of the differences in the apples' qualities. For purchasing habits, if a participant agreed that they would never buy the last item left on a display of a fresh produce item, then it was hypothesized that they would give lower quality rating to the apple in the single display, and higher ratings to the apples in the disorganized and blemished display. If a participant agreed that they would never buy fresh produce with a blemish or mark

on it, then it was hypothesized that they would give the apples in the blemished display low quality ratings, and then give the apples in the disorganized and single display high quality ratings.

#### 4.2.2 Conditional Logit

The second econometric model conducted was a conditional logit, which was used to specify how the participants' three quality ratings for the apples impacted their choice. The conditional logit model is an extension of McFadden's choice model (McFadden, 1974) and can also be extended to include participant attributes (Alvarez and Nagler, 1998; Hoffman and Duncan, 1988; Long, 1997). The model used in this study incorporated the explanatory variables listed in Table 4.1, to determine how demographic characteristics, the video variables, and purchasing habits impacted the participants' selection. A conditional logit model is derived by first explaining the utility model of the individuals making the choice. Based off of Alvarez and Nagler (1998), the utility function for the subjects in the study is:

$$(6) \quad U_{ij} = \beta X_{ij} + \Psi_j a_i + e_{ij}$$

In this utility function, the subscript  $i$  refers to the individual participants, with the subscript  $j$  referring to the alternatives. In this case, there are three alternatives (the three product displays) and 119 different individuals.  $X_{ij}$  is a vector representing the three quality ratings that individual  $i$  gave the apples in the three displays.  $a_i$  is also a vector of individual  $i$ 's characteristics (demographic traits, video variables, and purchasing habits).  $e_{ij}$  is the error term, and the conditional logit model assumes that it is independent among the alternatives. Therefore, the utility that participants gained

from each of the three displays was a function of the quality ratings they gave the apples, and their own personal characteristics. Following the previous literature (Alvarez and Nagler, 1998; Hoffman and Duncan, 1988; Long, 1997), the equation showing the probability that individual  $i$  would select each alternative is as follows:

$$(7) \quad P_{ij} = \frac{e^{\beta X_{ij} + \Psi_j a_i}}{\sum_{k=1}^J e^{\beta X_{ik} + \Psi_k a_i}}$$

The probability equation outlines the odds that individual  $i$  will select alternative  $j$  over another alternative (denoted by the subscript  $k$ ). This equation is equal to the utility they receive from  $j$  over the utility they are given from alternative  $k$ . Alternative  $k$  is referred to as the base alternative, to which alternative  $j$  is compared too. In this study, there were three sets of conditional logit models performed. Each model had a different base alternative, to which the other two displays were compared with.

With respect to the hypotheses made concerning the conditional logit models, it was uncertain how a portion of the included demographic variables would impact the probability of a participant selecting an apple from a particular display over the other two displays. It was unclear how gender, age, race, and education levels would effect the chance of a display being chosen from. For the variables Primary Shopper and Frequency, it was theorized that subjects who were the primary shoppers in their household and frequent fresh purchasers would have an increased odds of selecting an apple from a blemished or disorganized display, over the apple in the single display. This logic is from the thought that those participants who regularly shop for food

would want to take an apple from a bin with a larger variety of choices, rather on settling for the singular apple in the single bin.

The video variables were hypothesized to have influence on the choice probabilities. If a participant spent more time making their decision, picked up an apple to look it over, or moved to numerous displays – it was hypothesized that they would have an increased odds of selecting an apple from the blemished or single display over the disorganized display. If a participant took a longer period of time, and went over their options more carefully, it was theorized that they would be more likely to take from the blemished or single display, and not just automatically go to the disorganized display because it was fully stocked with apples with no imperfections. Lastly, for purchasing habits, if a participant stated that they would never select the last item on a fresh produce display, it was expected that there would be an increased odds of them taking an apple from a disorganized or blemished display over the single display. And if a participant agreed that they would never buy fresh produce with blemishes or marks on it, then it was hypothesized that they would pick an apple from the disorganized or single displays, rather than picking an apple from the blemished display.

## Chapter 5

### RESULTS AND DISCUSSION

This chapter contains the results gathered from this study. First, the number of participants that selected each display is shown. In addition, the mean quality ratings that they gave the apples in each display is presented. Next are a portion of the participants' explanations from the qualitative portion of the post-selection survey, where they were asked to justify why they did or did not choose an apple from each of the three displays. Then, the results from the ordered logit regressions are displayed, along with the predicted probabilities that show the chance the displays would receive a "Poor" through "Excellent" rating. Following the ordered logit regressions are the results from the conditional logit regression models. Lastly, this chapter concludes with the survey findings from the five Agree/Disagree questions on the post-selection survey. All data was analyzed using the statistical software program, STATA (StataCorp, 2011).

#### 5.1 Display Choice

**Table 5.1: Participants' Display Choice**

Display	Number of Participants	Percentage of Participants	Mean Quality Rating	Standard Error of Rating
Disorganized	69	57.98%	3.6555	0.7859
Blemished	42	35.29%	3.0252	1.0850
Single	8	6.72%	2.7143	1.2429

Table 5.1 displays how many participants chose an apple for each of the three displays, and the mean quality ratings for those displays. For the 119 participants in the study, about 58% of them selected an apple from the disorganized product display. This agreed with the hypothesis that this display would be chosen from the most, considering it was fully filled with items without any blemishes or marks. The next most popular display was the blemished display, with about 35% of the sample choosing an apple from that bin. Lastly, the single display was chosen from the least with only about 7% of the sample choosing from that bin.

The mean quality ratings for the displays are also found in Table 5.1. All three quality ratings were found to be statistically different from one another at the 5% level or lower. The quality ratings additionally corresponded with the popularity of the displays. Meaning, the disorganized display had the highest quality ratings, followed by the blemished display and then the single display. These results did not correspond with the hypothesis that the apple in the single display would have a higher quality rating than the apples in the blemished display. This reasoning was based on the apple in the single display being free from any imperfections, while a portion of the apples in the blemished display had blemishes or marks. Therefore, participants valued the apples in the blemished display as having a higher quality, even though a share of the apples in that bin did have an impaired appearance.

## **5.2 Qualitative Results from Post-Selection Survey**

The statements made by participants in this study on the section of the post-selection survey, where they were able to write about why they did or did not choose an apple for each display, provided a deeper understanding of their selection process. The disorganized bin's wide selection of apples appeared to be why it was chosen

from the most, with participant 54 stating that the bin had a “good selection” and participant 67 writing “these apples looked the nicest, there was a big variety and the quality was high”. Yet, one participant had an issue with the disorganized display’s apples because of how they were arranged in the display. Participant 28 stated that the apples in the bin “look like good apples but they aren’t neatly placed in the bin”, which shows that a tidy and orderly appearance of items in a display is an important factor to some participants.

Participants were also acutely aware of the blemished and marked apples in the blemished display, which was shown through their comments. Their recognition of the flaws on these apples seemed to be a driving factor for why they chose an apple from another display. Participant 17 wrote “a good amount of the apples looked bruised”, participant 35 commented “some more visible ones looked bruised and marked up”, and participant 52 stated “many looked bruised”. Participants 17, 35, and 52 selected an apple from the disorganized display.

The subjects’ overall distaste for the apple in the single display was additionally echoed in the comments section on the post-selection survey. Some participants noted that they wanted to take from a bin that provided them with many options to select from. Participant 19 wrote “I didn’t choose that one because I had more options in the other boxes”, while participant 49 stated “I like having options when choosing a product”. Other participants made quality inferences about the apple in the single display. Participants 83 asked “What’s wrong with that one apple? (hole, worm, etc.) and participant 38 asserted that “If there is only one apple left in the basket, there is probably something wrong with it / a reason why it is the last one left”. Participants also referred to the actions of previous participants to justify why they did

not take an apple from the single display, with participant 94 writing that the apple was “not chosen by prior shopper” and participant 26 stating that they “didn’t want the one no one wanted”. The comments of participants 83, 38, 94, and 26 demonstrate that a segment of participants believed that the apple in the single display was by itself due to other participants selecting from that bin, however, that idea did not increase their perceived value of that apple and instead had the opposite effect.

### **5.3 Ordered Logit Results**

Following are the regression results and subsequent discussions for the three ordered logit models that were conducted for this study. The first model analyzes the quality ratings for the single display, the next model is for the quality ratings for the blemished display, and the last model is for the quality ratings for the disorganized display. As previously mentioned in Chapter 4, the explanatory variables (presented in Table 4.1) are from the surveys given to participants, and the videos recorded. All of the coefficients for the independent variables were converted into odds ratios for easier interpretation.

All three ordered logit regression models were tested to determine if they met the requirements for the proportional odds assumption, the assumption that the relationship amongst each pair of ordinal categories is the same. It was found that the ordered logit models with the single and blemished display’s quality ratings as the dependent variable fit the assumption, but the model with the quality ratings for the disorganized display as the dependent variable did not. However this study proceeded with the ordered logit regression models for data analysis due to the assertion made in Agresti (2007) that changing the ordered logit model to another form (for example, a

base-line category logit model) to pass the proportional odds assumption could yield inaccurate and misleading findings.

### 5.3.1 Ordered Logit Regression Results: Single Display

**Table 5.2: Effect of participants' variables on quality rating of single display, Ordered logit model**

Variables	Odds Ratios	P-values
<i>Demographic variables</i>		
Female	1.0105	0.976
Age	1.0128	0.213
Caucasian	0.3807*	0.076
College	1.3932	0.476
Grad	1.0204	0.972
Income	1.0009	0.758
Primary Shopper	0.5589	0.180
Frequency	1.5418	0.375
<i>Video variables</i>		
Time	0.9958	0.854
Pickup	0.6593	0.380
Move	0.9712	0.948
<i>Purchasing habits</i>		
Last	0.4475**	0.037
Marked	0.8248	0.611

\* significant at the 10% level

\*\* significant at the 5% level

The ordered logit model results containing the quality ratings for the single display can be found in Table 5.2. The two statistically significant explanatory variables were the demographic variable Caucasian, and the purchasing habit variable Last. Caucasian was significant at the 10% level, and Last was significant at the 5% level. For Caucasian subjects, they were about 2.63 (1/0.3807) times less likely to give the apple in the single display a higher quality rating. For subjects who agreed that they would never pick the last item left on a display of a fresh produce item, they were about 2.23 (1/0.4475) times less likely to give a higher quality rating. That finding is supportive of the hypothesis made and it shows that participants who are opposed to choosing the last item on a display would be less likely to give a favorable quality rating to the solitary apple in the single display.

### **5.3.2 Ordered Logit Regression Results: Blemished Display**

Table 5.3 displays the outcome for the ordered logit model with the quality ratings for the blemished display as the dependent variable. Two explanatory variables were found to be statistically significant: Time and Last. Time was significant at the 5% level, and its odds ratio was less than 1, which can be interpreted to mean that as participants spent more time looking over the displays, they were about 1.05 (1/0.9541) times less likely to give a good quality rating to the apples in the blemished display. This finding is supportive of the hypothesis made about the relationship between Time and the blemished display's quality rating. A description of this relationship can be explained by theorizing that if the subjects were around the apples more, perhaps they noticed the apples in this display had imperfections.

**Table 5.3: Effect of participants' variables on quality rating of blemished display, Ordered logit model**

Variables	Odds Ratios	P-values
<i>Demographic variables</i>		
Female	0.683	0.283
Age	1.0146	0.142
Caucasian	1.4523	0.427
College	1.5214	0.452
Grad	0.8091	0.757
Income	0.9983	0.622
Primary Shopper	1.0013	0.998
Frequency	1.0420	0.941
<i>Video variables</i>		
Time	0.9541**	0.009
Pickup	1.7453	0.257
Move	0.7046	0.458
<i>Purchasing habits</i>		
Last	2.7054**	0.013
Marked	0.5336	0.114
* significant at the 10% level		
** significant at the 5% level		

On the contrary, Last had an odds ratio greater than 1, which can be understood to mean that participants who said they would never take the last item left on a display were about 2.71 times more likely to give the apples in the blemished display a better quality rating. This finding is additionally supportive of the hypothesis formulated for the correlation between the variable Last and the quality ratings for the

apples in the blemished display. Because the blemished bin was fully filled with apples, participants who had an aversion to picking the last item left would be expected to give higher quality ratings to the displays with many apples to choose from.

An interesting note to make for this model is that the purchasing habit variable Marked was not found to be statistically significant, yet was close to being significant at the 10% level with a p-value of 0.114. The odds ratio for Marked was less than 1, so participants who stated they would never buy fresh produce with marks on it were about 1.87 ( $1/0.5336$ ) times less likely to give a higher quality rating to the apples in the blemished display, which is an instinctive result. A theory for why this variable was not found to be statistically significant could be due to the imperfect apples in this display not being considered blemished enough by participants to warrant a lower quality rating. Another assumption is that participants were able to distinguish that this blemished display held both perfect looking and imperfect looking apples, and participants rated the quality of the apples in the display by balancing their thoughts between the faultless and flawed items.

### **5.3.3 Ordered Logit Regression Results: Disorganized Display**

Table 5.4 shows the concluding ordered logit model for this study, with the quality ratings for the disorganized display as the dependent variable. Similar to the regression results for the ordered logit model for the single display, the variables Caucasian and Last were the only two variables to be found statistically significant, at the 5% level. The odds ratio for the variable Caucasian was 3.9732. This odds ratio can be understood to say that Caucasian participants were about 4 times more likely to

give the apples in the disorganized product display a higher quality rating in comparison to non-Caucasian participants.

**Table 5.4: Effect of participants' variables on quality rating of disorganized display, Ordered logit model**

Variables	Odds Ratios	P-values
<i>Demographic variables</i>		
Female	1.4099	0.399
Age	1.0181	0.183
Caucasian	3.9732**	0.009
College	1.9147	0.190
Grad	1.5723	0.520
Income	0.9991	0.779
Primary Shopper	1.3052	0.576
Frequency	2.1756	0.186
<i>Video variables</i>		
Time	1.0110	0.612
Pickup	1.2221	0.689
Move	1.3646	0.508
<i>Purchasing habits</i>		
Last	2.7033**	0.014
Marked	1.7166	0.156

\* significant at the 10% level

\*\* significant at the 5% level

The odds ratio for the variable last was 2.7033. Last's odds ratio means that participants who claimed they would never select the last product last on a display of a fresh produce item were about 2.70 times more likely to give a better quality rating to

the apples in the disorganized display. This discovery for the disorganized display is supportive of the hypothesis that those participants who are opposed to taking the last product left would give higher quality ratings to the disorganized display, since it was fully supplied with apples throughout the experiment sessions.

#### 5.4 The Quality Ratings' Predicted Probabilities

Table 5.5 lays out what the predicted probability was for each quality rating (Poor through Excellent) for each of the three displays. For the single display, the probability of the apple in that bin receiving a good quality rating was the highest (0.3433) and the probability of that apple receiving an excellent quality rating was the lowest (0.0640). The same results were found for the apples in the blemished display, they were most likely to receive a good rating (0.3581) and least likely to receive an excellent rating (0.0506). For the disorganized display, the apples were most likely to be given a very good rating (0.6043) and least likely to be given a poor rating (0.0049). None of the displays were most likely to be given an excellent quality rating, probably due to each display having an unfavorable aspect to it<sup>1</sup>.

**Table 5.5: Predicted probabilities of quality ratings for displays with independent variables at their means**

Rating	Single	Blemished	Disorganized
Poor	0.2186	0.0681	0.0049
Fair	0.1808	0.2342	0.0563
Good	0.3433	0.3581	0.2628
Very Good	0.1932	0.2891	0.6043
Excellent	0.0640	0.0506	0.0717

<sup>1</sup> As suggested by the pilot study, likely only an unmarked, organized product display could achieve excellent ratings

These results are consistent with the popularity of the displays, and the mean quality ratings that were shown in Table 5.1. Even though the predicted probabilities for the single and blemished display were both highest for the good rating, and lowest for the excellent rating - the blemished display was still more likely to receive a better rating. The blemished display's probability for acquiring a very good rating was 0.2891 and was 0.0506 for an excellent rating, for a combined total of 0.3397. However, the single display's probability of getting a very good rating was 0.1932 and 0.0640 for an excellent rating, which equals 0.2572 when summed together. Thus, there was a greater chance of the blemished display gathering a very good or excellent rating, in comparison to the single display. Furthermore, the single display had a predicted probability of 0.2186 for receiving a poor rating, which was greatly higher than the predicted probability of the blemished and disorganized displays receiving a poor rating (0.0681 and 0.0049 respectively). The predicted probabilities again reveal that participants in this study were reluctant to give the apple in the single display a favorable quality assessment.

## **5.5 Conditional Logit Results**

The next section in this chapter presents the findings for the conditional logit models. The first table (Table 5.6) shows the outcome when the single display is designated as the base alternative, the second table (Table 5.7) is for when the blemished display was the base alternative, and the final table (Table 5.8) has the disorganized display being the base alternative. For each different base alternative, two regression models were performed. The first model consists of all of the demographic variables plus Time as explanatory variables (as seen in Table 4.1). The second model includes all of the variables collected as independent variables. Like

with the ordered logit models, all of the variables' coefficients were converted into odds ratios for a more straightforward explanation.

### **5.5.1 Conditional Logit Regression Results, Base: Single Display**

The first part of Table 5.6 displays the odds ratios of the independent variables for the blemished display when compared to the single display. In the first model, the demographic variables Caucasian, College, and Primary Shopper are all statistically significant. Caucasian participants were found to be about 10 times more likely to select an apple from the blemished display over the single display. Participants who only attended college for a Bachelor's degree were found to be about 7.69 (1/0.1301) times less likely to pick an apple from the blemished display over the single display. For participants who were the primary shoppers of their households, they were about 8.87 times (1/0.1127) less likely to take an item from the blemished display over the single display. This finding about primary shoppers was not supportive of the hypothesis that stated that those subjects who make a majority of the grocery purchases in their household would want to take an apple from a bin that was fully stocked, even if some of those items had imperfections, since they would like to have a variety of options to select from.

**Table 5.6: Effect of participant's variables on choice of display, Conditional logit model (Base: Single Display)**

Display	Variables	Odds Ratio	P-value	Odds Ratio	P-value
		[1]		[2]	
Single	Quality	1.9940***	0.001	1.9843**	0.003
Blemished					
	<i>Demographic variables</i>				
	Female	0.1947	0.142	0.0714*	0.067
	Age	1.0144	0.718	0.9950	0.900
	Caucasian	10.2374**	0.026	60.4261**	0.002
	College	0.1301*	0.076	0.0493	0.103
	Grad	0.6465	0.735	1.5723	0.817
	Income	0.9938	0.428	0.9951	0.600
	Primary Shopper	0.1127**	0.049	0.0672**	0.011
	Frequency	1.8021	0.606	1.1587	0.913
	<i>Video variables</i>				
	Time	0.9643	0.152	0.9598	0.377
	Pickup			2.9222	0.439
	Move			0.1665	0.141
	<i>Purchasing habits</i>				
	Last			17.7452**	0.018
	Marked			3.0821	0.350
	Intercept	80.0400**	0.011	337.9971**	0.008

\* significant at the 10% level

\*\* significant at the 5% level

\*\*\* significant at the 1% level

**Table 5.6 continued**

Display	Variables	Odds Ratio	P-value	Odds Ratio	P-value
		[1]		[2]	
Disorganized					
<i>Demographic variables</i>					
	Female	0.1109**	0.033	0.0384**	0.018
	Age	1.0042	0.912	0.9829	0.660
	Caucasian	6.4548*	0.070	43.7576**	0.004
	College	0.4663	0.483	0.1492	0.295
	Grad	1.9850	0.580	3.8898	0.488
	Income	0.9949	0.516	0.9966	0.722
	Primary Shopper	0.2109	0.158	0.1331*	0.056
	Frequency	1.2702	0.843	0.8114	0.888
<i>Video variables</i>					
	Time	0.9253**	0.002	0.9298	0.110
	Pickup			1.8106	0.672
	Move			0.1558	0.111
<i>Purchasing habits</i>					
	Last			36.0597**	0.002
	Marked			1.9346	0.574
	Intercept	130.9372**	0.005	586.5295**	0.005

\* significant at the 10% level

\*\* significant at the 5% level

\*\*\* significant at the 1% level

For the second model, the demographic variables Female and Caucasian were significant. Female participants were about 14 (1/0.0714) times less likely and Caucasian participants were about 60.43 times more likely to select an apple from the

blemished display in comparison to the apple in the single display. The variable Primary Shopper was also found to be statistically significant in the second model. Its odds ratio was less than one, meaning that primary shoppers were about 14.88 (1/0.0672) times less likely to take an apple from the blemished display, which again contradicts the hypothesis made. An explanation of this finding is that maybe those participants who are regular food purchasers were more conscious of the marks on some of the apples in the blemished display, and would of rather taken the apple without any blemishes that was in the single display. The variable Last was also significant in this second model, and participants who were reluctant to take the last item left on a display were about 17.75 times more likely to take an apple from the blemished display over the green display, which is supportive of the hypothesis and makes logical sense.

The second part of Table 5.6 presents the odds ratios for the disorganized display's explanatory variables as they relate to the single display. With the first model, the demographic variables Female and Caucasian were statistically significant. Female subjects were about 9.01 (1/0.1109) times less likely and Caucasian participants were about 6.45 times more likely to choose an apple from the disorganized bin over the solitary apple in the single display. Time was furthermore found to be statistically significant at the 5% level, and as participants spent one more second of time making their selection, they were about 1.08 (1/0.9253) times less likely to take an apple from the disorganized display over the apple in the single display. This result is supportive of the hypothesis formulated that as participants took more time going over the options in the three displays, they would be more inclined to

take an item from the blemished or single display and not instinctively take from the disorganized display.

In the second model, the same four variables for the disorganized display were found to be statistically significant as in the second model for the blemished display: Female, Caucasian, Primary Shopper, and Last. Females were about 26.04 (1/0.0384) times less likely and Caucasians were about 43.76 times more likely to take an apple from the disorganized display when compared to taking an apple from the single display. Primary shoppers were about 7.51 (1/0.1331) times less likely to take an apple from the disorganized display over the apple in the single display, which is additionally not supportive of the hypothesis made concerning the relationship between primary shoppers and choice. The final variable to be found significant was Last and if participants agreed that they would never take the last product on a display, they were about 36.06 times more likely to take an apple from the disorganized display over the one apple in the single display which is another reasonable finding that is supportive of the hypothesis.

### **5.5.2 Conditional Logit Regression Results, Base: Blemished Display**

Table 5.7 shows the conditional logit regression results for when the blemished display was the base alternative. The first section reveals the odds ratios for the single display's independent variables. In both models, the results are the opposite of what was discovered in Table 5.6, when the blemished product display was compared with the single display as the base alternative. In the first model, the demographic variables Caucasian, College, and Primary Shopper were the only three variables to be found statistically significant. Caucasian subjects were about 10.24 (1/0.0977) times less likely and subjects who had only attended an Undergraduate institution were about

7.68 times more likely to choose an apple from the single display over an apple from the blemished display. Primary shoppers were about 8.87 times more likely to take an apple from the single display, which once more contradicts the hypothesis that the main purchaser in a household would be more likely to take an item from a display with a variety of options.

For the second model that compares the single display to the blemished display and included all the explanatory variables, the demographic variables Female, Caucasian, and Primary Shopper were found to be significant. Female participants were about 14 times more likely, whereas Caucasian participants were about 60.61 (1/0.0165) times less likely to select an apple from the single display over selecting an apple from the blemished display. Primary shoppers were about 14.88 times more likely and those participants who agreed that they would never take the last item left on a product display were about 17.73 (1/0.0564) times less likely to take an apple from the single display over taking an apple from the blemished display. These findings for Female, Caucasian, Primary Shopper, and Last were the direct opposite of what was found in the second model when the blemished display was being compared to the single display as the base alternative.

**Table 5.7: Effect of participant's variables on choice of display, Conditional logit model (Base: Blemished Display)**

Display	Variables	Odds Ratios	P-value	Odds Ratios	P-value
		[1]		[2]	
	Quality	1.9940***	0.001	1.9843**	0.003
Blemished			(base alternative)		
Single					
	<i>Demographic variables</i>				
	Female	5.1374	0.142	14.0010*	0.067
	Age	0.9859	0.718	1.0050	0.900
	Caucasian	0.0977**	0.026	0.0165**	0.002
	College	7.6840*	0.076	20.2651	0.103
	Grad	1.5468	0.735	0.6360	0.817
	Income	1.0063	0.428	1.0049	0.600
	Primary				
	Shopper	8.8739**	0.049	14.8786**	0.011
	Frequency	0.5549	0.606	0.8631	0.913
	<i>Video variables</i>				
	Time	1.0370	0.152	1.0418	0.377
	Pickup			0.3422	0.439
	Move			6.0060	0.141
	<i>Purchasing habits</i>				
	Last			0.0564**	0.018
	Marked			0.3245	0.350
	Intercept	0.0125**	0.011	0.0030**	0.008

\* significant at the 10% level  
 \*\* significant at the 5% level  
 \*\*\* significant at the 1% level

**Table 5.7 continued**

Display	Variables	Odds Ratios	P-values	Odds Ratios	P-value
		[1]		[2]	
Disorganized					
	<i>Demographic variables</i>				
	Female	0.5699	0.231	0.5377	0.182
	Age	0.9900	0.491	0.9879	0.409
	Caucasian	0.6305	0.497	0.7241	0.640
	College	3.5828*	0.059	3.0238	0.104
	Grad	3.0703	0.146	2.4740	0.284
	Income	1.0012	0.737	1.0016	0.646
	Primary Shopper	1.8712	0.289	1.9801	0.255
	Frequency	0.7049	0.567	0.7003	0.597
	<i>Video variables</i>				
	Time	0.9595**	0.040	0.9687	0.248
	Pickup			0.6196	0.375
	Move			0.9357	0.913
	<i>Purchasing habits</i>				
	Last			2.0321	0.156
	Marked			0.6277	0.352
	Intercept	1.6359	0.647	1.7353	0.661

\* significant at the 10% level

\*\* significant at the 5% level

\*\*\* significant at the 1% level

In the second part of Table 5.7, the variables' odds ratios for the disorganized display are shown when that display was compared to the blemished display. The first

model was the only model out of the two performed that produced any significant explanatory variables. Subjects who had at most attended college for an undergraduate degree were about 3.58 times more likely to choose an apple from the disorganized display over choosing an apple from the blemished display. Time was the other variable to be found statistically significant. As subjects spent one more second of time making their final selection, they were about 1.04 (1/0.9595) times less likely to take an apple from the disorganized display over the blemished display, which is in favor of the hypothesis made in regards to the relationship between time and display choice.

### **5.5.3 Conditional Logit Regression Results, Base: Disorganized Display**

Table 5.8 displays the conditional logit regressions where the disorganized display was the base alternative. The first segment of this table is when the single display was being compared to the disorganized display. All of the significant variables' odds ratios were the reverse of what was found in the models when the disorganized display was compared to the single display as the base alternative (seen in Table 5.6). The variables that were significant in the first model were Female, Caucasian, and Time. Females were about 9.01 times more likely and Caucasian participants were about 6.46 (1/0.1549) times less likely to choose the apple from the single display over choosing an apple from the disorganized display. And as time increased by one unit, participants were 1.08 times more likely to take the apple from the single display over taking an apple from the disorganized display.

In the second model, Female, Caucasian, Primary Shopper, and Last were all statistically significant. Females were about 26.05 times more likely and Caucasians were about 43.69 (1/0.0229) times less likely to choose the apple from the single

display over an apple from the disorganized display. Primary shoppers were about 7.51 times more likely to take the apple from the single display. Finally, those subjects who would never take the last item remaining on a product display were about 36.1 (1/0.0277) times less likely to choose the apple from the single display over selecting an apple from the disorganized display.

The second part of Table 5.8 shows the variables for the blemished display when compared to the disorganized display. These variables and odds ratios are the inverse of the results displayed in Table 5.7 when the disorganized product display was matched with the blemished product display as the base alternative. The first model in the second portion of Table 5.8 is the sole model with any significant explanatory variables. Those participants who only attended college for an undergraduate degree were about 3.58 (1/0.2791) times less likely to pick an apple from the blemished display over selecting an apple from the disorganized display. An increase in the amount of time spent with the product displays increased the likelihood of a participant choosing an apple from the blemished display over the disorganized display. As Time increased by one second, participants were about 1.04 times more likely to pick an apple from the blemished display.

**Table 5.8: Effect of participant's variables on choice of display, Conditional logit model (Base: Disorganized Display)**

Display	Variables	Odds Ratios	P-value	Odds Ratios	P-value
		[1]		[2]	
	Quality	1.9940***	0.001	1.9843**	0.003
Disorganized					
Single					
	<i>Demographic variables</i>				
	Female	9.0153**	0.033	26.0534**	0.018
	Age	0.9958	0.912	1.0174	0.660
	Caucasian	0.1549*	0.070	0.0229**	0.004
	College	2.1447	0.483	6.7018	0.295
	Grad	0.5038	0.580	0.2571	0.488
	Income	1.0051	0.516	1.0034	0.722
	Primary				
	Shopper	4.7422	0.158	7.5140*	0.056
	Frequency	0.7873	0.843	1.2324	0.888
	<i>Video variables</i>				
	Time	1.0807**	0.002	1.0755	0.110
	Pickup			0.5523	0.672
	Move			6.4188	0.111
	<i>Purchasing habits</i>				
	Last			0.0277**	0.002
	Marked			0.5169	0.574
	Intercept	0.0076**	0.005	0.0017**	0.005

\* significant at the 10% level

\*\* significant at the 5% level

\*\*\* significant at the 1% level

**Table 5.8 continued**

Display	Variables	Odds Ratios	P-value	Odds Ratio	P-value
		[1]		[2]	
Blemished					
<i>Demographic variables</i>					
	Female	1.7548	0.231	1.8596	0.182
	Age	1.0101	0.491	1.0123	0.409
	Caucasian	1.586	0.497	1.3809	0.640
	College	0.2791*	0.059	0.3307	0.104
	Grad	0.3257	0.146	0.4042	0.284
	Income	0.9988	0.737	0.9984	0.646
	Primary				
	Shopper	0.5344	0.289	0.5050	0.255
	Frequency	1.4187	0.567	1.4280	0.597
<i>Video variables</i>					
	Time	1.0422**	0.040	1.0323	0.248
	Pickup			1.6139	0.375
	Move			1.0687	0.913
<i>Purchasing habits</i>					
	Last			0.4921	0.156
	Marked			1.5931	0.352
	Intercept	0.6113	0.647	0.5763	0.661

\* significant at the 10% level

\*\* significant at the 5% level

\*\*\* significant at the 1% level

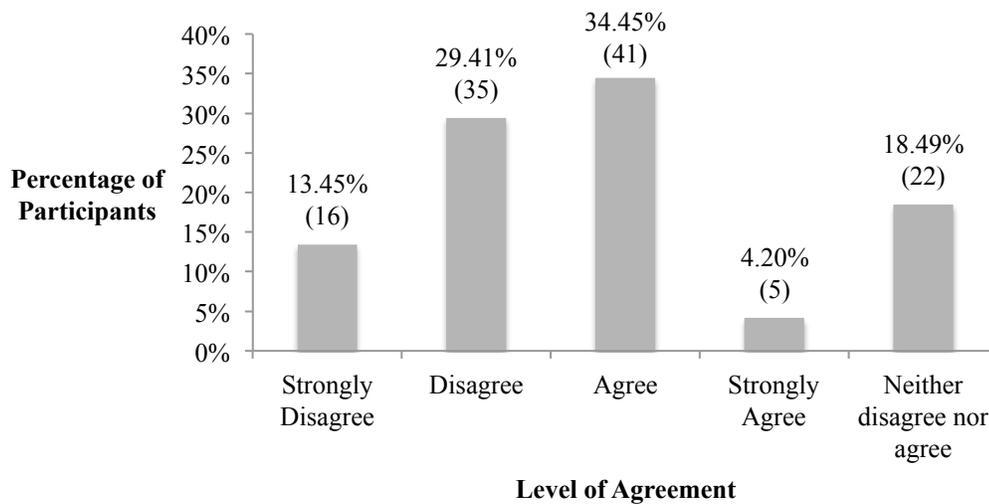
## 5.6 Post-Selection Survey Findings

Figures 5.1 through 5.5 reveal the findings for the post-selection survey given to participants at the end of the study. This part of the survey asked participants five Agree/Disagree questions about food waste. For the first statement (seen in Figure 5.1), “I waste too much fresh produce at home because my household can’t eat it in time before it goes bad”, 51 participants either disagreed or strongly disagreed with that statement, 46 either agreed or strongly agreed, and 22 neither disagreed or agreed. There was a fairly even split between participants who agreed and disagreed with that declaration. The second statement (Figure 5.2) concerning buying the last product left on a display of a fresh produce item had a majority of participants (55 in total) either agreeing or strongly agreeing with that assertion. This result furthermore shows that the participants who were involved with this study were not keen on taking the last item left on a product display.

The third statement (Figure 5.3) “Supermarkets are responsible for most food waste” provided a noteworthy finding. Most participants surveyed did not disagree nor agree with that statement, which conveys that subjects were unsure if that statement was factual or not, or did not have an opinion regarding the matter. The fourth statement (Figure 5.4) also gave an interesting result, with 50 of the participants either strongly disagreeing or disagreeing that they are impulse buyers and 51 of the participants either strongly agreeing or agreeing that they are impulse buyers. This result means that participants who consider themselves to be impulse purchasers when it comes to buying food is about equal to the participants who do not consider themselves to be impulse purchasers in this sample, which could of impacted the time it took participants to make their apple selection. The final statement (Figure 5.5) on the post-selection survey, “I would buy fresh produce with blemishes or marks on

them”, had participants predominantly strongly disagreeing or disagreeing with that statement with 57 participants in total. Thus, most participants were against buying a produce item with an imperfection which shows that a comprised quality is it a meaningful deterrent to purchasing intentions.

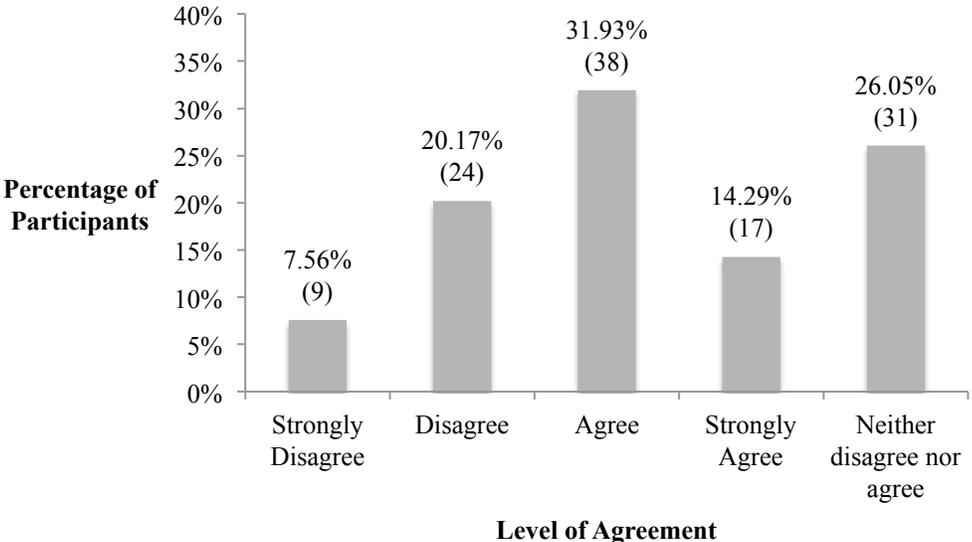
**Figure 5.1: Participants’ level of agreement with statement “I waste too much fresh produce at home because my household can’t eat it in time before it goes bad”<sup>2</sup>**



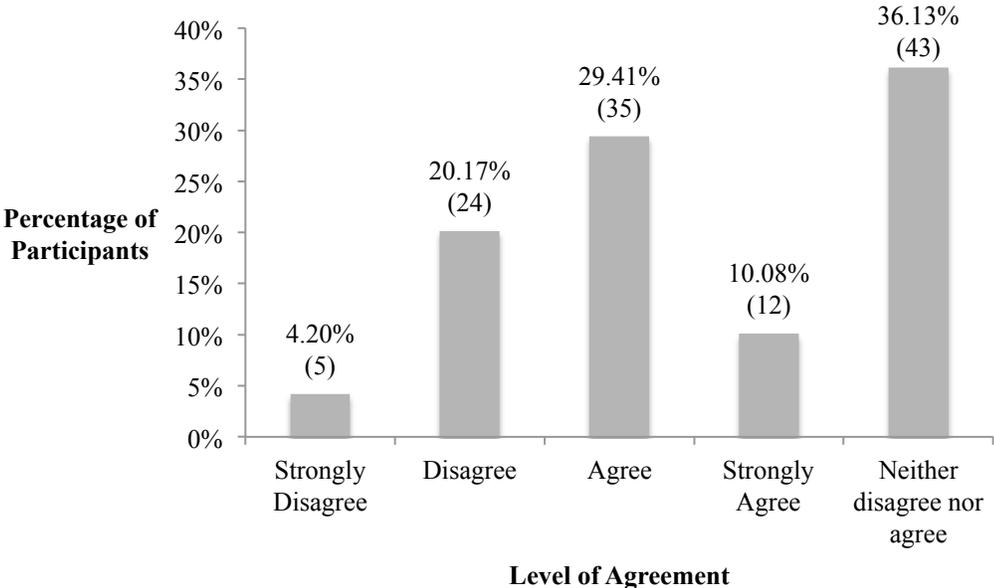
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<sup>2</sup> For Figures 5.1 through 5.5, the numbers in parenthesis underneath the percentages are the numbers of participants who selected each level

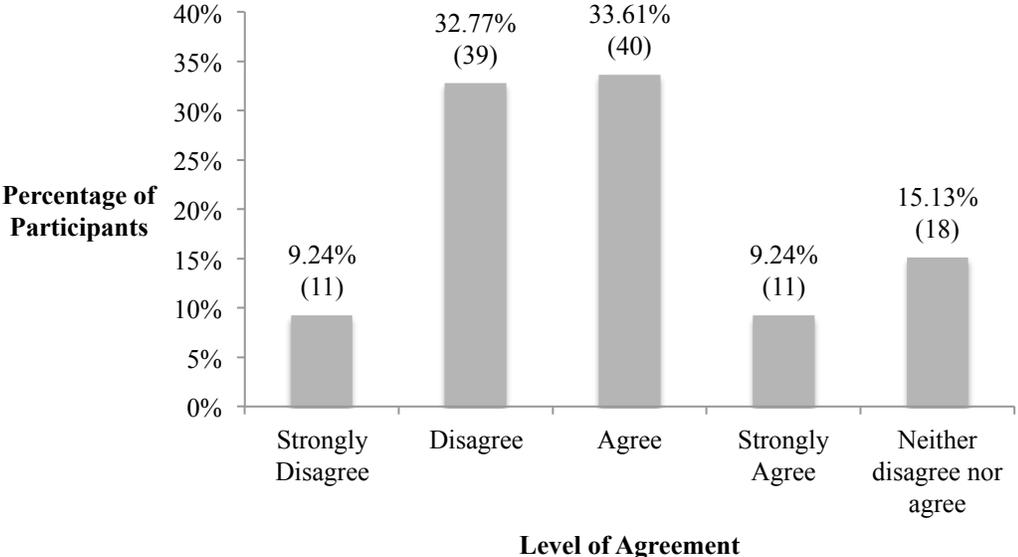
**Figure 5.2: Participants' level of agreement with statement "I would never buy the last product left on a display of a fresh produce item"**



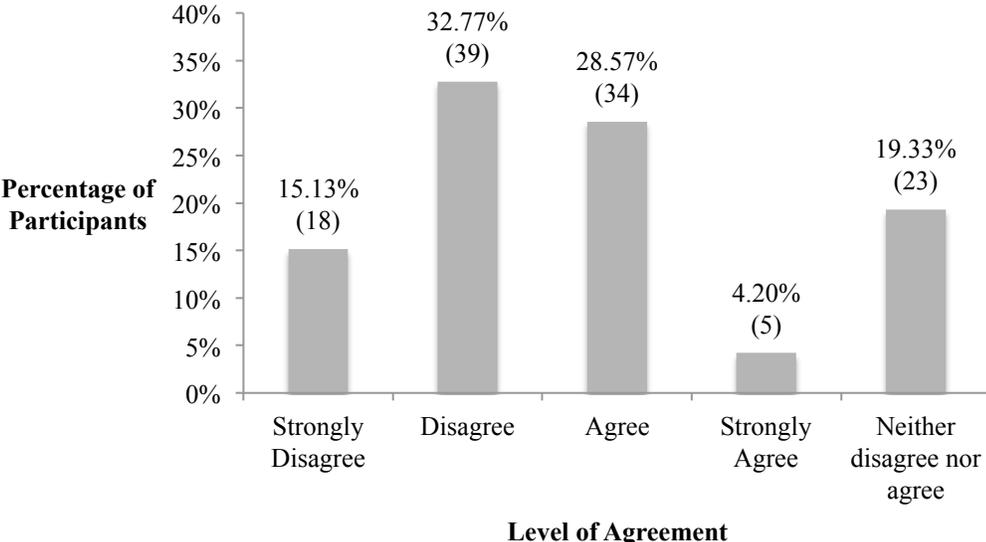
**Figure 5.3: Participants' level of agreement with statement "Supermarkets are responsible for most food waste"**



**Figure 5.4: Participants' level of agreement with statement "I am an impulse buyer when it comes to purchasing food"**



**Figure 5.5: Participants' level of agreement with statement "I would buy fresh produce with blemishes or marks on them"**



## **Chapter 6**

### **CONCLUSION**

The issue of food loss in the United States has been gaining more attention in recent years, with government officials vowing to take measures to reduce waste to increase food security. With projections that the country's population will be increasing steadily in the future, it is of critical importance to think about how food that would normally go into a landfill could instead go into people's homes. Previous studies have looked into measuring food waste, and examining the root causes of waste. However, how consumers behave in a retail setting and how those actions impact waste has not yet been fully examined. One of the sources of food waste at the retail step of the supply chain are product displays being kept fully stocked throughout the day, which leads to supply exceeding demand and food being thrown out because all of the items cannot be sold. The goal of this study was to observe how consumers would choose a product from three different displays and then survey them about their choice in order to discern how their actions and beliefs drive food waste.

This study utilized field experiments that occurred in October of 2015 in Delaware. Two sessions were held, one at the University of Delaware and the other at a local park in the northern Delaware area. Participants were invited to select one apple from three different product displays, and a total of 119 subjects were involved in the study. Each display had a different configuration of apples in it, one bin had only one apple in it (noted as the "single" display), another was fully stocked but had blemished apples along with apples with no imperfections ("blemished" display), and

the third display was fully stocked with all ideal looking apples but was disorganized (“disorganized” display). Participants were filmed by two camcorders as they made their selection, for the purposes of looking at how the total amount of time they spent making their choice and how their actions influenced their decision.

Results showed that over half of the sample (69 participants) took an apple from the disorganized display, 42 participants took from the blemished display, and only 9 participants took from the single display. Participants additionally rated the apples in the disorganized display as having highest quality and rated the apple in the single display as having the lowest quality. When these quality ratings were looked at through ordered logit regressions, the variable Last was the only explanatory variable to be statistically significant in all three models. The 55 participants who agreed on a survey question that they would never buy the last product left on a display of a fresh produce item were more likely to give the apples in the blemished and disorganized display a higher quality rating, and were less likely to give the apple in the single display a higher quality rating.

The conditional logit regression models furthermore provided notable findings. These models used explanatory variables gathered from the surveys given to participants and the videos recorded to determine what factors impacted the product display participants chose from. The independent variable Time was found to be statistically significant in the regression model where it was grouped with only the demographic variables. Participants who spent more time making their selection were less likely to take an apple from the disorganized display over taking the apple in the single or blemished display. The participants who were the primary shoppers in their households were more likely to take the apple from the single display over taking an

apple from the disorganized or blemished display. The explanatory variable Last was also found to be statistically significant in the conditional logit regressions. The participants who agreed that they would never buy the last product left on a display were less likely to choose an apple from the single display over choosing an apple from the blemished or disorganized display.

By linking this study to the greater issue of food waste in the United States, it can be established that in general, consumers are hesitant about taking a product from a display when that item is low in stock. This consumer unwillingness about selecting from a product display that only holds one item can give a reason behind why retailers keep their displays fully stocked with items, and thus why food waste occurs in the retail sector. In order to resolve this problem, retailers can take a number of measures. Product displays can be decreased in size, so that keeping the displays wholly stocked will require less items and thus, less waste. Or, retailers can educate their consumers about their store's food waste reduction practices, and explain to them that a low stocked display does not imply that those items have an unsatisfactory quality.

This study does have some limitations. The sample was collected from only two locations in the same geographic location, which has the potential to skew results. Another limitation is that a portion of the sample were University students. Most students rely on dining halls or restaurants for their food, and might not be familiar with buying their own food products. Also, students oftentimes do not have their own income, which could make them more careless about the food items they purchase. A further expansion of this study could include performing more field experiment sessions, to gain a larger sample of adult participants. Likewise, the study could be

performed in geographic locations outside the northern Delaware area to diversify the sample.

An additional expansion of this study could include labeling the product displays. Some of the displays could contain labels signifying the apples inside are organic or local, to observe how those labels effect participant choices. If the apple in the single display was labeled to signify it was organic, would that make it more appealing to consumers? Through observing the interactions between food labels and product displays, it could be determined if the label or the arrangement of items in the display has a larger influence on consumer choice.

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## Appendix A

### FIELD EXPERIMENT SCRIPT

Hi, I'm \_\_\_\_\_ and this is \_\_\_\_\_ and we are from the University of Delaware.

We are conducting an economic study looking at consumer preferences for apples in different product. At the end of the study, you will be able to take home 1 apple and earn 2 dollars. Participating includes filling out two short surveys and choosing 1 apple from 3 different product displays. When you choose the apple, you will be filmed by 2 camcorders so we can use that information for later research. These videos will not be shared with anyone outside the research team. Overall, it should not take more than 5 minutes of your time and all of your information will be kept anonymous and confidential. Are you willing to help us with our study?

#### **If No:**

Have a nice day.

#### **If Yes: Hand them the consent form**

Please read over and sign the consent form for this study. It carefully explains what the study consists of and what the information gathered today will be used for.

#### **Collect consent forms. Give participant pre-survey.**

Please fill out this pre-survey.

**Researcher at first table (researcher 1) collects finished pre-survey. Researcher 1 gives pre-survey to researcher inside the tent (researcher 2). Researcher 2 inside the tent shows camera the ID number of the participant. Researcher 1 leads participant to the tent where the product displays are.**

Please choose 1 apple from the 3 displays. Take as long as you need and you are free to touch any of the apples in the display..

**Researcher 2 records participant's choice on post-survey. Researcher 2 leads participant out of the tent and hands post-survey and pre-survey to the**

**researcher at the third table (researcher 3), outside the tent. Researcher 3 gives post-survey to participant.**

Please fill out this short survey on the three product displays you just saw and on your food purchasing habits.

**Collect survey when completed. Researcher 3 should staple pre and post surveys together.**

Thank you. For your participation, you will receive 2 dollars. Please fill out a receipt verifying you received the money.

**Researcher gives the participant the cash and the receipt to fill out. The receipt is collected when completed.**

Thank you and have a nice rest of your day!

## Appendix B

### INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL



RESEARCH OFFICE

210 Halliher Hall  
University of Delaware  
Newark, Delaware 19716-1551  
PA: 302/831-2136  
Fax: 302/831-2828

DATE: October 2, 2015

TO: Devon Meadowcroft  
FROM: University of Delaware IRB

STUDY TITLE: [B10878-1] "Understanding the Effect of Product Displays on Consumer Choice and Food Waste: A Field Experiment"

SUBMISSION TYPE: New Project

ACTION: APPROVED

APPROVAL DATE: October 2, 2015

EXPIRATION DATE: October 1, 2016

REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # (6,7)

Thank you for your submission of New Project materials for this research study. The University of Delaware IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.

If you have any questions, please contact Nicole Farnese-McFarlane at (302) 831-1119 or nicolefm@udel.edu. Please include your study title and reference number in all correspondence with this office.

## Appendix C

### PRE-SELECTION SURVEY

#### *Consumer Choice Survey*

*Please complete the following survey.  
Your answers will remain anonymous*

**1. What is your gender?**

Male       Female

**2. How old are you?**

\_\_\_\_\_

**3. What is your race or nationality?**

White       Black, African American  
 Asian       Hispanic or Latino  
 Other

**4. What is the highest level of education you have completed?**

<input type="checkbox"/> Less than high school graduate	<input type="checkbox"/> Associate's degree
<input type="checkbox"/> High school graduate	<input type="checkbox"/> Bachelor's degree
<input type="checkbox"/> Some college, no degree	<input type="checkbox"/> Graduate or professional degree

**5. Which of the following categories best describes your total household income annually?**

- |                                               |                                                 |
|-----------------------------------------------|-------------------------------------------------|
| <input type="checkbox"/> Less than \$20,000   | <input type="checkbox"/> \$75,000 to \$99,999   |
| <input type="checkbox"/> \$20,000 to \$34,999 | <input type="checkbox"/> \$100,000 to \$149,999 |
| <input type="checkbox"/> \$50,000 to \$74,999 | <input type="checkbox"/> \$150,000 to \$199,999 |

**6. Are you the primary food purchaser in your household?**

- Yes       No

**7. How often do you purchase fresh produce?**

- |                                 |                                  |
|---------------------------------|----------------------------------|
| <input type="checkbox"/> Daily  | <input type="checkbox"/> Monthly |
| <input type="checkbox"/> Weekly | <input type="checkbox"/> Never   |

*\*After completing Question 7, please see the researcher*

## Appendix D

### POST-SELECTION SURVEY

#### *Consumer Choice Survey*

*Please complete the following questions. Your answers will remain anonymous.*



In your opinion, how would you rate the quality of the apples in the green display?

Poor  Fair  Good  Very good  Excellent

Please leave a comment about why you did or did not choose an apple from the green display



In your opinion, how would you rate the quality of the apples in the orange display?

Poor  Fair  Good  Very good  Excellent

Please leave a comment about why you did or did not choose an apple from the orange display



In your opinion, how would you rate the quality of the apples in the purple display?

Poor  Fair  Good  Very good  Excellent

Please leave a comment about why you did or did not choose an apple from the purple display

Select your level of agreement with the following statements  
about your food purchasing habits

1. I waste too much fresh produce at home because my household can't eat it in time before it goes bad

Strongly disagree    Disagree    Neither disagree nor agree    Agree    Strongly agree

2. I would never buy the last product left on a display of a fresh produce item

Strongly disagree    Disagree    Neither disagree nor agree    Agree    Strongly agree

3. Supermarkets are responsible for most food waste

Strongly disagree    Disagree    Neither disagree nor agree    Agree    Strongly agree

4. I am an impulse buyer when it comes to purchasing food

Strongly disagree    Disagree    Neither disagree nor agree    Agree    Strongly agree

5. I would buy fresh produce with blemishes or marks on them

Strongly disagree    Disagree    Neither disagree nor agree    Agree    Strongly agree

*Thank you for your participation!*

## Appendix E

### COMMENTS FROM POST-SELECTION SURVEY

Subject Number	Single Display Comments
1	It was not the color I prefer
2	Seeing only one apple left made me assume that the highest quality apples of that type had already been selected
3	Only one apple - looked weird
4	There was only one in it
5	Apple looked a little bruised
6	Not many apples in bin
8	Assumed all the best apples were already selected
9	There was only one left, I didn't want to take the last one
13	Looks like left alone...
14	I don't like that kind of apple!
15	Not full
16	Less appealing because it's by itself
18	It was the last one
19	I didn't choose that one because I had more options in the other boxes. It was a good apple, just a little small
20	I'm very indecisive, so I chose the one where I had the least options. Plus, it didn't have bruising or evidence of insects.
21	Only one there
22	I didn't notice there were apples in this box!
23	This display was farthest from me
24	Not appealing because of lack of order
25	Didn't take it because it was the last one
26	Didn't want the one no one wanted
27	There was only one left and it didn't look appetizing

- 28 If they are almost all gone they must have been good apples but I couldn't find the one I wanted because of the low selection
- 29 It was the last one!
- 30 There were none
- 31 None left
- 32 Empty
- 33 There were none left
- 34 None there
- 35 Smaller sized
- 36 Quality looks good, quantity is not. Did not choose because nothing is there
- 37 I chose an apple from this display because the apples looked the best
- 38 If there is only one apple left in the basket, there is probably something wrong with it / a reason why it is the last one
- 39 Can't really tell what kind of apple
- 40 There was only one left and it didn't look appetizing
- 41 There was only one to choose from
- 42 Confused as to why there was only 1 apple
- 43 There were very minimal apples
- 44 Didn't grab my attention
- 46 Because there is only one
- 47 I thought it was empty
- 48 I did not choose this because it was the only apple in the box
- 49 I like having options when choosing a product
- 50 There was only one
- 51 Because I did not see it
- 52 Didn't see apple at first, didn't catch my eye
- 53 Nice and round and cute
- 54 Few in box - no choice
- 55 I chose an apple from the green display because there is only one apple in the green display and I don't need to pick
- 56 I didn't want to take the last one
- 58 Didn't see it
- 60 This is popular
- 61 Only apple

- 62 I chose an apple from this display because it was clean and unbruised
- 63 I chose this apple because it looked good and it was lonely
- 64 There weren't any other apples in the display with it
- 65 It was rolling solo
- 66 Didn't notice single apple in display
- 67 Only one, small apple was left
- 68 Low quantity of apples, did not look cared for
- 69 Just liked because only one and looked good
- 70 Did not choose because only one choice
- 73 The way feel
- 74 No apples
- 75 Did not see any green apples
- 77 Only 1 left
- 83 Too empty. What's wrong with that one apple? (Hole, worm, etc.)
- 84 Looking at an empty basket. No choice to pick.
- 85 Because there were none
- 86 Display was empty
- 87 No selection
- 89 I can't see the apple well enough
- 91 Only 1 present
- 92 Only one was there. No option to choose others.
- 93 Picked first ones I saw
- 94 Last one - not chosen by prior shopper
- 97 Looks organic - did not see the apple
- 98 No apples
- 99 Only 1 was in box
- 100 I didn't even look in green box!
- 102 I did not notice it - only one in green box
- 105 Is only 1 apple, I think maybe it is not good
- 106 Apples in green were a bit large
- 110 Not many so assume the bin has been out for a while
- 112 None in green but 1
- 113 Seemed like it was picked over already
- 115 Only one
- 116 Didn't notice apple in display - if any?

Subject Number	Blemished Display Comments
1	No real reason - just that one in the next tray caught my eye
2	Color - I prefer lighter colored apples
3	Not the type of apples I like
4	Most of them seemed to be rotting, so I chose from the bottom
5	Felt apples until I found a firm one
6	There are plenty
8	Bigger apples on top and some sort of insect damage
9	Some were a little dingy not as shiny. But I picked what I thought was the best one
13	The quality not seems evenly displayed...
14	A bit crowded, mixed types. I like Macintosh, so that's why I picked from here
15	Some apples are discolored
17	A good amount of the apples looked bruised, split, or rotting
18	Low quality
19	Definitely some bad apples, but some good ones as well
20	I preferred the apples in the green display, but there was nothing wrong with these apples
21	Looked less appetizing
22	I'm not a fan of the big shiny apples, the little ones looked tasty
23	This display was filled with more red delicious which is what I like
24	Wide variety of apples visually
25	These were my 2nd choice
26	Apples too red
27	The apples looked less flavorful, I like apples with more flavor
28	There is a large selection so I would be able to find the apple I wanted
30	I chose the darkest color red and a medium size with the least amount of blemishes that I could see without rummaging through, as I would at the store

31 They were larger  
32 They were bigger and I did not want a big apple  
33 There were more messed up ones  
34 Looked the most fresh  
35 Some more visible ones looked bruised and marked up  
36 I picked here because I liked the wider variety that  
seemed to be present  
37 I saw the green basket first and saw one I liked so did  
not really keep looking  
38 They looked well grown and well displayed  
39 Dislike red apples  
40 Smelled good  
41 I chose one from here because the apples were the most  
consistent in hardness  
42 They looked good some looked too perfect  
43 Good selection of apples  
44 Slightly bruised, some holes  
46 The apples got a lot of dark spots which makes me feel  
like they are not fresh  
47 The apples looked like they had wax  
48 I chose this one because it was very red and round  
49 Apples were too red for me  
50 They looked like most of the apples I normally see  
nothing different  
51 The quality was not good  
52 Many looked bruised  
53 Holes  
55 I don't want to waste them by picking an apple. Apples  
in the orange display do not look good.  
56 Too big  
58 The closest display from me  
60 Too normal  
61 Some had spots  
62 I did not choose an apple from this display because  
there were too many choices that appeared bruised  
63 These apples had some bruises  
64 There were a lot of beaten up apples in the display  
65 Bug marks, bruises  
67 I thought the other crates looked better

- 68 Lots of apples
- 69 Did not look fresh
- 70 Though the apples in the purple display looked better
- 73 The way they feel
- 74 Too big
- 75 No reason
- 77 Bruised apples
- 79 The other looked more appealing
- 83 I like the tablecloth, bin (container) but the apples looked a little too ripe
- 84 More opportunities to choose a color or different kind of apple
- 85 Too big
- 86 Display was full so I felt I had more options
- 87 Too dark
- 91 Already selected from other tray
- 92 The type of apple I like is not in this display
- 94 All apples looked good
- 97 Could be supermarket but selected because I was not paying attention
- 98 Apples did not look at ripe
- 99 They were too big
- 100 Some did not look organic
- 102 Bruised
- 103 They were bruised
- 106 They looked good
- 108 Aesthetic, appeal of produce
- 110 Too many to look through
- 112 Many had bruises
- 113 Was quite full, but no reason why
- 115 Appeared to love the type of apple I prefer
- 116 Apples looked darker in color

Subject Number	Disorganized Display Comments
1	Good variety of colors to choose from
2	I prefer apples of this color
3	Looked like apples I normally buy
4	I didn't even look
6	The in-between, small in size
8	Size, color mostly uniform - no visible damage
9	I like the middle
13	Shape is color, colors are all appealing. Just looks good!
14	Again, mixed types, no Macs so I skipped this one
15	Full and good looking apples
17	Almost none looked old or discolored
18	Choice! (of high quality)
19	All were good apples, I choose one from here because the overall quality of all of them was good
20	Some of the apples had evidence of insects attacking them
21	Looked more ripe
22	The little apples looked the tastiest!
23	I chose from this because it was the closest to me and had the type of apple I prefer
24	Nice display but did not seem like a variety of apples
25	I chose these because they looked the most appealing
26	They looked the most pink
27	They looked like highly flavorful apples - maybe Fiji?
28	They look like good apples but they aren't neatly placed in the bin
29	They looked good
31	They were smaller and looked better
32	I saw a cute tiny apple and wanted it
33	They looked to be in better condition
34	The orange display looked fresher
35	Looked less marked up and better tasting
36	Just wasn't interested
37	The apples were small
38	The apples seemed smaller even though they were presented in a similar fashion as the orange display

39 I like lighter apples  
40 They looked very tasty and smelled good too  
41 Many had blemishes on them  
43 Some apples looked rotten  
44 Pretty apples  
45 They looked good  
46 The apple looks good  
47 They looked fresh and good  
48 I did not choose this because it was not as red  
49 These apples looked the most like Fiji apples  
50 Looked more appealing  
52 Most looked good enough to eat  
53 Round and nice and fair  
54 Good selection  
55 I don't want to waste time by picking an apple  
56 They looked the best  
57 Mostly random. Didn't pick from green because there was only one left. No preference between orange and purple  
58 Didn't see it  
60 Not impressive to me  
61 Look ok  
62 I did not choose an apple from this display because I didn't see one I wanted  
63 I didn't want to take one because they were all too perfect  
64 All of the apples seemed to not have too many blemishes  
65 Looked best overall and had selection to pick from  
66 A few spots on some but others seem less waxed, so maybe actually better  
67 These apples looked the nicest, there was a big variety and the quality was high  
68 There are a lot of apples  
69 Too much to pick from  
70 The apples looked the best and I saw many I could choose. They looked very crisp.  
73 The color  
74 Small  
75 I love Gala apples

77 Small and sweet looking  
83 Nice apples  
84 Variety  
85 Red, good size to eat  
86 Display was not as full as orange display  
87 Looks appealing  
90 Apple looks soft and elegant  
91 By seeing the color  
92 I liked one of them  
93 Picked from orange display  
94 Most all apples looked good  
97 Did not look that closely  
98 I found a very nice red apple  
99 Look better  
100 Firm, smaller apples (I assumed they were organic)  
102 Looked like less bruises  
103 I liked the shape and color of the apple I chose  
105 Many apples there, I like the color and texture of them  
106 They looked very good and I chose a red McIntosh, my  
favorite type of apple  
107 I thought the apples were more pleasing in the orange  
display  
108 Produce looks fresh and widely assorted  
110 Easy to see quality quickly  
112 In good condition  
113 Apple I picked caught my eye  
116 Apples looked good. Bright and what I like to eat.  
117 The apple itself looked good!