

**Aesthetics of Produce:
A systemic and design-based approach to reducing food waste**

A Dissertation
SUBMITTED TO THE FACULTY OF THE
UNIVERSITY OF MINNESOTA
BY

SunMin May Hwang

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

Advisor: Dr. Barry Kudrowitz

December 2022

© 2022
SUNMIN MAY HWANG
ALL RIGHTS RESERVED

Acknowledgement

I would like to acknowledge and give my warmest thanks to my advisor, Barry Kudrowitz, who made this work possible. His vision and guidance broadened my perspective about design research. I appreciate the freedom and the support that he gave me throughout this PhD journey. I would also like to give special thanks to professor Abimbola Asojo, one of my committee members and career mentor, for her strong support and guidance while I was navigating through this uncertain journey as a graduate student. I also thank my committee members, Hikaru Peterson, Sauman Chu and Cecilia Wang immensely for their valuable comments and suggestions. They made my thesis more comprehensive and complete. I indeed enjoyed all the discussions with you.

Additionally, this endeavor would not have been possible without the generous support from the U.S. Department of Agriculture, College of Design at UMN, the Human Factors & Ergonomics Program and COSP (Community of Scholars Program) at UMN.

I am also grateful to the faculty mentors and my cohort members of UMN-SSRC DPD 2019 (Social Science Research Council Dissertation Proposal Development) as well as the Dissertation Writing Retreat team 2022 for their moral support - commiserating the joy and the agony of academic writing.

Many thanks also to my friends, families, and SAP community - teachers and families whom I met through childcare in Minnesota. Without reliable childcare, it would not have been possible to complete this journey.

I would like to express my deep and sincere gratitude to my families in Korea, especially my parents, for their love, caring and sacrifices for educating me for my future. They have given me unreserved support throughout my entire life, and I feel deeply indebted to them.

Lastly, I would be remiss in not mentioning my husband, Peter Kang and my two children. They kept my spirits and motivation high during this process. Despite the difficulties of being a parent, a wife, and a graduate student all at the same time, my family's loving presence is what kept me going, allowing me to come this far.

Abstract

The invention of the baby carrot is an exemplary case that illustrates the power of design for solving a major problem with food waste. In the early 1990s, a farmer from California, Mike Yurosek, came up with the idea of machining leftover carrots to produce a new miniaturized form of carrot. This not only reduced the amount of unsellable carrots to be discarded, but it also created a whole new vegetable commodity market that is widely popular among kids and adults alike. This thesis is based on the strong belief that *design thinking* can bring about positive changes to food systems to remediate unnecessary food waste problems.

Since the industrial revolution, we have been living in a world that has been designed for mass production and consumption. This ideology of “the more, the better” in industrial production and consumption has increased food wastefulness (Barber, 2014). As a result, a third of all food, equivalent to 1.3 billion tons, is lost or wasted each year globally, and in the U.S. alone, up to 40% of food supply, equivalent to 40 million tons of food, is estimated to be uneaten (Gunders, 2017).

While food loss occurs at various stages of the food chain, **consumers and retailers are mainly accountable** for food waste in the US and other higher income countries. One of the major reasons identified by farmers and food organizations is the “*imperfect*” appearance of natural products (e.g., produce & fruits). Although they are perfectly

edible, we, as consumers, tend to shy away from aesthetically displeasing looks of produce.

To prevent this biased perception from creating more food loss and food waste in the future, it is crucial that we understand the specificity of consumer perception, and behavior associated with aesthetic factors of food. This research examines aesthetic principles of produce from the *consumer's perspective* and provides the potential for seeking and applying design thinking to the problem of food being discarded due to cosmetic reasons.

Existing literature on food aesthetics, psychology and perception-based studies demonstrate how *visual aspects of food* can have a significant impact on consumers' perceptions. A myriad of studies uncovered the relationship between *cosmetically imperfect* produce and consumers' preferences. Over the past decade, a growing number of studies began investigating effective strategies to combat food waste due to cosmetic imperfection (e.g., anthropomorphism, price reduction, graphic signage/linguistic solution). Yet none have explicated on the wide breadth of aesthetic standards and definitions for produce and their relationship to consumer needs, willingness-to-pay and purchase behavior. The lack of these understandings have caused delays in remediating food waste due to aesthetics reasons.

This work uses mixed method research design and consists of three parts: 1) The first study captures the breadth of consumer perception on two produce types with varying aesthetic ranges. In this step, aesthetic attributes that have the most impact on consumers are identified. 2) The second study investigates the relationship between willingness-to-pay and average aesthetic ratings for three different types of produce. 3) The last study tests consumers' market behavior in relation to the consumers' willingness-to-pay. In all three studies, intended functionality of the produce was also examined.

Results from the three studies demonstrated that consumers perceive produce aesthetics from a more functional perspective. The first study revealed surface imperfections to have the most impact on consumer perception for tuber type produce. The second study demonstrated that the rate of depreciation for consumers' willingness to pay for cosmetically imperfect produce is consistently lower than the rate of reduction in average aesthetic rating. In the last study, the majority of the participants were not willing to trade their regular looking potatoes for the cosmetically imperfect produce for a small monetary value.

This research illuminates our true needs regarding produce aesthetics, which is not one that is driven by the force of the industry, outdated policy & guidelines, or our biological instinct. The implications of this research can be summarized in three parts: 1) Produce aesthetics can be re-defined from the functional perspective. For example, a perfect tuber crop could be described by the least amount of surface imperfections that would allow a

person to peel the surface more easily. 2) A redirection of consumer needs is suggested for food sellers, marketers, and designers. They can distinguish their strategies for the cosmetically imperfect produce by developing separate venues and locations, which helps consumers draw more attention to their intended purposes. 3) Revision of policies and guidelines for filtering produce is strongly advised to accommodate more practical and more modern consumer needs. For example, inspection criteria that are not directly related to edibility and the safety of produce should be eliminated as it is detrimental in creating a flawed perception to the consumers.

In conclusion, stakeholders and designers in the food industry should work in tandem to reformulate our flawed perception to cosmetically imperfect produce by making a wider range of aesthetic diversity acceptable to consumers. Ultimately, consumers should perceive what they know as “ugly” now, as “normal” in the future. This would allow us to build a more sustainable environment for future generations.

Table of Contents

Acknowledgement	i
Abstract	ii
List of Tables	viii
List of Figures	ix
Chapter 1: Introduction	1
1.1 Problem Statement	1
1.1.1 Staggering amount of Food waste in the U.S. and its ramifications	1
1.1.2 Reasons for food waste	3
1.1.3 Where food waste hits the hardest	6
1.1.4 Prevention as the key: Examining Farm Waste in Minnesota	9
1.2 Design and food	12
1.2.1 Food aesthetic in the context of historical, social, and technological development	12
1.2.2 Design thinking as a tool for Food design	17
Chapter 2: Aim, Significance & Hypothesis	22
2.1 Aim	22
2.2 Significance.....	23
2.3 Hypotheses	24
Chapter 3: Relevant Studies, Literature Review	25
3.1 Aesthetic Preferences	25
3.1.1 Aesthetic preferences for aesthetically pleasing visuals	25
3.2 Food Waste and Consumer behavior	26
3.2.1 Food waste & consumer behavior/perception.....	26
3.2.2 Food waste & consumer behavior/perception for cosmetically imperfect food 27	
3.3 Aesthetics from personal values and way of living perspective	30
3.3.1 Our perception and behavior to imperfections.....	30
3.3.2 Impact of personal values on food's aesthetic perception	31
3.4 Impact of design on Food	32
3.4.1 Impact of design/aesthetics on consumer behavior/perception for food	32

3.4.2 Impact of packaging design of food on consumer perceptions.....	33
3.2.8 Design thinking to bring about changes in human behavior about foods	35
3.5 Economic Methodologies	36
3.5.1 Economic experimental study methodology	36
Chapter 4: Methodology.....	39
4.1 Study 1: Identification of Attributes and Ratings for Select Produce.....	39
4.1.1 Materials and Methods.....	40
4.1.2 Results.....	43
4.1.3 Evaluations.....	50
4.1.4 Discussion & Implications	53
4.2 Study 2: Relationship between aesthetic attributes and willingness-to-pay	55
4.2.1 Material and Methods	55
4.2.2 Results.....	61
4.2.3 Evaluations.....	66
4.2.4 Discussion	70
4.3 Study 3: Market Study	74
4.3.1 Material and Methods	74
4.3.2 Results.....	79
4.3.3 Evaluations.....	82
4.3.4 Discussion.....	84
Chapter 5: Summary of Implications and Recommendation	87
5.1 Re-defining aesthetics from the functional perspective.....	87
5.2 Design implications	89
5.3 Education	92
5.4 New business opportunities for farmers	94
Chapter 6: Future Work and Limitations	95
6.1 Limitations	95
6.2 Future Research	98
Chapter 7: Conclusions	100
Bibliography	102
Appendices.....	116

List of Tables

Table 1-1. Potatoes –Expert’s individual attribute rating vs. average overall rating	45
Table 1-2. Sweet Potatoes – Expert’s individual attribute rating vs. average overall rating	46
Table 3. Difference between screen (online) vs. in-person survey ratings for potatoes	62
Table 4. Summary Statistics of Participant Demographics	79

List of Figures

Figure 1. U.S. Food loss distribution represented in billions of pounds.....	4
Figure 2. Food Waste Hierarchy Diagram.....	6
Figure 3. Greenhouse gas (GHG) emission proportion from food industry.....	7
Figure 3. Small scale farmer ecosystem diagram – Seed to Plate.....	12
Figure 4-1. Comparison of food industry production to Ford automobile production system.....	14
Figure 4-2. The evolution of the food industry in the past century.....	15
Figure 5. Domains of multi-sensory food experience.....	17
Figure 6. Human-centered design process diagram.....	19
Figure 7. Double diamond design process developed by the British Design Council..	20
Figure 8. Thesis positioning among major intersecting disciplines.....	38
Figure 9. Diagram of methodologies across studies.....	42
Figure 10. Study1 Setup.....	43
Figure 11-1. Potato - Criteria Preference Frequency Graph.....	44
Figure 11-2. Sweet Potato - Criteria Preference Frequency Graph.....	44
Figure 12-1. Potato criteria correlation matrix.....	47
Figure 12-2. Sweet potato criteria correlation matrix.....	48
Figure 13. Spider character chart for three select potatoes.....	49
Figure 14. Intended utility of potato and sweet potatoes.....	50
Figure 15-1. Example figure of survey interface.....	60
Figure 15-2. Online survey interface example.....	61
Participants were asked to slide the red dot to the left to state their WTP for each given potato.....	61
Figure 16-1. Potatoes’ average aesthetic online survey ratings and average in-person survey ratings in violin plot.....	62

Figure 16-2. Comparison of potatoes’ average aesthetic ratings and WTP in violin plot	63
Figure 16-3. Intended functionality response chart for potatoes	64
Figure 17-1. Comparison of carrots’ average aesthetic ratings and WTP in violin plot	64
Figure 17-2. Intended functionality response chart for carrots	65
Figure 18-1. Comparison of carrots’ average aesthetic ratings and WTP in violin plot	65
Figure 18-2. Intended functionality response chart for onions	66
Figure 19-1. Study 3 setup in the Minneapolis Farmers’ market in June 2022	77
Figure 19-2. Close-up of Study 3 setup in the Minneapolis Farmers’ market.....	77
Figure 19-3. Image of the farmers’ market survey sheet	78
Figure 20. Proportion of participant who traded regular potatoes for the seconds	80
Figure 21-1. Proportion of participant who traded regular potatoes for the seconds in relation to their income	80
Figure 21-2. Proportion of participant who traded regular potatoes for the seconds in relation to their education	81
Figure 21-3. Proportion of participant who traded regular potatoes for the seconds in relation to their age	81
Figure 22. Intended functionality response chart for potatoes in the farmers’ market .	82

Chapter 1: Introduction

1.1 Problem Statement

1.1.1 Staggering amount of Food waste in the U.S. and its ramifications

One- third of the food produced for human consumption goes uneaten (Gustavsson et al., 2011). In the U.S. alone, 31 percent or 133 billion lbs. is lost at the retail and consumer levels corresponding to \$161 billion worth of food in 2010. 10 Percent, equivalent to 43 billion pounds, and 21 percent, equivalent to 90 billion pounds, were lost from the retail-level and consumer-level respectively according to a report (Buzby, 2014). This does not take account of losses on the farm and between farm and retailers as resources are limited in acquiring such data.

With the onset of the COVID pandemic, more people spent more time and money on at home meals (Kuhns & Saksena, 2017). In the U.S., more food spendings often results in more food waste (Recycle Track Systems, 2022). Food takes up the most space in landfills, which is one of the reasons foods being dumped in trash should be avoided at all cost. Despite the social, environmental, and economic consequences of wasting food, Americans continue to waste food due to the deeply ingrained beliefs, behavior, perceptions, and misconceptions about consumption behavior around food. To remediate this problem, immediate attention is needed to investigate and understand the underlying causes of this problem.

a) Environmental impact.

Numerous studies have pointed out the negative environmental impacts associated with large quantities of food being wasted.

First, food waste contributes to a loss of natural resources and energy resources from production, harvesting, preparing and transporting food that's never eaten (FAO, 2013; Williams & Wikström, 2011). Additionally, water devoted to growing food that is never consumed in the U.S is equivalent to 20% of the national water supply (*ReFED U.S. Food Waste Investment Report*, 2018).

Second, agriculture and food waste combined is known to be one of the greatest contributing factors to greenhouse gas (GHG) emission (Rockström et al., 2009). Globally, GHG emission by food production ranks as the third top emitter after the USA and China. The global volume of food wastage of food commodities (e.g., goods sold for consumption as it was found in nature) is estimated to be 1.6 Gtonnes, while total wastage for the edible part of food is 1.3 Gtonnes (FAO, 2013). Food waste also takes up 22% of municipal landfills, and is the largest material contributor to landfills (EPA, 2020). In part due to this massive amount of food waste, landfills are the third largest source of human-related methane emissions in the United States (ibid).

There are also other issues associated with food production that does not get consumed, such as land use changes, diminishing biodiversity and production impeded by unpredictable natural disasters, which all contribute to aggravating climate change phenomena.

b) Food Security

Despite this excess and wastage of food, many still don't have access to enough food to support a healthy life in some areas around the world due to poverty, urbanization, growing population, inequitable distribution, and racial segregations that often results in food deserts (Foley & Steinmetz, n.d.; H Charles J Godfray et al., 2010).

In the U.S., 1 out of 10 Americans were at risk of going hungry which is equivalent to 35 million people in 2019. Each year, the number is growing and especially with the coronavirus pandemic, more are expected to be left without stable employment and food for their families. It is estimated that in 2020, 72 billion pounds of food (from farms, consumer-facing businesses and manufacturers - not including waste at home) will be going to waste while 50 million people may be found struggling with hunger (*Facts About Hunger and Poverty in America | Feeding America*, n.d.).

ReFED - a national nonprofit dedicated to ending food loss and waste across the U.S. food system by advancing data-driven solutions - noted that if just 15% of food waste can be rescued, we would be able to feed 25 million Americans per year (Gunders, 2017).

1.1.2 Reasons for food waste

Food waste occurs for different reasons at different stages of the food systems.

“Some parts of the food system are more vulnerable and harder to make changes while other areas can be less susceptible to negative impacts.”

Food waste occurs at various stages of the food system (Göbel et al., 2015) and over 30% of the food produced in the U.S. is wasted throughout the supply chain, with households’ waste accounting for the highest rates (Figure 1). However, not all food waste from every stage becomes food waste per se. Based on where it occurs and how it is treated, food waste can be defined in other terms and other uses.

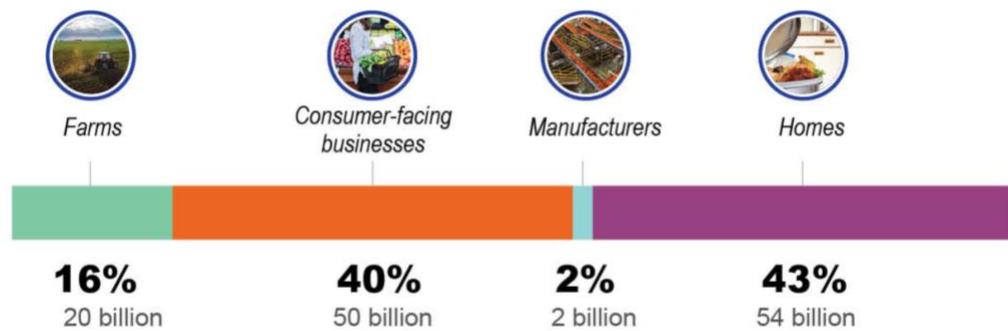


Figure 1. U.S. Food loss distribution represented in billions of pounds (ReFED U.S. Food Waste Investment Report, 2018)

Food loss

Food loss occurs at farms, processing stage, retail stage, and at the consumer stage.

Loss between the farm and retailers can be due to spoilage, drying, milling, transporting, or damage by insects or bacteria. At the retail level, it can be due to over-ordering, malfunctioning or accidents in facilities. In addition, lack of coordination between different actors in the supply chain and farmer-buyer sales agreements can contribute to quantities of farm crops being wasted. While

processing and manufacturing *discards* the highest proportion of food, it generates the smallest amount landfilled due to high diversion factor (Dusoruth et al., 2018). Discarded food usually ends up in an alternative destination other than its original intended destination.

Food diversion

When food is discarded for unintended purposes prior to consumption, 60% is diverted through recovery and recycling efforts to prevent food from being completely wasted. Diverted food can be upcycled for human consumption (e.g., juiced through distribution to value-added-sellers) and or reproduced for animal feed. It can also be repurposed for composting, anaerobic digestion and mechanical biological waste treatments (MBT) for industrial uses.

Food waste

The post-diversion remains get landfilled and this is what we commonly call “food waste”. Especially in a medium/high-income country, this end stage food waste is usually attributed to *consumer behavior* (Buzby, 2014; Gustavsson et al., 2011).

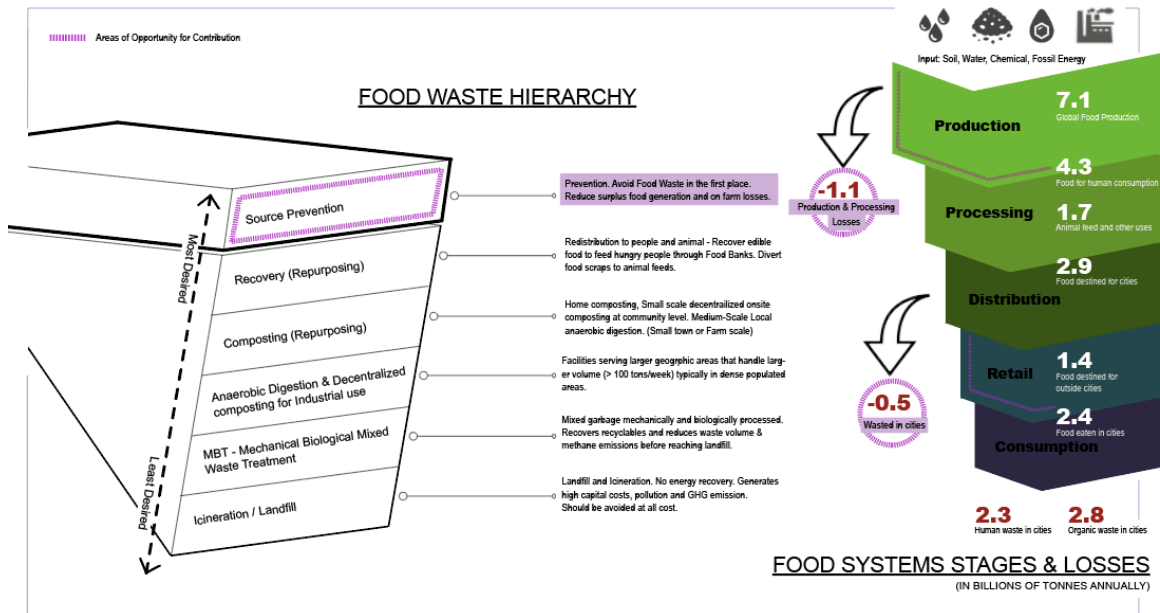


Figure 2. Food Waste Hierarchy Diagram

The figure on the right (food system stages) illustrates the amount of food waste in the world and the figure on the left (pyramid) indicates the potential impact each solution can have on each stage.

1.1.3 Where food waste hits the hardest

a) Early and end stages of food systems

The end stage of the food system which occurs at the household level poses one of the greatest challenges to the food waste problem. Not only is this stage responsible for 6% of global GHG emission (Poore & Nemecek, 2018) (Figure 3), but it is also one of the most incorrigible stages mainly because consumer behavior is hard to change systematically over a short period of time. Several factors contribute to food waste in the consumer stage including spoilage, over-consumption, *aesthetic appearances*, and misleading date mislabeling. In the food industry, a few terms are used to indicate low aesthetic appearances. “Cosmetically imperfect (CI)”, “Imperfect”, “suboptimal”, “seconds” and “second type” are all alternatives to the commonly used term “ugly”.

Farmers usually prefer to call theirs, “second type” or “seconds” as for them, they are perfectly edible despite the odd and irregular shapes. In fact, the “ugly produce” should be considered “normal” as they are perfectly edible and do not have any features that undermine the quality of the produce. The word “ugly” perpetuates the problem that all produce should look perfect and that there is something wrong with it if it is not. For clarity and brevity, this thesis will continuously use the term, “cosmetically imperfect” and “seconds” in place of the “ugly” or “suboptimal.”

Food waste which ends up in landfills also takes longer to decompose as landfills are designed to prevent waste from biodegrading. For instance, a banana peel can take as long as 6 months to 2 years to decompose while a cabbage head can take up to 25 years to decompose in a landfill (Chai & Kye, 2017). Therefore, food going to landfill is the least desired and the least sustainable method of disposal.

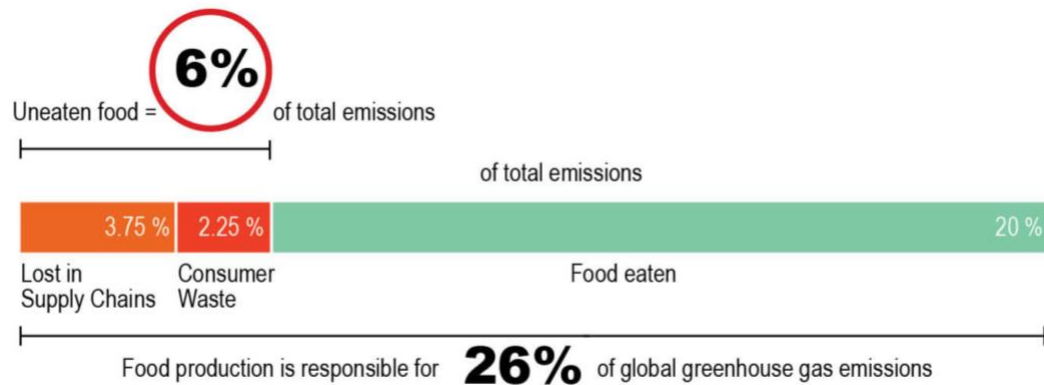


Figure 3. Greenhouse gas (GHG) emission proportion from food industry (Poore & Nemecek, 2018)

Likewise, early stages of the food system are also known to lose significant amounts of food, but they are rarely quantified or reported due to difficulty of logistics. The

6% of food waste indicated on figure 3., does not include on farm losses. Although environmental impact of initial stage food waste is less harsh than end stage food waste that ends up in landfill, considering the production resources and impact, early-stage waste cannot be neglected. On-farm losses are important and represent an opportunity for valuation, however most of these losses are plowed into the soil as compost, left on the fields, or processed for other uses (Berkenkamp & Nennich, 2015).

b) Most impact can be made by prevention

As illustrated in figure 2, prevention of food waste is the key in both early and end stages. At the processing, distribution, and retail level, diversion of food can be made more systematically. At the production and harvesting stage of smaller farms however, food loss rate depends heavily under the discretion of the farmer, resulting in a wide variation in the rate of loss among different farmers. Similarly, once food reaches household level, the use of food is completely up to the consumer which is hard to control at a systemic level. For this reason, preventive measures are the most effective strategy in managing food waste.

A study by Mourad, examining food waste solutions at each level of the food systems, has also suggested that “strong prevention” - efforts that are of interest to all stakeholders involved, hence a win-win strategy - would be the strongest solution to sustainable food systems (Mourad, 2016).

1.1.4 Prevention as the key: Examining Farm Waste in Minnesota

a) Large scale farming vs. small scale farming

Although big industrial farms are efficient in producing large quantities of food, there has been an increased awareness of the negative socioeconomic and environmental impact of large-scale open field farming. A couple drivers including global population growth, geopolitics, national development strategies and private capital in search of investment opportunities have given rise to large-scale farming across the world over the last decade (Oberlack et al., 2021). For example, large-scale farming causes loss of access to land and water on rural livelihoods, displacing many who already possess and occupy the land (Davis et al., 2014; Messerli et al., 2014; Schoneveld, 2017). Large-scale farming is often also associated with harming water resources, increases in greenhouse gas emissions, soil degradation, and loss of biodiversity which could all further amplify environmental degradation (F. & G.C., 2016; Zaehring et al., 2018).

On the other hand, small scale farming contributes significantly to local economies while strengthening rural communities and diversifying rural landscapes (Washington State University Extension, n.d.). Small scale farmers are especially vulnerable to the early-stage losses as they don't have the scale to systematically divert on-farm losses, turn them into other products, or sell them to secondary produce buyers. In order to reduce environmental impact due to large scale productions, local small farms have to thrive.

In the past decade, new farming practices have also emerged as an alternative to large-scale open field farming. For example, indoor farming is known to use less water than outdoor farming, and it also does not require large equipment like tractors or combines. It can also yield crops year-round so it has additional benefits to the traditional agricultural practices (Bowery Farming, n.d.; Stein, 2021). Aeroponic and hydroponic farming are few examples that are considered part of vertical indoor farming. In addition to these farming methods, regenerative farming has also been gaining prominence in the past five years. Regenerative farming is an agricultural practice that promotes the natural cycle of biodiversity, soil health, and livestock. It is known to reduce the use of tillage, pesticides and external nutrient inputs (Giller et al., 2021). Since it relies on the natural processes of nature, it takes several trial and errors, and a couple seasons for regenerative farming to show results. In the food systems that's driven by efficiency and production growth, more reward is inevitably given to big scale farmers in terms of income and production (USDA, 2018).

In a recent survey study conducted by Berkenkamp and Nennich in Minnesota, findings demonstrate that small scale farmers lack resources in both knowledge and actual venues to sell their cosmetically imperfect (CI) produce. More than 80% out of 138 growers stated that they are interested in finding out more about developing additional markets for cosmetically imperfect seconds (CI) and nearly 95% of farmers stated that they are willing to change their on-farm practices if they can find a suitable market for their CI's. In addition, nearly two-thirds identified the lack of market for CI's as a barrier to on-farm produce waste (Berkenkamp & Nennich, 2015).

b) Hmong farmers in Minnesota

Hmong farmers have taken a significant role in shaping the farming landscape of Minnesota since they began settling in 1970's as political refugees from the Vietnam War. Despite their hard-working ethics, they continued to face many barriers up until now including language barrier, land and financing issues and adequate training pertinent to U.S. market and consumers name a few (HAFA, n.d.).

Our field studies indicated that the rate at which one Hmong farmer discards “assumed unwanted produce” can be as much as 60%~70% compared to 15%~20% stated by an American farmer. This rate varies among Hmong farmers in HAFA (Hmong American Farmers Association) calling for a need in defining standards and consistency in knowledge about the consumer needs.

HAFA consists of farmers who grow produce on 5-10 acres of land. Hmong farmers associated with HAFA generally lack diversified venues, connections, or large-scale volume to upcycle farm waste, so they typically leave CI produce on the field to decompose or leave them on the plants unharvested. Preliminary studies conducted on HAFA indicate that these Hmong farmers are impacted more than other small-scale farmers, let alone compared to big, industrialized farms (D. Eeckhout, personal communication, August 29, 2019; K. Z. Xiong, personal communication, July 18, 2019).



Figure 3. Small scale farmer ecosystem diagram – Seed to Plate

1.2 Design and food

1.2.1 Food aesthetic in the context of historical, social, and technological development

a) *Development of aesthetic uniformity in food production*

The influence of a mass production system

Part of the reason for excess production of food resulting in food waste can be attributed to the mass production system that was adapted from the system that revolutionized production of industrialized goods. Over the past century, American culture of more production and more consumption has brought the same effect of wastefulness in the food industry (Barber, 2014).

We have come to adapt an extremely efficient, practical, system-based approach for the food systems which was originally designed for automobile productions (Figure

4-1). Using the principles of lean-ness of the system can provide many benefits to both small and big scale farmers in terms of production (Hays, 2015). It also provided consumers with exactly what they needed in the past century: consistent quality of food for an affordable price. However, it is harming the environment so much to a point where this production system will not be sustainable anymore. There needs to be another way to produce food, especially in agricultural practices.

Over the past century, the food system has overgone many changes and they were mainly due to consumer needs (Figure 4-2). Nowadays, we need a more sustainable and healthier food system. As an alternative solution to the current system, new practices such as regenerative agriculture and vertical farming have been emerging over the past few decades to combat wastefulness in the production systems (Francis, 2016; Kalantari et al., 2017). For these methods to work, consumer perception would need to change to accept more diverse variation in food aesthetics.



Figure 4-1. Comparison of food industry production to Ford automobile production system

Ford assembly line in the 19th century (left) is compared to today's food production assembly line in the 21st century (right). The food system that has been adapted from another industry, more than a century ago, is still being used today.

Image Source: Steinmetz, n.d.retrieved from: <https://www.thehenryford.org/collections-and-research/digital-collections/artifact/31264/> on Feb. 1, 2021 (left) | The future of food. Retrieved from: <https://www.nationalgeographic.com/foodfeatures/feeding-9-billion//> on Feb.1, 2021 (right)

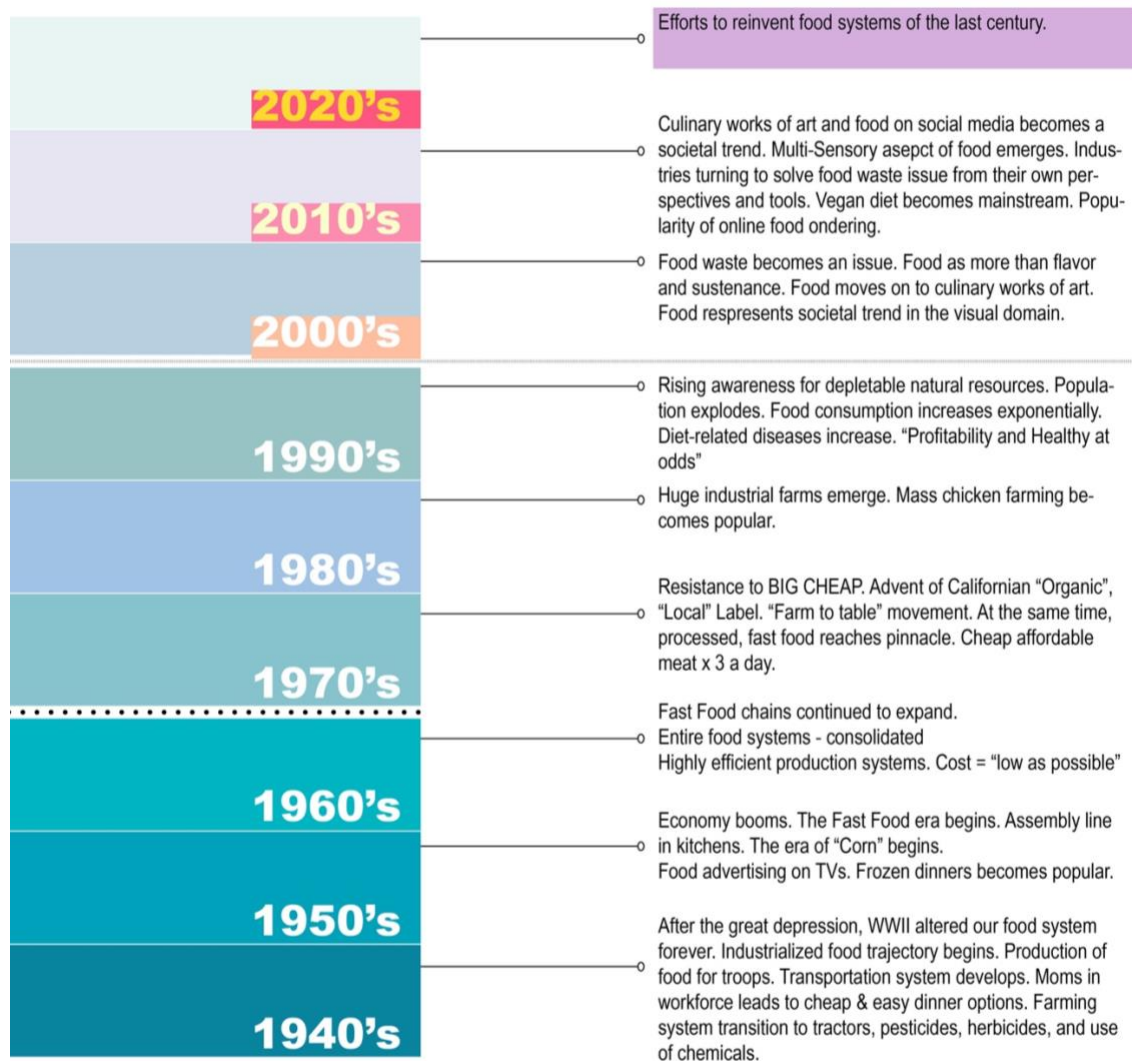


Figure 4-2. The evolution of the food industry in the past century
 The figure illustrates how the food industry and food system has evolved over the past few decades. This illustrates that the drive for change was mainly due to consumer needs. Current trends and consumer needs are very different from how it used to be couple decades ago, demanding another push for systems change.

b) Emergence of new "appetite-driven aesthetics" in food

Increasing role of the "new aesthetics principles" of food

Aesthetic qualities are often associated with visual senses. However, in fact, an aesthetic experience can be defined in broader terms that encompass visual, auditory,

gustatory, olfactory, and tactile properties (Shelley, 2022). Aesthetics is also dependent upon place and develops with on our engagement with place (Brook, 2014). This section is concerned with discussing visual aesthetics of food specifically.

Food has shifted its role from flavor and sustenance to culinary works of art. Aside from fulfilling basic human needs, food is a source of sensory stimulation that enriches people's lives. It has become more of a societal trend and a quest for the most "appetizing", which may not necessarily be defined by the taste (Auvray & Spence, 2008; Bordewijk & Schifferstein, 2020). This trend of appetite-driven focus on food is more evident since the early 2000's with the onset of popularity of social media platforms. One of the initial movements can be traced back to 2001 when Tumbler launched a *Foodstagram* site. Foodstagram was essentially a site where people uploaded photos of food. Since then, the phenomena of sharing food images have become explosive throughout the world. The emergence of celebrity chefs, the term "food porn" (Vohs et al., 2013), can all be attributed to the rising role of *visual aesthetics of food* in our lives.

Food consumption is an exemplary subject that demonstrates unique consumer behavior and perception, that is different from industrial goods or the built environment. It can also be a prism to which we view our society, history, and our atmosphere (Kissane, 2018; Zampollo, 2017). As such, examination of food consumption pattern and behavior reflects user needs in unique ways that are not explicable or present in other commodities, industries, or environments not involving food.

c) Growing importance of visual stimuli in food

A growing number of researchers are acknowledging the importance of sight to our perceptions of, and behavior around food. Spence has noted that the impact of sight (visual aesthetics) will not decline any time soon, especially given how much time most of us spend gazing at our mobile devices and computer screens (Spence, 2017).

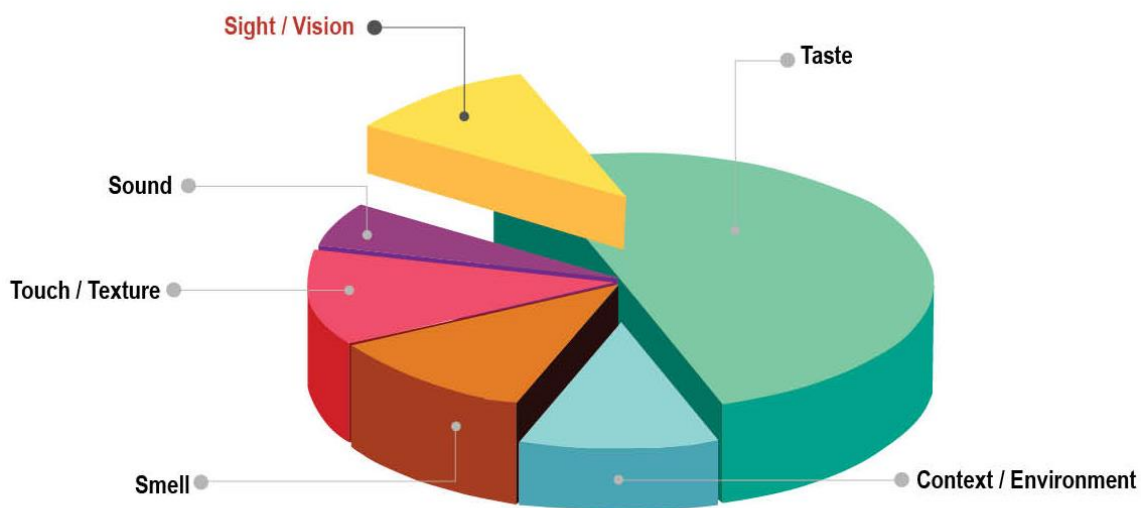


Figure 5. Domains of multi-sensory food experience

Food experience consists of 6 different components. The two shallower depth areas (sight/vision, context/environment, and sound) are non-obvious connections and areas of research that are largely underexplored. The visual impact on food experience is named “the new aesthetics” in this thesis as it does not affect consumer behavior/perception in the same way it does for other non-edible products. Elements of aesthetic principles for food will be dissected in depth for this research. The height/depth of each piece indicates the depth of current status of academic explorations.

1.2.2 Design thinking as a tool for Food design

a) Design thinking process applied to the food industry

In the early 1990s, a farmer from California named Mike Yurosek invented baby carrots by machining leftover carrots that were not visually appealing for sale. This

process not only created value from what would typically be waste, it also created an entirely new market and one of the most popular vegetable commodities for kids and adults alike (Elizabeth Weise, 2004). This is a good example of the power of design in generating a creative and valuable solution for an existing problem.

The holistic process of design thinking involves defining a problem, investigating needs, generating multiple ideas for a solution, and testing those ideas for final selection and implementation (Figure 6). Over the past decade, more emphasis has been put on user research, heightening the importance of understanding human needs. This process of giving more attention to the user research is often called the “human-centered design.” Designing for the food industry is not an exception to this trend and it would also benefit from the human-centered design strategy. Whether one is designing a new food product, redesigning the system, or changing the user’s perception about a product, *human-centered design thinking* as a tool can bring about positive changes to the industry (IDEO, 2019).

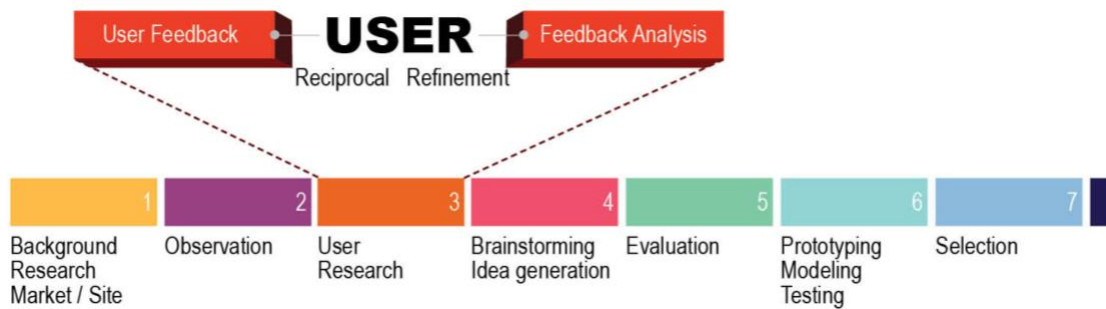


Figure 6. Human-centered design process diagram

The diagram illustrates a design process focused on human-centered design, which investigates user needs and user perception further in the research process. This human-centered design approach helps create solutions that are not of competing interest between users and the various stakeholders involved.

The human-centered design process can be divided into mainly two parts as shown in figure 7: The first part is concerned with *designing the right thing*, hence it involves investigation of background/context/site, observation, and user research. The latter part deals with *designing things right*, which is more about realizing and implementing a design solution based on findings from the former process.

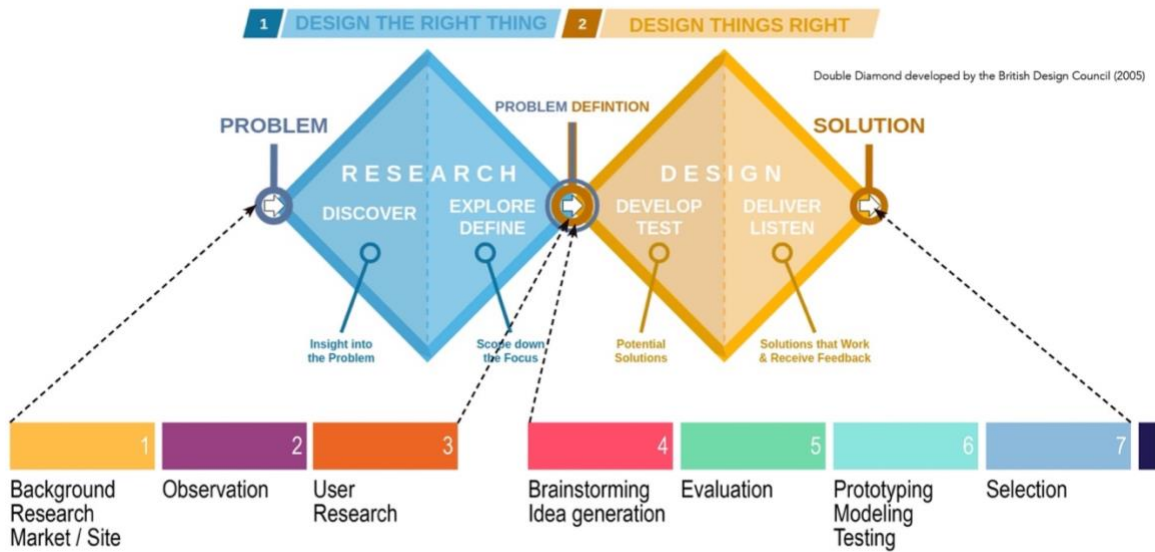


Figure 7. Double diamond design process developed by the British Design Council
Note. The image was created by adding the author’s own interpretation to the double diamond design process diagram developed by the British Design Council. The [Double diamond diagram] was developed by the British Design Council (2005) and is an adapted version from the (*Eleven Lessons: Managing Design in Eleven Global Brands A Study of the Design Process*, 2005). Retrieved from [https://en.wikipedia.org/w/index.php?title=Double Diamond \(design process model\)&oldid=1125205255#cite_note-1](https://en.wikipedia.org/w/index.php?title=Double_Diamond_(design_process_model)&oldid=1125205255#cite_note-1).

An exemplary product that illustrates human-centered design approach is the 1850 Coffee brand that targeted Millennials. JM Smucker Co. teamed with the design consultancy firm IDEO to remodel and launch the Folgers Coffee brand. The user research identified Millennial’s tendency to value heritage, authenticity, and entrepreneurship. The new brand 1850 Coffee emphasized those spirits to make the popular attributes of their coffee resonate with the Millennials. This collaboration spurred rapid growth for the company, putting the company in the lead despite tough competition in the coffee market (IDEO, 2019; Poiniski, 2019). As such,

implementing a user-centered marketing and advertising strategies, could provide innovative solutions to various types of challenges.

b) Contribution of the work in the field of food design thinking

Firstly, this work contributes to the largely unexplored discipline of *food design thinking* (Zampollo & Peacock, 2016). Bordewijk et al. stated that designing food products can be intrinsically different from industrial products in that there is a need to address: 1) the perishable nature of the material, 2) the need to make food system more sustainable by addressing agricultural production and its impact on biodiversity, quality of living environment, and waste generation, 3) the need to provide safe and nutritious food to keep people healthy, 4) the need for designers to provide full sensory experience including flavor and other senses that is not limited to visual aesthetics, and lastly 5) the need to address preparation practices and the associated cultural differences (Bordewijk & Schifferstein, 2020). Considering these aspects, the implication of this research is drawn from factors other than visual aesthetics.

Secondly, the relation between perceived aesthetics and willingness-to-pay is rarely discussed in current literature. This research examines consumers' perceived aesthetics and how that relates to consumers' willingness to pay both in stated ratings and in an ecologically valid marketplace. This understanding will allow people in the food industry to make more informed decisions that are directly applicable to marketing and production strategies of food items.

Chapter 2: Aim, Significance & Hypothesis

This work focuses on examining and evaluating *appearances* of early stage (on-farm losses) food products (produce) to understand *avoidance-related consumer perception and behavior* that causes retail-consumer level food waste.

Based on the notion that the nature of consumer demand fundamentally structures the direction of innovative activity (Baum, 2013), it is expected that the findings of this research will begin to inform designers, marketers and policy makers on how design thinking can help to divert this flawed perception for ugly produce and leverage this “imperfection” in food to create a more sustainable solution for the produce market.

2.1 Aim

a) *Investigation of aesthetic factors in crops*

Specifically focusing on the visual aspects of multisensory food experience that influence consumers’ behavior, I will investigate how varying degrees of aesthetics in produce products influence people’s perception in terms of their *preference* and *purchase intentions*. In other words, through the survey, I plan to dissect the multi-dimensional aspects of food *aesthetics’* function - pertaining to the vision sector (Figure 5) - on our perceptions.

b) *Use of design thinking to solve food waste problems due to aesthetic factors*

Food systems have more often been examined from public policy, economics, and food science related fields in the past. Rarely has it been discussed or investigated

from the design discipline. This research examines multi-dimensional features of *aesthetic factors* associated with people's perception on food, as the subject. It seeks to answer questions related to our flawed preference for "perfect looking produce".

2.2 Significance

c) Design thinking for food waste problem for small farms

This research would contribute to the largely unexplored area of *design solutions* for *food-related problems*. Examining *aesthetics* from the user perspective can give rise to new findings that could provide useful solutions to redirecting and reformulating people's flawed preference for produce's aesthetic perfection. It would also provide an opportunity for small farm owners and stakeholders like the farmers from Hmong American Farmers Association (HAFA) to reconsider some of their sales strategies and venues that would resonate better to their targeted customers.

d) Interdisciplinary research positioning

While centered around *design thinking methods* and *design thinking principles*, this research combines knowledge from various disciplinary backgrounds with much of the prior research coming from fields outside of design such as consumer behavior psychology, applied economics, and food science. In addition, this work also draws perspectives from industry which is directly related to the market's driving force and makes the studies more ecologically valid. In summary, this work is significant in that it involves multidisciplinary thinking and collaboration among scholars and stakeholders from different fields to remediate food waste problems.

2.3 Hypotheses

- a) Visual aesthetics of produce is the primary factor that determines consumer preference and WTP (willingness-to-pay).
- b) User's stated WTP for imperfect produce will have a proportional relationship to the overall aesthetic rating of the produce aesthetics. For instance, if the produce was rated 5/10 for aesthetics, then that item's WTP will be depreciated at a similar rate from the full price.
- c) In general WTP does not typically match actual purchase behaviors especially when the actual object is not present or they are out of context (Dodds et al., 2018; Suomala, 2020). As such in this study, we should find that user's actual purchase behaviors will NOT be directly proportional to the overall average rating nor the stated WTP of the produce item. It will be exponentially proportional (under-rated) meaning that users will not be willing to pay $\frac{1}{2}$ price for a $\frac{1}{2}$ score rated produce.
- d) People with higher income will not be willing to trade the cosmetically imperfect produce even with a price discount. In addition, people with higher education would be more open to taking cosmetically imperfect produce.

Chapter 3: Relevant Studies, Literature Review

3.1 Aesthetic Preferences

3.1.1 Aesthetic preferences for aesthetically pleasing visuals

Whether humans are naturally drawn to and prefer symmetrical visuals it is an ongoing debate and is continuously discussed in multiple fields including both psychology and arts/design. In the context of this research, we are associating symmetry to infer a broader meaning – a visual representation that is more balanced and is thus perceived as more aesthetically pleasing to humans. Studies conducted by Huang et al., (2018) - which compares attention and preferences to symmetrical and asymmetrical visual pattern of adults to 4 year old participants - suggests that the origin of human's aesthetic preference for symmetry is something that is developed as we grow rather than an innate inclination. In this article, the author questions the notion that attentional choices reflect subjective preferences or values since the 4-year-olds did not prefer the visual pattern that they were giving more attention to (ibid).

Similarly, another study tested preferences of 4-year-old children by exposing them to asymmetric and symmetric forms in a perceptually demanding game; children who received symmetric forms showed aesthetic preferences for the exposed pattern, while no preference was found for the other group. The result suggested that early emerging sensitivity to aesthetically pleasing features leads to positive experience with it, eventually allowing a person to form aesthetic preference for it. The authors

of this article argue that one's aesthetic appreciation is the outcome of the interplay between biological and ecological adaptation (Huang et al., 2020).

3.2 Food Waste and Consumer behavior

3.2.1 Food waste & consumer behavior/perception

Literature on the relationship between food waste and consumer behavior continues to grow with heightened environmental concerns regarding production of food, processing losses, and ethical reasons associated with throwing out edible food.

Dusoruth and Peterson examined food waste tendencies due to behavioral response to cosmetic deterioration of food at home stage. The researchers used two categorizations of consumers; planners and extemporaneous consumers to examine how they make decisions based on cosmetic deterioration and other factors such as date labels, package size, and implied shelf life. The author suggests that intervention to manipulate sensory expectations from cosmetic deterioration is needed to curtail food waste as many people did not have skills to discern edibility.

Adjusting the price of an item could also influence consumer's purchase intentions to a great extent. Several studies have examined the reduced-price effect on purchase intentions and its relation to household food waste level. Aschemann-Witzel and colleagues' study investigated whether price-focused consumers can contribute to reducing overall food waste produced in the nation. Results indicated that lower food waste was reported at household level for higher age and higher education consumers.

Age, education level, income and household numbers were considered as factors that influence the outcome. Yet, these results still indicated that consideration consumers engage in when deciding about the offer is still unknown (Aschemann-Witzel et al., 2017).

3.2.2 Food waste & consumer behavior/perception for cosmetically imperfect food

Few qualitative studies have examined consumer behavior towards suboptimal food products as a strategy for food waste reduction. The consensus was that considerations for suboptimal food are divergent. It is known that consumers who do buy suboptimal food are people who have a high level of awareness and concern for the environment. Most people however were looking for perfection when buying food products (Isadora do Carmo et al., 2019; Loebnitz et al., 2015; Loebnitz & Grunert, 2015). What specifically this perfection refers to and how it influences purchase intentions warrants a closer look.

Several studies also demonstrated that not only does the standard of aesthetic perfection fluctuate across different cultures or people with different values, but also within an individual based on what types of knowledge is available to them. Bunn et al.'s study about consumer acceptance on cosmetically scarred oranges rose significantly when consumers were informed that those oranges used less pesticide (Bunn et al., 1990). Yue also examined consumers' willingness to accept cosmetic damage in organic apples (Yue et al., 2009). In this study, researchers tested how much of a premium effect the organic designation had over conventional apples for

both spotted and unspotted apples. In general, consumers were willing to pay more for organic labeling, but not if it is heavily spotted. Marginal effect between organic and conventional apples was insignificant for heavily spotted apples. This illustrates that there is a universal standard as survey participants generally stopped valuing organic after a certain degree of spots. At the same time, the findings also imply that aesthetic standards are malleable and can be influenced by other factors to a certain degree. However, a produce with many (e.g., heavily spotted) unappealing attributes will continue to remain unappealing to consumers regardless of how many benefits or pros the consumer is introduced to.

On a similar note, de Hooge (2017) also studied under which conditions consumers purchase or consume sub-optimal food that are perfectly edible. This research examined various factors in addition to appearance including date labeling and damaged packaging as a predictor for consumer's unwilling behavior. The result demonstrated that these preferences widely varied depending on the place the consumers were making purchases at. It also varied based on their demographics and characteristics of the consumers.

More recently, scholarly articles investigating consumer's aversion to ugly produce have increased with heightened awareness for negative social and environmental consequences of the epidemic of food waste. Hingston and Noseworthy (2020) draw on the *prototype theory* to predict that consumers' past personal experiences influence how they define produce aesthetics. Authors of this article demonstrate that

consumers who have agricultural experience have a wider range of acceptability to produce aesthetics than people who encountered produce in a retail context. This article stands out from the other food waste literature in that it brings about another indicator of produce aesthetics – a person’s level of experience with agriculture – which was not a frequently mentioned criterion before. This will bring an important implication on the policy level, education and designers shaping user experience.

Following the recent trend of studies for ugly food, Mookerjee (2021) reported in a recent article that “ugly” labeling of produce can increase purchase of unattractive produce. The author argues that deliberately pointing out the aesthetic flaw specifically, corrects consumers’ bias about other attributes about the produce – particularly tastiness – thus leading to increased purchase intentions. The result indicates that “ugly” labeling is most effective when associated with moderate (rather than steep) price discounts. The findings of this research are relevant to the presented thesis in that it provides recommendations on appropriate pricing of unattractive produce and provides a way to redirect consumer perception for ugly produce, while addressing the issue of food waste. Other scholars have also found that discounted-price have an impact on raising consumers’ purchase intentions for unattractive produce (Aschemann-Witzel et al., 2018; de Hooge et al., 2017) but this article stands out particularly more in that it discovered that moderate discount (e.g., 20%) on pricing coupled with the “ugly” labeling has the most positive effective impact on consumers’ purchase intentions.

While existing literature's findings provide important insights for consumer preference for perceived suboptimal products, further empirical research on factors that influence consumer preferences would benefit our efforts in distributing and marketing food without loss.

3.3 Aesthetics from personal values and way of living perspective

3.3.1 Our perception and behavior to imperfections

People tend to put a premium on beautiful things. Today's society often deems non-perfect objects inferior or negative. *wabi-sabi* is a world view centered on the acceptance of transience and imperfection. According to this Japanese-Buddhist derived perspective of aesthetics, aesthetics is described as one that appreciates beauty regardless of how imperfect, impermanent, and incomplete it is. A *wabi-sabi* aesthetic principles include asymmetry, roughness, simplicity, economy, austerity, modesty, intimacy and the appreciation of both natural objects and forces of nature.

Based on the same philosophy, Saito (Saito, 2017) sheds light on the importance of acknowledging the aesthetic value of imperfect material objects that are considered to be defective or deficient. Saito argues that there is a need to develop a sense of acceptability to imperfection in our everyday experience in a discriminate manner so as not to cause damaging consequences to the quality of life. The author also states that imperfectionism brings out unexpected, sensuous qualities that enriches imagination while helping us maintain a desired attitude of humility and respect in our lives. Along the same lines of *wabi-sabi*, (Buetow & Wallis, 2017) elaborates on

kintsugi – a notion celebrating beauty in visible signs of repair. The underpinning notion in these bodies of concepts is that in readily accepting human nature, we come to appreciate beauty in the vulnerability and common irregularity of imperfection in daily practices.

These philosophies are noteworthy for the topics discussed in this thesis as it is time, we shy away from preferring only the “perfect looking” produce and to avoid thinking that only those with the “perfect looks” are okay to consume. Nature is not perfect, and like *wabi-sabi*, we should be celebrating and embracing the imperfections in nature. The following section describes more about our evolving perception of the relationship between aesthetics and perfection.

3.3.2 Impact of personal values on food’s aesthetic perception

On another note, it can be said that “Aesthetic perfection is in the eyes of the beholder.” As Korsmeyer noted in the book *Aesthetics, the big questions*, if we are to appreciate an object aesthetically, we must accept the object “on its own terms” whether the object be charming, stirring, vivid, or all of them (Korsmeyer, 1998). This philosophy should also apply to food flavor, especially for fresh natural products like produce. Regardless of the visual aesthetics, we should be able to enjoy the produce for what it is.

Retailers assess consumers’ preferences and translate them into appropriate strategies to market them. With regard to aesthetic standards in vegetables, discordance in

aesthetic agreement will inevitably arise among different groups with varying underlying characteristics, values and environments (e.g., culture) (Barkow et al., 1992; Loebnitz et al., 2015; Smith & Semin, 2004).

Without understanding the differences in aesthetic cues that appeal to different minded people, and their impact on consumer behavior, many edible fruits and vegetables will continue to be wasted.

3.4 Impact of design on Food

3.4.1 Impact of design/aesthetics on consumer behavior/perception for food

In the past, preference for aesthetics of food has been primarily driven by human instinct for survival and so humans were driven to select what was beneficial to our primary needs (Hekkert, 2006). However, we have evolved from the era of having to avoid unsafe food for our survival. In fact, trends over the past few years have shown that we can be driven by exactly the opposite reasons of “survival”, that is – simple pleasure and psychological satisfaction (Korsmeyer, 1998). Over time, scientists have also found that animals and humans are drawn more to “supernormal stimuli” even though they may look fake (Barrett, 2010; Tinbergen, 1961). This phenomenon of desiring abnormally strong, non-natural sensory stimuli may not have been applicable to the food sector before when food was the main source of sustenance. However, it is now becoming more evident in this era where food is so abundant as to be wasted.

The field of multi-sensory food experience – which is related to pleasure and psychological satisfaction – is growing, and the visual aspect of food experience is a significant part of it (Fitzgerald & Petrick, 2008). With the rise of various visual media and visual marketing strategies (e.g., social media, 2D images, graphic design) that utilize food aesthetics to entice consumers, the relationship between visual cues and consumer behavior has become an increasingly popular research topic to psychologists, food scientists, and designers alike.

For example, Spence contributed to a large body of research that delineates the impact of changing the hue/intensity of the color of food and beverage on people's expectations, while Delwiche stressed the importance of visual stimuli among other factors in altering taste assessments (Delwiche, 2012; Spence, 2015). Another study has shown that repeatedly exposing a person to sensory stimuli can make that person satiated without consuming the food (Larson et al., 2013). This study suggests that a sensory stimulus of food (e.g., visual exposure) can have a real effect on people, fulfilling satiety in ways other than mouthfeel-taste.

3.4.2 Impact of packaging design of food on consumer perceptions

Not only are humans sensitive to aesthetics of the actual food itself, but consumers are also affected by the physical form or design of the packaging that contains the food. Packaging and food form is known to be one of the major determinants of the product's marketplace success. The article 'Seeking the ideal form: Product Design and Consumer Response' by Bloch (Bloch, 1995) explicates how the form of a

product relates to consumers' psychological and behavioral responses. In this article, the author denotes that the 'ideal' form is one that evokes positive beliefs, positive emotions, and willingness-to-approach responses among target members. The author also adds that the product should simultaneously satisfy numerous design constraints including ergonomic efficiency, cost competitiveness, and adherence to regulations. This holds especially true for manufactured goods, but not much is known about natural food products such as fruits and vegetables (F&V). Studies on consumer preferences and criteria for F&V began to grow over the last decade in concerns for the environmental crisis.

On a similar note, other scholars have investigated consumers' responses to aesthetic packaging (Raghubir & Greenleaf, 2006; Reimann et al., 2010). Raghubir and Greenleaf found that the ratio of the sides of a rectangular product packaging can influence consumers' purchase intentions and preferences. On a deeper level, Reimann et al. investigated consumers' responses to behavioral, neural, and psychological properties of package design. The results of four series of experiments indicated that consumers had an increased activation response to aesthetic packaging based on fMRI data, which correlates with the consumers' self-reported choice measures with the product.

There is also an array of study that investigates influences of visual attributes of food packaging on consumer preference and associations with taste and healthiness. In the study by Marques da Rosa et al. (2019), consumers preferred colored packaging to

grayscale packaging and angular packaging to rounded packaging. More importantly, the color of the packaging was found to be associated with taste expectations, while shape only influenced expected sweetness.

Some important questions remain, such that consumers may simply have been stimulated by the more variety in packaging. However, implications from this research still holds true and is consistent with several existing literatures in that color and/or shape of packaging are often associated with particular taste or expectations. It is also suggested from these studies that humans develop a natural tendency toward visually appealing and more creative designs of products especially among adults, if the packaging is associated with the right kinds of taste expectations for the product.

All these articles suggest that what we “see” (visual aspect) modulates our perception of flavor, appetite, and avoidance-related food behaviors although variations exist due to the lack of universal aesthetic agreement among people.

3.2.8 Design thinking to bring about changes in human behavior about foods

Multiple studies mentioned above suggest that factors causing consumer-level food waste is mostly due to consumers’ internal motivation, predisposition rooted in values, attitudes, or beliefs. This suggests that we can bring about positive changes and waste less just by reformulating and redirecting people’s perception for imperfect food.

3.5 Economic Methodologies

3.5.1 Economic experimental study methodology

The main market study method for this thesis was borrowed from an experimental economic research methodology. A series of studies examined in-store valuation of steak tenderness by testing whether consumers paid a premium for guaranteed tenderness. The researchers found that consumers paid an average of \$1.23/lb (J. L. Lusk et al., 2001) in addition for tender steak compared to tough ones. This was conducted by having participants indicate the most they would be willing-to-pay to exchange their tough steak (default reward) for tender one. If the participant's indicated amount exceeded the predetermined original price of the tender steak, the participant would only pay for the difference between the tender steak and the tough one. If the bid price was less than the predetermined price, then the participant had to keep the tough steak. This bidding methodology allowed researchers to collect additional pay value that reflects true consumers' willingness-to-pay. Similarly, Lusk's former study examining consumers' willingness to pay for guaranteed tender steak using the Vickery auction method made a significant contribution on previous work in experimental valuation by shifting the laboratory setting to a grocery store where consumers make decisions and purchase goods (J. Lusk et al., 1999). In this study, consumers were given one free steak for participating in the experiment. They were asked to indicate their willingness-to-pay to exchange their meat for the more tender one. In the bid, the highest bidder received the product but paid the amount of the second highest bid. The experiment was designed to reveal respondents' true

maximum willingness-to-pay value. This method is known to show the differences in willingness to pay and willingness-to-accept values.

Lusk & Fox have also used choice experiment (CE) to examine the value of several ribeye steak attributes to predict consumer choice. The stated preference methodology (SPM) used in this experiment allows consumers to make decisions about products based on several product attributes. The assumption is that consumers consider a product 'useful' and 'worthy' not from the good itself, but from the attributes embodied in the good (Lancaster, 1966).

Borrowing from Lusk's methodologies, in this research, the final experiment was conducted in familiar territory for the consumers – a farmers' market - eliminating a greater sample selection bias. Although not everyone would participate, it is a more relevant (ecologically valid) setting where purchase decisions are normally made compared to a lab setting, reflecting a truer willingness-to-pay. The experiment was conducted with two categorizations of potatoes – perfect looking ones and “ugly”-second type ones, side by side to each other. Participants were asked to choose between the two groupings based on the attributes, replicating some of the approaches of the aforementioned studies

ECONOMICS /
Consumer Behavior,
Experimental Methodology

DESIGN /
Aesthetics
Psychology

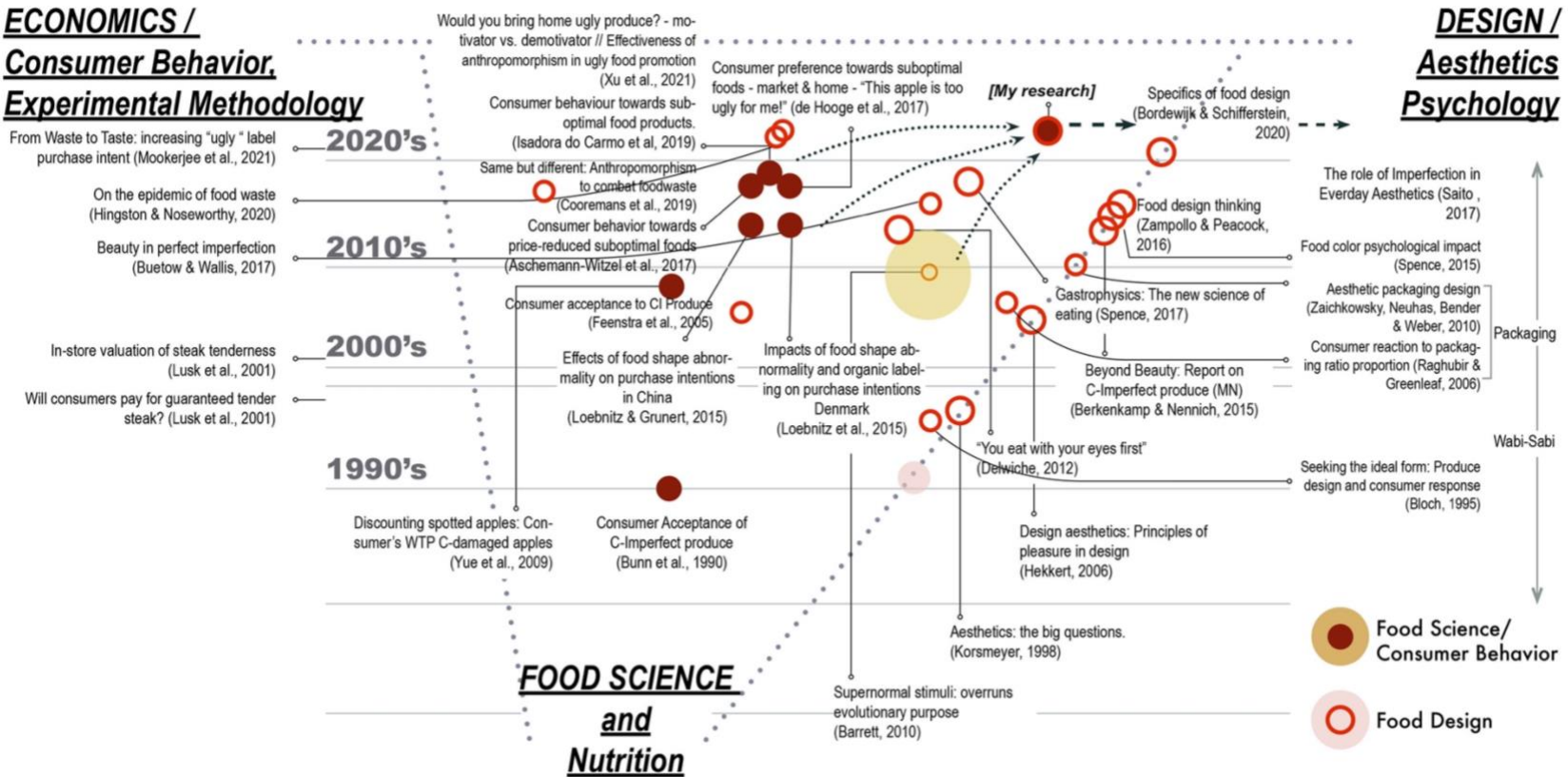


Figure 8. Thesis positioning among major intersecting disciplines

The major disciplines that the thesis is posited includes design, psychology, economics, and food science. The common theme throughout the three disciplines is consumer behavior, consumer preference and psychology of aesthetics preference

Chapter 4: Methodology

This work is divided into three different studies. These three studies were designed as a sequence, to be conducted one after another (Figure 9).

The first study analyzes consumer preferences and priorities to produce aesthetics based on hypothetical consumers and agricultural experts' verbal responses and ratings. The second study elaborates on the first part by presenting data from a larger pool of participants and for three types of produce: potato, onion, and carrot. This section analyzes the specificity of produce attributes that influence consumer decisions. The last study captures consumers' willingness-to-pay and purchase behaviors in an ecologically valid market setting.

4.1 Study 1: Identification of Attributes and Ratings for Select Produce

This first study resembles the *content analysis method*, in which the researcher determines the presence, meaning, and relationships of words, themes or concepts in qualitative data. An inference is made about what consumers care about the most in select produce types.

The first study's method aims to delineate consumers' criteria for produce aesthetics – both averse and desirable factors. This data is compared to agricultural experts' opinions to extract the primary factors influencing consumer perception. The main purpose of this study is to uncover underlying and subconscious aesthetic criteria and to point out the criteria that has the most impact on consumer perceptions.

4.1.1 Materials and Methods

Study 1 collected both qualitative and quantitative data from 10 participants. They were volunteer instructors in a product design course at the University of Minnesota. The survey was set-up in the classroom before class time, allowing survey participants to freely participate as they had wished. Another survey station was set up in the cafeteria of the university recruiting a few random students/professionals. 3 were female, 1 identified as others, and 6 were male. 2 were 19 and under, 3 were between 20-29, 1 between 30-39, 1 between 40-49, 3 between 50-59. 5 were design professionals, 2 were engineers, 2 agriculture related professions, and 1 was a human factors expert. A survey gathered verbal responses about what consumers care about when considering produce aesthetics, and asked participants to rate the given produce on a scale of 1-5. Two different crops, potatoes and sweet potatoes, of varying degrees of aesthetics were used in this study. The setup of the study is shown in figure 10.

Objective

Understand consumers' aversion/preference factors for two different types of produce – potato and sweet potato - by examining how they rate and verbally describe each crop of varying degrees of aesthetics.

Outcome Product

- 1) Lexicon of produce aesthetics criteria for potato and sweet potato
- 2) Two expert ratings for each criterion (for inter-rater reliability) mentioned by survey participants

Procedures

First, variants (12) of each produce were presented to each survey participant. Prior to the survey, the produce was selected by the researcher to have a varying range of aesthetics. Participants rated each produce by placing them on a plate numbered 1-5; 1 being the most aesthetically pleasing and 5 being the least aesthetically pleasing. After participants were done placing all produce, they were asked to state their reasonings for the rating.

From the verbal responses, the researcher developed a *lexicon of criteria* that the consumers mentioned. In doing so, each criterion that the participant mentioned was noted. Similar words that have the same meanings were merged and grouped under one overarching criterion.

After the set of lexicons was developed for potato and sweet potato, two experts in the agriculture field (for inter-rater reliability) rated each produce's criterion on a 10-point scale; 10 ranging from most aesthetically pleasing to most displeasing (1).

Finally, experts' ratings for each criterion were compared against participants' mean ratings of each produce. This shows which criteria have the strongest correlation to the overall rating of a produce, which is useful in defining high to low aesthetic preferences for each produce item.

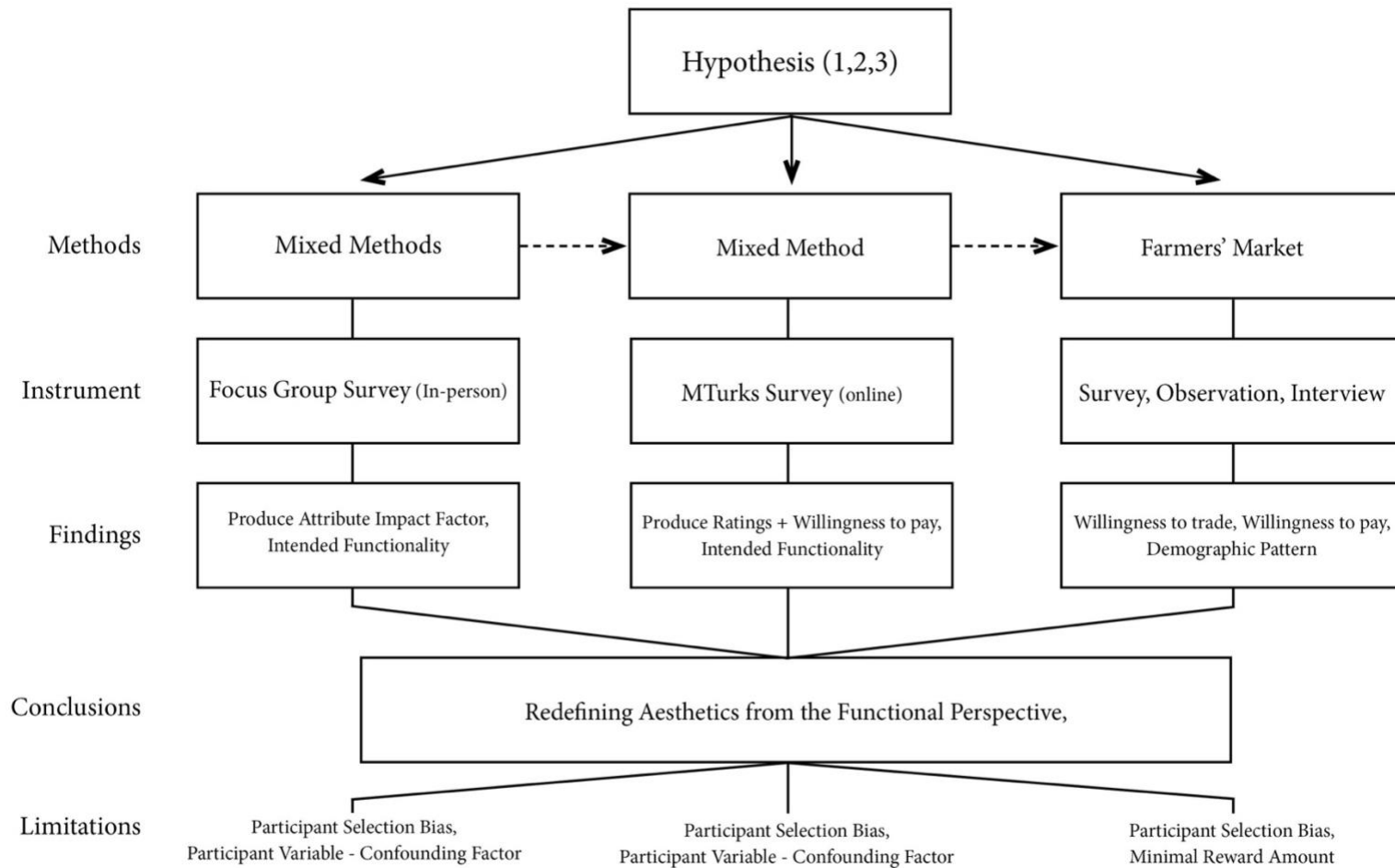


Figure 9. Diagram of methodologies across studies



Figure 10. Study1 Setup

4.1.2 Results

Six overarching criteria were identified: Surface (skin quality), freshness, size, shape, firmness, and color. The chart shows the frequency of which each criterion was mentioned during the participant interview illustrating the level of significance of each criterion to each participant when considering produce aesthetics.

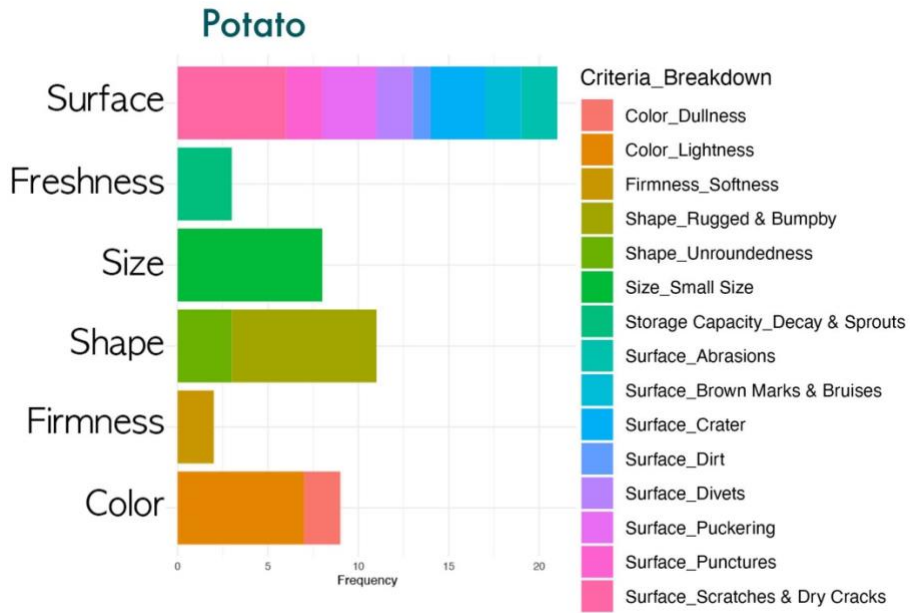


Figure 11-1. Potato - Criteria Preference Frequency Graph

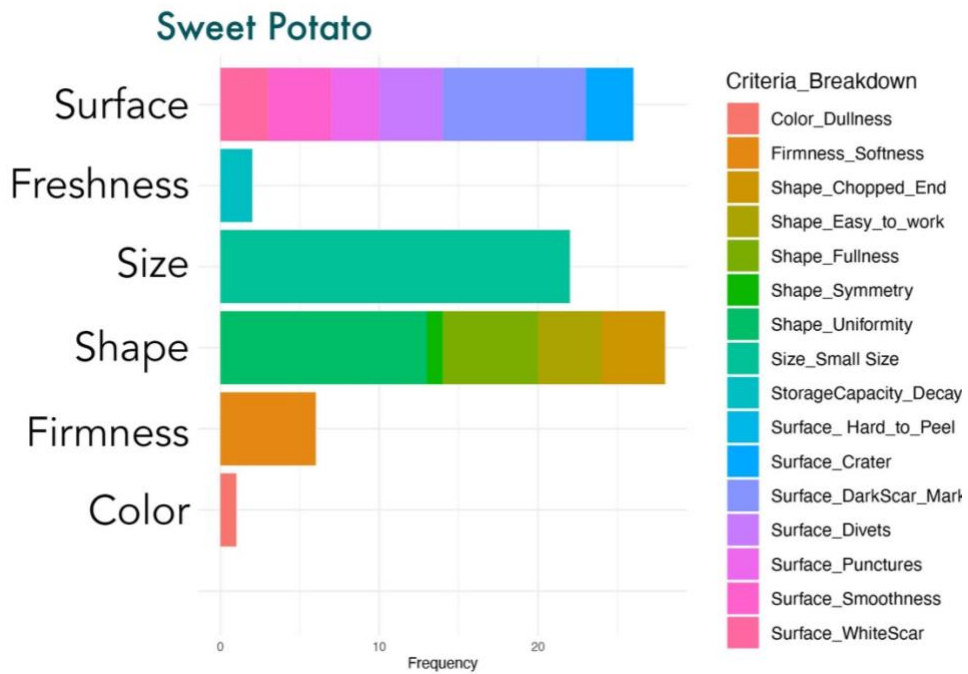


Figure 11-2. Sweet Potato - Criteria Preference Frequency Graph

Table 1-1. Potatoes –Expert’s individual attribute rating vs. average overall rating

POTATO																
Expert ratings -----																
Predictors	User Rating	Size (1 criterion)		Shape (2 criteria)		Color (2 criteria)		Surface (8 criteria)					Firmness (1 criterion)	Storage Capacity (1 criterion)		
		1 Small Size	2 Unrounded	3 Rugged and Bumpy	4 Light Color	5 Dull Color	6 Scratches, Dry Cracks	7 Abrasions	8 Punctures	9 Crater	10 Puckering	11 Brown Marks and Bruises	12 Divets	13 Dirt	14 Softness	15 Decay
Potato 2A	7.8	3	4	8	5	2	10	9	0	0	0	7	9	5	5	5
Potato 1B	7.4	6	3	2	5	6	7	1	0	8	0	2	7	2	1	2
Potato C	8.6	3	3	8	5	3	5	0	0	0	9	6	9	5	4	4
Potato D	8	5	4	6	7	6	9	1	4	0	8	7	3	2	5	5
Potato 6E	8.4	2	2	10	6	9	1	2	0	0	0	9	7	7	3	3
Potato 4F	8.4	3	4	10	5	7	3	1	2	0	0	8	7	3	2	3
Potato G	3.4	7	2	7	2	9	3	7	0	0	0	1	4	2	1	2
Potato 3H	2.8	5	2	1	8	0	2	2	2	0	0	0	3	1	2	0
Potato I	3.4	8	3	3	2	2	2	1	0	0	0	0	6	1	1	1
Potato J	2.6	5	3	8	3	8	3	4	2	0	0	0	5	1	1	2
Potato K	2.6	10	1	0	1	1	2	1	1	0	0	0	3	1	1	1
Potato 7M	4	4	1	2	8	10	2	1	0	0	0	2	4	5	5	3

Note1: Potato 5 - not used in the pre-study, Used in 2nd mass participant rating study & WTP study

Note2: The higher the number, the more ugly. (1 = Aesthetically pleasing, 10 = Aesthetically displeasing)

Note3: The Bold Potato ID's are the ones used for 2nd mass participant rating study. The Bold-underlined are the ones used in WTP study.

Table 1-2. Sweet Potatoes – Expert’s individual attribute rating vs. average overall rating

Sweet POTATO		Expert ratings																
Predictors	User Rating	Size (1 criterion)		Shape (5 criteria)				Color (1 criterion)			Surface (7 criteria)				Firmness (1 criterion)	Storage Capacity (1 criterion)		
		Small_Size	Thin_Mass	Uneven_Diameter	Aymmetric_Shape	Chopped-End	Easy-to-work	Dullness	Punctures	Craters	White_Scars	DarkScar_Marks	Divets	Hard_to_peel	Bumpy_and_Rugged_Surface	Softness	Decay_and_Sprouts	
S.Potato A	9.4	8	8	7	7	2	6	7.5	1	0	6	6	2	10	9	7	8	
S.Potato B	8.8	7	7	6	8	0	8	7	1	0	6	3	1	9	8	7	8	
S.Potato C	8	4	8	5	9	7	9	6	1	0	4	1	1	9	4	2	3	
S.Potato D	8	5	5	4	7	7	8	5	1	0	6	4	2	10	10	5	5	
S.Potato E	5.8	0	0	10	10	1	2	4	1	0	1	1	0	3	2	1	3	
S.Potato F	9.8	9	10	1	1	1	8	4	1	0	10	7	7	8	10	8	9	
S.Potato G	5.6	7	6	8	8	0	0	8	1	0	3	1	1	7	2	1	1	
S.Potato H	6.8	3	4	8	9	0	7	2	1	0	3	2	1	6	2	1	2	
S.Potato I	3	2	2	1	1	1	1	7.5	7	9	3	1	1	1	4	1	1	
S.Potato J	3.2	2	1	1	2	1	0	6	4	2	3	1	0	0	2	1	0	
S.Potato K	2.4	0	0	1	1	8	0	6.5	3	0	2	2	1	0	1	1	1	
S.Potato L	3.4	2	1	1	1	1	1	5	0	0	4	1	1	0	2	0	0	

Note: The higher the number, the more ugly. (1 = Aesthetically pleasing, 10 = Aesthetically displeasing)

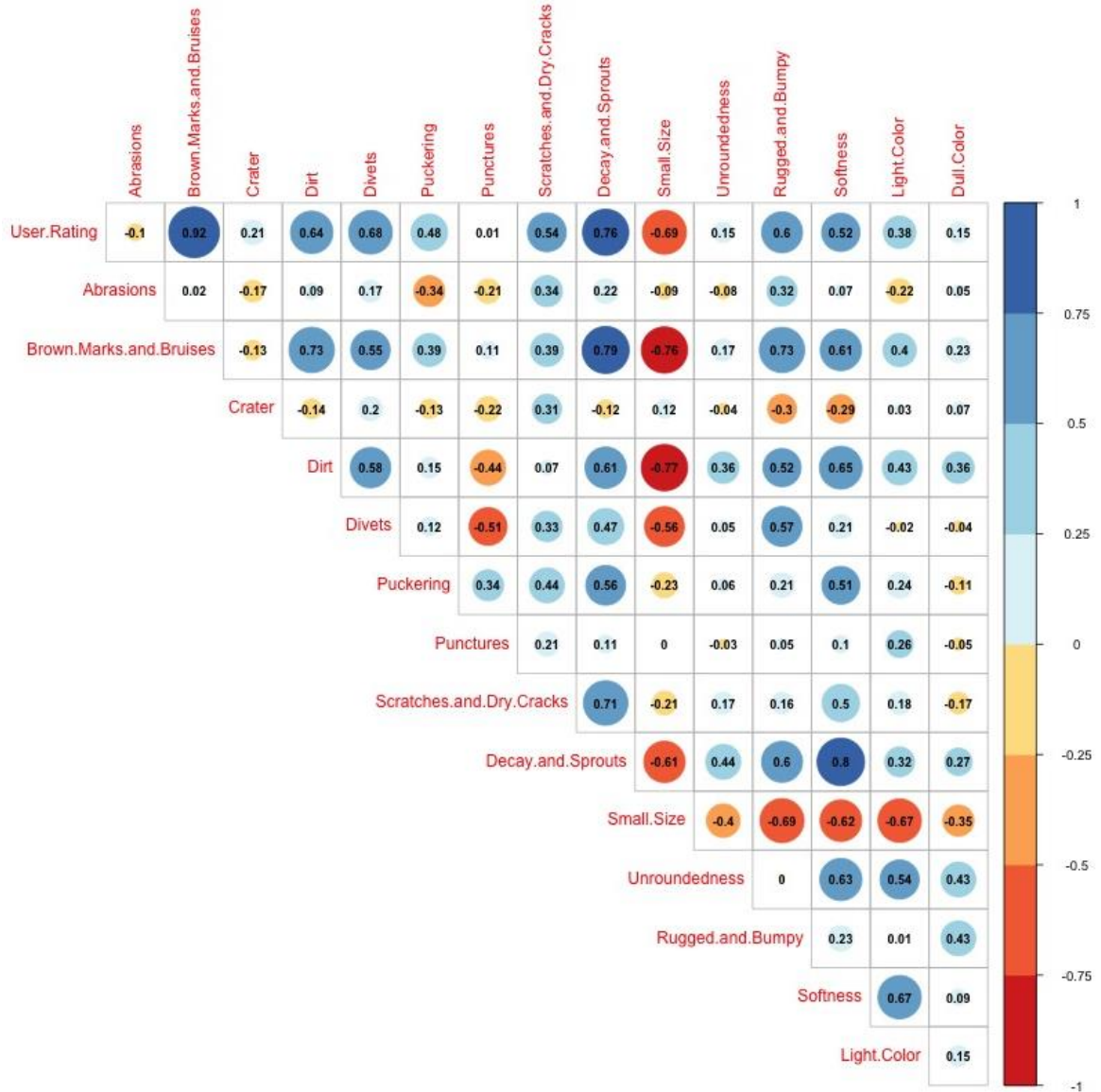


Figure 12-1. Potato criteria correlation matrix

The matrix shows the correlation between experts' attribute rating and the overall produce ratings by survey participants. The potato was rated with 15 attributes by experts while the sweet potato was rated with 16 attributes. Two experts rated each produce with each of the 15-16 attributes.

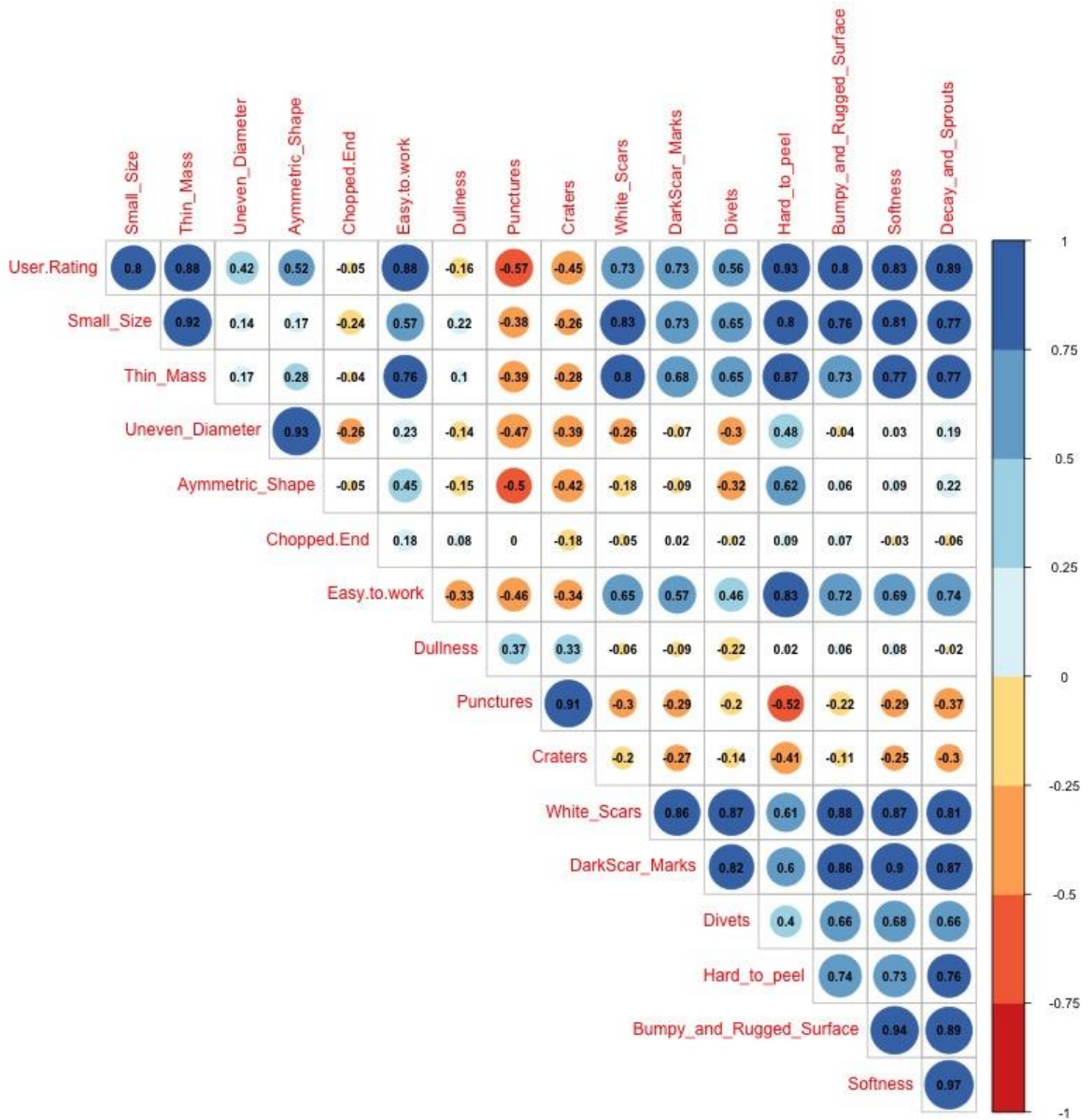
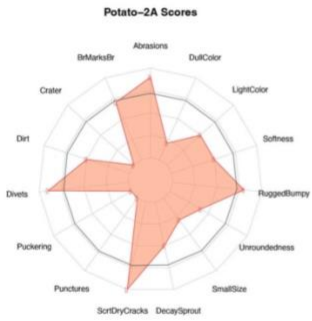


Figure 12-2. Sweet potato criteria correlation matrix



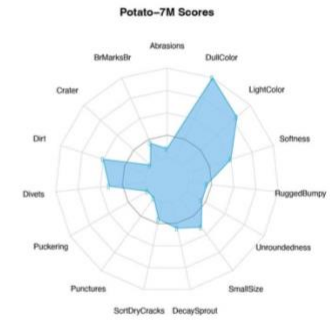
Average Rating: ●●●●○

Average Rating: 3.9/5



Average Rating: ●●●●○

Average Rating: 4.2/5



Average Rating: ●●○○○

Average Rating: 2/5

Figure 13. Spider character chart for three select potatoes

The map allows us to examine the impact of a few attributes on the potato's overall rating. The spider character chart was created based on two experts' ratings for each individual attribute. The dark line in the chart indicates the overall average rating of the potato.

<u>Potatoes</u>				<u>Sweet Potatoes</u>									
Bake	■	■	■		Bake	■	■						
Eat with Butter	■	■			Eat with Butter	■	■						
French Fry	■	■			French Fry	■	■	■	■	■	■	■	■
Sauteed	■				Sauteed	■							
Salad	■				-								
Roast	■				-								
Boiled	■				Boiled	■							
Mashed	■				Mashed	■	■	■	■				
Soup	■				-								
Casserole	■				Casserole	■							
Crockpot Slow cook	■				-								
-					Tots/Shredded	■	■	■					

Figure 14. Intended utility of potato and sweet potatoes
The result is based on 10 participants verbal responses from study 1. The number of blocks indicates the frequency of which each method was mentioned.

4.1.3 Evaluations

The assumption of this (pre)study was that there is an inherent consensus, in terms of the attributes people care about the most, regardless of the produce type. Attributes such as symmetry were assumed to be one of the greatest factors impacting consumer behavior. However, findings illustrate that the most important attribute people value the most for potatoes and sweet potatoes was surface-related imperfections. Attributes stated by participants were processed and categorized into six analytic categories: Surface, Freshness, (Berterö, 2012)Size, Shape, Firmness and Color. The six keywords were deduced from the natural themes that emerged from the collected qualitative data, that is not from preconceived logical hypotheses which is a common methodology used in grounded theory (Berterö, 2012). Attributes that had the most impact on consumer preferences among the surface-related category include *brown*

marks and bruises, bumpy and rugged surfaces, followed by scratches and dry cracks.

The attributes for potatoes were compared to the United States Department of Agriculture's inspection guidelines for potatoes to examine whether the food industry is using criteria that match consumers' preferences. The 2015 inspection manual for potatoes (USDA, 2015) is included in the appendix. In short, the industry criteria matched the data from this pre-study. It is noted that the potato should be off size within tolerance. If a potato is 2 inches in diameter or 4-10 ounces in weight, it is considered a "B" grade. Uniformity is also assumed. On one of the notes, the inspection manual says, 'Do not range defects, since there is only one sample.' This implies that potatoes from one batch should have similar shapes and sizes, which is an attribute that has nothing to do with the taste or freshness. The same attributes that were mentioned by survey participants (representing consumers) were indicated as important criteria on the inspection sheet. Examples include size, freshness (sprouts, growth, rot), brown marks & bruises. The official terminology for brown marks and black dots is silver scurf rhizoctonia (or bruises) respectively. Dull color is often referred to as discoloration and abrasions are referred to as cut and cracks in official terms. The inspection sheet also includes vague terms such as 'within tolerance' and 'off size', which is somewhat subjective and could vary among people inspecting the sample. In addition, potatoes with silver scarves are known to be harmless and safe for consumers. Consumer education is needed to inform this fact. Marking down potatoes with silver scarves as a lower grade produce is not only causing many

potatoes to be wasted, but distorting consumers' perception about what a 'perfectly edible' and "normal" potato should look like.

In the sense that both potatoes and sweet potatoes are root vegetables makes them have similar aesthetic standards. Their preferred cooking methods were also very similar with a slight difference. For sweet potatoes, criteria were slightly different although potatoes and sweet potatoes are both similar types of produce. The most frequently mentioned criteria are also ones that have the most correlation with the experts' ratings for sweet potatoes. These are: *ease of peeling, thin mass, easy to work with* followed by *bumpy and rugged surface* and *small size*. Interestingly, size was negatively correlated with potato preferences (smaller potatoes were preferred) whereas size was positively correlated for sweet potatoes, (larger sweet potatoes were preferred). This, however, cannot be concluded from this limited data or by simply looking at the correlation chart as smaller potatoes from this survey may have been the ones that had the smoothest surfaces, acting as a confounding factor. Another reason for determining size information to be inaccurate is that experts were rating sizing of a produce on the screen. Although all produce were taken from the same camera angle on the same spot, it would be hard for experts to determine how big or small an item is. Therefore, correlation regarding size is omitted from the analysis. Overall, from the verbal data, people cared more about the size and shape in sweet potatoes than for potatoes. This may have a relation to the desired cooking method which showed some differences as shown in figure 14. The data indicates that sweet potatoes are cooked in a wider variety of uses, that typically require the shape to be

more preserved (e.g., bake, roast, boil). Noticeably more people preferred to cook potatoes in a way that does not require the shape to be preserved (e.g., French fry, mashed, tots). The intended functionality from the human-centered perspective may be the key in explaining how people perceive produce aesthetics. The relation to the functionality will be discussed further in the next discussion section.

4.1.4 Discussion & Implications

The findings indicate 1) further exploration is needed to scaffold the meaning of aesthetics especially in the context of modern social demands, and that 2) there is a need to redefine aesthetics with the new lens that integrates more relevant components of this era, such as *functionality*, *environmental sustainability*, and *curated appetite*.

Belying the assumption that the most important attributes of a produce would be consistent throughout different types of produce, and that they would be similar to those we normally think of as important aesthetic criteria (e.g., symmetry), the attributes that people cared about the most varied noticeably in several ways, between produce, between people and between survey modes. This implies that we do not know much about what “perfect aesthetic produce” means, and how the assumptions about ‘what people want, and don’t want’ may be flawed.

There are multiple explanations for people’s perception about produce aesthetics:

1) Firstly, it could be that people didn't have much access to the varying ranges of produce aesthetics as a result of strict and exorbitant inspection policies. Consumers' initial encounter with produce can heavily affect people's perception about how produce should appear. Over time, we may have been primed to think 'what looks okay' and 'what doesn't'. Unless one grows their own produce or visits farms, a consumer's interaction with produce has been filtered by grocers and media such that irregular and less aesthetically pleasing produce do not get presented in a regular manner.

2) Secondly, there could be an evolutionary factor: survival instincts that have prevented us from eating abnormally shaped foods due to safety reasons may still exist. We are moving away from this notion as attributes that people preferred were not necessarily linked to safety issues.

3) Lastly, and perhaps most important for this thesis, is that people think about *functionality*, when they are considering the *aesthetics* of goods for a purpose. Form has an impact on function, and for many years, aesthetics has been associated with the functionality of a product/design/architecture. Prior literature has also classified a product design in two-fold; form (hedonic) and function (utilitarian) based (Kumar & Noble, 2016). Similar principles apply to a produce item. In order to make French fries, mashed potatoes, and tater tots, the skin of the potato is typically peeled. To peel the skin, it has to be in a shape that can be easily held. A larger potato, for example, may have a greater mass to surface area ratio which reduces the overall peeling time for the same volume of potato. Perhaps, people are more attracted to the

object if it requires the least amount of effort for the same outcome. On that note, if a produce can be marketed based on cooking method and sold at different venues and locations, this could serve as a novel marketing strategy diverting consumers' purchase intentions for the cosmetically imperfect produce. To some degree this is currently happening with very small potatoes which are packaged separately and sold as a luxury or gourmet product for quick cooking time and for uses in dishes that do not require peeling.

The findings of this section allow us to reconsider *aesthetics* from a broader perspective. Defining aesthetics should begin by scaffolding humans' perceptions, needs, and our awareness for the environment. The definition should reflect who we are and how we live today just in the same way the word "function" should not be interpreted in the same sense of direct applicability (Janson, 1982). This broad term for aesthetics could provide solutions for food being wasted due to conventional aesthetic standards.

4.2 Study 2: Relationship between aesthetic attributes and willingness-to-pay

4.2.1 Material and Methods

In the second phase of this work, an online survey was conducted to scaffold the meaning of aesthetics for three different types of produce: onions, carrots, and potatoes. The survey was set up to capture (real) consumers' willingness-to-pay (WTP) for the varying degrees of produce aesthetics. This study considers WTP as an important indicator as a mere verbal statement or a rating may not reflect true

consumers' perception about the produce. This study examines WTP in relation to the consumers' ratings. The WTP will be compared to the overall aesthetic rating of produce. The related hypothesis for this study is that the WTP will be significantly lower than the numerical ratings of aesthetics.

There are two parts to this study. In the first part, participants are asked to rate overall produce rating for seven of each of three types of produce. The seven produce presented showed a range of aesthetics chosen by the researcher (based on insights provided by the first study). In the second part of this study, participants are asked for WTP for three varying degrees of aesthetics for three produce respectively. This will allow us to see how much of a discrepancy there is between consumers' numerical ratings and willingness-to-pay when it is converted proportionately to numerical value. All participants received all three types of produce and with all levels of aesthetic quality in their surveys.

A total of 330 online surveys were distributed and 279 participants completed the survey. The survey was created using Qualtrics and distributed through various channels. 165 responses were collected through Amazon Mechanical Turk (MTurk) which rewarded payments ranging from \$0.10-\$0.12 per survey participant. The first 12 MTurks participants were awarded \$0.12 and the rest were awarded \$0.10. 114 participants were recruited through the researcher's college network email, and via the researcher's social network platform. Among the 279 participants, 145 (52%) were men, 130 (46.6%) were female and 4 (1.4%) stated their gender as others. In

addition, income range between \$55,000-\$100,000 was the majority with 96 participants (34.4%), followed by 88(31.5%) of \$32,000-\$55,000, 51(18.3%) of 32,000 or less, 41(14.7%) of \$100,000-350,000 and 3(1%) of \$350,000 and above. Multiple answers that did not seem valid were omitted from each section under the discretion of the researcher for a more accurate data analysis. As a result, the sample size was 238 for potatoes, 234 for onions, and 240 for carrots.

Survey part 1 and part 2 were administered in a counterbalanced way. Set 1 contains questionnaires about aesthetic ratings and Set 2 contained questionnaires about participants' willingness-to-pay (WTP). Some received set A first, and some received set B first to balance out the bias effects.

Objective

Obtain aesthetic ratings for three types of produce (carrot, onion and potato) and compare their numerical ratings' average to willingness-to-pay values. Another purpose is to examine if there are any noticeable differences in the uses among three varying degrees of produce of one type. This would allow us to verify any unspoken rationales behind preferring a more aesthetically pleasing produce.

Outcome Products

1) Survey participants' overall aesthetic ratings, in numerical value (Likert scale of 1-5), for seven of the three different types of produce (onion, carrot, and potato)

- 2) Willingness-to-pay value for each produce by each survey participant. Full price information was provided, and each participant selected their response by dragging a cursor to 5 evenly spaced points.
- 3) A comparison of 1) & 2)
- 4) The difference between online and in-person results.
- 5) participants' intention to use the given produce differently based on their visual assessment of them. Responses were in Yes or No format.
- 6) Participants' uses (e.g., cooking method) for each produce provided if they responded they would use it for different purposes.

Procedures

Participants were given either set A or set B. On set A, participants were shown seven carrots first. They were asked to rate the aesthetics of each carrot by click-dragging and placing them on a numbered box 1-5. Each box was indicated with a short description: 1 = Aesthetically pleasing, 2 = Somewhat aesthetically pleasing, 3 = Neutral (Not pleasing nor displeasing), 4 = Somewhat aesthetically displeasing and 5 = Aesthetically displeasing.

Each image was created in an animated image format (GIF) to provide a 360-degree view of a produce as shown in figure 15-1. The intention of creating the image in this rotating view was to avoid participants from making aesthetic judgment based on one side of the produce only. Since conducting in-person surveys were limited due to COVID-19 protocols, this format was devised to provide the closest visual experience

to consumers as possible to the in-person experience. The GIF image was created by Sirv online service platform.

Beneath each produce image, a small text box was provided prompting participants to note the reasoning for giving such a rating to the produce. This applies to all produce types administered in the survey. After the participant completed rating all of the carrots, the participant was then shown seven onions and asked to do the same for what they did for carrots. Then, on set A, the same procedures were repeated for potatoes.

Set B follows a different format as Set A in which participants are asked first about WTP. In set B, the first question asks how much the participant is willing to pay for one pound of carrot for the three different carrots. For this round, only three select carrots of varying aesthetics are shown. Participants are asked to select their willingness to pay by dragging down a cursor that adjusts the WTP amount as shown in figure 15-2. The produce's actual retail market price is provided in the given format: \$0.XX/pound; Carrot - \$0.77/pound, Onion - \$1.05/pound, Potato - \$0.60/pound. Following the carrot WTP question, the same questions are asked for onions and potatoes.

The final part of this study consists of questions related to demographics and personal information including:

- a. What is your gender?

b. What is your annual household income?

Participants are asked to select from these options: \$32,000 or less, \$32,000-\$55,000, \$55,000-\$100,000, \$100,000-\$350,000, \$350,000 and above.

Participants are thanked for their participation. If the participant is an MTurk participant, they are asked to copy the given value and paste into MTurk to receive payment for participation.



Figure 15-1. Example figure of survey interface
Multiple individual snapshots of a rotating GIF image were provided

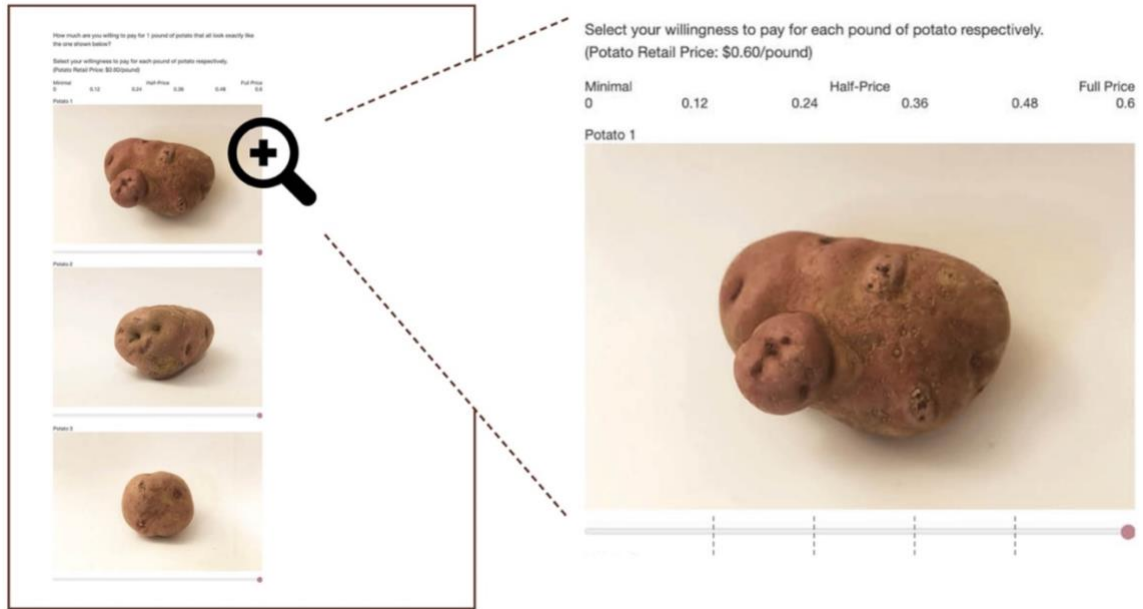


Figure 15-2. Online survey interface example
 Participants were asked to slide the red dot to the left to state their WTP for each given potato.

4.2.2 Results

In general, WTP for each produce was significantly lower than its overall average aesthetic rating. The decrease in value ranged from -2%~-28% for potatoes, -10%~-35% for carrots, and -22%~-0.5% for onions. The WTP for Potato 6 was minimally higher (+6%) than its aesthetic average rating.

The difference of average aesthetic ratings between online and in-person surveys was also noticeable, with in-person ratings being significantly lower than online survey results.

In the functionality question, produce with lower aesthetic ratings were described by participants to be used for a wider variety of uses. This was evident for potatoes and carrots but not for onions. Results are shown in figure 16, 17, 18 and table 2.

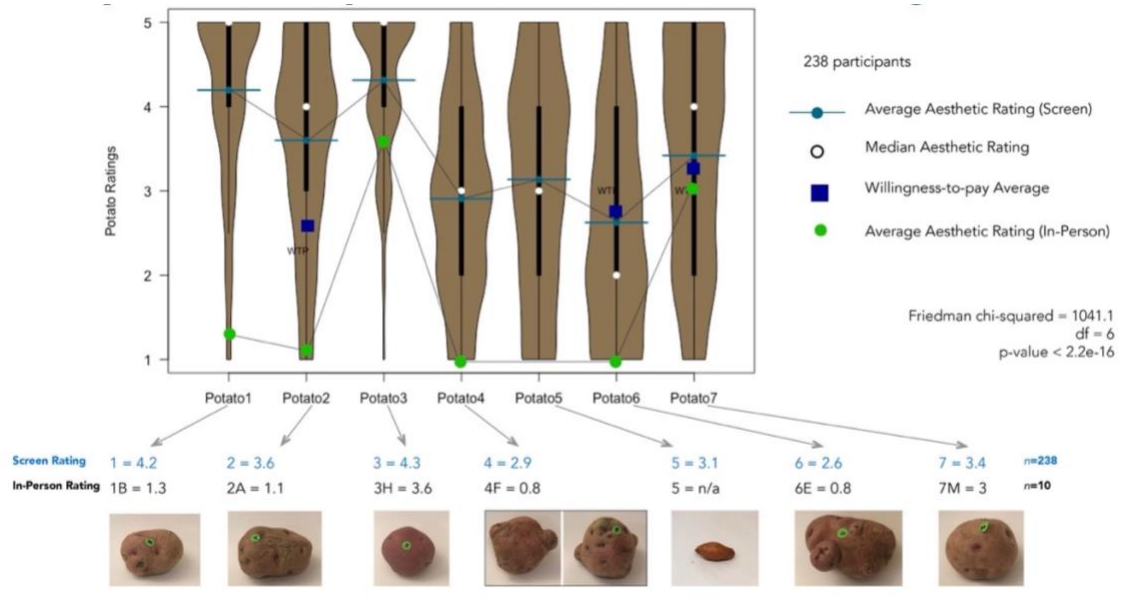


Figure 16-1. Potatoes’ average aesthetic online survey ratings and average in-person survey ratings in violin plot

Table 3. Difference between screen (online) vs. in-person survey ratings for potatoes
This information is also illustrated in the violin plot in figure 16-1 above. The significance test between screen (online) and in-person evaluation was not conducted as sample size difference was too large.

	Screen Online Survey (n=238)	In-Person Survey (n=10)
Potato 1B	4.2	1.3
Potato 2A	3.6	1.1
Potato 3H	4.3	3.6
Potato 4F	2.9	0.8
Potato 5	3.1	n/a
Potato 6E	2.6	0.8
Potato 7M	3.4	3

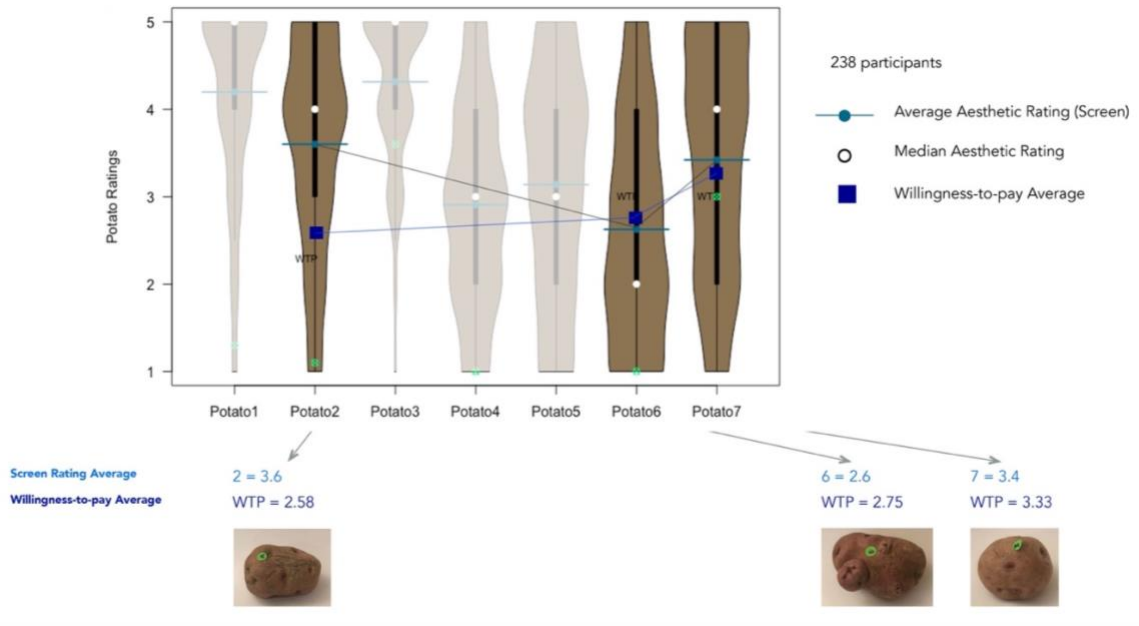


Figure 16-2. Comparison of potatoes' average aesthetic ratings and WTP in violin plot (Only three select potatoes were surveyed for WTP to avoid survey fatigue.)

We have sufficient evidence to conclude that each potato's aesthetic is significantly different from other potatoes' aesthetics based the statistical analysis of the ratings. A Friedman rank sum test was conducted to examine differences in rating (Friedman chi-squared = 1041.1, $df = 6$, p -value < $2.2e-16$).

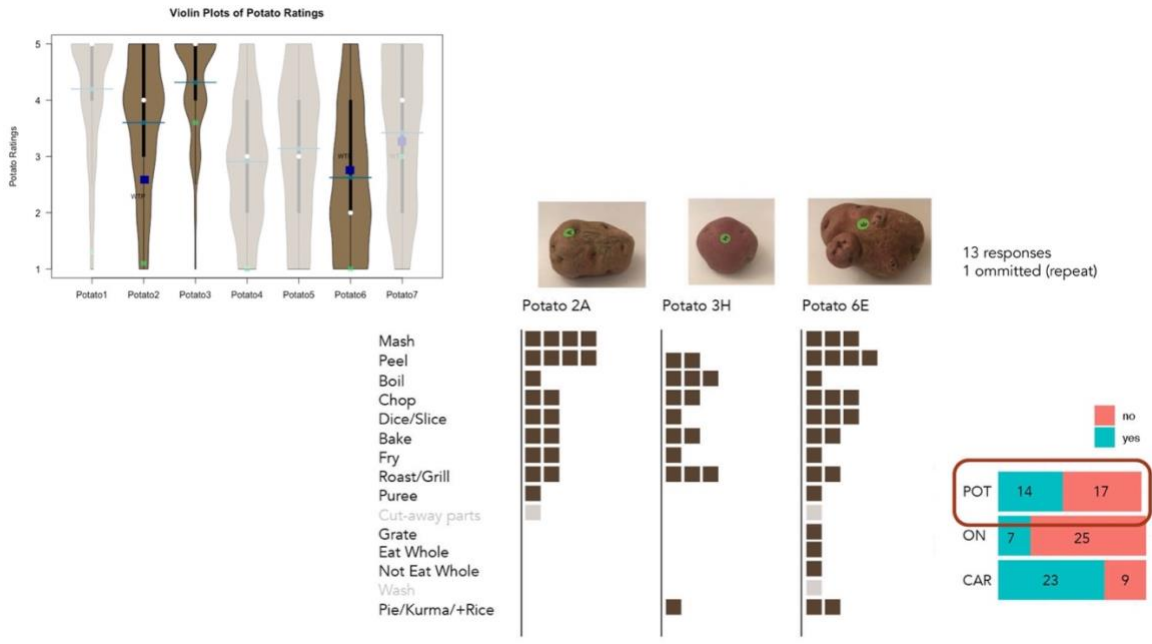


Figure 16-3. Intended functionality response chart for potatoes
 The bar on the bottom of the right-hand corner indicates the number of people who responded “Yes” and “No” to the question, “Would you be using potatoes differently because of the way they look?”

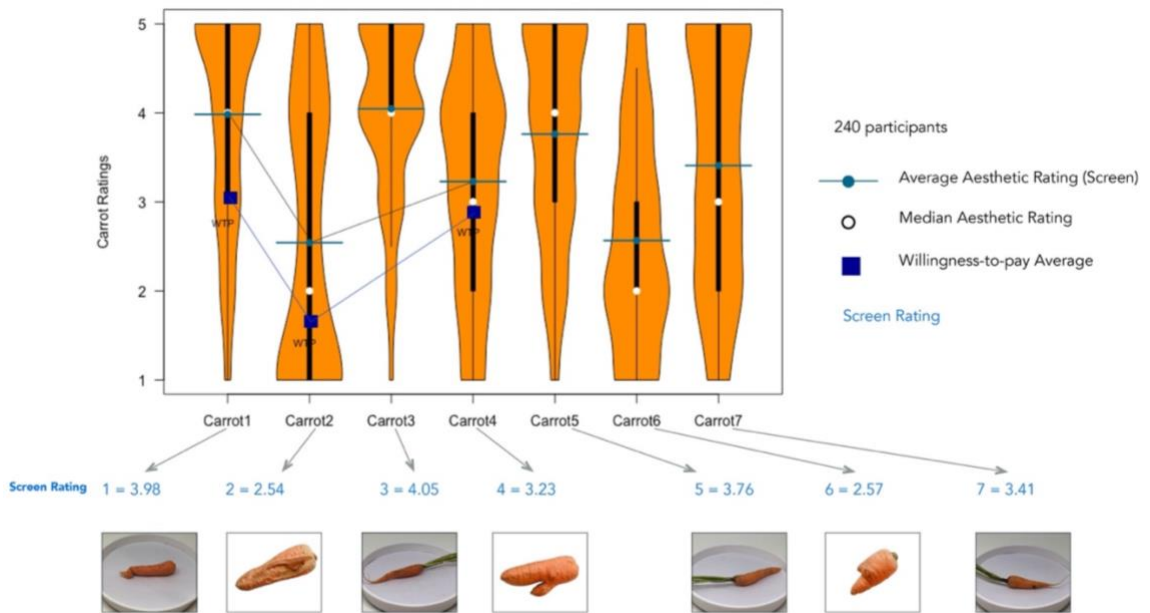


Figure 17-1. Comparison of carrots’ average aesthetic ratings and WTP in violin plot

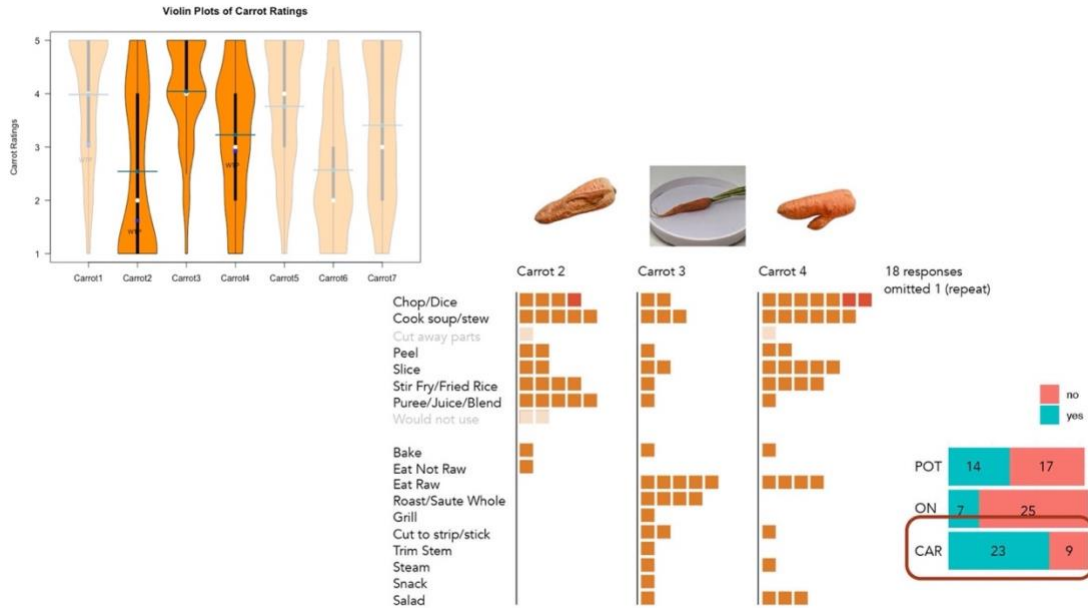


Figure 17-2. Intended functionality response chart for carrots
The bar on the bottom of the right-hand corner indicates the number of people who responded “Yes” and “No” to the question, “Would you be using carrots differently because of the way they look?”

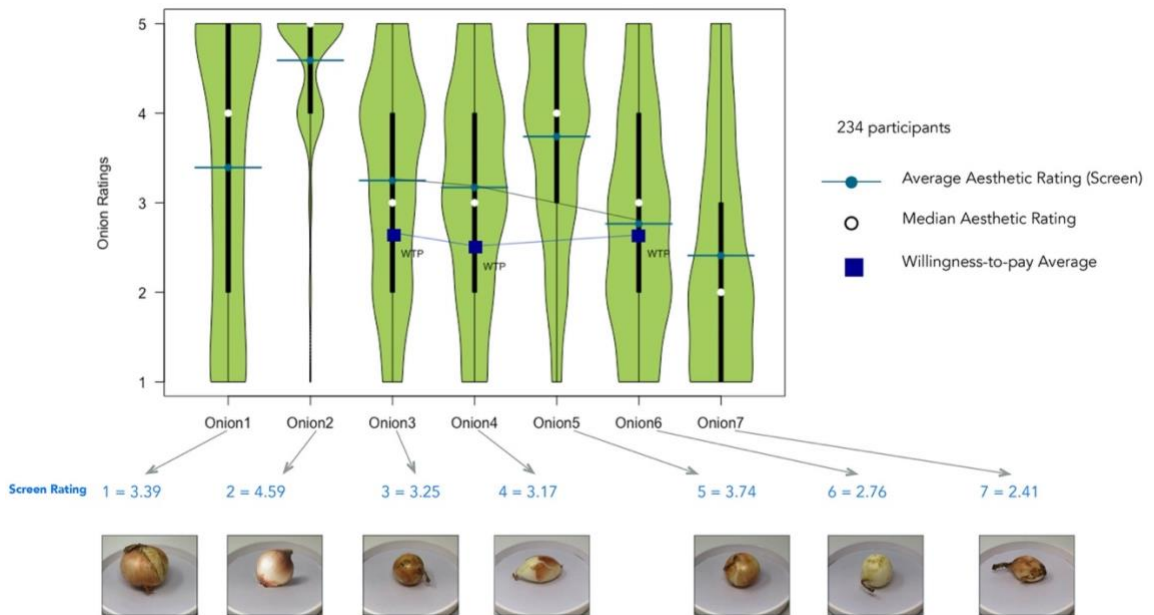


Figure 18-1. Comparison of carrots’ average aesthetic ratings and WTP in violin plot

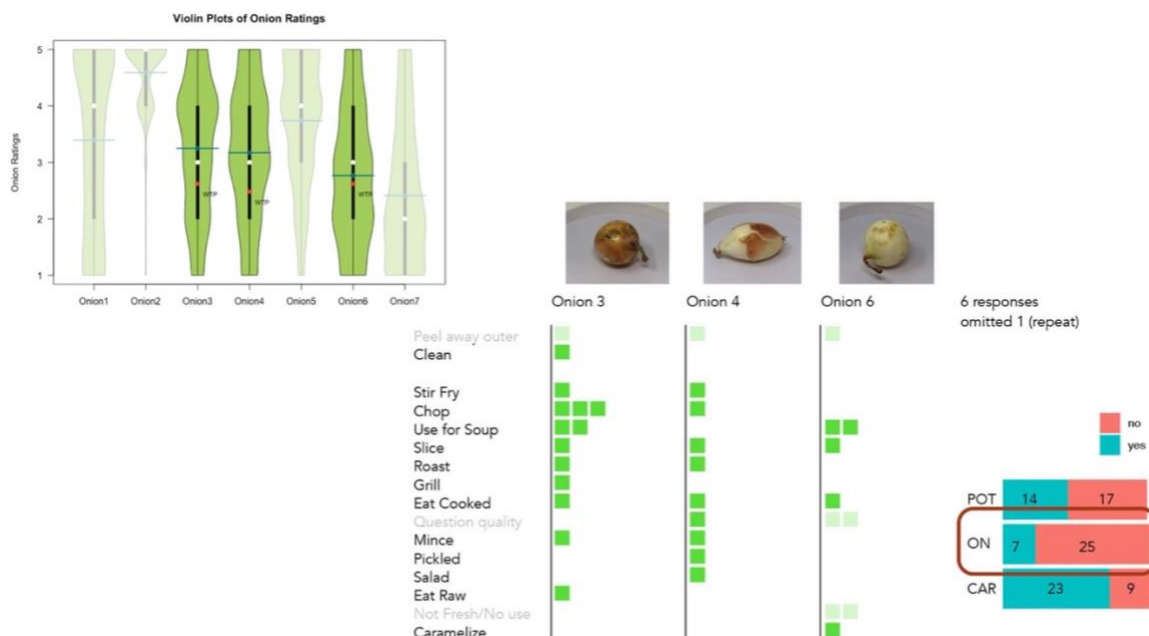


Figure 18-2. Intended functionality response chart for onions
 The bar on the bottom of the right-hand corner indicates the number of people who responded “Yes” and “No” to the question, “Would you be using onions differently because of the way they look?”

4.2.3 Evaluations

Although aesthetic rating and WTP are in different units, comparison of depreciation rates in aesthetic rating (from perfect 5-point scale) to depreciation of WTP (from a full price scale) is possible. It was hypothesized that the depreciation of aesthetics would be linearly proportional to depreciation of willingness-to-pay (WTP) from full price scale. For example, a perfect or unblemished product would get full market price whereas produce with some number of aesthetic imperfections that is below consumer expectation would result in a linear depreciation of WTP from market price. Depreciation of WTP was found to be significantly lower than the depreciation of average aesthetic ratings for most produce. The one produce that had a higher WTP than its average rating is potato 6E, with an overall rating of 2.6 and WTP of

2.75, which is close enough to conclude that they were at least the same. When it comes to evaluating monetary value of the produce, people were more reserved than when rating aesthetic value alone.

This finding reinforces the first study, which found that surface imperfection is the most influential factor determining consumer preferences. The distinctly low WTP for potato 2 and carrot 2 supports the notion found from study 1 as those had the highest levels of surface imperfections. Potato 2 has the most severe level of surface imperfection with deep, visible scars on the surface. Carrot 2 also had the most imperfect surface among the three carrot options. The differences between WTP and the overall aesthetic rating were the greatest for both (Potato 2 and Carrot 2), verifying the observation that the “uglier” it is (having traits that people dislike), the greater WTP deduction rate is compared to “less ugly” ones.

The hypothesis prior to conducting the study was that shape or symmetry would have a greater impact on overall aesthetic value. The fact that carrot 4 and potato 6, which are two asymmetric and irregular shaped options among the same produce type, were rated higher than carrot 2 and potato 2 (ones that had the most surface imperfection) demonstrates that our hypothesis was perhaps not supported.

The discrepancies between the online ratings and in-person ratings were the greatest for potatoes 2, 4, and 6. The significance of surface imperfection could explain this discrepancy. When potatoes were shown in-person, people were better able to feel

and sense the surface imperfections more so than viewing the potato in an image on a screen.

Compared to potatoes, carrots showed WTP depreciation rates that are equally lower for all three carrots. For potatoes, the one that had surface imperfection had the lowest relative WTP compared to the average aesthetic rating. For onions, the WTP for onion 3 and 4, were similarly lower than their average overall aesthetic rating. Onion 6, which was presented without a peel, showed WTP depreciation value that was almost equal to the depreciation rate of the overall rating.

The average reduction rate between overall rating and WTP was, -28% ~ -2% for potatoes, -23% ~ -1% for carrots and -22% ~ -5% for onions.

Difference Between In-person (study1) & Screen Rating (study2)

Another interesting finding in this study is the difference between in-person ratings and screen ratings. This data is only available for potatoes as in-person ratings were part of the data obtained from study 1. Although the difference may not be statistically significant due to the large difference in sample size (e.g., 10 for study 1 vs. over 238 for study 2), it is worth noting the stark difference in rating between the two modes. This is especially important to note as food is a subject that cannot be evaluated solely by the eyes. It is a subject that involves multiple senses including tactility and olfactory senses. In fact, most people prefer to buy produce in-person rather than through an online platform (Kim Dang et al., 2018; Russell, 2018). Lack

of these interactions would not reflect the consumer's true evaluation. When people can physically interact with the produce and look closer, the shape of the produce seems to play a greater role in determining people's perceptions. Potato 4 and Potato 6, which were potatoes with bumpy surfaces, were rated much lower (approximately -70%) than its screen rating. The one with the severe surface imperfection had a similar rating reduction of -70% while other potatoes' reduction ranged only in-between -20% ~ 12% from online to in-person.

Functionality

In terms of functionality, the "ugly" produce was noted by participants to be cooked for 'mashed', 'diced' or 'fried' for the potatoes and carrots.

For each of the three produce items, the ratio varied between people who responded Yes and No to the question "Would you be using these produce differently because of the way they look?". For potatoes, it was similar in ratio (14:17), whereas for carrots, significantly more people responded 'Yes', they would use them differently (23:9).

On the other hand, people responded it wouldn't make a difference in terms of functionality whether they look ugly or not (7:25). The functionality response table also demonstrates the differences in uses for each produce. The carrot intended functionality response chart (Figure 17-2) shows noticeable contrasts between Carrot 2 and 4. Both the frequency and the uses vary significantly amongst the three carrots. For onions, the frequency doesn't show significant difference, but there seems to be a slight difference in uses, especially in-between Onion 6 and the other two.

For potatoes, the potato with relatively few imperfections (Potato 3H) was indicated to be cooked in a ‘boiled’ method more than the other two potatoes. Common methods throughout all potatoes were to peel, chop, bake and roast. The only noticeable difference was for Potato 6E where people indicated more uses for this compared to the other two potatoes. Similar patterns are shown for Carrot 4, where more people indicated a wider variety of uses despite its odd shape. For those produce with more surface imperfection, people indicated the least uses.

Mixed Feedback regarding Positive and Negative Attributes

Not all negative features were negative to everyone. Likewise, not all positive features were positive to everyone. In reviewing the aesthetics of Potato 7M it was generally round, and symmetrical in shape. This was determined to be a positive feature of 7M (15 count). However, some indicated this potato to be bumpy, lumpy, and deformed in shape (4 count). Similarly, 4 people mentioned sprouts (4 sprouts) while 1 responded that there are no sprouts in this potato. These kinds of mixed reviews were more commonly seen for ‘regularly shaped’ potatoes than for potatoes that had more distinct characteristics (e.g., big bump, or severe scars).

4.2.4 Discussion

As expected, when it comes to what consumers are willing to pay for, the price of an imperfect good becomes more depreciated than the simple perceived value of the good (in numerical rating). The range of depreciation for WTP compared to the

aesthetic rating can go down up to approximately 30% based on this study. Consumer perception and actual purchase behavior warrants a closer as appreciating imperfect produce and actually purchasing them may require a different state of mind.

Furthermore, it is suggested from the comparison of criteria for potato aesthetics from Study 1 and Study 2 that the two different modes of evaluation (e.g., online and in-person) elicited different ranges of aesthetic standards. There were some overlapping intersections too. The similarities between the two modes is that people consistently note attributes related to surface imperfections (e.g., eyes, bumps, bruises, scars) as their main determinants of preference or dislike. People were also more descriptive when they report negative attributes that affect them but more general when it comes to giving details about the positive factors. Potato 2A was described with the words “scarring”, “eyes”, and “uneven surface” while “odd growth”, “lumpy”, and “bumpy” were the most outstanding words used to describe potato 6E. On the other hand, words such as “good”, “fine”, “unique” were frequently used to express positive feelings about the produce without specific details about the attribute of the potato. What was also interesting is that some participants described the produce with phrases like “look unhealthy to eat” and “not too tasty”. Certain aesthetic attributes seem to raise concerns related to taste and health. This occurred less often when participants were able to hold, smell, and see the produce. An online mode seems to appeal more to the participants’ sentiments than the in-person mode evaluations. The mixed review within the potato variants further supports this notion of incongruence among consumer preferences and dislikes.

These results suggest that a “perfect aesthetic produce” is not universal, and that our assumptions need to be reconsidered. Food producers and sellers who have been relying on their acquired knowledge of “acceptable produce” could use this to their advantage and expand the bandwidth of available produce for sale to tap into this wider range of acceptability. Sales channels and venues have increased significantly over the past few years (e.g., effect of pandemic on the food industry). Not only are consumers getting food delivered to their doorstep (which was not very common in the past), but they are also exploring various services that aid them to cook and consume more fresh food. There are also more small-scale value-added sellers who would not require perfect-looking produce.

Based on survey participants’ responses, the “ugly” potatoes are perceived to be used more for recipes that don’t require the shape to be seen. A relatively greater number of participants indicated they would ‘mash’ or ‘dice’ an “ugly” potato compared to a “good looking” one. The same was true for carrots. Interestingly enough, “uglier” potato with a big bump (Potato 6?) was also indicated to be more likely peeled than the other two which is seemingly contradictory given the difficulty of peeling such a bumpy surface. There seems to be consistency in people’s perceived aversion factors for the tuber type vegetables. For tuber type of produce, people indicate they will peel the skin off, and use it for food recipes involving other sauces and spices rather than eat it whole. The incongruence of willingness to peel the bumpy potato may also result from the fact that participants were all assessing the produce via screen. It is

likely that more accurate findings may have been available if this study was conducted in-person.

Another interesting finding is that the “ugly” produce tends to be viewed as more versatile when it comes to cooking methods. For potato 6E and Carrot 4, which had the most irregular shapes among the ones shown, participants indicated a wider variety of uses for them than the normal looking ones. This belies our notion that perfect looking produce will be more useful.

In summary, people do elicit different functionalities depending on the range of aesthetics available to them. Consumers indicate a preference for perfect looking produce, but at the same time, they indicate that the non-perfect shape produce can be utilized for more uses. The irregular shapes do not limit the range of possibilities the produce could be used for, but rather expands the range of uses. This is an important finding as it could bring to light to strategies that have not been used before to encourage people to have an unbiased perception for “ugly” produce.

Making a wider range of produce aesthetic available to the consumers in various ways may be the first step in changing consumers' view on consuming “ugly” produce. Policy makers, marketers, food producers and value-added sellers can use these findings to their advantage and work on creating sub-markets, sub-sections for the varying degrees of aesthetics rather than classifying them as “seconds” which infer a lesser value.

4.3 Study 3: Market Study

4.3.1 Material and Methods

For the last phase of the research, an in-situ farmers' market study was conducted to investigate consumers' actual willingness to pay for reduced, ugly produce items when they are placed next to regular produce (potatoes). Consumers did not pay any monetary value out-of-pocket, but they were rewarded a bag of potatoes for participating in the survey. As part of the survey, they were given a choice to switch their regular looking potatoes to a cosmetically imperfect tray of potatoes with an added monetary value ranging from \$0.50 to \$1.50. By having survey participants take home their choice of potatoes, sales data along with relative WTP were collected in an indirect way (i.e., hypothetical sales data). The regular potatoes are potatoes that would normally be sold by the farmer at the market, and the ugly ones are the ones that the farmer has deemed *seconds*.

Objective

Obtain hypothetical sales data and the willingness-to-pay-price-value for the “ugly” potatoes when they are placed next to the typical looking potatoes. This information facilitates an understanding of consumers' actual behavior that may be different from their verbal statements from Studies 1 and 2.

Outcome Product

- 1) Participants' choice between regular looking potatoes vs. potato seconds.
- 2) The monetary value participants decided to receive as a result of trade-off for the ugly seconds.

- 3) Participants are asked to briefly note their uses for the potatoes they selected.
- 4) A list of “Yes” and “No” for the responses to the intended use question; for those who decided to trade their regular potatoes for the “ugly” tray of potatoes.
- 5) Basic demographic information including age, income level, education level, and gender for external validity.

Note

* All potatoes were all acquired from a farmer who sells at the farmer’s market. They were all fresh potatoes picked around the same time.

*The regular potato sale price was \$2.75/lbs. The second type potatoes were purchased for \$1.50/lbs. (a 45% reduction) from the seller. This reduced cost was just the cost sold to the researchers which was not an option for market goers.

*Considering that the potato price is \$2.75/lbs., 3 levels of discount were given for survey participants. \$1.50, \$1.00, \$0.50, which is 54%, 36% and 18% reduction in price respectively.

Procedures

Two sets of potatoes were displayed apart from each other on a table at a farmers’ market on June 2022 Saturday morning from 8:00 a.m.-10 a.m. Each tray was 3.3-inch x 2-inch and contained approximately 1-4 potatoes depending on the size. One side displayed “seconds” type produce – ugly ones that the seller decided not to sell

in the market. The other side displayed ones that would normally be sold in the market. The stand had a chalkboard sign inviting participants to stop by if they are interested in participating in a survey conducted by a researcher from the College of Design at the University of Minnesota. The sign also indicated that they would receive a free tray of potatoes for participating in the survey. The setup is shown in figure 19-1 and 19-2.

When visitors agreed to participate, they were informed that, by default, they will take one tray of potatoes home from the regular looking side (researcher points at that side). Then they were asked to fill out the demographic information first on the right-hand side of the survey sheet. Next, participants are asked if they are willing to trade their “regular looking” tray of potatoes with the “ugly” ones with some monetary value of \$0.50, \$1.00 or \$1.50. The researcher does not use the word ‘regular looking’ or ‘ugly’, but rather just points at the two groups of potatoes. Participants are informed that all potatoes are fresh without mentioning what distinguishes the two groups of potatoes. Once the participants made the decision, the experimenter takes note of the participant’s decision on the survey sheet. The survey sheet is as shown in figure 19-3.

Lastly, participants are asked to write down what they intended to cook with the potatoes they are taking home. If the participant traded for the “seconds”, they are asked if they would have used the other group of potatoes in a different manner. In this part of the survey, the word “ugly” is used to finally elicit the difference between the two groups of potatoes.

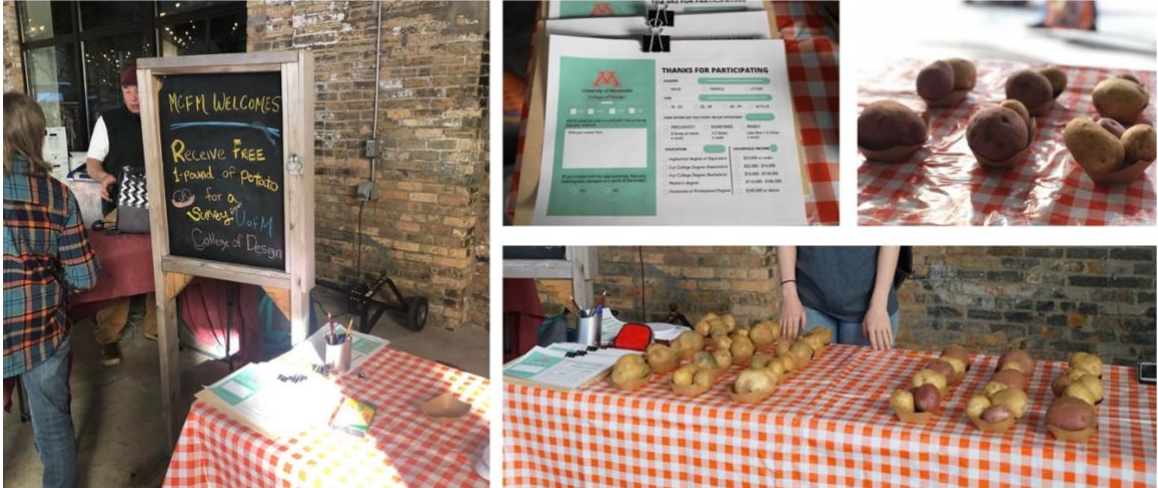



Figure 19-1. Study 3 setup in the Minneapolis Farmers' market in June 2022



Figure 19-2. Close-up of Study 3 setup in the Minneapolis Farmers' market. One side (left) displayed regular looking potatoes that would normally be sold in the market. The opposite side (right) displays the seconds that the farmer decided not to bring to the market due to cosmetic imperfections.



University of Minnesota
College of Design

N/A
 0.50
 1.00
 1.50

WRITE what you plan to cook with the potatoes that you received.

Write your answer here.

IF you traded with the ugly potatoes, has your cooking plan changed as a result of the trade?

YES
 NO

THANKS FOR PARTICIPATING

GENDER

MALE
 FEMALE
 OTHER

AGE

18 - 24
 25 - 39
 40 - 59
 60 PLUS

HOW OFTEN DO YOU COOK OR EAT POTATOES?

FREQUENTLY
3 times or more
a week

SOMETIMES
1-2 times
a week

RARELY
Less than 1-2 times
a week

EDUCATION

HOUSEHOLD INCOME

Highschool degree or Equivalent

\$33,000 or under

2-yr College Degree (Associate's)

\$33,000 - \$74,000

4-yr College Degree (Bachelor's)

\$74,000 - \$118,000

Master's degree

\$118,000 - \$185,000

Doctorate or Professional Degree

\$185,000 or above

Figure 19-3. Image of the farmers' market survey sheet

4.3.2 Results

Table 4. Summary Statistics of Participant Demographics

	Overall n = 32 (%)	
Age in range		
18-24	3	9%
25-39	8	25%
40-59	13	41%
60 plus	8	25%
Gender N		
Female	25	78%
Male	7	22%
Education N		
Highschool Degree or Equivalent	1	3%
2-year College Degree (Associate's)	3	9%
4-year College Degree (Bachelor's)	16	50%
Master's Degree	5	16%
Doctorate or Professional Degree	7	22%
Household income N (State Percentile)		
\$33,000 or under	2	6%
\$ 33,000 - \$ 74,000 (25%-50%)	7	22%
\$ 74,000 - \$118,000 (50%-75%)	1	3%
\$118,000 - \$185,000 (75%-90%)	11	34%
\$185,000 or above (90% or above)	11	34%
Potato consumption frequency		
Rarely (less than 1-2 times a week)	12	38%
Sometimes (1-2 times a week)	15	47%
Frequently (3 times or more a week)	5	16%
Traded for Ugly produce		
Yes - \$0.50	6	19%
Yes - \$1.00	5	16%
Yes - \$1.50	2	6%
No	19	59%
Cooking plan changes due to trade (among the 13 who traded)		
Yes	1	8%
No	12	92%

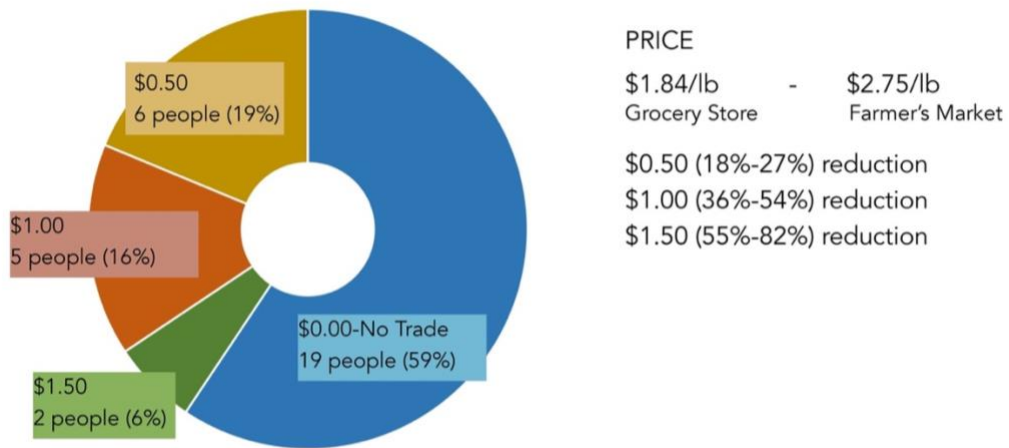


Figure 20. Proportion of participant who traded regular potatoes for the seconds

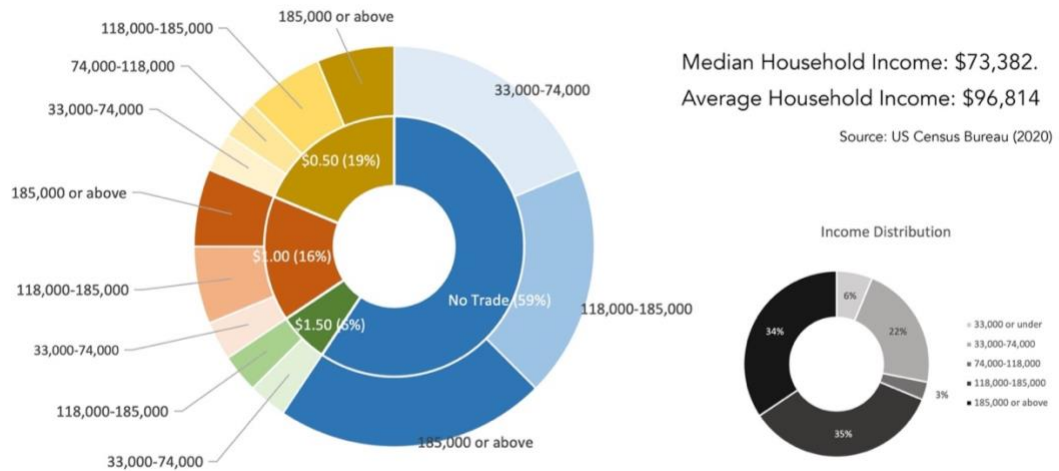


Figure 21-1. Proportion of participant who traded regular potatoes for the seconds in relation to their income

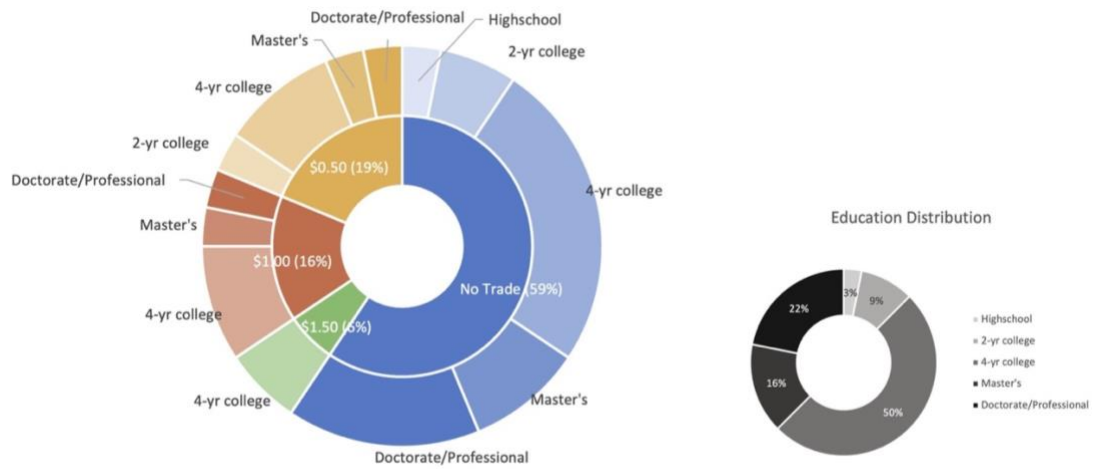


Figure 21-2. Proportion of participant who traded regular potatoes for the seconds in relation to their education

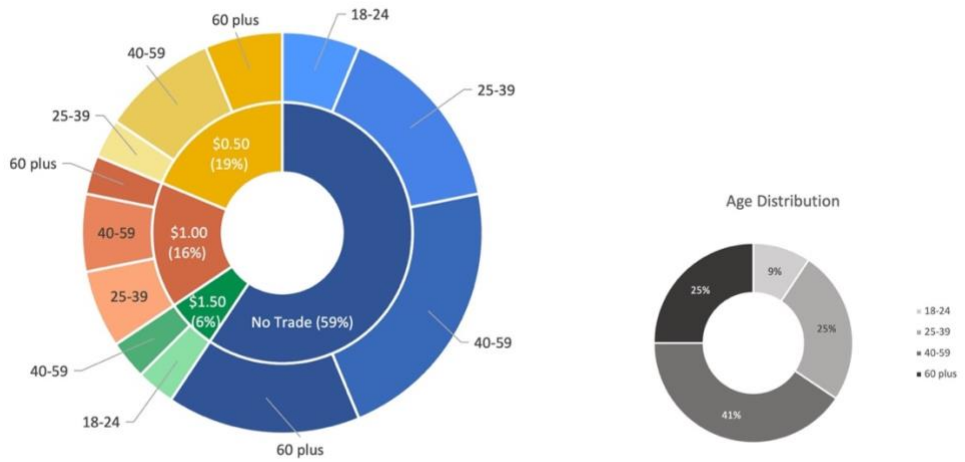


Figure 21-3. Proportion of participant who traded regular potatoes for the seconds in relation to their age

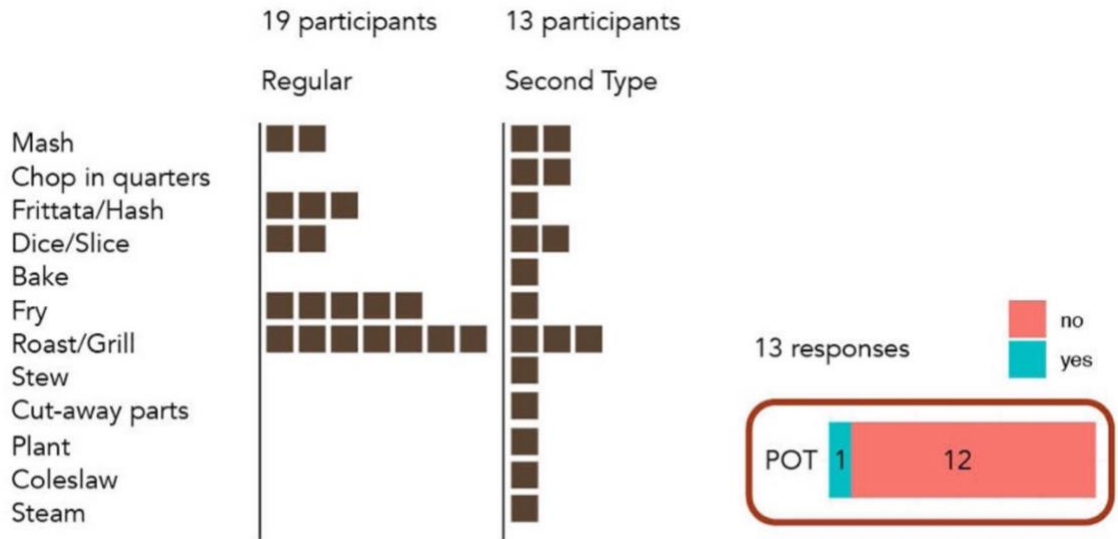


Figure 22. Intended functionality response chart for potatoes in the farmers’ market
 The bar on the bottom of the right-hand corner indicates the number of people who responded “Yes” and “No” to the question, “Would you be using potatoes differently because of the way they look?”

4.3.3 Evaluations

The assumption that people with higher income would prefer to not trade and keep the regular looking potatoes was not supported. Income level did not seem to influence people’s decision. The effect of education level was also similar in that sense. It was hypothesized that the education level would have an influence on how people perceive cosmetically imperfect produce because it was assumed that the more educated consumers are, the more they tend to have higher awareness of the environmental and socioeconomic consequences regarding food waste. Surprisingly there was no impact of education level or income level on willingness to trade.

Overall, more than half of the participants decided not to trade for the ugly potatoes even with an additional monetary reward. Among the 13 who decided to trade their

regular potatoes with the second types, all but one stated that she/he would cook the potato differently from the regular looking one. This indicates that regardless of the way it looks, consumers are willing to use the potato for the same purpose they intended in the first place. However, responses show a bit of a difference between the intended use of two groups of potatoes. This result is consistent with the findings from Study 2, in which consumers incline more towards cooking “regular” looking potatoes for recipes that don’t destroy its inherent shape such as baked, roasted, or grilled. Even though consumers stated they wouldn’t cook the two groups of potatoes differently, the “seconds” type potatoes clearly evoke a wider range of recipes than the regular potatoes. This unconscious mindset is interesting in a way because produce sellers and marketers may not assume people could perceive ugly produce to be more versatile. Sellers and markers also may not realize that the majority of people (13 out of 19 based on this survey) would willingly trade their “regular” looking potatoes for “ugly” ones, even at a very small discount rate (18%), without necessarily changing their plans for the usage.

The fact that consumers don’t necessarily prefer a radical discount rate is also consistent with Mookerjee’s argument that (just a) moderate discount is effective in making people purchase unattractive produce (Mookerjee et al., 2021). Efforts to increase the purchase of unattractive produce can be approached from various angles including discounts, appeal for different functionalities, tools, and services to aid user experience as well as extending education beyond the marketplace.

4.3.4 Discussion

The range of monetary value awarded to participants didn't seem to significantly impact participants' decisions to trade or keep the default-regular potatoes. Having added monetary value as a reward itself did help, but the range of amount didn't seem to appeal to even the lower income participants as hypothesized. This indicates that the discount in produce - which many marketers and farmers use as a default solution to sell their seconds and leftovers – is not the most effective way of marketing seconds, nor a sustainable way that would alter consumers' perceptions about secondary produce. Prior studies have indicated that too much of a discount undermines consumers' perception about the edibility of the produce. A steep discount may suggest that something is very wrong with the product such that it necessitates such a steep discount. This was also true in this study even when consumers were informed that the potatoes were fresh, eliminating the assumption that something may be wrong with the produce. The average depreciation rate for WTP compared to the depreciation rate of aesthetic rating was -24%. The average discount rate for the ugly potatoes that consumers agreed upon as a trade down was -30% (equivalent to \$0.85). The average discount rate could be lower considering that the price of the potato at the market (\$2.75) was higher than the conventional market price (approximately \$1.85). The finding aligns well with the hypothesis that consumers in an actual market setting will pay less than what they stated as WTP.

The reason for not accepting a higher discount value seems to be more related to an ethical and a self-effacing issue at the farmers' market. Unlike industrialized goods in

which the same object is manufactured and purchased for the same purpose; produce can be prepared in many ways. Similarly, unlike industrialized goods in which a second grade or a B-C grade is considered defective, aesthetic imperfection should not define the quality of the produce. Current inspection guidelines and sales strategy makes such connotations implicit to the consumers. Discounts are also one of the factors that could provide an inaccurate impression to the consumers about the quality of the produce. Rather than demoting irregularly shaped produce, accepting the diversity and promoting such knowledge from the first place may be more effective in making edible produce reach more homes (and mouths).

It is worth noting the special context effect of where the study was conducted. People who come to farmers markets tend to lean liberal and they can also be more educated about the environmental consequences of food waste. They come and spend money at the farmers market intentionally and their leniency to the wider range of produce may be reflected in the study's result. Many people who visit the farmers market come primarily to purchase local, fresh produce but there are also another group of people who come for purposes of local market support, social interaction, purchasing ready-to-go foods, or buying packaged foods, arts and crafts; Hence people may not necessarily have a specific to-buy list as they do for when shopping in grocery stores (Gumirakiza et al., 2014; Joenpolvi et al., 2022). And therefore, people are much more open minded and flexible than at a grocery store. The variance of produce aesthetics is larger in farmers' markets than in traditional grocery stores and consumers are aware of this. Not only are visitors to the farmers market more

educated about food and health (Gumirakiza et al., 2014), but the context of the farmers' market also changes consumers' perception temporarily to accept a wider range of aesthetics. This is to say that the person's inclinations, level of knowledge, and the context all become a catalyst to create a tolerance for the "ugly" produce. For this reason, samples used in the study may not be generalizable to the greater mass.

Still, the inconsistency in responses between use of regular potatoes vs. ugly ones, despite the high number of respondents who responded 'no' to 'would you be using it differently?' demonstrates that there are some things that could be concluded about the consumer perception that we were not aware of. These incongruencies cannot be discovered solely by examining consumers' verbal responses or observation of behavior. Tapping into this unconscious perception of ugly produce's versatility may be the key in making a wider range of produce aesthetics acceptable to consumers.

High environmental awareness is not always correlated with higher education levels. A college student may be more aware of the environmental issues than a suburban business owner who does not pay much attention to his/her environment. In this sense, the traditional standards of demographic criteria may not be enough to provide useful information to researchers. Consumer dispositions are more complex than ever before. Regardless of income, some consumers may choose to purchase the same item from Etsy rather than from Amazon for environmental and ethical reasons. This inclination cannot be captured through traditional demographic measures such as age, income, or education. A more subtle measure that captures consumers' style of shopping may be needed. When it comes to food items, consumer preference

becomes even more complicated and different from the preceding generations. Millennials and Generation Z are not frugal on food experience (Kuhns & Saksena, 2017). A closer look into the life patterns of Millennials, who are now head of households, will warrant next best steps for creating a sustainable marketplace for consumers. These consumers are the ones changing eating habits to be healthier, fresher, and more organic. A more holistic human-centered solution is needed to nudge consumers' purchase decisions.

Chapter 5: Summary of Implications and Recommendation

5.1 Re-defining aesthetics from the functional perspective

A good visual aesthetic could be defined in many ways. It does not have to be based on conventional standards of aesthetics, but it can be rather defined from the functional perspective especially when it comes to food. A good-looking potato for example, could be defined by a potato that has the least amount of surface imperfections, less bumpiness as well as less marks and divets. A sweet potato with good aesthetics would have a shape that is easy to peel, and a form that would serve well cooked whole. An aesthetic onion would be an onion that still has the peel, and is brightly colored, as well as an onion that would serve well as a flavor. The determining factors among the three produce types differ because they all serve different purposes and needs. The way they are cooked is different and the way people consume them is also different. A potato would be more of a sustenance type food whereas an onion would be more of a flavor-inducing food. Deep inside consumers' minds, primary needs for produce are to be able to do what they had

intended to use the produce for, and not necessarily in its visual aesthetics. Functional aesthetics is their primary goal. If we could disconnect that association of “visual aesthetics = good food”, then it could make people more willing to pay for the cosmetically imperfect produce.

The thesis supports the assumption that consumers’ perceptions are primarily shaped by what they are familiar with and what they have seen in markets. The findings also indicate that while consumers tend to incorporate functionality of the produce into their own definition of aesthetic standards, they do not necessarily realize that they are associating unattractive produce to be more versatile. The aesthetic standards for the examined produce were disparate from the standards that we commonly use to evaluate aesthetics of industrialized goods or graphic prints (e.g., symmetry, balance). Conceived depreciation rate in willingness-to-pay was also significantly lower than the depreciation rate in produce’s overall aesthetic ratings. The actual consumer behavior of WTP in the market was even lower than the conceived WTP. Considering that more than half of the participants in Study 3 were not willing to trade down at all, this rate may be lower or inapplicable in an actual market setting. It was suggested by this study that consumers’ reasoning behind not wanting to trade for the lowest possible discount rate is not solely due to the fact that it is viewed as a lower quality. There must be other factors that cannot be explained through simple demographics such as income or education levels.

In addition, depending on the context, users don't always make decisions based on the functionality of the produce. While isolated context (e.g., surveys) could urge users to think about the specific functionality, real marketplace environments are designed in a way that does not aid users to think about the specificity of the intended functionality. This was especially true in the farmers' market setting where people usually don't come with a specific cooking plan or purpose. People are more prone to making heuristic decisions that may not reflect their true shopping patterns or deep inner values. This also varied between survey modes (e.g., online vs. in-person), among produce and within one produce. The findings of this thesis are important in that they offer a range of acceptable aesthetic criteria, and that it brings to light our subconscious associations that could be utilized to educate, market, and change policies regarding aesthetically unattractive produce to make real change in consumer behavior towards more sustainable consumption practices.

5.2 Design implications

Policies

The findings of this thesis provide useful policy and marketing strategies that can have a nudging effect on consumer decisions. First, inspection guidelines should be updated to incorporate and reflect consumers' modern values. It will also need to be more versatile in the sense that the guidelines cannot be tailored for one or few uses of cooking and for one specific produce type. For example, criteria used for apples should not be used for tomatoes or potatoes. Based on the intended use, the acceptability could range widely, and the current guidelines do not accommodate for

this. A more flexible guideline is needed to make a wider range of aesthetics available in the marketplace, including conventional grocery stores. Produce growers and sellers have been relying on this current inspection guideline for a long time (Johnson et al., 2019). Making changes on a systemic level, should begin from the policy level most importantly as many growers and sellers will acknowledge and abide by these guidelines.

Marketing & Trends

Marketers are also influenced by the inspection guideline and thus have used those standards to appeal to the consumers. Similarly, like a ripple effect, consumers are affected by those marketing efforts that are based on the guidelines that draw from a narrow range of acceptability. Visual imagery of an appetizing fruit or vegetable (in an advertisement, cookbook, commercial, signage, etc.) has always been a perfectly shaped produce that may even seem unnatural. A similar trend is in the beauty industry for human figures and fashion. With heightened awareness for environmental protection and health and well-being of our society, movements highlighting natural aesthetics seem to appeal to more people nowadays. Fashion industry that utilizes recycled materials has a greater influence on purchase intentions of the younger generation (e.g., especially to Millennials) and more people are willing to buy clean food that comes from ethical and environmentally friendly farming practices (Bollani et al., 2019; Lin & Chang, 2012; Nunes et al., 2021). This would be possible only as a result of a mutual recognition of the new trend's values. Yet, we are still far from the ideals of environmental justice. Produce seconds often go to

feeding the hungry and profit-making from the produce seconds (e.g., Misfit, Imperfect Produce) is creating an imbalance of distribution of food resources (Mull, 2019). In this world of excess, we are constantly desiring “more and more”, and we tend to get satisfied only by stimulating the extreme ends of our pleasure spectrum. Thinking about the people who are suffering at the opposite end of the pleasure spectrum (e.g., confronting crime, lacking necessities in living), we need to be more prudent in making consumption choices.

Millennials are choosing to eat healthier and sustainably while at the same time, ‘eating with your eyes’ have become a norm, a world-wide phenomenon of feverishly seeking new stimuli in food. Consumers are uploading mouthwatering food images on one’s own social networking system such as Instagram and Tiktok and this phenomenon will only grow (Spence, 2017). With this trend, images of desirable food (‘visual hunger’) will continue to be used and will continue to aggrandize unhealthy eating habits (Spence et al., 2016). It goes the same for the fashion industry where luxury brands have become more exclusive and pleasing to the eyes, while a tantamount number of innovations have occurred in sustainable material development and ethical practices. Consumers’ willingness to pursue one end or the other is not a simple answer for themselves either. It cannot be predicted simply by the traditional demographic standards.

Aesthetic representation, along with the story it carries, has become important and critical in a society where even the smallest aspects of one’s daily life is shared

through social media platforms and online communications. Social screening is also prevalent, meaning new lines of thoughts are subject to both quick attention and controversies if it doesn't meet certain standards or expectations. That being said, the question of defining new aesthetics is much in the hands of marketers and designers who can wield the power to influence consumers through their work.

It would help to have a more versatile marketplace that allows small farmers to sell the naturally wide aesthetic range of their produce. This will include but is not limited to store displays, placing of items – groupings of items that aid consumers to find certain ingredients more quickly for an intended purpose, tools that aid functionality and services for cooking certain recipes, diversification of venues for the varying degrees of aesthetics (e.g., a venue specifically for value-added sellers) and store experiences that evoke positive emotions for the consumers inducing pragmatic decision-making process.

5.3 Education

Education is also one of the most critical areas that needs immediate attention. Not only is the main aim to educate consumers about the natural and normal range of aesthetics, but also to help consumers become aware of the impact of their food purchase decisions on themselves and the planet.

Firstly, providing a holistic view of the food systems could motivate consumers to make more sustainable decisions. Learning about the system, as well as why the few

choices matter, will be an effective strategy in making positive changes to the food industry. Studies on the effects of individuals' Agricultural Literacy (AL) or agricultural knowledge on purchase decision and behavior is growing. An AL can be defined as "possessing knowledge and understanding of food and food fibers" , whereas agricultural knowledge can be defined as an individual's scope of knowledge about agricultural concepts (Clemons et al., 2018). There is a growing knowledge and importance about ways to nurture AL as a means of preserving the future of the agriculture industry (Gann, 2021).

Secondly, nurturing a *wabi-sabi* mindset allows consumers to accept a more naturalistic lifestyle. This would lead to a healthier and a more sustainable eating habit and choices for the individuals. As much as associating imperfection in oneself or others as inferior is erroneous and harmful, consumers shouldn't associate eating ugly food with inferiority. It should in fact be the inverse. Eating a wider range of food in general, including a wider range of aesthetics, should be celebrated, and encouraged. This could be done both at a clinical setting or through easily accessible media such as social networks considering that many people obtain tailored information online (Scharnow et al., 2020).

Thirdly, higher institutions should incorporate as part of their pedagogy, an active engagement in the challenges we face today. The food waste problems and consumers' attitudes and baseline knowledge toward it is one of them. In the design discipline, it could be given as a prompt, 'How could we design for consumers to

accept a wider range of produce aesthetics?’ (e.g., visual communications), or ‘How could we allow consumers to make better food choices in a marketplace?’ (e.g., spatial design). Educating the next generations of leaders is extremely important considering that they will be the ones updating the policy, making marketing strategies, and ones who will educate their own next generations for the future.

5.4 New business opportunities for farmers

This research can aid farmers in creating a new business model for their produce seconds. The findings suggested that selling produce seconds at a second market, apart from the primary venues such as grocery stores and farmers market, would be beneficial. Currently, the seconds are sold to value-added sellers, restaurants or food harvest sites which are not available to small scale farmers with few business connections. The second market could be a mobile farmers market truck that brings produce seconds to the neighborhoods at a much affordable price. The second market could also be a market where produce is sold in alignment with the consumers’ intended functionality of the produce. For example, cosmetically imperfect produce could be sold with ingredients for mashed potatoes so that consumers are easily able to think about their real needs rather than the conventional aesthetic standards that they have become used to. Solutions to cosmetically imperfect produce are not just to sell them at a lower price. Accompanying varying strategies including 1) graphic signage and linguistic solutions, 2) devising related product solutions (e.g., a potato peeler that not only has a good hand grip, but is optimized to peel bumpy surface), and 3) reconsidering retail locations could bring synergy to the existing market

solution. As such, the findings of this research could be used to generate new business opportunities for small scale farmers and produce sellers.

Over the past decade, few solutions have emerged to combat food waste due to aesthetic imperfections but most of them were ad-hoc solutions that rather feed into the inappropriately established system. These solutions may seem to solve the problem in the beginning but in fact, could aggravate the problem as it is built upon a system that needs radical intervention. To build a more sustainable food system, a more fundamental change in the policy, marketing, and education is needed.

Chapter 6: Future Work and Limitations

6.1 Limitations

Limited range of aesthetic variability in a limited context

Only a few types of produce were examined in this thesis. This was due to time, seasonality, availability, shelf-life of produce for testing purposes, etc. The range of the produce used in the study also does not represent the full range of existing potatoes, carrots, or onions (i.e. not all varieties of each were explored). In that sense, the study would not have captured the full range of consumer perception for the ugly potatoes, carrots, and onions as not all features of “ugliness” were presented to the survey participants. Also, consumers’ perception of “ugliness” must have been influenced by the produce presented to them in the survey. In other words, if the group of select potatoes shown in the survey were relatively uglier in general, then

consumers would not have perceived the less ugly one as “less ugly” but rather “okay” or “good looking” because the other ones were relatively “uglier”. The aesthetic ratings in this research will not be an absolute standard that can be generalized to the existing range of produce.

Participant Selection Bias

It should be noted that the participants who participated in the survey would not represent the greater public. People who came to the farmers market, and especially those who approached the stand at the farmers (study 3), are likely those interested in supporting local business and the environment – thus those who are more lenient to the aesthetics of produce. Some of the participants from study 1 and 2 were also acquaintances of the researcher so they may have provided biased responses in favor of the researcher which could have skewed the result.

Participant variable as a confounding factor

In relation to the participant selection bias, the characteristics of participants’ internal values may have been the reasoning behind produce ratings and WTP. The farmers’ market study attempted to induce this, if there are any, but no distinguishing pattern was found from the small sample size. For example, in examining the functionality response from participants, people who are open to irregular produce may be people who are open to nontraditional cooking methods.

Minimal amount of reward amount

The monetary value provided to participants was not progressive enough to trigger behavioral changes. The reward amount ranging from \$0.50 cent to \$1.50 was considered not critical enough to motivate willingness-to-trade. Participants' decision to trade may have been more based on their mood, rather than by the stimuli offered by the researcher. In that sense, the farmers' market may not have captured inherent human perception and behavior accurately, invalidating our understanding and findings.

Mode Shift

Because of COVID, the mode of study was also shifted from in-person lab setting, an online survey, to an in-person farmers' market setting. Food aesthetics is a perception that can be heavily affected by the mode it is being presented as food is assessed through multiple senses including smell and touch. Lack of access to these senses could have a critical impact on the evaluation of administered produce. In addition, people also shift modes within themselves when they are in different contexts. For instance, the same person might come with different expectations and purposes when they are coming to a farmers' market as opposed to when she/he is shopping at a grocery store. It seems that in-person evaluation of aesthetics provides a richer understanding and there is less clarity when using images (screen mode). All studies conducted in-person could have yielded a more holistic result that takes account of various multi-sensory influences presented by the produce. This, however, was not possible due to the COVID-19 pandemic which prohibited in-person studies for over two years during the main research period.

6.2 Future Research

a) Agricultural Experience

Another major factor influencing perception to produce aesthetics is the users' prior experience in agriculture and or exposure to agricultural products. This seems to have a greater effect on consumer perception more than education and income level. Most existing studies have investigated consumers income, education, and few other inner values such as the participant's environmental awareness level. It is also anticipated based on a series of studies that farmers and food makers (e.g., chefs and value-added sellers), and home gardeners would have a much greater tolerance on the various ranges of aesthetics of produce (Berkenkamp & Nennich, 2015) – although specific relationship between cosmetically imperfect produce and agricultural literacy is still unknown. Future research would benefit from seeing the direct effects of these experience levels on the consumers' perceptions, preferences, and purchase behaviors. It is suggested that agricultural experience be incorporated in educational systems grade K-12, and that it should be implemented by hands-on learning activities, farm tours, and other various experiential educational methods rather than rote memorization techniques (Gann, 2021).

b) Cross-cultural differences

Cultural differences exist especially when it comes to behavior around food. Although the food waste problem is a global problem, every country has different policies and campaigns in place. Marketplace environments and shopping patterns also vary significantly among different cultures and countries. This will have an

impact on the consumers, thus constructing different aesthetic criteria among the consumers within a country. The implications of this research will be most applicable in the U.S. as all survey participants were either Americans or foreigners living in the U.S.

c) Examining participant variable confounding factors

Although it would be impossible to rule out all existing confounding factors, few demographic characteristics could be examined further. Currently, there isn't an instrument that measures an individual's inclination for food shopping style (for produce) in relation to their previous experiences, characteristics, or personal traits. Understanding the relationship between these factors and consumers' tendency to buy cosmetically imperfect produce could provide more helpful direction for the food industry.

d) Deeper examination into Millennials' lifestyle

Millennials now are the generation that's revolutionizing the many parts of our society. Food industry is not an exception. They are buying more fruits and vegetables and less processed foods, like pasta, as per capita income rises compared to other older generations (Kuhns & Saksena, 2017). They also dine at restaurants more often and make fewer grocery store trips than prior generations (Kuhns & Saksena, 2017). In addition, online grocery shopping, preference for ready-to-go foods (not necessarily healthier), less time spent on cooking, and high emphasis on convenience requiring minimal preparation efforts for the maximum benefits are all

patterns shown from the Millennials, which differentiates themselves from the generational predecessors. It would be interesting to explore how their perceptions of and interactions with ugly produce differ from prior generations.

Millennials now have the most purchasing power in America and will continue to do so for the next decades as their incomes increase. Millennials are also emerging leaders of our society, as well as educators for the younger generations, who will shape the future, including the grocery scenes. For this reason, future work would benefit from examining the Millennials specifically to a further extent.

Chapter 7: Conclusions

This research investigates our deeply rooted perception for considering the “ugly” produce, “ugly.” Our perception for considering it “ugly” is in part due to our biological instinct, but in modern days, it is more due to the current agricultural practices, and the way our society has shaped our views on “perfection.” The three studies conducted in this thesis uncovers that we need not necessarily pursue conventionally perfect looking produce as they are unrelated to the edibility or the quality of the produce. The surveys conducted in Study1 and Study2 in this research helps clarify that our unconscious needs are more focused on the functionality (utilitarian) aspect of the produce rather than the form (hedonic). The form of the produce is only relevant when it interferes with the intended functionality of the produce. Yet, demographic factors determining consumers’ purchase behaviors to cosmetically imperfect produce is still unknown as the third study in the farmers’ market did not help us delineate a pattern. The main implication of this research is that we could re-define produce aesthetics from a more functional aspect and

that we should word towards re-directing and re-formulating our flawed perception to produce aesthetics through more appropriate marketing strategies, policies, agricultural practices, and guidelines. Further studies should examine characteristics of different demographics particularly reflected by their lifestyles, which would deepen our understanding of the purchase behavior for cosmetically imperfect produce. In addition, further exploration is needed to examine the impact and the effectiveness of the new endeavors developed based on the findings of this research.

Bibliography

- Aschemann-Witzel, J., Giménez, A., & Ares, G. (2018). Consumer in-store choice of suboptimal food to avoid food waste: The role of food category, communication and perception of quality dimensions. *Food Quality and Preference*, 68, 29–39. <https://doi.org/10.1016/j.foodqual.2018.01.020>
- Aschemann-Witzel, J., Jensen, J. H., Jensen, M. H., & Kulikovskaja, V. (2017). Consumer behaviour towards price-reduced suboptimal foods in the supermarket and the relation to food waste in households. *Appetite*, 116, 246–258. <https://doi.org/10.1016/j.appet.2017.05.013>
- Auvray, M., & Spence, C. (2008). The multisensory perception of flavor. *Consciousness and Cognition*, 17(3), 1016–1031.
- Barber, D. (2014). *The third plate: Field notes on the future of food*. The Penguin Press.
- Barkow, J. H., Cosmides, L., & Tooby, J. (1992). *The Adapted mind: Evolutionary psychology and the generation of culture*. Oxford University Press.
- Barrett, D. (2010). *Supernormal stimuli: How primal urges overran their evolutionary purpose* (1st ed.). WWNorton & Co.
- Baum, C. M. (2013). Mass-Produced Food: The Rise and Fall of the Promise of Health and Safety. In *Papers on Economics and Evolution* (No. 2013–03; Papers on Economics and Evolution). Philipps University Marburg, Department of Geography. <https://ideas.repec.org/p/esi/evopap/2013-03.html>
- Berkenkamp, J., & Nennich, T. (2015). *Beyond Beauty: The Opportunities and Challenges of Cosmetically Imperfect produce*. (No. 1; Survey Results From Minnesota Produce Growers).

- Berterö, C. (2012). Grounded theory methodology—Has it become a movement?
International Journal of Qualitative Studies on Health and Well-Being, 7.
<https://doi.org/10.3402/qhw.v7i0.18571>
- Bloch, P. H. (1995). Seeking the ideal form: Product design and consumer response.
Journal of Marketing, 59(3), 16–29.
- Bollani, L., Bonadonna, A., & Peira, G. (2019). The millennials’ concept of sustainability
in the food sector. *Sustainability (Basel, Switzerland)*, 11(10), 2984-
<https://doi.org/10.3390/su11102984>
- Bordewijk, M., & Schifferstein, H. N. J. (2020). The specifics of food design: Insights
from professional design practice. *International Journal of Food Design*, 4(2),
101–138. https://doi.org/10.1386/ijfd_00001_1
- Bowery Farming. (n.d.). *Indoor Farming: The Future of Agriculture - Bowery Farming*.
Retrieved December 24, 2022, from <https://boweryfarming.com/indoor-farming/>
- Brook, I. (2014, May 8). *Aesthetic experience of place and the mutable sensorium*.
<https://www.iash.ed.ac.uk/multi-sensory-aesthetics-and-environment>
- Buetow, S., & Wallis, K. (2017). The Beauty in Perfect Imperfection. *Journal of Medical
Humanities*, 40(3), 389–394. <https://doi.org/10.1007/s10912-017-9500-2>
- Bunn, D., Feenstra, G. W., Lynch, L., & Sommer, R. (1990). *CONSUMER
ACCEPTANCE OF COSMETICALLY IMPERFECT PRODUCE - Twin Cities*.
24(2), 268–279.
- Buzby, J. C. (2014). *The estimated amount, value, and calories of postharvest food losses
at the retail and consumer levels in the United States*. United States Department
of Agriculture, Economic Research Service. <http://purl.fdlp.gov/GPO/gpo46469>

- Chai, A., & Kye, N. (Directors). (2017). *Wasted! The Story of Food Waste*.
- Clemons, C., Linder, J., Murray, B., Cook, M., Sams, B., & Williams, G. (2018).
Spanning the Gap: The Confluence of Agricultural Literacy and Being
Agriculturally Literate. *Journal of Agricultural Education*, 59(4), 238–252.
<https://doi.org/10.5032/jae.2018.04238>
- Davis, K. F., D’Odorico, P., & Rulli, M. C. (2014). Land grabbing: A preliminary
quantification of economic impacts on rural livelihoods. *Population and
Environment*, 36(2), 180–192. <https://doi.org/10.1007/s11111-014-0215-2>
- de Hooge, I. E., Oostindjer, M., Aschemann-Witzel, J., Normann, A., Loose, S. M., &
Almli, V. L. (2017). This apple is too ugly for me!: Consumer preferences for
suboptimal food products in the supermarket and at home. *Food Quality and
Preference*, 56, 80–92. <https://doi.org/10.1016/j.foodqual.2016.09.012>
- Delwiche, J. F. (2012). You eat with your eyes first. *Physiology & Behavior*, 107(4),
502–504. <https://doi.org/10.1016/j.physbeh.2012.07.007>
- Dodds, R., Jenkins, B., Smith, W., & Pitts, R. (2018). *Chapter 4: Willingness-to-Pay vs
Actual Behavior: Sustainable Procurement at Festivals* (pp. 67–78).
<https://doi.org/10.1108/S1871-317320180000015009>
- Dusoruth, V., Peterson, H. H., & Schmitt, J. (2018). Estimating a Local Food Waste
Baseline. *Journal of Food Products Marketing*, 24(5), 654–680.
<https://doi.org/10.1080/10454446.2018.1472698>
- Eeckhout, D. (2019, August 29). *The Good Acre farmer, problem identification interview*
[Personal communication].

Eleven lessons: Managing design in eleven global brands A study of the design process.

(2005). Design Council.

Elizabeth Weise. (2004). Digging the baby carrot.(LIFE). *USA Today*, 01D.

EPA. (2020). *2018 Wasted Food Report* (EPA 530-R-20-004; p. 42). Office of Resource Conservation and Recovery.

F., D. M., & G.C., S. (2016). *Agricultural investments in Mozambique: An analysis of investment trends, business models and social and environmental conduct.*

<https://doi.org/10.17528/cifor/005958>

Facts About Hunger and Poverty in America | Feeding America. (n.d.). Retrieved

November 23, 2020, from <https://www.feedingamerica.org/hunger-in-america/facts>

FAO. (2013). *Food wastage footprint: Impacts on natural resources: summary report.*

FAO.

Fitzgerald, G. J., & Petrick, G. M. (2008). In Good Taste: Rethinking American History with Our Palates. *Journal of American History*, 95(2), 392–404.

<https://doi.org/10.2307/25095625>

Foley, J., & Steinmetz, G. (n.d.). Future of Food: Feeding the World. *National Geographic Magazine.*

<https://www.nationalgeographic.com/foodfeatures/feeding-9-billion/>

Francis, C. (2016). *The carbon farming solution: A global toolkit of perennial crops and regenerative agriculture practices for climate change mitigation and food security*, by Eric Toensmeier: Chelsea Green, White River Junction, VT, 2016. Hardcover,

512 p., \$75.00. 978-1-60358-571-2. *Agroecology and Sustainable Food Systems*, 40(9), 1039–1040. <https://doi.org/10.1080/21683565.2016.1214861>

Gann, L. E. (2021). *The effects of prior exposure to agriculture on college students' food purchasing decisions*.

Giller, K. E., Hijbeek, R., Andersson, J. A., & Sumberg, J. (2021). Regenerative Agriculture: An agronomic perspective. *Outlook on Agriculture*, 50(1), 13–25. <https://doi.org/10.1177/0030727021998063>

Göbel, C., Langen, N., Blumenthal, A., Teitscheid, P., & Ritter, G. (2015). Cutting Food Waste through Cooperation along the Food Supply Chain. *Sustainability*, 7(2), Article 2. <https://doi.org/10.3390/su7021429>

Gumirakiza, J. D., Curtis, K. R., & Bosworth, R. (2014). *Who Attends Farmers' Markets and Why? Understanding Consumers and their Motivations*. 2.

Gunders, D. (2017). *Wasted: How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill*. Natural Resources Defense Council. <http://search.proquest.com/docview/2175797749/?pq-origsite=primo>

Gustavsson, J., Cederberg, C., & Sonesson, U. (2011). *Global food losses and food waste: Extent, causes and prevention ; study conducted for the International Congress Save Food! at Interpack 2011, [16 - 17 May], Düsseldorf, Germany*. Food and Agriculture Organization of the United Nations.

H Charles J Godfray, John R Beddington, Ian R Crute, Lawrence Haddad, David Lawrence, James F Muir, Jules Pretty, Sherman Robinson, Sandy M Thomas, & Camilla Toulmin. (2010). *Food Security: The Challenge of Feeding 9 Billion*

- People. *Science (American Association for the Advancement of Science)*, 327(5967), 812–818. <https://doi.org/10.1126/science.1185383>
- HAFA. (n.d.). *About HAFA / Hmong American Farmers Association*. Retrieved December 29, 2022, from <https://www.hmongfarmers.com/about-hafa/>
- Hays, C. (2015). *The Lean Farm: How to Minimize Waste, Increase Efficiency, and Maximize Value and Profits with Less Work.* (Book review). 112(1), 20-.
- Hekkert, P. (2006). Design aesthetics: Principles of pleasure in design. *Psychology Science*, 48(2), 157–172.
- Hingston, S. T., & Noseworthy, T. J. (2020). On the epidemic of food waste: Idealized prototypes and the aversion to misshapen fruits and vegetables. *Food Quality and Preference*, 86, 103999. <https://doi.org/10.1016/j.foodqual.2020.103999>
- Huang, Y., Lyu, J., Xue, X., & Peng, K. (2020). Cognitive basis for the development of aesthetic preference: Findings from symmetry preference. *PLoS ONE*, 15. <https://doi.org/10.1371/journal.pone.0239973>
- Huang, Y., Xue, X., Spelke, E., Huang, L., Zheng, W., & Peng, K. (2018). The aesthetic preference for symmetry dissociates from early-emerging attention to symmetry. *Scientific Reports*, 8(1), Article 1. <https://doi.org/10.1038/s41598-018-24558-x>
- IDEO. (2019). *A Leading Food Company's Human-Centered Transformation Spurs Rapid Growth*. <https://www.ideo.com/case-study/a-leading-food-companys-human-centered-transformation-spurs-rapid-growth>
- Isadora do Carmo, S., Duarte Ribeiro, J. L., & Barcellos, M. (2019). *Consumer Behaviour towards Suboptimal Food Products: A Strategy for Food Waste*

Reduction. <https://www.emerald.com/insight/content/doi/10.1108/BFJ-12-2018-0817/full/html>

Janson, H. W. (1982). *Form follows function--or does it? : Modernist design theory and the history of art : the first Gerson lecture, held in memory of Horst Gerson (1907-1978) in the aula of the University of Groningen on October 2, 1981*.

<https://www.semanticscholar.org/paper/Form-follows-function--or-does-it-%3A-modernist-and-%3A-Janson/730ee24e950f2fe0d3fed759d58dd223a08b32d7>

Joenpolvi, E., Mortimer, G., & Mathmann, F. (2022). Can attending farmers' markets lead to unplanned deviant visitor behavior? *Tourism and Hospitality Research*, 146735842211176-. <https://doi.org/10.1177/14673584221117680>

Johnson, L. K., Bloom, J. D., Dunning, R. D., Gunter, C. C., Boyette, M. D., & Creamer, N. G. (2019). Farmer harvest decisions and vegetable loss in primary production. *Agricultural Systems*, 176, 102672. <https://doi.org/10.1016/j.agsy.2019.102672>

Kalantari, F., Mohd Tahir, O., Mahmoudi Lahijani, A., & Kalantari, S. (2017). A Review of Vertical Farming Technology: A Guide for Implementation of Building Integrated Agriculture in Cities. *Advanced Engineering Forum*, 24, 76–91. <https://doi.org/10.4028/www.scientific.net/aef.24.76>

Kim Dang, A., Xuan Tran, B., Tat Nguyen, C., Thi Le, H., Thi Do, H., Duc Nguyen, H., Hoang Nguyen, L., Huu Nguyen, T., Thi Mai, H., Dinh Tran, T., Ngo, C., Thi Minh Vu, T., Latkin, C. A., Zhang, M. W. B., & Ho, R. C. M. (2018). Consumer Preference and Attitude Regarding Online Food Products in Hanoi, Vietnam. *International Journal of Environmental Research and Public Health*, 15(5), 981. <https://doi.org/10.3390/ijerph15050981>

- Kissane, C. (2018). *Food, religion, and communities in early modern Europe*. Bloomsbury Academic.
- Korsmeyer, C. (1998). *Aesthetics: The big questions*. Blackwell Publishers.
- Kuhns, A., & Saksena, M. (2017). *Food Purchase Decisions of Millennial Households Compared to Other Generations*. 57.
- Kumar, M., & Noble, C. H. (2016). Beyond form and function: Why do consumers value product design? *Journal of Business Research*, 69(2), 613–620.
<https://doi.org/10.1016/j.jbusres.2015.05.017>
- Lancaster, K. J. (1966). A New Approach to Consumer Theory. *Journal of Political Economy*, 74(2), 132–157.
- Larson, J., Redden, J. P., & Elder, R. (2013). *Satiation from Sensory Simulation: Evaluating Foods Decreases Enjoyment of Similar Foods* (SSRN Scholarly Paper ID 2325157). Social Science Research Network.
<https://doi.org/10.2139/ssrn.2325157>
- Lin, Y.-C., & Chang, C. A. (2012). Double Standard: The Role of Environmental Consciousness in Green Product Usage. *Journal of Marketing*, 76(5), 125–134.
<https://doi.org/10.1509/jm.11.0264>
- Loebnitz, N., & Grunert, K. G. (2015). The effect of food shape abnormality on purchase intentions in China. *Food Quality and Preference*, 40, 24–30.
<https://doi.org/10.1016/j.foodqual.2014.08.005>
- Loebnitz, N., Schuitema, G., & Grunert. (2015). *Who Buys Oddly Shaped Food and Why? Impacts of Food Shape Abnormality and Organic Labeling on Purchase Intentions*. *Psychology&Marketing*(32(4)), 408–421.

- Lusk, J., Fox, J. A., Schroeder, T. C., Mintert, J., & Koohmaraie, M. (1999). *Will consumers pay for guaranteed tender steak?*
- Lusk, J. L., Fox, J. A., Schroeder, T. C., Mintert, J., & Koohmaraie, M. (2001). In-store valuation of steak tenderness. *American Journal of Agricultural Economics*, 83(3), 539–550.
- Marques da Rosa, V., Spence, C., & Tonetto, L. M. (2019). Influences of visual attributes of food packaging on consumer preference and associations with taste and healthiness. *International Journal of Consumer Studies*, 43(2), 210–217.
<https://doi.org/10.1111/ijcs.12500>
- Messerli, P., Giger, M., Dwyer, M. B., Breu, T., & Eckert, S. (2014). The geography of large-scale land acquisitions: Analysing socio-ecological patterns of target contexts in the global South. *Applied Geography*, 53, 449–459.
<https://doi.org/10.1016/j.apgeog.2014.07.005>
- Mookerjee, S. (Sid), Cornil, Y., & Hoegg, J. (2021). From Waste to Taste: How “Ugly” Labels Can Increase Purchase of Unattractive Produce. *Journal of Marketing*, 85(3), 62–77. <https://doi.org/10.1177/0022242920988656>
- Mourad, M. (2016). Recycling, recovering and preventing “food waste”: Competing solutions for food systems sustainability in the United States and France. *Journal of Cleaner Production*, 126, 461–477.
<https://doi.org/10.1016/j.jclepro.2016.03.084>
- Mull, A. (2019, January 25). *The Murky Ethics of the Ugly-Produce Business*. The Atlantic. <https://www.theatlantic.com/health/archive/2019/01/ugly-produce-startups-food-waste/581182/>

- Nunes, F., Madureira, T., & Veiga, J. (2021). The Organic Food Choice Pattern: Are Organic Consumers Becoming More Alike? *Foods*, *10*(5), 983.
<https://doi.org/10.3390/foods10050983>
- Oberlack, C., Giger, M., Anseeuw, W., Adelle, C., Bourblanc, M., Burnod, P., Eckert, S., Fitawek, W., Fouilleux, E., Hendriks, S., Kiteme, B., Masola, L., Mawoko, Z. D., Mercandalli, S., Reys, A., da Silva, M., van der Laan, M., Zaehring, J., & Messerli, P. (2021). Why do large-scale agricultural investments induce different socio-economic, food security, and environmental impacts? Evidence from Kenya, Madagascar, and Mozambique. *Ecology and Society*, *26*(4).
<https://doi.org/10.5751/ES-12653-260418>
- Poinski, M. (2019, September 23). *How Folgers has ushered in almost 170 years of happy mornings*. Food Dive. <https://www.fooddive.com/news/how-folgers-has-ushered-in-almost-170-years-of-happy-mornings/559247/>
- Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, *360*(6392), 987–992.
<https://doi.org/10.1126/science.aaq0216>
- Raghubir, P., & Greenleaf, E. A. (2006). Ratios in Proportion: What Should the Shape of the Package Be? *Journal of Marketing*, *70*(2), 95–107.
<https://doi.org/10.1509/jmkg.70.2.095>
- Recycle Track Systems. (2022). *Food Waste in America in 2021: Statistics & Facts*.
- ReFED U.S. *Food Waste Investment Report*. (2018). ReFED.

- Reimann, M., Zaichkowsky, J., Neuhaus, C., Bender, T., & Weber, B. (2010). Aesthetic package design: A behavioral, neural, and psychological investigation. *Journal of Consumer Psychology*, 20(4), 431–441. <https://doi.org/10.1016/j.jcps.2010.06.009>
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., de Wit, C. A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., ... Foley, J. A. (2009). A safe operating space for humanity. *Nature*, 461(7263), Article 7263. <https://doi.org/10.1038/461472a>
- Russell, R. (2018, May 25). Many Americans unconvinced about buying groceries online. *Supermarket News*. <https://www.supermarketnews.com/consumer-trends/many-americans-unconvinced-about-buying-groceries-online>
- Saito, Y. (2017). The Role of Imperfection in Everyday Aesthetics. *Contemporary Aesthetics (Journal Archive)*, 15(1). https://digitalcommons.risd.edu/liberalarts_contempaesthetics/vol15/iss1/15
- Scharkow, M., Mangold, F., Stier, S., & Breuer, J. (2020). How social network sites and other online intermediaries increase exposure to news. *Proceedings of the National Academy of Sciences*, 117(6), 2761–2763. <https://doi.org/10.1073/pnas.1918279117>
- Schoneveld, G. C. (2017). Host country governance and the African land rush: 7 reasons why large-scale farmland investments fail to contribute to sustainable development. *Geoforum*, 83, 119–132. <https://doi.org/10.1016/j.geoforum.2016.12.007>

- Shelley, J. (2022). The Concept of the Aesthetic. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Spring 2022). Metaphysics Research Lab, Stanford University. <https://plato.stanford.edu/archives/spr2022/entries/aesthetic-concept/>
- Smith, E. R., & Semin, G. R. (2004). Socially Situated Cognition: Cognition in its Social Context. *Advances in Experimental Social Psychology*, 36, 53–117. [https://doi.org/10.1016/S0065-2601\(04\)36002-8](https://doi.org/10.1016/S0065-2601(04)36002-8)
- Spence, C. (2015). On the psychological impact of food colour. *Flavour*, 4(1), 21. <https://doi.org/10.1186/s13411-015-0031-3>
- Spence, C. (2017). *Gastrophysics: The new science of eating*. Viking.
- Spence, C., Okajima, K., Cheok, A. D., Petit, O., & Michel, C. (2016). Eating with our eyes: From visual hunger to digital satiation. *Brain and Cognition*, 110, 53–63. <https://doi.org/10.1016/j.bandc.2015.08.006>
- Stein, E. W. (2021). The Transformative Environmental Effects Large-Scale Indoor Farming May Have On Air, Water, and Soil. *Air, Soil and Water Research*, 14, 1178622121995819. <https://doi.org/10.1177/1178622121995819>
- Suomala, J. (2020). The Consumer Contextual Decision-Making Model. *Frontiers in Psychology*, 11. <https://www.frontiersin.org/articles/10.3389/fpsyg.2020.570430>
- Tinbergen, N. (1961). *The herring gull's world ; a study of the social behavior of birds* ([Rev. ed.].). Basic Books.
- USDA. (2015). *Fresh Fruit and Vegetables Inspection Certificate (FV-300) Manual* [SCI Division Inspection Series]. United States Department of Agriculture (USDA). <https://www.ams.usda.gov/sites/default/files/media/FV-300%20Certification%20Manual.pdf>

- USDA. (2018). *Farms and their value of production by ERS farm type*. Economic Research Service and National Agricultural Statistics Service, Agricultural Resource Management Survey. <http://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=58288>
- Vohs, K. D., Wang, Y., Gino, F., & Norton, M. I. (2013). Rituals Enhance Consumption. *Psychological Science, 24*(9), 1714–1721.
<https://doi.org/10.1177/0956797613478949>
- Washington State University Extension. (n.d.). Small-Scale Farmers and the Environment: How to be a Good Steward | Animal Agriculture | Washington State University. *Animal Agriculture*. Retrieved December 23, 2022, from <https://extension.wsu.edu/animalag/content/small-scale-farmers-and-the-environment-how-to-be-a-good-steward/>
- Williams, H., & Wikström, F. (2011). Environmental impact of packaging and food losses in a life cycle perspective: A comparative analysis of five food items. *Journal of Cleaner Production, 19*(1), 43–48.
<https://doi.org/10.1016/j.jclepro.2010.08.008>
- Xiong, K. Z. (2019, July 18). *HAFAs farm visit and interviews with farmers* [Personal communication].
- Yue, C., Alfnes, F., & Jensen, H. (2009). Discounting Spotted Apples: Investigating Consumers' Willingness to Accept Cosmetic Damage in an Organic Product. *Journal of Agricultural and Applied Economics, 41*(1), 29–46.
- Zaehring, J. G., Atumane, A., Berger, S., & Eckert, S. (2018). Large-scale agricultural investments trigger direct and indirect land use change: New evidence from the

Nacala corridor, Mozambique. *Journal of Land Use Science*, 13(3), 325–343.

<https://doi.org/10.1080/1747423X.2018.1519605>

Zampollo, F. (2017). *The four Food Design pillars*.

<https://doi.org/10.13140/RG.2.2.27830.40002>

Zampollo, F., & Peacock, M. (2016). Food Design Thinking: A Branch of Design

Thinking Specific to Food Design. *The Journal of Creative Behavior*, 50.

<https://doi.org/10.1002/jocb.148>

Appendices

Appendix A: Survey Sheets

1) Study 1: Survey Sheets for potatoes

Name or Initial: _____

Ballot # : _____

Question 1.

Do you eat POTATOES? and How often?

- Regularly (multiple times a week)
- Often (Multiple times a month)
- Rarely (Multiple times a year)
- Almost never

Question 2.

Do you buy POTATOES? and How often?

- Regularly (multiple times a week)
- Often (Multiple times a month)
- Rarely (Multiple times a year)
- Almost never

Question 3.

How do you eat them? What do you do with them?
Please describe

- Whole : _____
- Cut : _____
- Smash / Pureed : _____
- Others (specify) : _____

Question 4.

Where do you buy them? (You can select multiple)

- Bir Grocery Stores (Lunds, Cub's, Wholefoods)
- Co-op's
- Farmer's markets
- Online
- Restaurants

Question 5.

How important is aesthetics to you in purchasing
produce?

- A lot 1 2 3 4 5 Not so much

Please enter your gender:

- Male Female Other (specify) : _____

Please select your age:

- 19 and under 30 to 39 50 to 59
- 20 to 29 40 to 49 60 and over

Please circle : Engineer / Designer

2) Study 1: Survey Sheets for sweet potatoes

Name or Initial: _____

Ballot #: _____

Question 1.

Do you eat sweet potatoes? and How often?

- Regularly (multiple times a week)
 Often (Multiple times a month)
 Rarely (Multiple times a year)
 Almost never

Question 2.

Do you buy sweet potatoes? and How often?

- Regularly (multiple times a week)
 Often (Multiple times a month)
 Rarely (Multiple times a year)
 Almost never

Question 3.

How do you eat them? What do you do with them?
Please describe

- Whole : _____
 Cut : _____
 Smash / Pureed : _____
 Others (specify) : _____

Question 4.

Where do you buy them? (You can select multiple)

- Bir Grocery Stores (Lunds, Cub's, Wholefoods)
 Co-op's
 Farmer's markets
 Online
 Restaurants

Question 5.

How important is aesthetics to you in purchasing
produce?

- A lot 1 2 3 4 5 Not so much

Please enter your gender:

- Male Female Other (specify) : _____

Please select your age:

- 19 and under 30 to 39 50 to 59
 20 to 29 40 to 49 60 and over

Please circle : Engineer / Designer

3) Study 1: Online Survey Interface



UNIVERSITY OF MINNESOTA
Driven to Discover®

Hello,

I am a design researcher at the University of Minnesota conducting research on aesthetics of produce. The survey asks questions about your opinion and preferences regarding carrots, onions and potatoes.

The survey consists of three parts in a random order:

- 1) Usage (for cooking)
- 2) Aesthetic Rating
- 3) Willingness-to-pay

Each part contains questions for all three types of produce.
(It should take <10 minutes)

Please rate **ALL** items and **provide text response** as detailed and specifically as possible.





UNIVERSITY OF MINNESOTA
Driven to Discover®

Note to MTurk Worker:

If you are not an MTurk worker, please disregard this message.

Here is your Response ID: R_1ezuZFtXQ0eQuwT
Copy this value to paste into MTurk Survey Code.

If you cannot see the Response ID, try this Random ID: 54930

Without a Response ID or a text ID, credit cannot be given. ***Please also note that credit cannot be given to an incomplete survey where no text response has been provided.**

Please follow instructions in each question carefully to receive credit.



How much are you willing to pay for 1 pound of potato that all look exactly like the one shown below?

Select your willingness to pay for each pound of potato respectively.
(Potato Retail Price: \$0.60/pound)

Minimal			Half-Price		Full Price
0	0.12	0.24	0.36	0.48	0.6

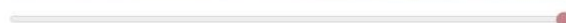
Potato 1



Potato 2



Potato 3



How much are you willing to pay for 1 pound of carrot that all look exactly like the one shown below?

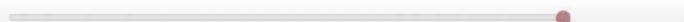
Select your willingness to pay for each pound of carrot respectively.
(Carrot Retail Price: \$0.77/pound)

Minimal	0.15	0.31	Half-Price	0.46	0.62	Full Price	0.77
---------	------	------	------------	------	------	------------	------

Carrot 1



Carrot 2



Carrot 3









Click and Drag to **rate ALL onions** based on aesthetics. You can put more than one into each box.

Then briefly **state THREE attributes** of the onion **in text** that made you rate it as such.

(e.g., *dark/light color, carved/bumpy surface, peeled off, brown/white scar, too much dirt, asymmetric shape...etc.*)

Write the reasoning in the textbox provided below each onion.

Please **move ALL onions** into a box.

Items		1 = Aesthetically pleasing
Onion 1	 <input type="text"/>	
Onion 2	 <input type="text"/>	2 = Somewhat aesthetically pleasing
Onion 3	 <input type="text"/>	3 = Neutral (Not pleasing nor displeasing)
Onion 4	 <input type="text"/>	4 = Somewhat aesthetically displeasing
Onion 5	 <input type="text"/>	
Onion 6	 <input type="text"/>	5 = Aesthetically displeasing

Onion 7



Click and Drag to **rate ALL potatoes** based on aesthetics. You can put more than one into each box.

Then briefly **state THREE attributes** of the potato **in text** that made you rate it as such.

(e.g., *dark/light color, carved/bumpy surface, brown/white scar, too much dirt, asymmetric shape...etc.*)

Write the reasoning in the textbox provided below each potato.

Please **move ALL potatoes** into a box.

Items

Potato 1



Potato 2



Potato 3




1 = Aesthetically pleasing


2 = Somewhat aesthetically pleasing

3 = Neutral (Not pleasing nor displeasing)


Potato 4




Potato 5



Potato 6



Potato 7



4 = Somewhat aesthetically displeasing

5 = Aesthetically displeasing

Click and Drag to **rate ALL carrots** based on aesthetics. You can put more than one into each box.


Then briefly **state THREE attributes** of the carrot **in text** that made you rate it as such.
 (e.g., *dark/light color, carved/bumpy surface, brown/white scar, too much dirt, asymmetric shape...etc.*)

Write the reasoning in the textbox provided below each carrot.

Please **move ALL carrots** into a box.

Items

Carrot 1



Carrot 2



1 = Aesthetically pleasing

2 = Somewhat aesthetically pleasing

Carrot 3



Carrot 4



Carrot 5



Carrot 6



Carrot 7



3 = Neutral (Not pleasing nor displeasing)

4 = Somewhat aesthetically displeasing

5 = Aesthetically displeasing





Would you be using/cooking each of the previously shown ONIONS differently because of how they look?

(e.g., chopping/slicing for soups/stir-fry vs baking vs blending...etc.)

YES

NO

If you answered "Yes" on the previous question, specify **in text** how you would use/cook each of these onions differently.

If your response was a "No", click next to move on to the next question.

Onion3



Onion 4



Onion 6





Would you be using/cooking each of the previously shown potatoes differently because of how they look?

(e.g., chopping vs baking vs blending...etc.)

YES

NO

If you answered "Yes" on the previous question, specify **in text** how you would use/cook each of these potatoes differently.

If your response was a "No", click next to move on to the next question.

Potato 2



Potato 3



Potato 6





Would you be using/cooking each of the previously shown CARROTS differently because of how they look?

(e.g., chopping/slicing for soups/stir fry vs baking whole vs use it raw on salads...etc.)

YES

NO

If you answered "Yes" on the previous question, specify **in text** how you would use/cook each of these carrots differently.

If your response was a "No", click next to move on to the next question.

Carrot 2



Carrot 3



Carrot 4





What is your gender?

Male

Female

Other

What is your annual household income?

\$32,000 or less

\$32,000 - \$55,000

\$55,000 - \$100,000

\$100,000 - \$350,000

\$350,000 and above



4) Study 3: Farmers' Market Survey Sheet



University of Minnesota
College of Design

N/A 0.50 1.00 1.50

WRITE WHAT YOU PLAN TO COOK WITH THESE POTATOES.

Write your answer here.

IF YOU TRADED WITH THE UGLY ONES, HAS YOUR PLAN CHANGED AS A RESULT OF THE TRADE?

YES NO

THANKS FOR PARTICIPATING

GENDER

- MALE FEMALE OTHER

AGE

- 18 - 24 25 - 39 40 - 59 60 PLUS

HOW OFTEN DO YOU COOK OR EAT POTATOES?

- FREQUENTLY SOMETIMES RARELY
- 3 times or more a week 1-2 times a week less than 1-2 times a week

EDUCATION

- Highschool Degree or Equivalent
- 2-year College Degree (Associate's)
- 4-year College Degree (Bachelor's)
- Master's degree
- Doctorate or Professional Degree

HOUSEHOLD INCOME

- \$33,000 or under
- \$33,000 - \$74,000
- \$74,000 - \$118,000
- \$118,000 - \$185,000
- \$185,000 or above

Appendix B: Fresh Fruits and Vegetables Inspection Guidelines for Potatoes

SCI Division Inspection Series
Effective Date: March 2015

Fresh F&V Inspection Certificate (FV-300) Manual
Page 73 of 112


Example # 4: Potatoes – Visible Sprouts

CARRIER or LOT IDENTIFICATION			Loading		Applicant:		U.S. DEPARTMENT OF AGRICULTURE		
I	X	B	Z	8	5	0	4	5	2
PREFIX NUMBER STATE			Loaded - LO Ply Unit - PU Unloaded - UL Lot Insp - LI		POGO'S POTATOES, LLT		AGRICULTURAL MARKETING SERVICE		
Carrier / Lot ID Stated by: INSPECTOR			Additional Lot ID: PO 102828		Address: ANYWHERE, NY		INSPECTION CERTIFICATE		
Carrier Type / Name: MECHAN. REFRIG. TRAILER			Shipper: GREAT POTATOE CORP.		Inspection Started:		M - EXAMPLE # 4		
Refrigeration Unit: <input checked="" type="checkbox"/> On <input type="checkbox"/> Off <input type="checkbox"/> Open <input checked="" type="checkbox"/> Closed			Insp. Site: APPLICANT'S WAREHOUSE		m m d d y y hour min. A/P		0 9 2 0 1 3 0 8 3 5 A M		
LOT	TEMPERATURES	Product:	Brand/Markings:	Origin	Lot ID:	Number of Containers:	Inspected		
A:	40 to 45 °F	POTATOES, RUSSET	"PAPAS" US NO. 1, 70, 80, 90 SIZE	IDA	USDA ID-454-09 / 454-11	700 CARTONS	Y		
B:	40 to 42 °F	POTATOES, RUSSET	"GRANDMAS" US NO. 1, 10/5 LB.	IDA	USDA ID-454-11	100 MASTER CARTONS	Y		
C:	41 to 43 °F	POTATOES, ROUND WHITE	"UNCLE ED" US NO. 1, 2" MIN, 50 LB.	IDA	USDA ID-454-12	100 BAGS	Y		
D:									
LOT	AVERAGE DEFECTS	Including DAMAGE SER. DAM	Including SER. DAM	OFFSIZE/DEFECTS	OTHER				
A:	02	%	00	%	QUALITY – OLD CUTS	LOT A: MEETS SIZE AS STAMPED.			
	03	%	00	%	SILVER SCURF (0 TO 9%)	OFFSIZE WITHIN TOLERANCE.			
	01	%	00	%	INTERNAL BLACK SPOTS				
	1/2	%	1/2	%	SOFT ROT (0 TO 4%), EARLY STAGES	LOT B: 2 INCHES IN DIAMETER, OR			
	07	%	01	%	CHECKSUM	4 TO 10 OUNCES IN WEIGHT.			
B:	03	%	00	%	QUALITY – OLD CUTS	NO OFFSIZE.			
	07	%	02	%	SILVER SCURF (4 TO 13%)	LOT B: IN MOST SAMPLES SOME			
	03	%	00	%	NET NECROSIS	TO MANY POTATOES SHOW			
	02	%	00	%	INTERNAL BLACK SPOTS	SPROUTS RANGING FROM BARELY			
	03	%	03	%	SOFT ROT (1 TO 4%), EARLY STAGES	VISIBLE TO 1/4 INCH IN LENGTH, NOT			
	18	%	05	%	CHECKSUM	AFFECTING GRADE.			
C:	04	%	00	%	QUALITY – OLD CUTS, GROWTH CRACKS				
	17	%	05	%	INTERNAL BLACK SPOTS (11 TO 26%)	LOT C: SIZE 2 TO 3 INCHES			
	06	%	00	%	SPROUTS (3 TO 12%)	IN DIAMETER. NO OFFSIZE.			
	01	%	01	%	SOFT ROT, EARLY STAGES	LOT C: ALL SAMPLES SHOW ALL			
	28	%	06	%	CHECKSUM	POTATOES HAVING SPROUTS			
						RANGING FROM BARELY VISIBLE			
						TO 1 INCH IN LENGTH.			
GRADE:	LOT A: U.S. NO. 1, 70, 80, OR 90 SIZE. LOT B: FAILS TO GRADE U.S. NO. 1, 2 INCH OR 4 OUNCE MINIMUM, ACCOUNT CONDITION.								
LOT C:	FAILS TO GRADE U.S. NO. 1, 2 INCH MINIMUM DIAMETER ACCOUNT CONDITION.								
REMARKS:	ABOVE LOTS INSPECTED DURING PROCESS OF UNLOADING.								
	LOT B: SIZE BASED ON IDAHO MARKETING ORDER, AT APPLICANT'S REQUEST.								
WARNING: Any person who knowingly shall falsely make, issue, alter, forge, or counterfeit this certificate or participate in any such actions, is subject to a fine of not more than \$1,000 or imprisonment for not more than one year, or both.			I, the undersigned, a duly authorized inspector of the United States Department of Agriculture, do hereby certify that at the request of the applicant and on the date indicated, samples of the herein described product were inspected and the quality and/or condition as shown by said samples were as herein stated.				ESTIMATED TOTAL		
Inspector's Signature:			<i>Inspector's Signature</i>			Market Office:	BRONX, NY		
							\$\$\$\$		

Example # 27: Potatoes – Mixed, Sprouts

CARRIER or LOT IDENTIFICATION PREFIX: P 0 1 0 5 0 2 1 NUMBER: 105021 STATE: 1			Loading: Loaded - LO Ptlly Unld - PU Unloaded - UL Lot Insp - LI		Applicant: PATTY'S POTATO PAD		U.S. DEPARTMENT OF AGRICULTURE AGRICULTURAL MARKETING SERVICE INSPECTION CERTIFICATE M - EXAMPLE # 27	
Carrier / Lot ID Stated by: APPLICANT Carrier Type / Name:			Address: ANYWHERE, PA Shipper: SPUDMANIA, LLC Address: SOMEWHERE, ID Insp. Site: APPLICANT'S STORE		Inspection Started: m m d d y y hour min. A/P 0 9 1 8 1 3 0 7 0 0 A M			
Refrigeration Unit: <input type="checkbox"/> On <input type="checkbox"/> Off Doors: <input type="checkbox"/> Open <input type="checkbox"/> Closed								
LOT	TEMPERATURES	Product:	Brand/Markings:	Origin	Lot ID:	Number of Containers:		Insp count
A:	44 to 52 °F	POTATOES, MIXED	"PICNIC" MIXED, U.S. NO. 1, 10 LBS.	ILL	ROUND	1025 BAGS		Y
B:	39 to 43 °F	POTATOES, MIXED	"RED & WHITE" U.S. NO. 1, 5 LBS.	ILL	RED & WHITE	365 BAGS		Y
C:	/ to / °F							
D:	/ to / °F							
L O T	AVERAGE DEFECTS		OFFSIZE/DEFECTS			OTHER		
		Including DAMAGE SER. DAM	Including SER. CROTCH V. @-Blem					
A.	02 %	00 %	%	QUALITY – CUTS			LOT A: 1-3/4 TO 3-1/4 INCHES,	
	07 %	00 %	%	SPROUTS (0 TO 16%)			MOSTLY 2-1/4 TO 2-3/4 INCHES IN	
	03 %	02 %	%	BROWN SURFACE DISCOLORATION (0 TO 8%)			DIAMETER. UNDERSIZE WITHIN	
	02 %	01 %	%	RAISED, ENLARGED, DISCOLORED LENTICELS			TOLERANCE.	
	-1/2 %	-1/2 %	%	SOFT ROT, EARLY STAGES				
	14 %	03 %	%	CHECKSUM			LOT A: MOST SAMPLES SHOW	
B.	01 %	00 %	%	QUALITY – CUTS			MANY TO ALL POTATOES HAVING	
	03 %	02 %	%	RAISED, ENLARGED, DISCOLORED LENTICELS			SPROUTS RANGING FROM BARELY	
	02 %	01 %	%	BROWN SURFACE DISCOLORATION			VISIBLE TO 2 INCHES IN LENGTH.	
	1/2 %	1/2 %	%	SOFT ROT, EARLY STAGES			LOT B: 2 TO 3-1/4 INCHES, MOSTLY	
	07 %	04 %	%	CHECKSUM			2-1/4 TO 2-3/4 INCHES IN DIAMETER.	
	%	%	%				NO UNDERSIZE.	
	%	%	%				LOT B: MOST SAMPLES SHOW SOME TO MANY POTATOES HAVING SPROUTS	
	%	%	%				RANGING FROM BARELY VISIBLE TO 2 INCHES IN LENGTH, WITH 5% OVER 1/2 INCH IN	
	%	%	%				LENGTH, NOT AFFECTING GRADE.	
GRADE:	LOT A: FAILS TO GRADE U.S. NO. 1, 2 INCH MINIMUM DIAMETER ACCOUNT CONDITION (SPROUTS).							
	LOT B: MEETS U.S.NO. 1, 2 INCH MINIMUM DIAMETER.							
REMARKS:	EACH LOT: INSPECTION BASED ON 2 INCH MINIMUM DIAMETER AT APPLICANT'S REQUEST.							
WARNING: Any person who knowingly shall falsely make, issue, alter, forge, or counterfeit this certificate or participate in any such actions, is subject to a fine of not more than \$1,000 or imprisonment for not more than one year, or both.			I, the undersigned, a duly authorized inspector of the United States Department of Agriculture, do hereby certify that at the request of the applicant and on the date indicated, samples of the herein described product were inspected and the quality and/or condition as shown by said samples were as herein stated. Inspector's Signature: <i>Inspector's Signature</i>				ESTIMATED TOTAL Market Office: MARKET CITY, STATE \$\$\$\$	

Example # 28: Potatoes – Size A

CARRIER or LOT IDENTIFICATION U P F E 5 4 0 4 5 0 PREFIX NUMBER STATE		Loading Loaded - LO Ppty Unld - PU Unloaded - UL Lot Insp - LI	L O L O	Applicant: SUPER-MART, INC. Address: ANYWHERE, NJ Shipper: NORTHWEST POTATO CO. Address: SOMEWHERE, WA Insp. Site: APPLICANT'S WAREHOUSE	U.S. DEPARTMENT OF AGRICULTURE AGRICULTURAL MARKETING SERVICE INSPECTION CERTIFICATE  M - EXAMPLE # 28 Inspection Started: m m d d y y hour min. A/P 0 5 1 5 1 3 0 7 0 0 A M		
Carrier / Lot ID Stated by: INSPECTOR Carrier Type / Name: MECH. REFRIG. RAILCAR Refrigeration Unit: <input checked="" type="checkbox"/> On <input type="checkbox"/> Off Doors: <input type="checkbox"/> Open <input checked="" type="checkbox"/> Closed		Additional Lot ID: PO 50991		Insp. Site: APPLICANT'S WAREHOUSE			
LOT	TEMPERATURES	Product:	Brand/Markings:	Origin	Lot ID:	Number of Containers:	insp. count
A:	39 to 45 °F	POTATOES, RUSSET	"BIG A" U.S. NO. 1	W I A	SIZE A	2300 MASTER CARTONS	Y
B:	38 to 43 °F	POTATOES, RUSSET	"SUPER-SIZE" U.S. NO. 1, 60 SIZE	W I A		100 CARTONS	Y
C:							
D:							
LOT	AVERAGE DEFECTS	Including SER. DAM	Including SER. DAM	OFFSIZE/DEFECTS		OTHER	
A.	02 %	00 %		QUALITY – SCAB			
	06 %	03 %		SUNKEN DISCOLORED AREAS WITH UNDERLYING FLESH DISCOLORED (0 TO 15%)			
	04 %	01 %		SUNKEN DISCOLORED AREAS (0 TO 11%)			
	-1/2 %	-1/2 %		SOFT ROT, EARLY STAGES		LOT A: 1-3/4 TO 3 INCHES IN	
	12 %	04 %		CHECKSUM		DIAMETER, OR 4 TO 16 OUNCES IN	
						WEIGHT, WITH 40% OR MORE 2-1/2	
B.	15 %	02 %		QUALITY – HOLLOW HEART WITH DISCOLORATION (5 TO 23%)		INCHES IN DIAMETER OR 6 OUNCES	
	03 %	02 %		SKIN CHECKS		IN WEIGHT OR LARGER. UNDERSIZE	
	00 %	00 %		SOFT ROT		WITHIN TOLERANCE.	
	18 %	04 %		CHECKSUM			
						LOT B: MEETS SIZE AS MARKED.	
						UNDERSIZE WITHIN TOLERANCE.	
GRADE:	LOT A: FAILS TO GRADE U.S. NO. 1, SIZE A, 2 INCH MINIMUM DIAMETER, ACCOUNT CONDITION.						
	LOT B: FAILS TO GRADE U.S. NO. 1, 60 SIZE ACCOUNT QUALITY.						
REMARKS:	ABOVE LOTS UNLOADED DURING PROCESS OF INSPECTION.						
	LOT A: INSPECTION BASED ON SIZE A, 2 INCH MINIMUM DIAMETER, AT APPLICANT'S REQUEST.						
WARNING: Any person who knowingly shall falsely make, issue, alter, forge, or counterfeit this certificate or participate in any such actions, is subject to a fine of not more than \$1,000 or imprisonment for not more than one year, or both.		I, the undersigned, a duly authorized inspector of the United States Department of Agriculture, do hereby certify that at the request of the applicant and on the date indicated, samples of the herein inspected product were inspected and the quality and/or condition as shown by said samples were as herein stated.			ESTIMATED TOTAL		\$\$\$\$
		Inspector's Signature: <i>Inspector's Signature</i>			Market Office: MARKET CITY, STATE		

Example # 18: Potatoes – Appeal Sustained

CARRIER or LOT IDENTIFICATION PREFIX: P 5 1 0 0 5 M E NUMBER: STATE:		Loading: Loaded - LO Pty Unld - PU Unloaded - UL Lot Insp - LI	Applicant: PRODUCE DEALER, INC. Address: ANYWHERE, WA	U.S. DEPARTMENT OF AGRICULTURE AGRICULTURAL MARKETING SERVICE INSPECTION CERTIFICATE APPEAL M - EXAMPLE # 18			
Carrier / Lot ID Stated by: MANIFEST Additional Lot ID: PO 3156		Shipper: PRODUCE SHIPPER, INC. Address: SOMEWHERE, NY	Insp. Site: APPLICANT'S WAREHOUSE				
Refrigeration Unit: <input type="checkbox"/> On <input type="checkbox"/> Off		Doors: <input type="checkbox"/> Open <input type="checkbox"/> Closed		Inspection Started: m m d d y y hour min. A/P 0 9 2 0 1 3 0 7 0 0 A M			
LOT A: 45 to 47 °F B: to °F C: to °F D: to °F	TEMPERATURES	Product: POTATOES, ROUND RED	Brand/Markings: RED GODDESS' 50 LBS.	Origin: W I A	Lot ID: LOT NO. 222	Number of Containers: 300 CARTONS	Insp count: Y
AVERAGE DEFECTS Including DEFECTS SER. DAM. Including DEFECTS SER. DAM.		OFFSIZE/DEFECTS			OTHER		
04	%	00	%	QUALITY – CUTS	SIZE: 2 TO 3-1/2 INCHES, MOSTLY		
10	%	06	%	BROWN SURFACE DISCOLORATION (7 TO 20%)	2-1/2 TO 3 INCHES IN DIAMETER.		
02	%	02	%	SOFT ROT, MODERATE STAGES	NO UNDERSIZE.		
16	%	08	%	CHECKSUM			
THIS CERTIFICATE COVERS AN APPEAL INSPECTION, WHICH WAS PREVIOUSLY CERTIFIED ON FEDERAL CERTIFICATE NUMBER T-XXXXXX-X, DATED SEPTEMBER 19, 2013, WHICH IS SUSTAINED AS TO QUALITY, CONDITION, AND GRADE.							
GRADE: FAILS TO GRADE U.S. NO. 1 ACCOUNT CONDITION.							
REMARKS: SEE FEDERAL CERTIFICATE T-XXXXXX-7 FOR REMAINDER OF LOAD (500 CARTONS OF RUSSET POTATOES).							
WARNING: Any person who knowingly shall falsely make, issue, alter, forge, or counterfeit this certificate or participate in any such actions, is subject to a fine of not more than \$1,000 or imprisonment for not more than one year, or both.		I, the undersigned, a duly authorized inspector of the United States Department of Agriculture, do hereby certify that at the request of the applicant and on the date indicated, samples of the herein described product were inspected and the quality and/or condition as shown by said samples were as herein stated. Inspector's Signature: <i>Inspector's Signature</i>			Market Office: BRONX, NY		ESTIMATED TOTAL \$\$\$

Example # 17: Potatoes – Appeal Reversed

CARRIER or LOT IDENTIFICATION PREFIX: P 5 1 0 0 5 M E NUMBER: STATE:		Loading: Loaded - LO Pkly Unld - PU Unloaded - UL Lot Insp - LI	Applicant: PRODUCE DEALER, INC. Address: ANYWHERE, ID	U.S. DEPARTMENT OF AGRICULTURE AGRICULTURAL MARKETING SERVICE INSPECTION CERTIFICATE APPEAL M - EXAMPLE # 17			
Carrier / Lot ID Stated by: MANIFEST Carrier Type / Name:		Additional Lot ID: PO 3156	Shipper: PRODUCE SHIPPER, INC. Address: SOMEWHERE, PA				
Refrigeration Unit: <input type="checkbox"/> On <input type="checkbox"/> Off Doors: <input type="checkbox"/> Open <input type="checkbox"/> Closed		Insp. Site: APPLICANT'S WAREHOUSE		Inspection Started: m m d d y y hour min. A/P 0 9 2 0 1 3 0 8 0 0 A M			
LOT	TEMPERATURES	Product:	Brand/Markings:	Origin	Lot ID:	Number of Containers:	Imp Count:
A:	40 to 26 °F	POTATOES, RUSSET	"KING SPUD" 70 SIZE, 50 LBS.	U I D	USDA/ID-XXXXXX	500 CARTONS	Y
B:							
C:							
D:							
L O T	AVERAGE DEFECTS Including SER. DAM Excluding SER. DAM		OFFSIZE/DEFECTS		OTHER		
	%	%	%	%			
	09	00			INTERNAL QUALITY – HOLLOW HEART (3 TO 15%)		
	03	00			EXTERNAL QUALITY – GROWTH CRACKS, OLD BRUISES, CUTS		
	06	01			DRY ROT (2 TO 8%)		
	02	02			SOFT ROT		
	20	03			CHECKSUM		
					MEET SIZE AS MARKED.		
					THIS CERTIFICATE COVERS AN APPEAL INSPECTION OF ABOVE LOT, WHICH WAS PREVIOUSLY INSPECTED AND REPORTED ON FEDERAL CERTIFICATE M-XXXXXX, DATED SEPTEMBER 19, 2013, WHICH IS REVERSED AS TO QUALITY AND GRADE.		
GRADE:	FAILS TO GRADE U.S. NO. 1, 70 SIZE ACCOUNT QUALITY.						
REMARKS:	SEE FEDERAL CERTIFICATE M-XXXXXX-6 FOR REMAINDER OF LOAD (300 CARTONS RED POTATOES).						
WARNING: Any person who knowingly shall falsely make, issue, alter, forge, or counterfeit this certificate or participate in any such actions, is subject to a fine of not more than \$1,000 or imprisonment for not more than one year, or both.			I, the undersigned, a duly authorized inspector of the United States Department of Agriculture, do hereby certify that at the request of the applicant and on the date indicated, samples of the herein described product were inspected and the quality and/or condition as shown by said samples were as herein stated. Inspector's Signature: <i>Inspector's Signature</i>			ESTIMATED TOTAL SEE M-XXXXXX	
			Market Office:			BRONX, NY	

Tip: No charge (fee) for inspection. However, charge any mileage, overtime, tolls, Etc.

Appendix C: Short Answer Responses for Screen (online) Potato Survey

Potato 2A-Observed Criteria from Survey Participants:

Eyes (x3), dents, scoring, some scarring (easy to peel away), good coloring, pleasing oblong shape, slightly bad, an average looking potato, looks cut, odd shape, major scarring, bumpy, round-ish, uniform color, deep crétacés make less usable, spores, good shape/color, too many eyes, dried out surface, too small, looks like common potato, familiar, surface damage, score marks on one side make it look damaged, uneven surface, deformed, holes, chunky, too many eyes, it is a little lumpy, looks good, more noticeable divots, shape looks easy to handle, even color, fair, half of it is brown, scratch marks, lots of places starting to sprout, too much skin would have to be removed before eating, scars, tampered with, dirty, large, no parts sticking out, very good, slightly bad, good in color, some eyes but intact, scars, ok, good, needs to be eaten soon, not healthy, a bit deformed, looks old, just ok-more pits than I prefer, the potato is not peeled but it has bruises, just a regular potato, bad, not fresh, looks fine, very bad, not fresh, roundy, it's somewhat rotten, looks old, dry, and dirty, very damaged, seems clean and decent for kitchen use, good.

Potato 6E-Observed Criteria from Survey Participants:

odd growth, size, lots of eyes, noticeable growth, pimple texture, bumpy, moderate, deformed, knob on end, the potato does not need to be symmetrical, but it needs to be all one surface without extra knobs and growths, growth seems unhealthy making it not aesthetically pleasing, Bumpy, scaring, uneven color, strange shape, bumps, scars on surface, ugly but 80% usable as potato, weird shape, dull color, spores, irregular shape, bump, color variation, a lot of bumps, the one large bump is kind of cute, not symmetrical, shape, eyes, ridiculous, but the little nub on it is displeasing, I would use this if it was purchased in a large bag but would avoid selecting it from a bin, random shape, dirty, chunky, irregular protrusion, deformed, somewhat displeasing, looks odd, lumpy, color is okay, no exposed eyes or anything, good, weird extra part, no sprouts, slightly brown color, this potato is fine, unique, good size, edible, hard to peel, rough texture, neutral, good, looks unhealthy, weird knob, but otherwise decent, bad, lump, gross, fair, misshapen and old, not good for health, the outgrowth is not pleasing, looks old and a bit rotten, disfigured shape - unattractive, the potato is not peeled but it has large deformities, bumps look pretty weird, bad, somewhat ok, fine but lumpy, not fresh, bulky, looking not so attractive, it looks old and weirdly shaped, extra layers, I know you might feel compelled to say that the results are due to my inability to cook, but I honestly believe that my choice of potatoes is as much at fault as my inability to cook them, I have never had any issues when trying to cook anything else, good.

Potato 7M-Observed Criteria from Survey Participants:

eyes, bruise, broken skin, fresh sprout spots, unnatural globe shape, good, an average looking potato, surface is same all around, without any knobs or extra bits, color is expected, dimples do not bother me, pleasant color, roughly symmetrical shape, uniform size, minimal scars or eyes, round, not much dirt, brown color, smooth surface, totally usable, color, regular shape, clean, round shape, symmetrical, less bumps, shape, but eyes too deep, looks like a good potato, small sprout makes me think it has been sitting a while, looks slightly soft, bumpy, deformed, browning, kind of small, it is small and lumpy, somewhat good, looks good, nice shape, even enough color, clean, good, no sprouts, a lot of places starting to sprout, round, this potato is OK, bruises, light, bumpy, bright, even, round, bad, very good, great, some eyes, but nice shape, it is OK, round, norm, OK, fair, sprouty, not too tasty, OK, looks a bit old, appears just OK, the potato is not peeled but it has bruises, a nice shape, would eat, good, somewhat OK, looks fine but small, slightly good, looks old, very round, an artful picture to look at, it looks okay to eat but has some eyes starting, fresh, upon initial glance, this potato is tiny, good

Appendix D: Farmer Reduced Price Seconds Survey Responses

3 Farmers' Responses

Q1. I sell potatoes – Yes or No

Q2. Are you willing to bring your potatoes "seconds" to the market for a reduced price? (Specifically at 18%-27% discounted price).

By produce "seconds" - I mean "ugly", "cosmetically imperfect", "suboptimal", "abnormally shaped and/or irregularly shaped" potatoes that are perfectly edible.

With no discount, you will capture 60% of the consumers, while providing 18%-27% discount will capture 80% of the consumers interested in buying potatoes.

Q3. This is the end of the survey. Please provide other comments (e.g., any foreseeable barriers to this idea) if you would like.

Thank you!

Q1.I sell potatoes	Yes	Vegetables	No
	Yes, Definitely! Any way I can get rid of my seconds will be great.	Maybe I'll consider it.	No. It's not worth the effort

<p>Q3. This is the end of the survey. Please provide other comments (e.g., any foreseeable barriers to this idea) if you would like.</p>	<p>we're in the process of getting a new van since the old ones are limited in space. We only bring firsts but once we have more space, I would love to bring seconds</p>	<p>So...there is a lot to be said around Ugly produce and local markets, starting with the fact that at local markets, farmers aren't able to ask a price that reflects their work in real terms. This things tend to get dictated by other market forces, especially in the Twin Cities where there are a LOT of food options relative to the population served. That is just to say that to offer an even lower price for produce, even for unmarketable uglies; right next to the sorted pretties, might reduce an already low farm income. Just a though, a hypothesis to consider, and by no means a hard truth :)</p>	<p>a complicated subject. I don't like the premise of producers trying to get rid of produce. Were trying to make money, produce value/quality, not get rid of stuff</p> <p>I sell seconds, but am careful to offer it only to people who I know regularly buy my tomato firsts, and/or will pay me adequately for the seconds</p> <p>If you put it out there too much, the seconds price will gradually become the price.</p> <p>I'd rather leave them at home and sell them or give them to family and friends</p> <p>Low quality produce has wrecked the Mnpls market. Everyone over there has to compete with all the seconds that resellers are selling. The retail price is same or even under wholesale price</p> <p>Good news about the market numbers. Wow</p> <p>I've still got tomatoes for the market!</p> <p>Thank you</p>
--	---	---	---