Food Safety and Quality:

A User Research for Shopper Insights Into Food Traceability Information Provided at Grocery Stores With a Focus on Produce

by

Yisha Wang

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Graduate Supervisory Committee:

John H. Takamura Jr., Chair
Carola Grebitus
Michelle Fehler

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ABSTRACT

Food safety incidents have constantly hit society and threatened human health. Hundreds of millions of people become sick after eating contaminated food every year. As the problem continues to emerge, consumers must take action to avoid purchasing risky food products. As one of the solutions, food traceability systems have been developed rapidly in many countries in recent years. More food products can now be provided with traceability information to assist consumers in making purchase decisions. To design services for grocery shoppers to access food information from food traceability systems possibly through modern technologies, this transdisciplinary user research study investigated shopper insights into food traceability information on produce provided at grocery stores, with a fusion of ideas from the disciplines of design and consumer behaviors. Through literature reviews, an online survey study, and an online interview study, this research revealed a series of shopper insights concerning (1) shoppers' knowledge about food traceability information, (2) shoppers' behaviors and motivations for using traceability information on produce, (3) shoppers' perceptions towards providing traceability information on produce to them at grocery stores, (4) shoppers' perceived important traceability information on produce, (5) shoppers' behavior intentions of using specific ways to access traceability information on produce, and (6) shoppers' thresholds to pay for traceability information on produce. Based on the results, this study identified design opportunities for the features, components, and mediums of the service design of future food traceability systems.

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TABLE OF CONTENTS

Page

CHAPTER Page

CHAPTER Page

CHAPTER Page

CHAPTER Page

APPENDIX Page

LIST OF TABLES

LIST OF FIGURES

Figure Page

CHAPTER 1

INTRODUCTION

1.0.0 Introduction

People care about the safety and quality of their food, as both factors are associated with their health. Since ancient times, people have taken particular foods as medicine to cure diseases or promote health, as described in the ancient theory of "Medicine Food Homology" (as cited in Xia & Xiao, 2021, p. 2), "eating on an empty stomach as food, and administering to the patient as medication" (p. 2). People wish to maintain good health from nutritious and pure ingredients.

Today's food markets face a series of challenges that worth attention. These challenges include foodborne diseases, food frauds, consumers' health concerns about food additives, genetically modified organisms (GMOs), pesticide residues, added growth hormone residues, and antibiotics. These issues are not only associated with human health but also affect the environment, economy, and society. Many consumers deliberate when deciding which food products are worth buying by considering characteristics such as food quality, fair prices, minimum food risks, and sustainability.

In commercialized shopping environments, many shoppers rely on reading product labels, certifications, packaging and signs to access food-related information. The information is usually offered by grocers, suppliers and producers. However, compared to the food information in the entire supply chain, these approaches conveyed a limited amount of information to consumers. In other words, there may be more information from the supply chain that shoppers need in order to decide which food products to buy or avoid. Moreover, some businesses choose to play marketing tricks on product labels

and packaging to mislead shoppers' perceptions of their products, which hinders them from accessing accurate product information for making purchase decisions (Hussain, 2021; Harvard, 2017).

Without knowing the necessary information about where, when, and how food has been produced, processed, transported, and maintained before they arrive at the hands of consumers, it is hard for them to evaluate if the food can pose potential risks to them. Therefore, shoppers may need to use food traceability information (FTI) to assess the safety and quality characteristics of the food products when buying them. "Food traceability information" can be interpreted as "any or all information relating to food which is under consideration, throughout its entire life cycle, by means of recorded identifications", adapted from Olsen & Borit's definition of "traceability" (Olsen & Borit, 2013, p. 148).

Nowadays, with the development of food traceability systems in many countries, more food information in the food supply chains can be collected and recorded, even for global trade. More emerging technologies are also being developed to enable consumers to access product traceability information (TI) through the Internet of Things when products move along the supply chains, such as Quick Response code (QR code), Radio-Frequency Identification (RFID), and Near Field Communication (NFC). To design the services of future food traceability systems that can better serve the needs of consumers to make informed purchase decisions, it is necessary to investigate their perspectives on the FTI based on their real-life shopping experiences. This study shed light on shopper insights into FTI with a focus on produce provided at grocery stores through the lens of

user research. The results of this study may provide design implications for the service design of future food traceability systems.

1.1.0 Justification

According to the 15th report (HLPE, 2020) by experts from the Food and Agriculture Organization of the United Nations (FAO), "food environments in different contexts are deteriorating and food safety is an ongoing concern" (p. xvi). It revealed that "unsafe food is responsible for a large number of illnesses and deaths worldwide" (HLPE, 2020, p. 20), and "these illnesses can be acute or chronic, and can be caused by agents such as bacteria, viruses, parasites, mycotoxins, chemical contaminants, heavy metals and natural toxins" (p. 20). Moreover, a piece of evidence from the WHO Foodborne Disease Burden Epidemiology Reference Group (FERG) indicated that "31 food-borne hazards were responsible for around 600 million foodborne illnesses and 420000 deaths in 2010" (as cited in HLPE, 2020, p. 20), while "children under 5 years old account for approximately 40 percent of the food-borne disease burden" (HLPE, 2020, p. 24). Unsafe food can bring tremendous hazards to people.

As one of the solutions to this problem, traceability has been developed as a tool to improve the assurance of food safety and quality in society (Aung & Chang, 2014). From the consumer's standpoint, developing a robust food traceability system is paramount because it can help consumers access necessary food information to make informed and safe food choices (Rodriguez-Salvador & Dopico, 2020; Aung & Chang, 2014; Coff et al, 2008). Moreover, FTI also enables them to monitor unethical and

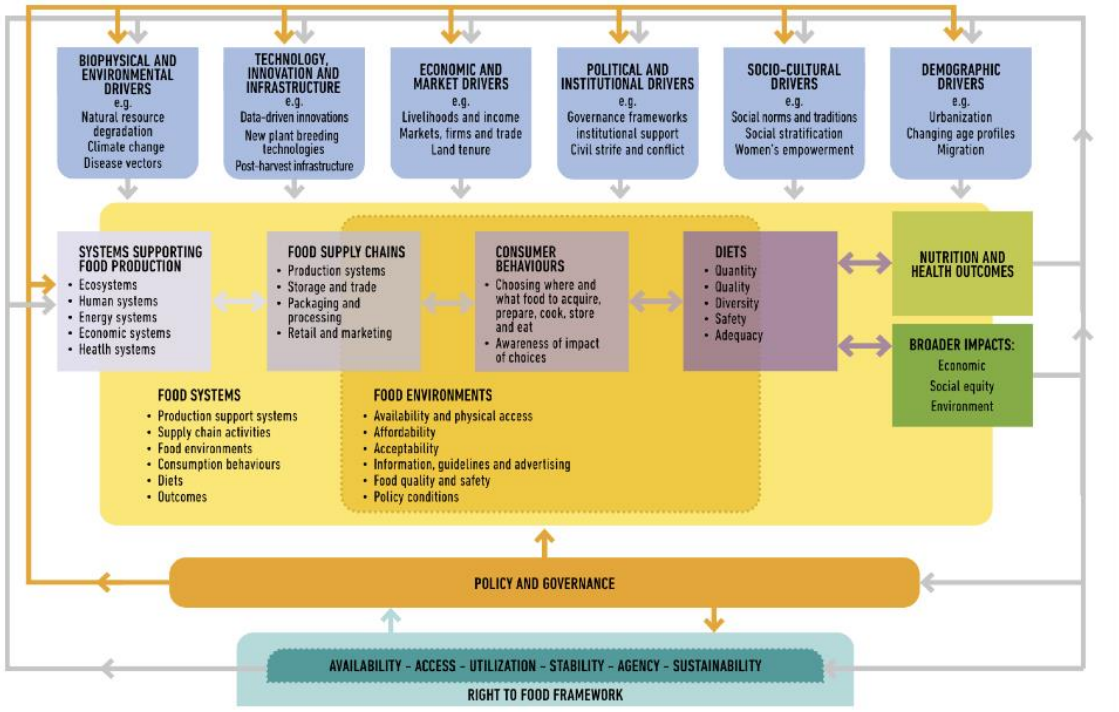
inappropriate practices in food supply chains and therefore be responsible for their health, community, and environment (Coff et al, 2008).

On another side, a consumer's food choices can affect the sustainability of food systems, as depicted in the Sustainable Food System Framework (see Figure 1) (HLPE, 2020, p. 13). As studies indicated that food information could influence consumers' food choices (Bradu et al, 2014, p. 293; du Plessis & du Rand, 2012, p. 216; Grebitus, 2008, p. 35), it can be inferred that food choices influenced by FTI can likewise affect the sustainability of food systems. However, further theoretical evidence is needed on this inference.

Furthermore, academic research has shown a rapid increase in food traceability to bolster food safety in recent years (Sinha et al, 2021, p. 257). Those studies mainly focused on technology development of food traceability systems (Lin et al, 2020; Feng et al, 2020; Qian et al, 2020), food safety and quality management (Aung & Chang, 2014), economics (Kshetri, 2021), and consumer behaviors (Lu et al., 2016; van Rijswijk & Frewer, 2008). However, there is a lack of data on this topic from the design perspective, which is an important discipline for modern system design and development (ISO, 2019). Therefore, this study uses the lens of user research to investigate shopper insights into food traceability, which may contribute to the academic knowledge for developing food traceability from the design perspective.

Figure 1

Sustainable Food System Framework



Note. From "Figure 2 - Sustainable Food System Framework," by HLPE, 2020, *Food security and nutrition: building a global narrative towards 2030*. p. 13 (https://www.fao.org/3/ca9731en/ca9731en.pdf). Copyright by the High-level Panel of Experts (HLPE) on Food Security and Nutrition of the Committee on World Food Security, Rome. Citation with permission.

1.2.0 Scope

This study has the following aspects of scopes:

(1) Food category. This study only focused on the FTI of produce (fruits and vegetables) other than any other food categories because produce had the simplest form of supply chains, which can reduce the complexity of the study.

(2) Location of data collection. The research collected data in the Phoenix metropolitan area, Arizona, a populous metropolitan area in the United States (Statistical Atlas, n.d.), and had a great variety of brands of grocery stores.

1.3.0 Limitations

This study has the following aspects of limitations:

(1) Timeframe. This research project was allowed for a limited timeframe.

(2) Funding. This research project had a low cost, which limited the use of additional research services.

(3) Data collection. This research project chose online approaches to collect data, which limited the variety of the demographics of the samples.

(4) Sample size. The sample size of the survey and the interview studies were limited due to the limits of timeframe and funding.

(5) Representability. Due to the chosen sample strategies, the study results are not representative beyond the sample population.

(6) Data analysis. The results generated from the data analysis methods were limited to depth, breadth, and rigorousness.

1.4.0 Research Topics

This section introduces the main topics of this study in terms of food traceability, design, food safety and quality, and sustainable food system framework.

1.4.1 Food Traceability

Food traceability has been a trendy topic in the food industry in recent years, as it is valued as a tool to improve food safety and quality assurance in society. Nowadays, many food companies provide TI on their products to consumers, which helps them become more aware of the food they buy and eat. This study shed light on food traceability by investigating shopper insights into FTI on produce provided at grocery stores from the lens of user research.

1.4.2 Design Perspectives and Theories

This study rationalized why design is important for developing food traceability systems. It also provided implications for the service design of future food traceability systems.

1.4.3 Food Safety and Quality

This study introduced many current food safety and quality challenges threatening people's safety and health, and explained how food traceability has been used to solve the issues.

1.4.4 Sustainable Food System Framework

The Sustainable Food System Framework proposed by scholars from the Committee on World Food Security (CFS) (HLPE, 2020) was introduced in the literature review section, as it is related to food safety and quality, and consumers' food choices.

1.5.0 Operational Definitions

This section introduces the definitions of concepts mentioned in this study.

1.5.1 Consumer Behavior

"Consumer behavior" refers to "all the choices and decisions made by consumers, at the household or individual level, on what food to acquire, store, prepare, cook and eat, and on the allocation of food within the household" (HLPE, 2017, p. 31).

1.5.2 Food Chain

"Food chain" refers to "the series of stages that food passes along as it goes from being grown or produced to being sold and then eaten" (Oxford University Press, 2022).

1.5.3 Food Supply Chain

"Food supply chain" refers to "an important component of food systems, and include all the stages and actors, including private sector businesses, from production to trade, processing, retail marketing, consumption, and waste disposal" (HLPE, 2017, as cited in HLPE, 2020, p. 11).

1.5.4 Food System

"Food system" refers to "the entire range of actors and their interlinked value-adding activities involved in the production, aggregation, processing, distribution, consumption and disposal of food products that originate from agriculture, forestry or fisheries, and parts of the broader economic, societal and natural environments in which they are embedded" (FAO, 2018).

1.5.5 Grocery Store

"Grocery store" refers to "a store that sells food and household supplies: supermarket" (Merriam-Webster, n.d.).

1.5.6 Human-centered Design

"Human-centered design" refers to the "approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques" (ISO, 2019).

1.5.7 Stakeholder

"Stakeholder" refers to "an individual or organization having a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations" (ISO, 2019).

1.5.8 Sustainability

"Sustainability" refers to "the long-term ability of food systems to provide food security and nutrition in a way that does not compromise the economic, social and environmental bases that generate food security and nutrition for future generations" (HLPE, 2020, p. xv)

1.5.9 Traceability

"Traceability" refers to "the ability to access any or all information relating to that which is under consideration, throughout its entire life cycle, by means of recorded identifications" (Olsen & Borit, 2013, p. 148).

1.5.10 Usability

"Usability" refers to the "extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO, 2019).

1.5.11 User

"User" refers to a "person who interacts with a system, product or service" (ISO, 2019).

CHAPTER 2

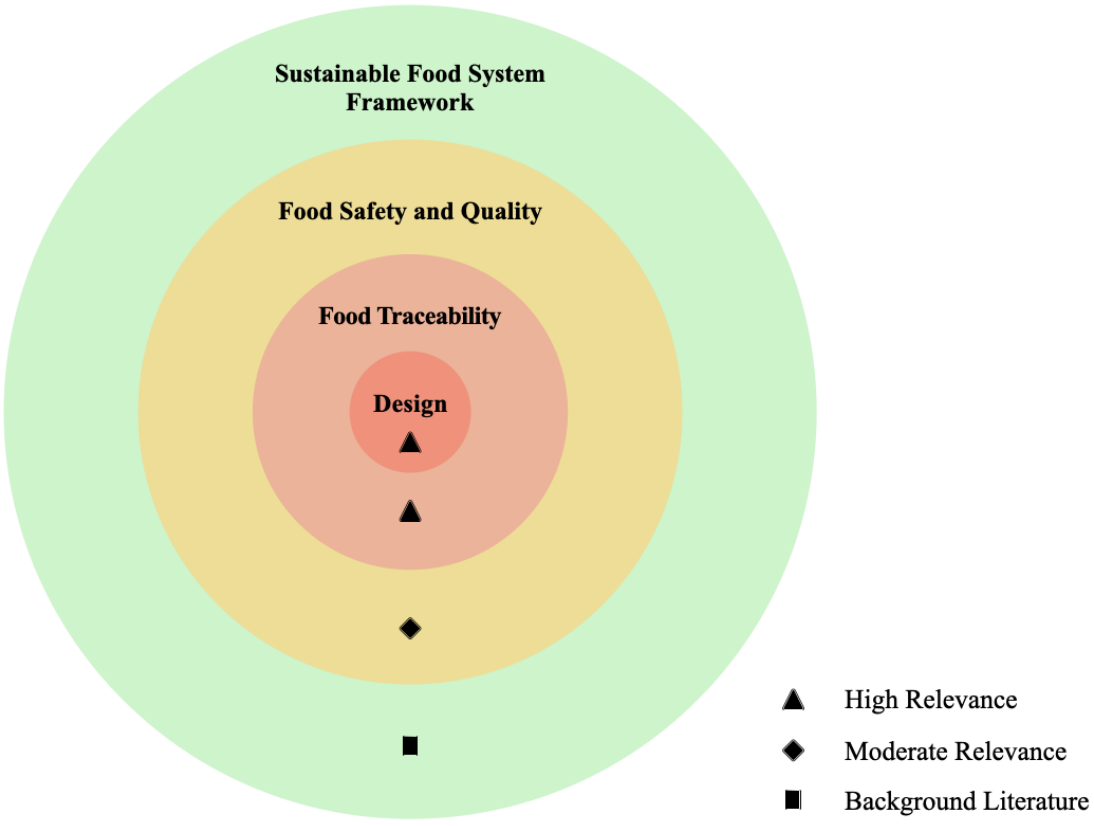
LITERATURE REVIEW

2.0.0 Introduction

This chapter overviews the topics of food traceability, design, food safety and quality, and sustainable food system framework, which provides this study's social and theoretical background.

Figure 2

Conceptual Framework I



The conceptual framework I (see Figure 2) illustrates the main concepts of this study and their relationships. From the inner circles to the outer ones, the figure indicates that this study focuses on the design perspectives aiming to address the need for the development of food traceability to improve food safety and quality in society, which is an important sector in the sustainable food system framework (see Figure 1) (HLPE, 2020, p. 13).

2.1.0 Food Traceability (Aung & Chang, 2014)

"Traceability" is a term that has become popular in recent years in the food industry (Aung & Chang, 2014, p. 173). Adapted from Olsen and Borit's (2013, p. 148) definition, "food traceability" can be generally interpreted as "the ability to access any or all information relating to food which is under consideration, throughout its entire life cycle, by means of recorded identifications" for this study. "Traceability" has been applied as a tool to track food movement in the supply chain and record food-related information throughout all stages of the supply chain (Aung & Chang, 2014, p. 173; FDA, 2020; Safe Food Advocacy Europe, n.d.; Qian et al., 2020).

For the benefit of consumers, food traceability enabled them to access more food information in the food chain to make informed purchase decisions and reduce safety concerns (Tyson Fresh Meats, 2020; Aung & Chang, 2014; Coff et al, 2008). For the benefit of producers, food traceability enabled companies to monitor product information provided by food traceability systems (Qian et al., 2020, p. 405; Aung & Chang, 2014). For the benefit of governments, food traceability enabled relevant officials to identify the

sources of food risks in the supply chain and rapidly order withdraws or recalls of risky food products from the markets (FDA, 2020; European Commission, n.d.).

2.1.1 Consumer Knowledge and Attitudes Towards Food Traceability (Hansstein, 2014)

How familiar are shoppers in the US with the concept of food traceability, and what are their attitudes towards it? This section introduces the relevant findings on consumer knowledge and attitudes towards food traceability in the US in recent years.

Researcher Hansstein (2014) studied consumer knowledge and attitudes towards food traceability in European Union, China, and North America. Her study reviewed academic articles published between 2003 and 2013, with four studies reporting findings about US consumers. Her study found that “US consumers are quite familiar with food traceability and its features, at least in the meat sector" (Hansstein, 2014, p. 117), and “they value information on food safety, quality and also country of origin” (p. 117). One study (Ward et al., 2005) referenced in Hansstein’s research (2014) revealed that TI was valuable to US consumers since the outbreak of Bovine Spongiform Encephalopathy (BSE) in Washington State in 2003. And many US consumers would be willing to support a mandatory animal traceability system and pay extra for it (Ward et al., 2005). Based on those findings, researcher Hansstein (2014) recognized the needs to communicate traceability to consumers effectively and develop traceability to ensure food safety and quality. Furthermore, she suggested that traceability could enable consumers to check food information throughout the food chain and to have a certain level of control over the food systems, which could reduce consumer perceived risk and

increase the trust of the stakeholders of the food chain (Hansstein, 2014). Finally, she recommended collaboration between producers and policymakers to increase consumer awareness about the benefits of food traceability systems (Hansstein, 2014).

From 2015 to 2022, only one published study was found to report relevant findings regarding US consumers' attitudes towards food traceability. The study (Shew et al., 2022) revealed that consumers valued USDA certification more than Blockchain technology-enabled traceability for making purchase decisions specifically on meat. Moreover, the researchers suggested an important implication for business and consumer education to value product data rather than the value of the technologies that manage data (Shew et al., 2022).

To conclude, many consumers in North America were likely to have an interest and a positive attitude towards traceability (Hansstein, 2014). Moreover, researchers in this field suggested creating educations for consumers about recognizing the value of FTI and the benefits of food traceability systems (Shew et al., 2022; Hansstein, 2014).

2.1.2 Food Traceability Systems (Aung & Chang, 2014)

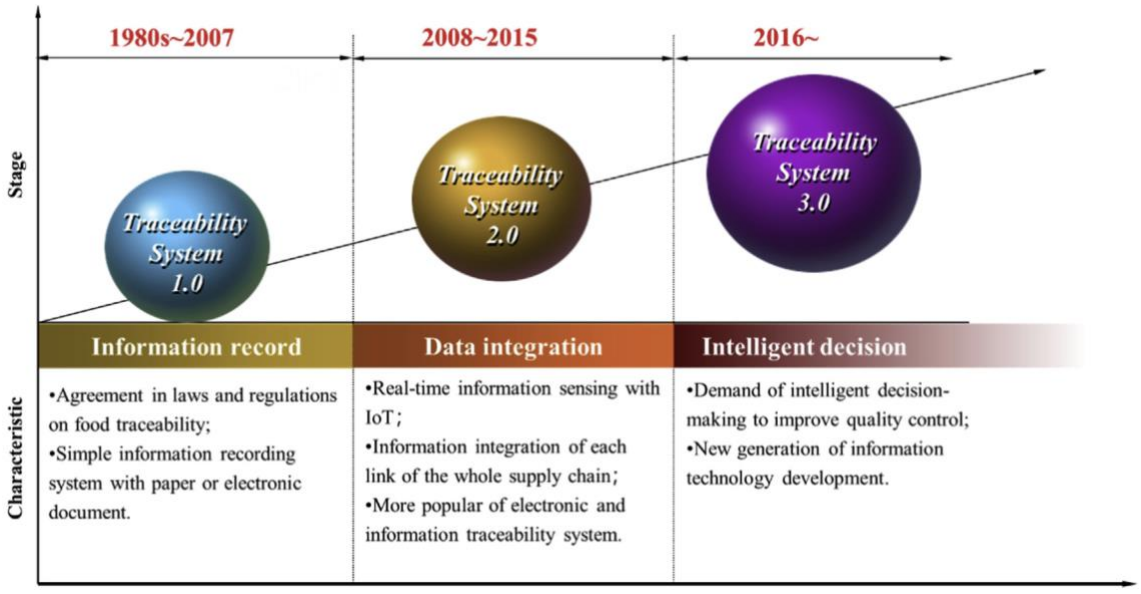
In the US, the US Food & Drug Administration (FDA) recognized a need to develop a traceability system "from farm to fork" that requires the participation of all stakeholders in the food supply chain (FDA, 2021). An official blueprint was released to create technology-enabled end-to-end traceability for all food (FDA, 2020). "Food traceability systems" refer to the systems that can track the movement of food with its recorded information generated throughout the supply chains, both backward to suppliers and forward to consumers (FDA, 2020; Food Standards Agency, 2019). Moreover, the

food industry has discussed how to utilize advanced technologies to provide traceability and transparent information about food throughout the supply chains to consumers for making informed decisions (Bumblauskas et al, 2020; Kamilaris et al, 2019).

A group of researchers summarized the development stages of food traceability systems from the 1980s to 2016 and later in a world trend (Qian et al, 2020), as presented in Figure 3.

Figure 3

Three Development Stages of Traceability Systems



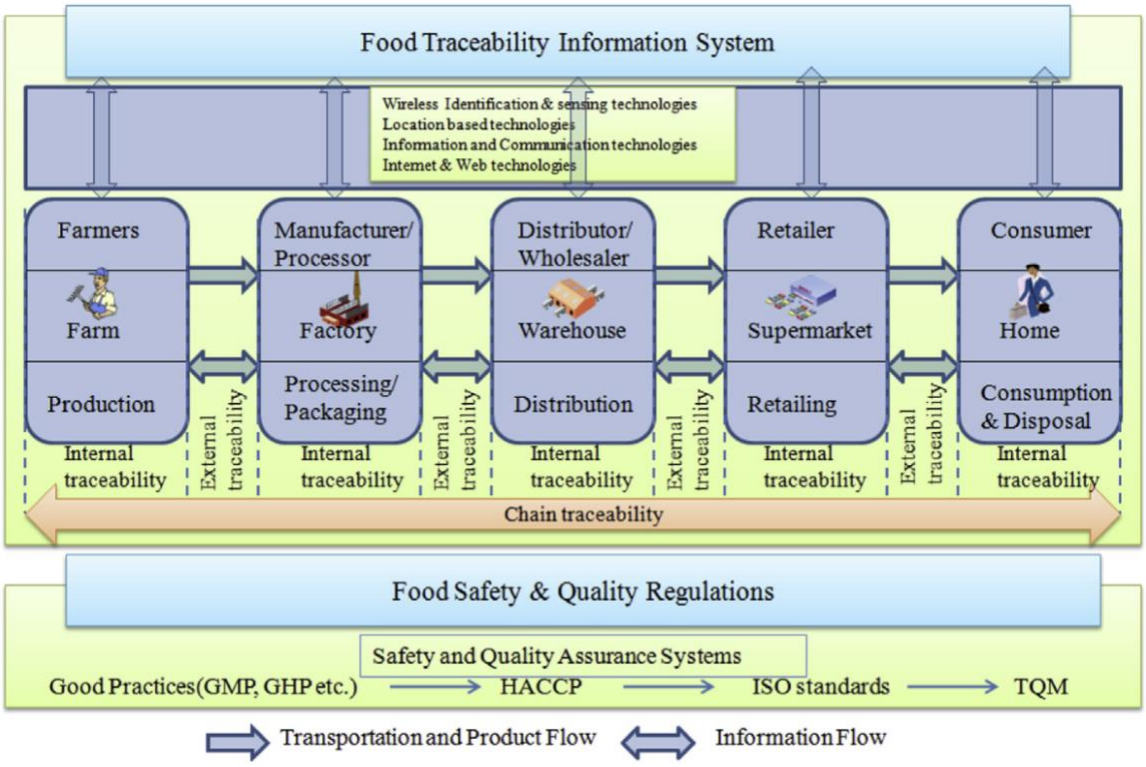
Note. From "Fig. 1. Three development stages of TS," by Qian et al, 2020, Food traceability system from governmental, corporate, and consumer perspectives in the European Union and China: A comparative review. *Trends in Food Science & Technology, 99,* p.402-412 (https://doi.org/10.1016/j.tifs.2020.03.025). Copyright Elsevier (2020).

The first stage of food traceability system development from the 1980s to 2007 mainly relied on paper or electronic documentation covering limited supply chain sectors

(Qian et al, 2020). The second stage from 2008~2015 incorporated real-time information technology, which enabled data integration covering the sectors throughout the supply chains (Qian et al, 2020). The third stage, from 2016 to later, integrated the new generation of information technology and intelligent decision-making to improve food quality control (Qian et al, 2020). Researchers Aung and Chang (2014) illustrated a conceptual framework of a hypothetical food traceability system achieving a whole supply chain traceability, as presented in Figure 4.

Figure 4

Conceptual Framework of Food Traceability Systems



Note. From "Fig. 4. Conceptual framework of food traceability system," by Aung & Chang, 2014, Traceability in a food supply chain: Safety and quality perspectives. *Food Control, 39,* p.172-184 (http://dx.doi.org/10.1016/j.foodcont.2013.11.007). Copyright Elsevier (2013).

Figure 4 demonstrates that all supply chain sectors (production, processing/packaging, distribution, retailing, consumption and disposal) report information about a food product to the FTI system via modern technologies when it moves along the chain (Aung & Chang, 2014). And technologies can be used as facilitators to connect all sectors of the supply chain to the food traceability information system (Aung & Chang, 2014). Moreover, each supply chain sector is internal traceable, and also connects with other sectors with external traceability to achieve whole chain traceability (Aung & Chang, 2014). Safety and quality assurance systems at the bottom of this figure ensure that all supply chain sectors comply with food safety & quality regulations (Aung & Chang, 2014).

From a worldview, many countries have developed their food traceability systems to improve food safety and quality, such as a cloud computing center in Shanghai's Jinshan district in China (Wei, 2011), the European Union's "RASFF - the Rapid Alert System for Food and Feed" (European Commission, n.d.; Qian et al, 2020), a blockchain-based food safety platform in Korea (Ledger Insights, 2019), a boat-to-plate traceability program featuring fish and seafood products in Canada (Canadian Food Inspection Agency, 2019), a traceability system for rice/rice products and cow/beef in Japan (MAFF, n.d.), and National Livestock Information System (NLIS) in Australia (VCM International, n.d.). Overall, compared to the past, more comprehensive food information in the supply chains can be collected and recorded by modern food traceability systems.

2.1.3 Trendy Technologies for Consumers (Pigini & Conti, 2017)

To help consumers access TI of the food they buy at grocery stores, technology-enabled approaches were developed and implemented. The following sections introduce the trendy technologies that serve the consumers.

2.1.3.1 QR Code (Pigini & Conti, 2017)

QR Code is an extended form of a traditional barcode, square-shaped, that can be printed on product packaging (Kaspersky, n.d.; MEQR, n.d.). It is usually used as a quick link to the company's website, where FTI can be presented (Pigini & Conti, 2017). Shoppers can scan the product QR codes by using a mobile phone's camera launched by mobile applications, and then view the company's webpage for more information (Pigini & Conti, 2017).

2.1.3.2 RFID (Pigini & Conti, 2017)

Radio Frequency Identification (RFID) is a wireless technology system that uses radio waves to exchange data (Hayes, 2020; FDA, 2018). It comprises two components: tags and readers (FDA, 2018). The tag has a chip that contains the information, including tracking information or a unique identification code that can be received by the reader through radio waves (FDA, 2018; Hoffman, 2016).

RFID has been used in the food chain process since the 2000s (Pigini & Conti, 2017). Shoppers can use a mobile phone embedded with an RFID reader to sense the RFID tags attached to food products to access FTI set by the company (Aung & Chang, 2014).

2.1.3.3 NFC (Pigini & Conti, 2017)

Near Field Communication (NFC), a derived technology based on RFID, is a wireless communication system with close-range connectivity, which can be as short as a few centimeters (Pigini & Conti, 2017). It allows data communication between either an NFC-enabled device and an NFC tag, or two NFC-enabled devices (Pigini & Conti, 2017).

NFC can be integrated into mobile phones, tablets, and notebooks (Pigini & Conti, 2017). By approaching one of the smart devices integrated with NFC to another NFC device or an NFC tag, the smart device can automatically launch its application so that all the data on the NFC tag or NFC device can be read (Pigini & Conti, 2017). Moreover, the NFC device or tag can send the customer's information to the company (Pigini & Conti, 2017). The application can not only open the website of the company but also automatically activate more phone functionalities, such as sending a text message, initiating a call, and sending GPS locations (Pigini & Conti, 2017).

Briefly, consumers can use NFC-enabled smart devices to approach a food product with an NFC tag nearby to access the company's website where more food information can be presented.

2.1.4 Prospect of Using Mobile Phones to Access FTI (Aung & Chang, 2014)

Many shoppers use websites and smartphone applications to purchase products (Pigini & Conti, 2017). In Italy, “50% of Italians read comments on products on social networks and blogs to decide if and what to buy, while 44% use advanced tools such as smart phone apps to receive information on promotions and offers” (as cited in Pigini &

Conti, 2017). In the UK, “76% of UK consumers research or get inspiration online before they make a purchase” (Briggs, 2018). In China, “on average a Chinese consumer will make 10 to 12 visits to online and offline touch points — including search engines, product sites, and physical stores—before buying an expensive item such as consumer electronics” (as cited in Chu, 2016). It can be seen that the Internet of Things and mobile phones are important mediums for many shoppers to access desired product information for making purchase decisions.

2.2.0 Design Perspectives and Theories

As depicted by the studies (Aung & Chang, 2014; Lin et al, 2020), consumers are considered as users of future food traceability systems. To design services of food traceability systems for them, it’s important to understand the users’ needs and opinions on FTI from the design perspective so that designers can work on solutions based on the insights.

2.2.1 User Research (Goodman et al, 2012)

User Research is an effective approach to understand users’ needs, motivations, and behaviors in a user-centered design process (Usability, n.d.; ISO, 2010). It examines the user’s perspective with a consistent, rapid, controlled, and thorough method, with various techniques applied at each iterative phase in a product’s development process (Goodman et al, 2012). It provides an approach to help designers and researchers to understand usability problems and create a more user-oriented experiences so that users may have a higher chance to use their products, services or sites (Adobe, n.d.).

User research often adopts specific qualitative research methods, such as user interviews, focus groups, and usability testing, or quantitative methods, such as surveys, eye-tracking, and product analytics (Adobe, n.d.).

This study adopted user research approach to investigate shoppers' needs and points of view on using FTI so that the data may be used by designers and researchers to identify design opportunities for the service design of future food traceability systems.

2.2.2 User-centered Design (Endsley et al, 2003; ISO, 2019)

User-centered design (UCD) refers to "a collection of processes that focus on putting users at the center of product design and development" (Babich, 2019). It is viewed as "a philosophy based on the needs and interests of the user, with an emphasis on making products usable and understandable" (Norman, 1988, p. 188). It utilizes "an iterative design process framework that incorporates validation from the user every step of the way" (Tran, 2019).

A similar term to "user-centered design" is "human-centered design (HCD)" (ISO, 2010; ISO, 2019), which was defined as the "approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques" (ISO, 2010; ISO, 2019). The systems mentioned in this definition were expected to provide benefits to users in terms of "improved productivity, enhanced user well-being, avoidance of stress, increased accessibility and reduced risk of harm" (ISO, 2019). This definition of HCD was used in the 2010 and 2019 versions of the International Organization for Standardization (ISO) for Ergonomics of Human-system

Interaction - Part 210: Human-centered Design for Interactive Systems (ISO 9241-210) (ISO, 2010; ISO, 2019). It addresses the impacts of interactive systems on the stakeholders including users (ISO, 2019). However, “UCD” and “HCD” are often used synonymously (ISO, 2019). As this study emphasizes the design for end users of food traceability systems, the following content of HCD can be referred to UCD whenever appropriate from now on in this paper.

To organize and use HCD effectively, human factors/ergonomics and usability disciplines were adopted (ISO, 2019). Human factors/ergonomics refers to the “scientific discipline concerned with the understanding of interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance” (ISO, 2019). Another important concept “usability” for HCD refers to the “extend to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO, 2019).

As an important design philosophy in the worldwide design industry, HCD generalized through its international standardization (ISO, 2010) is used as a powerful and popular tool/approach in academia, governmental organizations, computing, and design departments (Thomas et al, 2017).

This study adopted HCD thinking to explore design opportunities for the service design of future food traceability systems based on the research data.

2.3.0 Food Safety and Quality (FAO & WHO, 2022)

Food safety and quality are perceived to be important by consumers (van Rijswijk & Frewer, 2008). Food safety refers to the "assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use" (CAC, 2003). Quality refers to "the totality of features and characteristics of a product that bear on its ability to satisfy stated or implied needs" (van Reeuwijk, 1998). Food quality are associated with product characteristics and process characteristics (Northen, 2000, Caswell et al, 1998, as cited in Grebitus, 2008, p. 52). When associating with product characteristics, food quality includes the attributes of food safety, nutrition, sensory, functional, and image (Northen, 2000, Caswell et al, 1998, as cited in Grebitus, 2008, p. 52). When associating with process characteristics, it includes the attributes such as organic production, traceability, and animal welfare (Northen, 2000, Caswell et al, 1998, as cited in Grebitus, 2008, p. 52). In the consumer's mind, food safety and quality are mostly seen as interlinked concepts (van Rijswijk & Frewer, 2008), and both associated with food choice and consumer demand (Grunert, 2005).

Food safety and quality play a critical role in people's everyday life, as they directly impact human health and wellness (FAO & WHO, 2022; Holban & Grumezescu, 2018). Since the past decades, different scales of food scares and scandals have been happening endlessly in many places worldwide (Newell et al, 2010), which led to deadly or severe sickness to human and animals, such as the listeria-contaminated ice cream products in Florida (Genovese, 2022), the outbreaks of avian flu in 25 counties in early 2022 (Flynn, 2022), E. coli infections in frozen pizzas (Whitworth, 2022), and Vibrio infections in seafood (News Desk, 2022). Notably, the World Health Organization

(WHO) revealed that children under five years old take up 40% of the foodborne disease, with 125,000 deaths yearly (WHO, 2022).

With the food globalization (FDA, 2022) and the development of logistics (Hayaloğlu, 2015), food supply chains are getting increasingly complex and dynamic (Trienekens et al, 2012). Many foods need to travel long distances to destinations, even for fresh produce or perishables (USDA, 2020). Various foodborne hazards may potentially occur in food products along the way, including bacteria, viruses, protozoa, worms, and chemicals (Fung et al, 2018). A study in foodborne diseases indicated that "the microbiological safety of food remains a dynamic situation heavily influenced by multiple factors along the food chain from farm to fork" (Newell et al, 2010, p. S3), while "the burden of diseases caused by food-borne pathogens remains largely unknown" (p. S3).

2.3.1 Common Food Concerns (IFIC, 2021)

What are the common concerns about food that consumers have to face today? The International Food Information Council (IFIC) conducted a Food & Health Survey to address some perspectives from Americans in 2021. According to the survey results, the most critical food safety issues in the US today are "1) foodborne illnesses from bacteria, 2) chemicals in food, 3) carcinogens or cancer-causing chemicals in food, 4) pesticides/pesticide residues, 5) food additives and ingredients, 6) antibiotics, 7) the presence of allergens in food, 8) GMOs, and 9) bioengineered food/contains bioengineered ingredients, and 10) other" (IFIC, 2021). Moreover, research by Gizaw (2019) summarized seven common public health risks concerning food safety in the food

market, namely, microbial contaminations, chemical contamination, food adulteration, misuse of food additives, mislabeling, genetically modified foods (GM foods), and outdated foods or foods past their use-by dates. The following sections introduce some typical food concerns from the public.

2.3.1.1 Foodborne Illnesses (WHO, 2020)

Foodborne illnesses are diseases transmitted through food, often caused by harmful bacteria, viruses, parasites, chemicals, toxins, or prions, which can lead to more than 200 diseases (WHO, 2020). About 10% of people in the world can get sick after consuming contaminated food (WHO, 2020).

With the globalization of food trade and increasingly complex food supply chains (HLPE, 2020; Sanders, 1999), food products can carry foodborne pathogens from one place and then cause outbreaks of foodborne illnesses while transported to another country (Sanders, 1999). People in developing and underdeveloped regions with poor food safety management and measures are at greater risk of suffering from foodborne diseases (WHO, 2019; Yeni et al, 2016; Grace, 2015).

2.3.1.2 Food Additives (WHO, 2018)

Food additives are a series of substances added to food, while not used as characteristic ingredients of food that have the technological functions of maintaining or improving the safety, freshness, flavors, texture, appearance, preservation, coloring, and sweetening of food (WHO, 2018; BfR, 2021). Thousands of food additives are sourced from natural or artificial synthetics (WHO, 2018). Many food additives have chemical-

sounding names that many shoppers are unfamiliar. The German Federal Institute for Risk Assessment (BfR) conducted a survey in May 2021, which revealed German shoppers' understanding of food additives (BfR, 2021). The study showed that 60% of respondents felt they were not well informed at all about the manufacturing process of food with additives; 58% not felt well informed at all about the health risks of additives; 49% not felt well informed about the functions of additives; and 42% not felt well informed about the labeling of additives on food (BfR, 2021). The 2021 Food & Health Survey (IFIC, 2021) conducted in the US revealed that 54% of Americans regarded it important to avoid chemical-sounding ingredients in their food. Moreover, among those who believed not having chemical-sounding ingredients was important, nearly 85% were concerned that chemical-sounding ingredients were related to healthfulness and/or food safety (IFIC, 2021).

Many food safety incidents were related to the misuse of food additives, illegal use of food additives, or use of unhealthy food additives, with cases such as toxic heavy metals in baby food across the US (LaMotte, 2021), ethylene oxide scandal in Europe (Whitworth, 2021), widely used emulsifiers that cause colitis and obesity (Chassaing et al, 2015), and melamine milk scandal in China (Xiao, 2011).

2.3.1.3 Pesticide Residues (NIEHS, 2022)

Agricultural chemicals are widely used in food production, including herbicides, insecticides, fungicides, disinfectants, and others, which leads to the phenomenon that their residues remain in food ingredients (NIEHS, 2022). The National Institute of Environmental Health Sciences defined a pesticide as "any substance used to kill, repel,

or control certain forms of plant or animal life that are considered to be pests" (NIEHS, 2022), which includes the herbicide "for destroying weeds and other unwanted vegetation" (NIEHS, 2022), the insecticide "for controlling a wide variety of insects" (NIEHS, 2022), the fungicide "used to prevent the growth of molds and mildew" (NIEHS, 2022), the disinfectant "for preventing the spread of bacteria" (NIEHS, 2022), and the chemical compound "used to control mice and rats" (NIEHS, 2022).

A study (Sabarwal et al, 2018) stated that pesticide poisoning is a global public health problem that causes nearly 300,000 deaths yearly worldwide. It also claimed that pesticides are associated with many disorders in human and wildlife including cancer, the pathogenesis of Parkinson's and Alzheimer's diseases, respiratory and reproductive tracts, and oxidative stress that may cause malignancies (Sabarwal et al, 2018). WHO (2020) stated that many outdated pesticides, such as dichlorodiphenyltrichloroethane (DDT) and lindane, can stay in soil and water for years, damaging the ecosystem and accumulating in the food chain. WHO (2020) also stated that the general public who consumes conventional agri-products is exposed to low levels of pesticides, while people who work with pesticides or are in the immediate areas applied with pesticides are at higher risk.

2.3.1.4 Animal Growth Hormone and Antibiotics (FDA, 2021; Paudel et al, 2022)

Animal growth hormones and antibiotics are common drugs used to promote the growth and health of agricultural animals for meat or milk production (FDA, 2021). Growth hormones are often treated on beef cattle and dairy cows (FDA, 2021), while

antibiotics are often treated on beef cattle, dairy cows, broiler chickens, laying hens, turkeys, swine, fish, honey bees, and fruits (Dietitians of Canada, 2019).

There have been considerable controversies around the world for decades about the use of added growth hormones and antibiotics in agricultural animals (Paudel et al, 2022; Government of Canada, 2012; Graham et al, 2007; Kuchler et al, 1988; Solomons, 1978). Consumers may consume animal products that contain the residues of those growth hormones or antibiotics in their diets (Muaz et al, 2018; Jeong et al, 2010). Moreover, many consumers also concern about animal health and welfare (The Humane Society of The United States, 2016). A group of researchers in Korea (Jeong et al, 2010) conducted research in 2010 on the risk assessment of growth hormonal and antibiotic residues in meat. They claimed that the health effects on human from a series of hormonal substances such as “estradiol-17β”, “progesterone”, “testosterone”, “zeranol”, “trenbolone”, and “melengestrol acetate” were under debate, while the natural steroid hormones had negligible impacts on human if they were handled with appropriate control (Jeong, 2010). They further stated that the major health concerns about antibiotics on human were “the induction of antimicrobial resistant bacteria and the disruption of normal human intestinal flora” (Jeong, 2010).

2.3.1.5 GMOs (WHO, 2014)

Genetically modified organisms (GMOs) refer to “organisms (i.e., plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination” (WHO, 2014), and “it allows selected individual genes to be transferred from one organism into another, also

between non-related species" (WHO, 2014). This technology is often referred to the term "genetic engineering" (FDA, 2022), which is used to meet some greatest challenges of the 21st century (Bawa & Anilakumar, 2013). After applying this technology to plants and animals, the original species can be equipped with particular characteristics, such as herbicide-and-insecticide resistant, virus-resistant, nutritional, quickly growing, and more productive (Bawa & Anilakumar, 2013). The typical GM food includes corn, soy, canola, potato, cotton, apple, and salmon (Yushin, 2019).

Although GM food can solve a series of human food challenges, there is considerable oppositions and concerns. Research by Bawa and Anilakumar (2013) summarized the general concerns about GM food, including the issues regarding "human and environmental safety, labeling and consumer choice, intellectual property rights, ethics, food security, poverty reduction, and environmental conservation" (Bawa & Anilakumar, 2013).

2.3.1.6 Food Frauds (Spink & Moyer, 2011)

Food fraud is often associated with adulteration as a public health threat (Spink & Moyer, 2011). It refers to "the act of purposely altering, misrepresenting, mislabeling, substituting or tampering with any food product at any point along the farm–to–table food supply chain" (FSNS, 2016), which "can occur in the raw materials, in an ingredient, in the final product or in the food's packaging" (FSNS, 2016).

Nowadays, food fraud crimes are happening worldwide. According to Interpol and Europol's latest OPSON IX report targeting counterfeit-and-substandard foodstuff and drink in 77 countries, 12,000 tons of illegal food products were seized (Interpol &

Europol, 2021). The report (Interpol & Europol, 2021) stated that the types of seized illegal products include raw animal feed, alcoholic and non-alcoholic beverages, produce, dairy products, meat and meat products, cooking oils, sugar and sweet products, seafood, livestock, mixed food and drinks, and food supplements/additives. Jong (2022) summarized the trends of food fraud based on this report: 1) high fraud risk in the meat category; 2) threat in seafood is increasing and becoming more complex; 3) fraud for food supplements and additives becoming common; 4) expired goods are sold on the rise; 5) fruits, vegetables and legumes have moderate threats. It can be recognized that food fraud can pose significant dangers to people's lives, and food globalization can bring food risks to people all over the countries.

2.3.2 Food Safety and Quality with Relation to Human Health (FAO & WHO, 2022; Rodríguez, 2019; WHO, 2020)

Food safety and quality have multiple relations with human health.

Firstly, safe and good-quality food brings good sources of nutrition to human body. According to the Food and Agriculture Organization of the United Nations (FAO & WHO, 2022), safe and nutritious food is critical for human to sustain life and promote good health. Human body functions require the nourishing substances from food called nutrients to grow, develop and maintain, otherwise, human health declines (Wardlaw & Insel, 1996). Rachael Link, a registered dietitian (Link, 2020) claimed that there are 11 essential nutrients that human body needs to intake, generally from food, namely, carbohydrates, protein, fat, water, vitamins, minerals, calcium, sodium, potassium, Omega-3 Fatty Acids, and Vitamin D. Moreover, the food, including fruits, vegetables,

whole grains and lean proteins, can provide sufficient nutrients that most people require (Link, 2020). The Dietary Guidelines for Americans demonstrated complete guidance on the necessary nutrients to promote health and prevent diseases (USDA & HHS, 2020; HHS & USDA, 2015).

Secondly, food safety and quality also relates to human health through microbiomes. Microbiomes are "the infection intersection: where host, food, and pathogen intersect" (Hill, 2017, as cited in Bedale, 2018). They consist of bacteria, viruses, fungi and other genomes in human body (Bedale, 2018). Microbiomes allow human to harvest nutrients, extract inaccessible energy, produce vitamins, metabolize carcinogens, and compete with pathogens (Bedale, 2018). In 2017, a symposium gathered academics, regulators and industry experts in Illinois named "Microbiomes in Food Safety, Food Quality, and Human Health" reported findings about human gut microbiome and its relationship with diet and disease (Bedale, 2018). The symposium introduced that diet affects microbiomes which can thereby affect the nutritional benefits of food (Bedale, 2018). Moreover, a group of researchers from Baylor College of Medicine identified "an association between diet quality and microbiome composition in human colonic mucosa" (Liu et al, 2019, as cited in Rodríguez, 2019). Another researcher (Rodríguez, 2019) further interpreted their results by explaining that "a good-quality diet as the one recommended by the Dietary Guidelines for Americans to be high in fruits, vegetables and whole grains, and low in added sugar, alcoholic beverages and solid fats is associated with higher abundance of beneficial bacteria such as those with anti-inflammatory properties" (Liu et al, 2019, as cited in Rodríguez, 2019), and "a poor-quality diet, on the other hand, is associated with more potentially pathogenic bacteria,

such as Fusobacteria, which has been linked to colorectal cancer" (Liu et al, 2019, as cited in Rodríguez, 2019).

Thirdly, food safety and quality are associated with diseases. Consuming food in poor safety or quality conditions may lead to diarrhea (WHO, 2020), malnutrition (Keenan, 2021), foodborne diseases (Scott, 2003; WHO, 2020), type 2 diabetes (CDC, 2020), obesity (CDC, 2020), heart diseases (CDC, 2020), and cancer (WHO, 2020). Among the population, infants, young children, seniors, and patients can be particularly affected by the vicious cycle of diseases and malnutrition caused by consuming unsafe food (WHO, 2020).

Fourthly, food safety and quality are associated with diet, which thereby may also be associated with mental health (Selhub, 2020; Clay, 2017; El Ansari et al, 2014). A medical field, named Nutritional Psychiatry, studies about how food relates to human mental health (Adan et al, 2019). A group of researchers (Adan et al, 2019) studied Nutritional Psychiatry claimed that diet and nutrition might be critical not only for human physiology and body composition, but also for mood and mental well-being. They also claimed that more evidence found that a poor diet was strongly associated with the exacerbation of mood disorders and other neuropsychiatric conditions (Adan et al, 2019).

To conclude, it can be recognized that safe and good-quality food plays a crucial role for human in sustaining life and maintaining overall health and well-being.

2.3.3 Shopper's Preferences for Safe and Healthy Food (IFIC, 2021)

Many food shoppers have safety and health awareness when selecting food (Gardner, 2022; IFIC, 2021; Nagyová et al., 2019; Ho et al., 2019). Health-conscious

shoppers search for food products with attributes including “organic”, “gluten-free”, “local”, “low-sodium” and “heart-healthy” (Robbins, 2021). Responding to those demands, many food companies print that food attribute information on their product packaging and labeling to indicate that they are healthier than others in specific aspects (Plasek et al., 2020; Ježovičová, 2016). However, many shoppers are still skeptical about the authenticity of the attribute claims (Visciano & Schirone, 2021; Mitra et al., 2019; Askew, 2018), because these claims could be used as advertising, and could be misleading, deceptive or confusing (Askew, 2018; Chan et al, 2005). Therefore, helping shoppers verify the authenticity of food attribute information is deemed to be paramount.

2.3.4 Impact of Food Safety and Quality Issues on Society, Economy and Environment (Aung & Chang, 2014)

Facing today’s food industry, food safety and quality issues have a large impact on the environment, economy, and society (Aung & Chang, 2014; WHO, 2020). As indicated in the Sustainable Food System Framework (Figure 1), food safety and quality, as a critical part of food environments within food systems, are related to ecosystems, human systems, energy systems, economic systems, and health systems (HLPE, 2020).

From the social perspective, food safety has been considered an increasingly important public health issue (Aung & Chang, 2014), which has a broad range of impacts on trade (WHO, 2020), tourism (WHO, 2020), workforce plagued with absenteeism (Fitzgerald et al., 2016), trust in government (FSN, 2022), health care systems (WHO, 2020), and crime activities (Interpol & Europol, 2021). Foodborne diseases have burdened many countries (Odeyemi, 2016). An estimation from WHO (2022) described

that around 600 million people become ill and 420 thousand people die yearly from eating unsafe food.

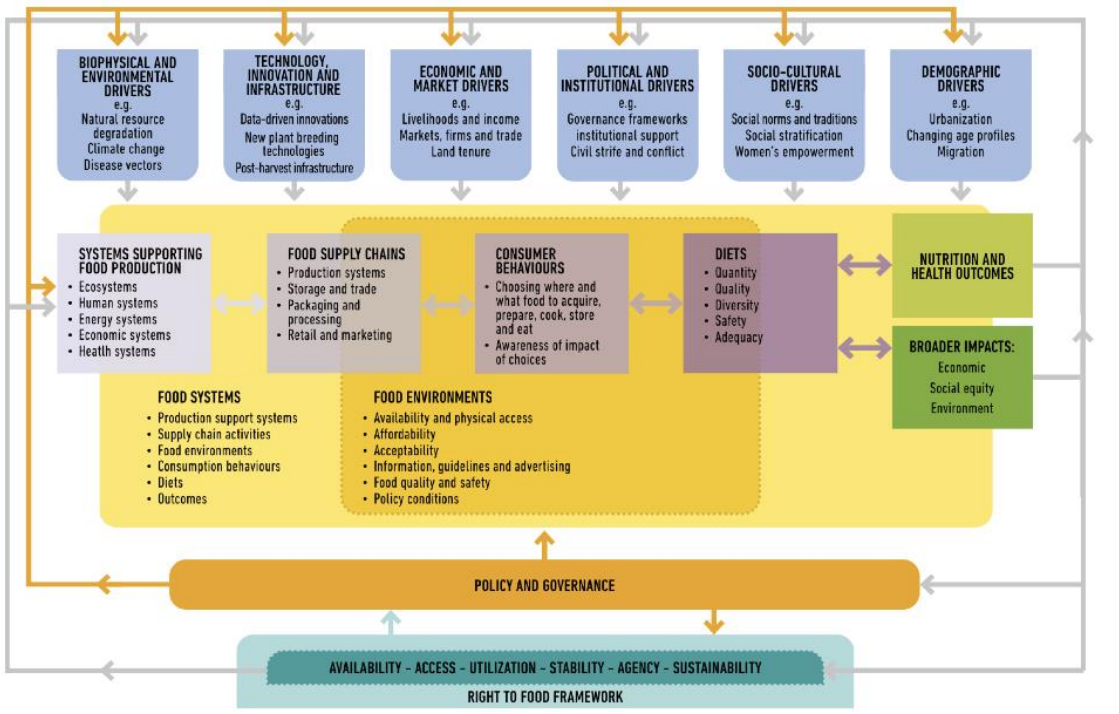
From the economic perspective, food safety issues pose heavy burdens on national economies and healthcare systems in many places worldwide. In the US, $15.5 billion was estimated as an annual economic burden due to foodborne illnesses (Hoffmann et al, 2015). In low- and middle-income countries, food safety issues result in a US $110 billion loss yearly in productivity and medical expenses (WHO, 2020).

From the environmental perspective, food supply chains that can maintain the safety and quality of food can create numerous kinds of impacts on the environment at every step from production to waste disposal, including energy and resource use, emissions of Green House Gases (GHG), biodiversity, and pollution (Ritchie & Roser, 2020). Much perishable food needs cold chain management to preserve the freshness, quality and safety of food in the supply chains, which requires continuous refrigeration (Cold Chain Science Enterprises, n.d.). As a result, the cold chain poses significant impacts on the environment including especially GHG (Dong et al., 2021).

2.4.0 Sustainable Food System Framework (HLPE, 2020)

Figure 1

Sustainable Food System Framework



Note. From "Figure 2 - Sustainable Food System Framework," by HLPE, 2020, *Food security and nutrition: building a global narrative towards 2030*. p. 13 (https://www.fao.org/3/ca9731en/ca9731en.pdf). Copyright by the High-level Panel of Experts (HLPE) on Food Security and Nutrition of the Committee on World Food Security, Rome. Citation with permission.

The High-Level Panel of Experts on Food Security and Nutrition (HLPE) proposed a "Sustainable Food System Framework" (Figure 1) (HLPE, 2020, p. 13) in its 15th report named "Food Security and Nutrition - Building A Global Narrative Towards 2030" aiming to achieve The Right to Food (in other words: "The Right to Adequate Food") of all people (HLPE, 2020). This group serves as the science-policy interface of the Committee on World Food Security (CFS), which is an intergovernmental platform for Food Security and Nutrition (FSN) (HLPE, 2020).

"The Right to Food" as one of the fundamental human rights (OHCHR & FAO, 2010), refers to "the right of every individual, alone or in community with others, to have physical and economic access at all times to sufficient, adequate and culturally acceptable food that is produced and consumed sustainably, preserving access to food for future generations" (de Schutter, 2014).

"Food Security" is a situation that exists "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2001). This concept was perceived within legal interpretations of the right to food (HLPE, 2020), which lays a foundational conceptual framework for a Sustainable Food System Framework (HLPE, 2020).

"Food Security" encompasses six dimensions to support its core concept with definitions as follows:

Table 1

Definitions of 6 Dimensions of Food Security

Availability	"Having a quantity and quality of food sufficient to satisfy the dietary needs of individuals, free from adverse substances and acceptable within a given culture, supplied through domestic production or imports" (p.10).
Access (economic, social and physical)	"Having personal or household financial means to acquire food for an adequate diet at a level to ensure that satisfaction of other basic needs are not threatened or compromised; and that adequate food is accessible to everyone, including vulnerable individuals and groups" (p.10).
Utilization	"Having an adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met" (p.10).

Stability	"Having the ability to ensure food security in the event of sudden shocks (e.g. an economic, health, conflict or climatic crisis) or cyclical events (e.g. seasonal food insecurity)" (p.10).
Agency	"Individuals or groups having the capacity to act independently to make choices about what they eat, the foods they produce, how that food is produced, processed, and distributed, and to engage in policy processes that shape food systems. The protection of agency requires socio-political systems that uphold governance structures that enable the achievement of FSN for all" (p.10).
Sustainability	"Food system practices that contribute to long-term regeneration of natural, social and economic systems, ensuring the food needs of the present generations are met without compromising the food needs of future generations" (p.10).

Note. From "Box 1 The Six Dimensions of Food Security," by HLPE, 2020, *Food security and nutrition: building a global narrative towards 2030*. p. 10 (https://www.fao.org/3/ca9731en/ca9731en.pdf). Copyright by the High-level Panel of Experts (HLPE) on Food Security and Nutrition of the Committee on World Food Security, Rome. Citation with permission.

Food Systems refer to "all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the output of these activities, including socio-economic and environmental outcomes" (HLPE, 2014).

Sustainable Food Systems are the food systems that deliver "food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised" (FAO, 2018). A sustainable food system has six characteristics that support the six dimensions of food security, namely, "productive and prosperous"; "equitable and inclusive"; "empowering and respectful"; "resilient"; "regenerative"; and "healthy and nutritious" (HLPE, 2020, p. 13).

HLPE recognized a growing need to transform current food systems into more sustainable ones to approach Food Security and Nutrition policy grounded by the Right to Food as a guiding principle, and to achieve further Sustainable Development Goals (HLPE, 2020; HLPE, 2017; UN, 2015). As presented in Figure 1, multiple drivers of changes in food systems (biophysical and environmental drivers; technology, innovation, and infrastructure; economic and market drivers; political and institutional drivers; and socio-cultural drivers; and demographic drivers) and the systems that support food production (ecosystems; human systems; energy systems; economic systems; and health systems) all work in specific roles to impact the food systems with the input of policy and governance of food security and nutrition (HLPE, 2020).

A food system consists of six critical sectors including "food production support systems", "food supply chains", "food environments", "consumer behaviors", "diets", and the outcomes of diets towards "nutrition and health" and diets' broader impacts on "economic, social equity, and environment" (HLPE, 2020, p. 13). A sustainable food system was designed to: 1) be "profitable (economic sustainability)" (FAO, 2018); 2) have "broad-based benefits for society (social sustainability)" (FAO, 2018); and 3) have "a positive or neutral impact on the natural environment (environmental sustainability)" (FAO, 2018).

This study was embedded into the Sustainable Food System Framework for exploration because it intended to examine the needs of designing services for grocery shoppers to access FTI possibly through modern technologies for making more informed purchase decisions during grocery shopping, which belonged to the scope of "technology,

innovation and infrastructure" sector (Figure 1) (HLPE, 2020) as one of the drivers of changes on food systems into more sustainable ones.

The following sections introduce the more specific scopes within the Sustainable Food System Framework (Figure 1) that this study fits into.

2.4.1 Food Environments (HLPE, 2020)

"Food Environments" refers to "the physical, economic, socio-cultural and policy conditions that shape access to, affordability of, the safety of, and preferences over, food" (as cited in HLPE, 2020, p. 89) and is placed at the central part of the sector of "food systems" in the Sustainable Food System Framework (see Figure 1) (HLPE, 2020, P. 13). They serve a context where food shoppers engage with the food systems to decide on "acquiring, preparing and consuming food" (HLPE, 2017, p. 28).

Food environments consist of "availability and physical access"; "affordability"; "acceptability"; "information, guidelines and advertising"; "food quality and safety"; and "policy conditions" (see Figure 1) (HLPE, 2020, p. 13), which are associated with "food supply chains", "consumer behaviors", and "diets" (see Figure 1) (p. 13).

2.4.2 Food Supply Chains (HLPE, 2020)

Food Supply Chains consist of "all the stages and actors, including private sector businesses, from production to trade, processing, retail marketing, consumption and waste disposal" (HLPE, 2017b, as cited in HLPE, 2020, p. 11). Another terminology similar to this concept is "food chains", which refers to "the series of stages that food passes along as it goes from being grown or produced to being sold and then eaten"

(Oxford University Press, 2022). In the Sustainable Food System Framework (see Figure 1), food supply chains encompass production systems; storage and trade; packaging and processing; and retail and marketing (HLPE, 2020, p. 13).

Food supply chains serve an important role in food systems because they are driven by the supporting systems of food production (ecosystems, human systems, energy systems, economic systems, and health systems) (see Figure 1) and ended by the consumption or disposal of consumers (HLPE, 2020). The whole process directly impacts the planet in multiple ways and plays a critical role in human food security and nutrition (HLPE, 2020).

There are many food concerns about the food supply chains (Aung & Chang, 2014; Wu et al., 2021, p. 2). With the trend of increasingly complex food supply chains (HLPE, 2020, p. 11), there are likely more chances for food risks to occur when food moves along the chains (Deloitte, 2017). Facing many food safety incidents nowadays, consumers should be informed with more transparent food information to ensure the food they buy is safe (Trienekens et al., 2012, p. 55).

2.4.3 Consumer Behaviors (HLPE, 2020)

Consumer Behaviors refer to "all the choices and decisions made by consumers, at the household or individual level, on what food to acquire, store, prepare, cook and eat, and on the allocation of food within the household" (HLPE, 2017, as cited in HLPE, 2020, p. 88), which is "influenced by personal preferences and shaped by the existing food environment" (p. 88).

Considerable studies have focused on the purchase decision-making process of consumers and revealed that specific information about products may lead to certain kinds of consumer responses regarding purchase intentions, purchase decisions, attitudes, brand knowledge, and attention towards products (Howard & Sheth, 1969). Based on this fact, it can be inferred that providing more FTI to grocery shoppers may change consumers' shopping behaviors.

2.4.4 Diets (HLPE, 2020)

Diets refer to "the individual foods that a person consumes" (HLPE, 2017, p. 32). Responded to the food environments, shoppers make food choices (HLPE, 2020, p. 12) that shape their diets in terms of "quantity, quality, diversity, safety and adequacy of food" (see Figure 1) (Downs et al, 2020, as cited in HLPE, 2020, p. 13).

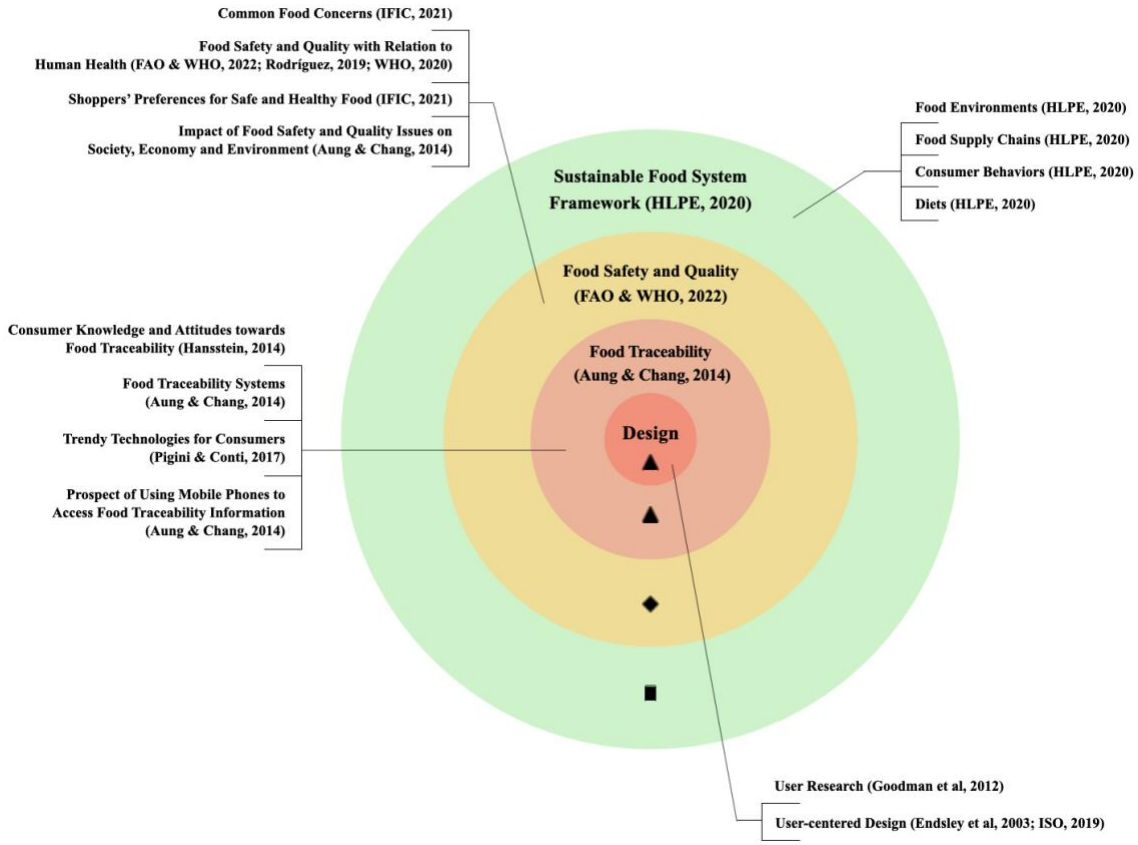
Diets need to meet the needs of people's nutrition and health (HLPE, 2020, p. 13). Healthy diets are the dietary patterns that can help people prevent malnutrition and specific diseases including "diabetes, heart diseases, stroke and cancer" (WHO, 2020).

Diets can make a broader impact on society, economy, and environment (see Figure 1) (HLPE, 2020). Sustainable healthy diets refer to "dietary patterns that promote all dimensions of individuals' health and wellbeing; have low environmental pressure and impact; are accessible, affordable, safe and equitable; and are culturally acceptable" (FAO & WHO, 2019, p. 9). The purpose is "to achieve optimal growth and development of all individuals and support functioning and physical, mental, and social wellbeing at all life stages for present and future generations" (FAO & WHO, 2019, p. 9).

As previously discussed, providing FTI to consumers may influence their food choices (Bradu et al, 2014, p. 293; du Plessis & du Rand, 2012, p. 216; Grebitus, 2008, p. 35). Adding to the fact that food choices can shape consumers' diets (Downs et al, 2020), it can be inferred that the food choices influenced by FTI may also affect consumers' diets, which provides significance to the exploration of this study.

Figure 5

Conceptual Framework II



CHAPTER 3

METHODOLOGY

3.0.0 Introduction

This chapter introduces the research questions, approach, data collection methods, sampling strategies, and data analysis of this study.

3.1.0 Research Questions

The research questions of this study are introduced in the following sections.

3.1.1 Shoppers' Knowledge About FTI

1. Do shoppers have good knowledge about food traceability information?

Rationale: In recent years, there has been increasing public attention towards food traceability due to food safety concerns (Bellavia, 2021). However, there is a lack of data on consumers' knowledge about food traceability after Hansstein's study (Hansstein, 2014). To explore shopper insights on FTI, it is necessary to understand shoppers' current knowledge about the core concept so that the researcher can better understand their perspectives on relevant issues and have further discussions based on their understanding.

3.1.2 Shoppers' Behaviors and Motivations for Using TI on Produce

2. Do shoppers use traceability information on produce to make purchase decisions at grocery stores?

Rationale: Understanding the practical usage of TI on produce by shoppers in their real-life shopping experiences would be important to evaluate the actual demand of

shoppers on FTI to make purchase decisions. The answers to this question can provide justifications for creating services of food traceability systems for shoppers.

2.1. If yes, what are the shoppers' motivations for using traceability information on produce to make purchase decisions at grocery stores?

Rationale: Discovering the shopper motivations for using TI on produce would allow designers to understand the actual needs, values and considerations behind their behaviors and determine how services of future food traceability systems may address those motivations.

3.1.3 Shoppers' Perceptions Towards Providing TI on Produce to Them at Grocery Stores

3. How do shoppers perceive providing traceability information on produce to them to make purchase decisions at grocery stores?

Rationale: To explore the necessity of designing services of food traceability systems for shoppers, it is necessary to understand their' perceptions towards the purpose of the services. The answers to this question would provide knowledge on how shoppers feel and think about the purpose of the services of food traceability systems to be designed for them with a focus on produce.

3.1.4 Shoppers' Perceived Important TI on Produce

4. What traceability information on produce may be important to shoppers when they purchase produce at grocery stores?

Rationale: Studies indicated that consumers have various preferences and demands for traceable food attributes (Lu et al, 2016; Rijswijk & Frewer, 2008). However, a systematic exploration of what specific TI on produce that is important to shoppers from the entire food chain perspective has yet been studied. The answers to this question can contribute to this area of knowledge and provide implications for the service design of future food traceability systems.

3.1.5 Shoppers' Behavior Intentions of Using Specific Ways to Access TI on Produce

5. In what ways might shoppers begin to use traceability information on produce to make purchase decisions at grocery stores?

Rationale: The food industry has discussed how to utilize advanced technologies to provide traceability and transparent information about food throughout the supply chains to consumers for making informed decisions (Bumblauskas et al, 2020; Kamilaris et al, 2019). From the consumer's perspective, how they respond to this idea has yet been explored. The answers to this question would provide shoppers' feedbacks on this discussion and provide implications for the service design of future food traceability systems.

5.1 Do shoppers have a positive attitude towards using a mobile phone to find traceability information on produce to make purchase decisions at grocery stores?

Rationale: Research by Aung & Chang (2014) predicted the consumer trend of using smart phones to access real-time food product information from web-based food traceability systems to check food quality and safety status. To evaluate if the mobile

phone is a good tool to provide TI to end users (grocery shoppers), it is necessary to investigate shoppers' attitudes towards using a mobile phone to access traceability information on produce to make purchase decisions. The answers to the question would provide implications for evaluating the importance of designing mobile phones services of future food traceability systems for shoppers.

5.2 Do shoppers have a positive attitude towards using a mobile phone to search traceability information on produce on a webpage to make purchase decisions at grocery stores?

5.3 Do shoppers have a positive attitude towards using a mobile phone to search traceability information on produce through an application (app) to make purchase decisions at grocery stores?

5.4 Do shoppers have a positive attitude towards using a mobile phone to scan the product codes of produce to access traceability information on the phone to make purchase decisions at grocery stores?

5.5 Do shoppers have a positive attitude towards holding a mobile phone close to the smart tags of produce to access traceability information on the phone to make purchase decisions at grocery stores?

Rationales of 5.2-5.5: According to the literature review in Section 2.1.3, emerging technologies have been developed to help shoppers access TI including through using mobile applications (apps), scanning product codes (e.g., QR codes), and sensing smart tags of products. To evaluate if these new approaches are likely to be used by end users (grocery shoppers) in real-life shopping experiences, it is necessary to investigate shoppers' attitudes towards using these approaches to access TI. The answers to these

questions would provide implications for the design directions for the service design of future food traceability systems.

3.1.6 Shoppers' Thresholds to Pay for TI on Produce

6. Would shoppers be willing to use traceability information on produce to make purchase decisions if this information leads to an increase in the price of produce at grocery stores?

Rationale: To explore the necessity of designing services of food traceability systems for shoppers, it is necessary to understand the thresholds of shoppers on how much they are willing to use FTI and if they are willing to pay more for the produce provided with FTI. The answers to this question would help evaluate the value of services of food traceability systems from the shoppers' perspective.

3.2.0 Approach (O′Leary, 2017)

To address the research questions, the study adopted a mixed methodology to expand the views on the issues and get rich and in-depth data (O′Leary, 2017). A mixed methodology is an approach that incorporates "quantitative and qualitative paradigms, approaches, concepts, methods and/or techniques in a single study" (O′Leary, 2017). A triangulation approach (O′Leary, 2017) was used to gather various data types so that different data sources could be compared and validated for more credible research results. Triangulation refers to "a technique to analyze results of the same study using different methods of data collection" (O′Leary, 2017), and the goal was to achieve enhanced validity, a more in-depth picture of a research problem, and the interrogation of different

ways of understanding a research problem (Nightingale, 2019). The qualitative and quantitative data collection processes were designed to be independent of each other (O′Leary, 2017). Both data analysis processes were also designed to be independent of each other, while the results from both analyses can be integrated for discussion of commonalities and divergences (O′Leary, 2017).

As the type of this study was user research, the research approach was mainly designed to offer beneficial results for designers. Furthermore, this study relied on primary data, as credible secondary data was little found.

This mixed research methodology was the most suitable approach to answer the research questions because it constituted the contextualization and credibility of this study that a single methodology could not achieve (O′Leary, 2017).

3.3.0 Research Method

To address the research questions, the study chose the methods of online surveying and semi-structured online interviewing to explore the answers from the targeted grocery shoppers. A Method Justification Table was summarized in section 3.6.

3.3.1 Online Survey (O′Leary, 2017)

The study used online surveying to collect data for research questions. Surveying is “the process of collecting data through a questionnaire that asks a range of individuals the same questions related to their characteristics, attributes, how they live or their opinions” (O′Leary, 2017).

The rationales for choosing this method were: 1) the cost of online surveying meets the limited fund of this study; 2) online surveying can help reach geographically distant participants; 3) online surveying can reach a large number of respondents; 4) there is no interviewer bias (O′Leary, 2017); 5) the data generated from the survey can directly reflect direct opinions from the participants; 6) the data generated from the survey can be analyzable, standardized, comparable, quantifiable, and representable (O′Leary, 2017); 7) the approach can be confidential and anonymous (O′Leary, 2017).

The type of survey was cross-sectional and descriptive. “Cross-sectional surveys” means “surveys that use a sample or cross-section of respondents” (O′Leary, 2017). “Descriptive surveys” means “surveys that can describe information about respondents including demographic information, personal behaviors, and attitudinal information” (O′Leary, 2017).

The survey was administered online due to two considerations: 1) the researcher needs to investigate participants from a distant location; 2) online surveying provides great convenience for collecting a large sample.

Surveying was one of the best methods to answer the research questions in this study because it has the unique advantages: 1) collecting a large quantity of data that can be analyzable, standardized, comparable, quantifiable, and representable (O′Leary, 2017); and 2) be confidential and anonymous (O′Leary, 2017).

To conclude, the objectives of surveying in this study were to collect a large quantity of quantitative data for the direct responses to the research questions and then further interpret them to meaningful shopper insights.

3.3.2 Online Interview (O′Leary, 2017)

The study also used an interview study to collect in-depth qualitative data from grocery shoppers. Interviewing is "a method of data collection that involves researchers seeking open-ended answers related to a number of questions, topic areas or themes" (O′Leary, 2017).

The rationales for choosing this method were: 1) the researcher can build rapport with interviewees for conversations (O′Leary, 2017); 2) collect in-depth and rich qualitative data (O′Leary, 2017); 3) the researcher can build empathy with the participants on the issues for discussion (O′Leary, 2017); 4) follow up vague or interesting clues discussed during the interview (O′Leary, 2017); 5) generate standardized and analyzable data (O′Leary, 2017).

The type of interviewing in this study was formal, semi-structured, and one-on-one. "Formal" means "the interviewer attempts to be removed from the interviewee and maintains an objective stance" (O′Leary, 2017). The rationale for choosing "formal" was that the researcher wanted to get objective, straightforward and purposeful results that could minimize the researcher's bias and influences on participants (O′Leary, 2017). "Semi-structured" means "use of a flexible structure" (O′Leary, 2017) so that "interviewers can start with a defined questioning plan, but will shift in order to follow the natural flow of conversation" (O′Leary, 2017). The rationale for choosing "semi-structured" was that this type of interview might have unexpected data, and participants' answers to specific questions may also be the answers to other questions discussed in the interview (O′Leary, 2017). "One-on-one" means "an interaction between an interviewer

and a single interviewee" (O′Leary, 2017). The rationale for choosing "one-on-one" was that this approach allowed interviewees to express themselves freely in the interview.

The interviewing was administered online mainly due to the convenience of reaching geographically distant interviewees. Audio recording with consent was implemented during the interview for transcript purposes.

Interviewing is one of the best methods to answer the questions for this study because it has the unique advantages: 1) pursuing rich and in-depth qualitative data (O′Leary, 2017); 2) building rapport with interviewees and extending conversations for more information to be discussed when necessary (O′Leary, 2017).

To conclude, the objectives of conducting interviews in this study were to collect in-depth and rich qualitative data and understand the values, motivations, reasons, or ideas behind grocery shoppers' answers.

3.4.0 Sampling Strategy

To collect valid data to answer the research questions, two sampling strategies were adopted for the survey study and the interview study.

3.4.1 Sampling for Surveying (O′Leary, 2017; Acharya et al, 2013)

Snowball sampling strategy (Acharya et al, 2013) was used to recruit participants for surveying, as it could help reach the maximum number of possible participants online within the funding and timeframe of this study. Snowball sampling is the sampling procedure that "the initial respondents are chosen by probability or non-probability methods, and then, additional respondents are obtained by information provided by the

initial respondents" (Acharya et al, 2013). Snowball sampling also belongs to "non-probability sampling" (Acharya et al, 2013), and the results of the data also cannot be generalized beyond the sample itself. The rationales for choosing snowball sampling were: 1) each initial participant is resourceful to help find more potential participants for this study; 2) the cost of this sampling is inexpensive; 3) there is no need to examine all the population elements (O′Leary, 2017).

200 participants (N_1= 200) were expected to be recruited for online surveying, considering the timeframe and funding of the research.

There were three approaches for the researcher to recruit participants for surveying: 1) distribute invites of the online survey to potential participants and target groups through university affiliations by email; 2) post invites of the online survey to potential participants and target groups on social networks; 3) ask if initial participants of the survey would like to pass on the questionnaire to others who may fit the study.

At the end of the online survey, each participant was asked if they were also willing to be contacted for a 45-minute interview for this study.

3.4.2 Sampling for Interviewing (Acharya, 2013)

The convenience sampling and snowball sampling strategies were used to select participants for interviewing (Acharya, 2013). The rationales for choosing convenience and snowball sampling strategies were: 1) the researcher has convenient access to the qualified participants, or each initial participant is resourceful to help find more potential participants for this study; 2) the cost of this sampling is inexpensive; 3) no need to

examine all the population elements. However, the results of the data collected with the two sampling strategies cannot be generalized beyond the sample itself.

Five participants ($N_2 = 5$) were expected to be recruited for online interviewing, considering the timeframe and the funding.

There were four approaches for the researcher to recruit interviewees: 1) distribute invites for the interview to potential participants or target groups through university affiliations by email; 2) post invites of the online survey to potential participants or target groups on social networks; 3) ask if initial participants of the interview would like to pass the invite to those who may fit the study; 4) recruit participants by asking if initial participants of the survey would like to be contacted for an interview.

3.5.0 Analysis Methods

This study applied descriptive analysis (O′Leary, 2017) to analyze the data from the survey study, and applied the methods of color coding (Bianco et al, 2015) and affinity diagramming (Hanington & Martin, 2019) to analyze the data from the interview study.

3.5.1 Descriptive Analysis (Bhandari, 2022)

Descriptive analysis is a method to "summarize and organize characteristics of a data set"(Bhandari, 2022). This approach helps describe the features of a sample.

The rationales for using this method are: 1) it can measure the central tendency, including the mean, median, and mode, which can reflect the comprehensive summary of

the dataset (Bhandari, 2022); 2) it can measure the spread of data including range and standard deviation (Bhandari, 2022).

Descriptive analysis is the best method for the quantitative data collected for this survey study due to 1) it is a systematic and versatile approach to gaining insights from a series of numbers; 2) it is a scientifically approved approach to gaining conclusions from data sets.

To conclude, the objective of using descriptive analysis in this study is to interpret quantitative data collected from the survey study into meaningful consumer insights.

3.5.2 Color Coding (Bianco et al, 2015)

Color coding refers to "the use of color for encoding information" (Bianco et al, 2015). It is an approach of data visualization, which is "a process of mapping data onto visual dimensions to create a pictorial representation" (Bianco et al, 2015).

The rationales for using this method are: 1) it can make highlighted contextual information with different colors distinguishable (ASU, 2018; Bianco et al, 2015); 2) it can help distinguish elements into typologies (ASU, 2018); 3) it can help identify patterns of data visually (ASU, 2018); 4) it can help organize characteristics of data into matrix, guidelines or diagrams (ASU, 2018).

Color coding is the best analysis method for the transcript analysis of the interview study due to the reasons: 1) it allows the researcher to extract keywords of characteristics and create typologies manually; 2) it allows the researcher to compare and contrast coded information on different transcripts efficiently; 3) it creates a creative way to communicate meanings of data to researchers.

3.5.3 Affinity Diagramming (Hanington & Martin, 2019)

Affinity diagramming is "a process used to externalize and meaningfully cluster observations and insights from research, keeping design teams grounded in data as they design" (Hanington & Martin, 2019). It can be used as "a tool that gathers large amounts of language data (ideas, opinions, issues) and organizes them into groupings based on their natural relationships" (as cited in Abulmajd, 2013). This approach is also often used to find themes in brainstorming (Boogaard, n.d.).

The rationales for using this method are: 1) it allows a large volume of ideas to be gathered and organized from a large and diverse group (Boogaard, n.d.); 2) it helps identify themes and build connections between ideas and themes (Boogaard, n.d.); 3) it helps make clearer and easy-to-understand themes and reach consensus (Boogaard, n.d.); 4) it can avoid habitual thinking and preconceptions of the researcher (Tague, 2005).

Affinity diagramming is the best data analysis method for the data collected from the interviews of this study due to 1) it helps identify gaps and opportunities that lead to discussions of solutions or innovations; 2) it makes the findings easy to be interpreted by readers; 3) it makes notes and findings easily manageable by the researcher.

To conclude, the objective of using affinity diagramming in this study is to analyze data from the interview study so that qualitative data can be processed into themes, meanings, or potential patterns.

3.6.0 Method Justification Table

Table 2

Research Method Rationale

Research Question/Hypothesis	Research Method	Rationale
1. Do shoppers have good knowledge about food traceability information?	Online survey & Semi-structured online interview	The online survey will allow a large quantity of data to be collected regarding the shopper insights into TI on produce provided at grocery stores. Online surveying will also allow low costs and great convenience to conduct this study. The survey responses will be kept anonymous. The semi-structured online interview will allow the researcher to build rapport with the interviewees and have in-depth discussions with them (O′Leary, 2017b) regarding the shopper insights into TI on produce provided at grocery stores. And shoppers' values, motivations, reasons behind their responses, and vague or interesting ideas can be followed up during the interviews (O′Leary, 2017b).
2. Do shoppers use traceability information on produce to make purchase decisions at grocery stores?		
2.1 If yes, what are the shoppers' motivations for using traceability information on produce to make purchase decisions at grocery stores?		
3. How do shoppers perceive providing traceability information on produce to them to make purchase decisions at grocery stores?		
4. What traceability information on produce may be important to shoppers when they purchase produce at grocery stores?		
5. In what ways might shoppers begin to use traceability information on produce to make purchase decisions at grocery stores?		
5.1 Do shoppers have a positive attitude towards using a mobile phone to find traceability information on produce to make purchase decisions at grocery stores?		
6. Would shoppers be willing to use traceability information on produce to make purchase decisions if this information		

leads to an increase in the price of the produce at grocery stores?		
5.2 Do shoppers have a positive attitude towards using a mobile phone to search traceability information on produce on a webpage to make purchase decisions at grocery stores?	Semi-structured online survey	The online survey will allow a large quantity of data to be collected regarding the shoppers' attitudes towards using mobile phones to access TI on produce in various specific ways provided at grocery stores. Online surveying will also allow low costs and great convenience to conduct this study. The survey responses will be kept anonymous.
5.3 Do shoppers have a positive attitude towards using a mobile phone to search traceability information on produce through an application (app) to make purchase decisions at grocery stores?		
5.4 Do shoppers have a positive attitude towards using a mobile phone to scan the product codes of produce to access traceability information on the phone to make purchase decisions at grocery stores?		
5.5 Do shoppers have a positive attitude towards holding a mobile phone close to the smart tags of produce to access traceability information on the phone to make purchase decisions at grocery stores?		

CHAPTER 4

RESEARCH FINDINGS / ANALYSIS OF DATA

4.0.0 Introduction

This chapter reports the findings of the survey study and the interview study concerning six aspects of shopper insights into FTI:

(1) Shoppers' knowledge about FTI.

(2) Shoppers' behaviors and motivations for using TI on produce.

(3) Shoppers' perceptions towards providing TI on produce to them at grocery stores.

(4) Shoppers' perceived important TI on produce.

(5) Shoppers' behavior intentions of using specific ways to access TI on produce.

(6) Shoppers' thresholds to pay for TI on produce.

4.1.0 Survey Findings

The researcher conducted the survey study on an online survey platform named QuestionPro from August 9 to August 24, 2022. The survey targeted shoppers who were at least 18 years old and had shopped for produce at least once in the grocery stores in Phoenix metropolitan area, Arizona in the past 30 days. The survey sample consisted of 200 participants (N_1=200) recruited from emails, social media posts and social media text messaging with a snowball sampling strategy. Two hundred valid online questionnaires were collected. The completion rate of the online questionnaires was 78.12%. Table 3 presents the demographic information of this survey sample.

Table 3

Demographic Information of the Survey Sample

Demographics	Total Sample	Percentage
Gender		
Female	151	75.5%
Male	43	21.5%
Other	6	3%
Age		
18-34	125	62.5%
35-49	42	21%
50-64	28	14%
>64	5	2.5%
Education		
High School Diploma	12	6%
Some college	53	26.5%
Technical School Diploma	3	1.5%
Bachelor's Degree	46	23%
Master's Degree	50	25%
Doctorate	35	17.5%
Other	1	0.5%
Frequency of Produce Shopping		
Daily	2	1%
Weekly	163	81.5%
Monthly	31	15.5%
Less than monthly	4	2%
Never	0	0%

The Grocery Stores Where Participants Usually Shopped for Produce in Phoenix metropolitan area, Arizona [Multiple Answers]		
Safeway	86	43%
Fry's Marketplace	125	62.5%
Target	45	22.5%
Walmart	68	34%
Costco	64	32%
Sprouts Farmers Market	83	41.5%
Food City	12	6%
Trader Joe's	90	45%
Whole Foods Market	38	19%
Others (Asian markets, Bashas', ALDI, Albertsons, Sam's Club, etc.)	22	11%
N Total	200	100%

Note. These results are from a snowball sampling of 200 people surveyed online in Phoenix metropolitan area, Arizona.

According to the results shown in Table 3, the sample has the following features:

(1) Gender. Female participants (75.5%) dominated the sample.

(2) Age. Participants who were 18-34 years old (62.5%) dominated the sample.

(3) Frequency of produce shopping. Participants who shopped for produce weekly dominated the sample.

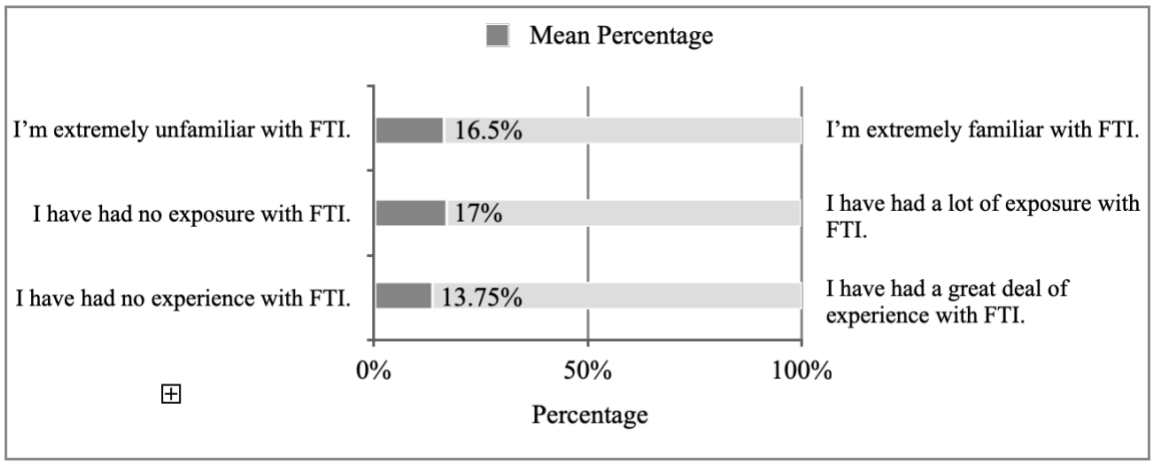
(4) Grocery stores. Participants (62.5%) who shopped for produce at Fry's Marketplace dominated the sample.

4.1.1 Shoppers' Knowledge About FTI

RQ 1: Do shoppers have good knowledge about food traceability information?

Figure 6

The Mean Percentages of Participants' Overall Knowledge About FTI



Note. These results were calculated through SPSS statistic software.

To obtain an overview of shoppers' knowledge about FTI, survey participants were asked to select predetermined statements to describe their knowledge about FTI in terms of their familiarity, exposure, and experience with FTI. Meanwhile, they were asked to indicate their familiarity, exposure, and experience with FTI on a 5-point Likert Scale matrix. The knowledge questions were adapted from Joiner's version (Joiner, 1998) in which the answers could reflect an individual's subjective knowledge as an important concept to understanding the consumer decision-making process (Alemu & Grebitus, 2020). Participants' responses were recorded as ordinal data and processed on a percentage scale through SPSS statistic software.

Figure 6 demonstrates the mean percentages of participants' overall knowledge about FTI in terms of their familiarity, exposure, and experience with FTI. On the Familiarity scale, from 0% of familiarity ("I'm extremely unfamiliar with FTI") to 100% of familiarity ("I'm extremely familiar with FTI"), the mean percentage of participants' knowledge about FTI regarding familiarity is 16.5%. On the Exposure scale, from 0% of exposure ("I have had no exposure with FTI") to 100% of exposure ("I have had a lot of exposure with FTI"), the mean percentage of participants' knowledge about FTI regarding exposure is 17%. On the Experience scale, from 0% of experience ("I have had no experience with FTI") to 100% of experience ("I have had a great deal of experience with FTI"), the mean percentage of participants' knowledge about FTI regarding experience is 13.75%.

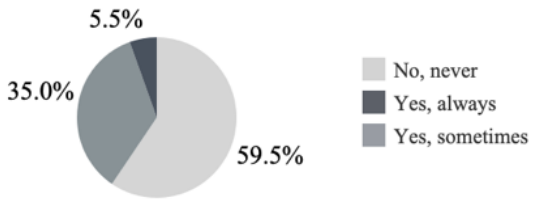
Overall, participants indicated that they had a relatively low level of knowledge about FTI regarding their familiarity, exposure, and experience with FTI. This result underlines that participants (N_1=200) in this sample may need to understand further about the functions, values, and benefits of FTI.

4.1.2 Shoppers' Behaviors and Motivations for Using TI on Produce

RQ 2: Do shoppers use traceability information on produce to make purchase decisions at grocery stores?

Figure 7

The Percentages of Participants' Behaviors of Using TI on Produce to Make Purchase Decisions



Regarding shoppers' behaviors of using TI on produce, results in Figure 7 presents that 59.5% of the participants indicated that they never used TI on produce to make purchase decisions when purchasing produce at grocery stores; 35.0% of the participants indicated that they sometimes used TI on produce to make purchase decisions when purchasing produce at grocery stores; while 5.5% of the participants indicated that they always used TI on produce to make purchase decisions when purchasing produce at grocery stores.

Based on the results, it can be highlighted that the great majority of the participants in the sample did not rely on using TI on produce to make purchase decisions when purchasing produce at grocery stores.

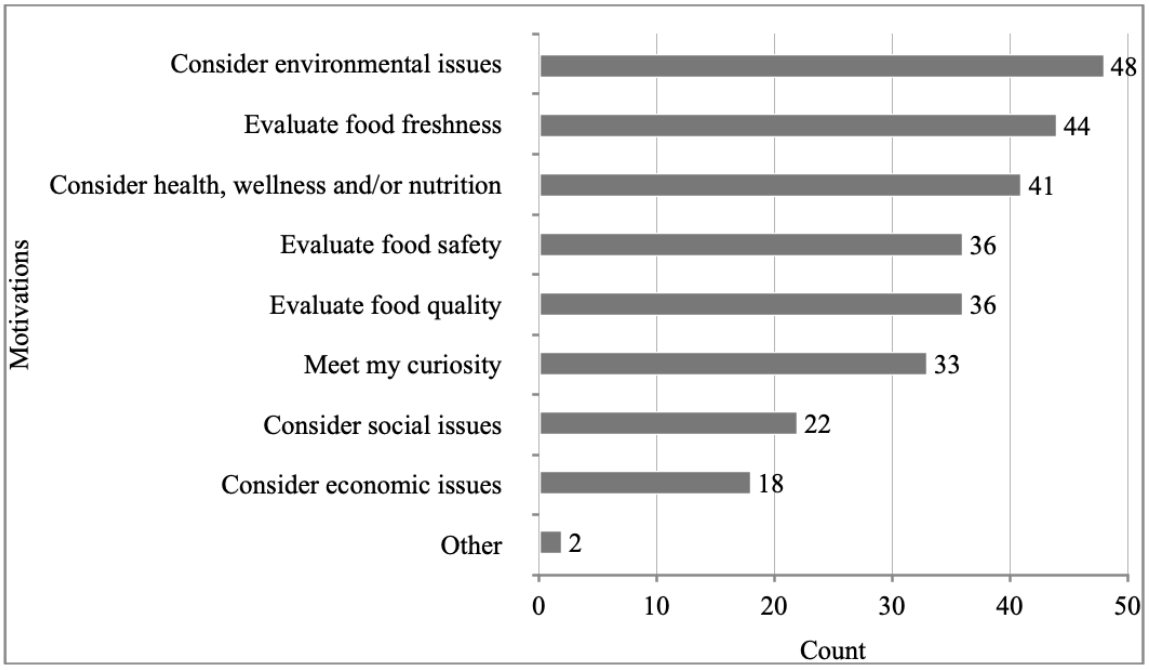
The participants who answered that they "sometimes" or "always" used TI on produce to make purchase decisions when purchasing produce at grocery stores were further asked about why they used that TI by selecting predetermined options with an open-ended option on the questionnaire. Figure 8 demonstrates the various motivations of those participants who "sometimes" or "always" used TI on produce to make purchase

decisions when purchasing produce at grocery stores. 81 participants in total answered RQ 2.1.

RQ 2.1: If yes, what are the shoppers' motivations for using traceability information on produce to make purchase decisions at grocery stores?

Figure 8

Participants' Motivations for Using TI on Produce to Make Purchase Decisions



Note. These results were calculated through the SPSS statistic software.

As shown in Figure 8, participants' motivations were "consider environmental issues" (48 counts), "evaluate food freshness" (44 counts), "consider health, wellness and/or nutrition" (41 counts), "evaluate food safety"(36 counts), "evaluate food quality"

(36 counts), “meet my curiosity” (33 counts), “consider social issues” (22 counts), “consider economic issues” (18 counts), and “other” (2 counts).

Moreover, the two participants who chose the “other” option explained their motivations as follows:

Respondent #135 was quoted as saying that “I prefer to buy local when I can to support our farmers”. In other words, this participant used TI on produce to make purchase decisions because he/she wanted to support local farmers.

Respondent #155 was quoted as saying that “sometimes Fry (Fry’s Marketplace) will have signs posted stating 'I'm local', so I will try to figure out where”. Similarly, this participant used TI on produce to make purchase decisions because he/she wanted to know where the produce came from in the local area.

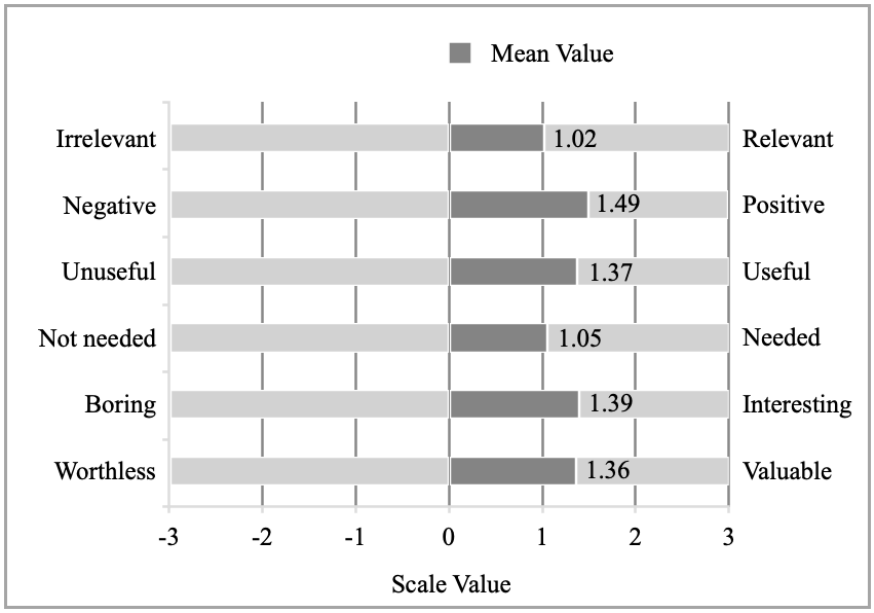
To summarize, the participants of the sample had various motivations for using TI on produce to make purchase decisions when purchasing produce at grocery stores. Furthermore, it can be highlighted that “consider environmental issues”, “evaluate food freshness”, and “consider health, wellness, and/or nutrition” were likely to be the top motivations among the participants in the sample.

4.1.3 Shoppers’ Perceptions Towards Providing TI on Produce to Them at Grocery Stores

RQ 3: How do shoppers perceive providing traceability information on produce to them to make purchase decisions at grocery stores?

Figure 9

The Mean Values of Participants' Perceptions Towards Providing TI *on Produce to Them at Grocery Stores*



Note. These results were calculated through the SPSS statistic software.

To understand shoppers' perceptions towards providing TI on produce to them to make purchase decisions at grocery stores, survey participants were asked to select predetermined terms on a 7-point bipolar Likert Scale matrix to indicate their levels of perceptions. Participants' responses were recorded as ordinal data and processed on the bipolar scale with values from "-3" to "3" for each pair of descriptors, as presented in Figure 9. The descriptors at the endpoints of each scale were in pairs including "relevant" vs. "irrelevant", "positive" vs. "negative", "useful" vs. "unuseful", "needed" vs. "not needed", "interesting" vs. "boring", "valuable" vs. "worthless".

Figure 9 demonstrates the overall mean values of participants' perceptions towards providing TI on produce to them to make purchase decisions at grocery stores. According to the data analysis through SPSS, participants earned the overall mean value of +1.02 on the "relevant"-vs.-"irrelevant" scale, which means that their perception was overall "somewhat relevant"; they earned the mean value of +1.49 on the "positive"-vs.-"negative" scale, which means that their perception was overall "kind of positive"; they earned the mean value of +1.37 on the "useful"-vs.-"unuseful" scale, which means that their perception was overall "kind of useful"; they earned the mean value of +1.05 on the "needed"-vs.-"not needed" scale, which means that their perception was overall "somewhat needed"; they earned the mean value of +1.39 on the "interesting"-vs.-"boring" scale, which means that their perception was overall "kind of interesting"; they earned the mean value of +1.36 on the "valuable"-vs.-"worthless" scale, which means their perception was overall "kind of valuable".

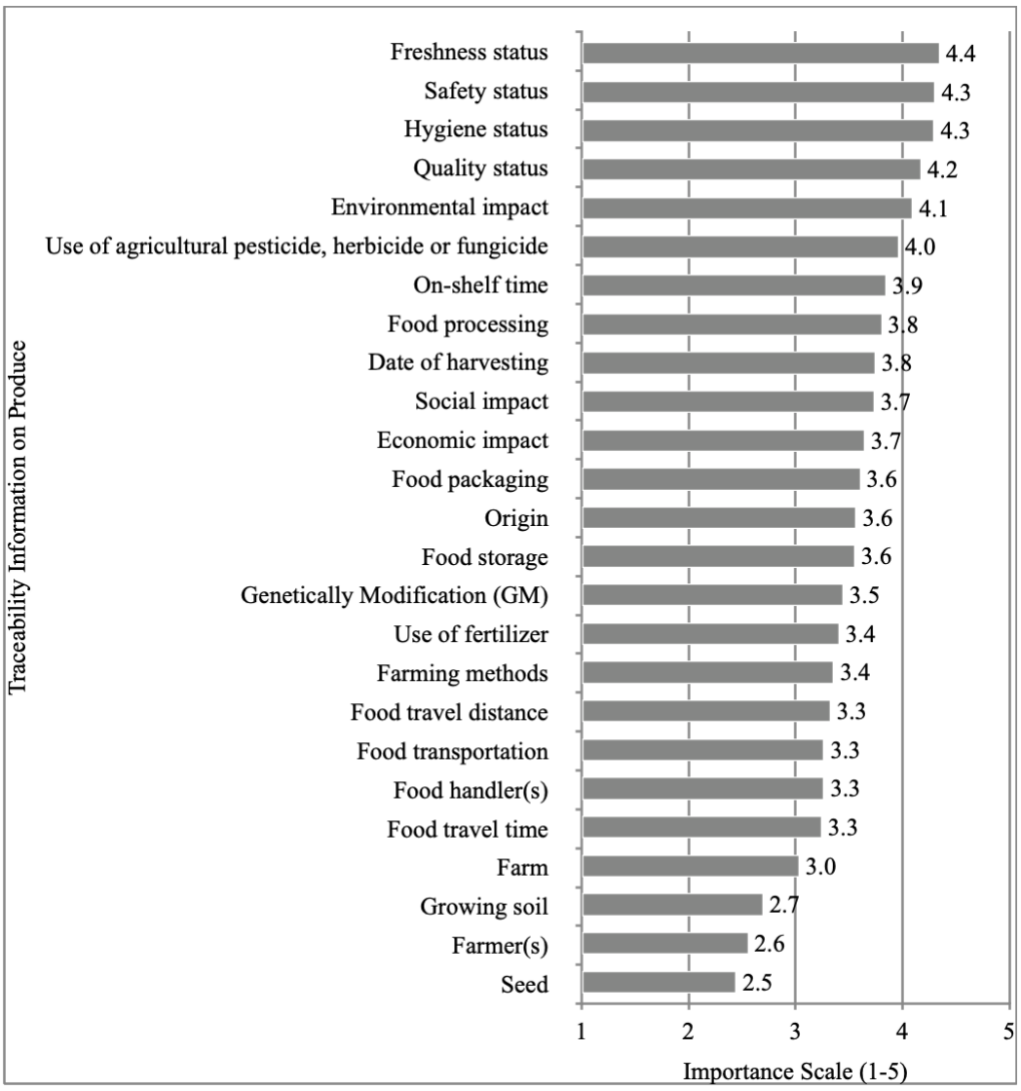
To summarize, the results indicated that participants held the perceptions of "somewhat relevant", "kind of positive", "kind of useful", "somewhat needed", "kind of interesting", and "kind of valuable" towards providing TI on produce to them to make purchase decisions at grocery stores. Therefore, it can be inferred that participants had a relatively good perception towards providing TI on produce to make purchase decisions at grocery stores.

4.1.4 Shoppers' Perceived Important TI on Produce

RQ 4: What traceability information on produce may be important to shoppers when they purchase produce at grocery stores?

Figure 10

Mean Values of The Importance of TI on Produce Rated by Participants



Note. These results were calculated through the SPSS statistic software.

Regarding the TI on produce that may be important to shoppers when they purchase produce at grocery stores, participants were asked to select the level of

importance of 25 kinds of predetermined TI on a 5-point Likert Scale (1 = not important and 5 = very important).

Figure 10 demonstrates the mean value of each kind of predetermined TI on produce in terms of "freshness status" (4.4), "safety status" (4.3), "hygiene status" (4.3), "quality status" (4.2), "environmental impact" (4.1), "use of agricultural pesticide, herbicide, or fungicide" (4.0), "on-shelf time" (3.9), "food processing" (3.8), "date of harvesting" (3.8), "social impact" (3.7), "economic impact" (3.7), "food packaging" (3.6), "origin" (3.6), "food storage" (3.6), "genetically modification (GM)" (3.5), "use of fertilizer" (3.4), "farming methods" (3.4), "food travel distance" (3.3), "food transportation" (3.3), "food handler(s)" (3.3), "food travel time" (3.3), "farm" (3.0), "growing soil" (2.7), "farmer(s)" (2.6) and "seed" (2.5).

Based on the results, it can be highlighted that "freshness status", "safety status", "hygiene status", "quality status", and "environmental impact" of produce were likely to be the most important kinds of TI perceived by the participants when they purchased produce at grocery stores.

4.1.5 Shoppers' Behavior Intentions of Using Specific Ways to Access TI on Produce

RQ 5: In what ways might shoppers begin to use traceability information on produce to make purchase decisions at grocery stores?

RQ 5.1: Do shoppers have a positive attitude towards using a mobile phone to find traceability information on produce to make purchase decisions at grocery stores?

RQ 5.2: Do shoppers have a positive attitude towards using a mobile phone to search traceability information on produce on a webpage to make purchase decisions at grocery stores?

RQ 5.3: Do shoppers have a positive attitude towards using a mobile phone to search traceability information on produce through an application (app) to make purchase decisions at grocery stores?

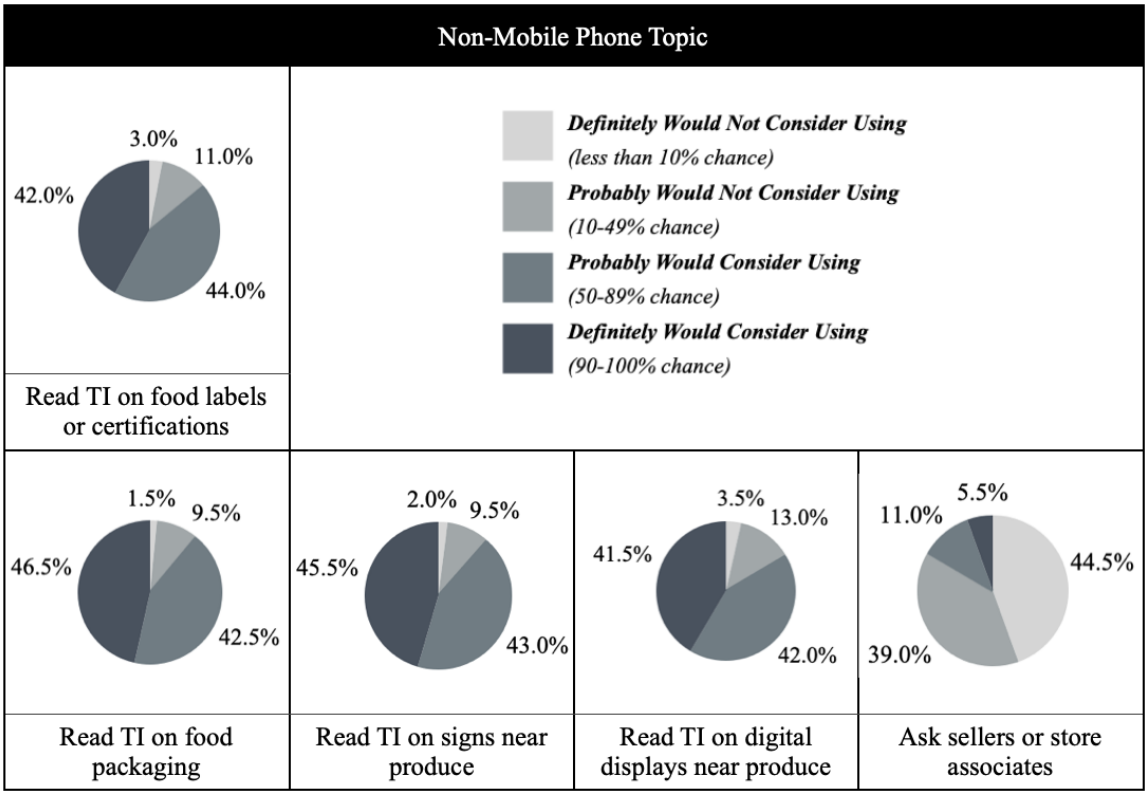
RQ 5.4: Do shoppers have a positive attitude towards using a mobile phone to scan the product codes of produce to access traceability information on the phone to make purchase decisions at grocery stores?

RQ 5.5: Do shoppers have a positive attitude towards holding a mobile phone close to the smart tags of produce to access traceability information on the phone to make purchase decisions at grocery stores?

4.1.5.1 Non-Mobile Phone Topic

Figure 11

Participants' Behavior Intentions of Using Specific Ways to Access TI on Produce (1)



Note. The results were analyzed through the data visualization software Tableau.

Figure 11 demonstrates the findings on participants' behavior intentions of using specific ways to access TI on produce. The behavior intention scale was used to "capture the likelihood that people will demonstrate some type of predictable behavior intent toward purchasing an object or service in a future time frame" (ASU, 2018).

(1) 42.0% of participants definitely would consider (90-100% chance) reading TI on food labels or certifications; 44.0% of participants probably would consider (50-89% chance) reading TI on food labels or certifications; 11.0% of participants probably would not consider (10-49% chance) reading TI on food labels or certifications; 3.0% of

participants definitely would not consider (less than 10% chance) reading TI on food labels or certifications.

(2) 46.5% of participants definitely would consider (90-100% chance) reading TI on food packaging; 42.5% of participants probably would consider (50-89% chance) reading TI on food packaging; 9.5% of participants probably would not consider (10-49% chance) reading TI on food packaging; 1.5% of participants definitely would not consider (less than 10% chance) reading TI on food packaging.

(3) 45.5% of participants definitely would consider (90-100% chance) reading TI on signs near produce; 43.0% of participants probably would consider (50-89% chance) reading TI on signs near produce; 9.5% of participants probably would not consider (10-49% chance) reading TI on signs near produce; 2.0% of participants definitely would not consider (less than 10% chance) reading TI on signs near produce.

(4) 41.5% of participants definitely would consider (90-100% chance) reading TI on digital displays near produce; 42.0% of participants probably would consider (50-89% chance) reading TI on digital displays near produce; 13.0% of participants probably would not consider (10-49% chance) reading TI on digital displays near produce; 3.5% of participants definitely would not consider (less than 10% chance) reading TI on digital displays near produce.

(5) 5.5% of participants definitely would consider (90-100% chance) asking sellers or store associates; 11.0% of participants probably would consider (50-89% chance) asking sellers or store associates; 39.0% of participants probably would not consider (10-49% chance) asking sellers or store associates; 44.5% of participants definitely would not consider (less than 10% chance) asking sellers or store associates.

4.1.5.2 Mobile Phone Topic

Figure 12

Participants' Behavior Intentions of Using Various Ways to Access TI on Produce (2)

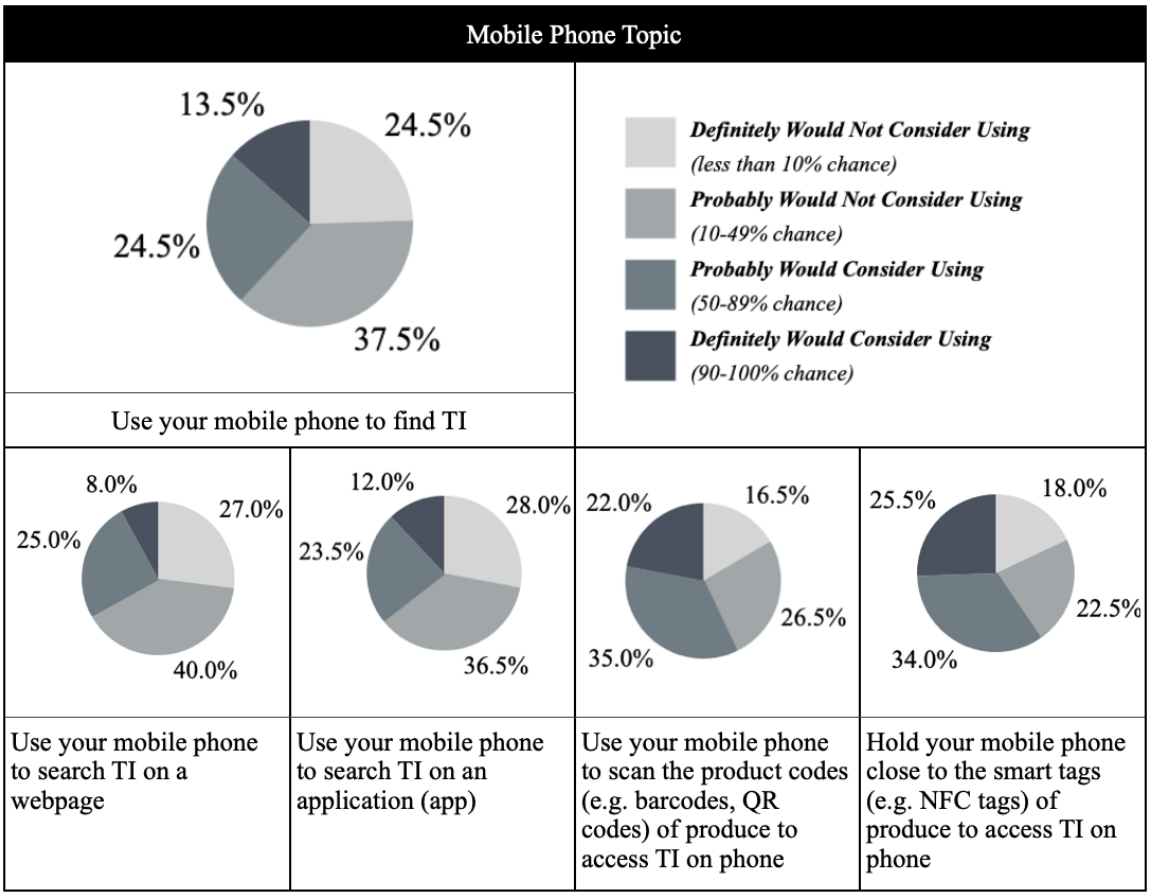


Figure 12 demonstrates the findings on participants' behavior intentions of using a mobile phone to access TI on produce regarding using the mobile phone to "find TI" (general), " search TI on a webpage", "search TI on an application (app)", "scan the product codes (e.g., barcodes, QR codes) of produce to access TI on the phone" and "get close to (sense) the smart tags (e.g., NFC tags) of produce to access TI on the phone". The results are described as follows:

(1) 13.5% of participants definitely would consider (90-100% chance) using their mobile phones to find TI; 24.5% of participants probably would consider (50-89% chance) using their mobile phones to find TI; 37.5% of participants probably would not consider (10-49% chance) using their mobile phones to find TI; 24.5% of participants definitely would not consider (less than 10% chance) using their mobile phones to find TI.

(2) 8.0% of participants definitely would consider (90-100% chance) using their mobile phones to search TI on a webpage; 25.0% of participants probably would consider (50-89% chance) using their mobile phones to search TI on a webpage; 40.0% of participants probably would not consider (10-49% chance) using their mobile phones to search TI on a webpage; 27.0% of participants definitely would not consider (less than 10% chance) using their mobile phones to search TI on a webpage.

(3) 12.0% of participants definitely would consider (90-100% chance) using their mobile phones to search TI on an application (app); 23.5% of participants probably would consider (50-89% chance) their mobile phones to search TI on an app; 36.5% of participants probably would not consider (10-49% chance) their mobile phones to search TI on an app; 28.0% of participants definitely would not consider (less than 10% chance) their mobile phones to search TI on an application (app).

(4) 22.0% of participants definitely would consider (90-100% chance) using their mobile phones to scan the product codes (e.g., barcodes, QR codes) of produce to access TI on the phone; 35.0% of participants probably would consider (50-89% chance) using their mobile phones to scan the product codes (e.g., barcodes, QR codes) of produce to access TI on the phone; 26.5% of participants probably would not consider (10-49%

chance) using their mobile phones to scan the product codes (e.g., barcodes, QR codes) of produce to access TI on the phone; 16.5% of participants definitely would not consider (less than 10% chance) using their mobile phones to scan the product codes (e.g., barcodes, QR codes) of produce to access TI on the phone.

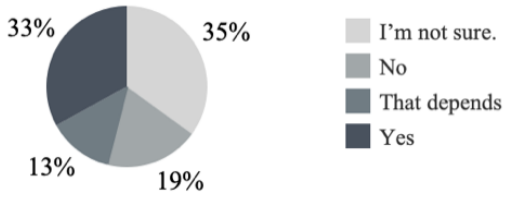
(5) 25.5% of participants definitely would consider (90-100% chance) holding their mobile phones close to the smart tags (e.g., NFC tags) of produce to access TI on the phone; 34.0% of participants probably would consider (50-89% chance) holding their mobile phones close to the smart tags (e.g., NFC tags) of produce to access TI on the phone; 22.5% of participants probably would not consider (10-49% chance) holding their mobile phones close to the smart tags (e.g., NFC tags) of produce to access TI on the phone; 18.0% of participants definitely would not consider (less than 10% chance) holding their mobile phones close to the smart tags (e.g., NFC tags) of produce to access TI on the phone.

4.1.6 Shoppers' Thresholds to Pay for TI on Produce

RQ 6: Would shoppers be willing to use traceability information on produce to make purchase decisions if this information leads to an increase in the price of the produce at grocery stores?

Figure 13

The Percentages of Participants' Thresholds to Pay for TI on Produce



Regarding participants' thresholds to pay for having TI on produce to make purchase decisions at grocery stores, 33% of participants indicated that they were willing to use TI on produce to make purchase decisions at grocery stores if this information leads to an increase in the price of the produce; 19% of participants indicated that they were not willing to use TI on produce to make purchase decisions at grocery stores if this information leads to an increase in the price of the produce; 35% of participants indicated that they were not sure if they were willing to use TI on produce to make purchase decisions at grocery stores if this information leads to an increase in the price of the produce; 13% participants indicated "that depends" and further explained their thoughts, as summarized in Table 4 below.

Table 4

Further Explanations of the Participants Who Indicated "That Depends" for RQ 6

Participant #	Explanation
3	*Depends on the increase, if it's a couple of cents it's fine.*
17	*Depends on how much of an increase in price, if it's a crazy amount then I may stick with the cheaper option.*
28	*That depends on food categories.*
38	*the increase in price delta (50 cents? no, 5 cents? Probably)*
40	*It depends on how big of an increase in price.*
42	*Costs*
60	*Depends on if the information is making me want to or confirming my decision of buying that product.*
72	*On the trade-offs between quality and price for the item*
73	*It depends on current inflation and price gouging*
78	*Cost*
87	*If under a 15% price increase*
92	*Depends on how accurate and detailed the TI are*
99	*If the store was open with signange on what the purpose is of the TI. For example, a sign explaining the 'quality' and how knowing this empowers the customer to limit food waste. If it was just vague signage that I didn't understand the context and value of that information I wouldn't see why I should pay more for info I don't know how to use.*
113	*On how much other grocery items and other expenses cost*
117	*It would be helpful but we're in an time when inflation is outpacing incomes in my industry so money is tight. I would need to understand the full value of TI before believing it was worth extra money. It also depends on how much of an increase.*
128	*no more than 5-10% mark up*
139	*how big the increase is and how reliable the information provided is. if only some items are using this option there is less overall value*
146	*Less than 10% increase would be ok/ over that is ridiculous*
151	*Depends how much of an increase*
155	*food/inflation is expensive right now, not sure I have the luxury to purchase more expansive food based on RTI information.*
157	*depends on how much i like the produce*
165	*if it aligned with what I value (sustainability from an environmental protection and social equity perspective*
166	*If it ensures I'm getting locally sourced produce. Yes*
169	*If the information proves an increase in price is worth it (ie, that the produce is local, responsibly farmed and has a positive impact)*
178	*It is odd to think that the information does not already exist in the store. It is strange that there is not the pride of sourcing and quality from a minimum of a food born illness perspective. So if the perception is that the increased cost is more to do with adding additional profit than value added, it would be less valuable to me as a consumer. It is the value of going to a farmer's market that you can talk to the farmer directly about their farming practices.*
200	*That depends on how large the price increase would be.*

Based on the discussions above, it can be summarized that participants had various thresholds to pay for having TI on produce to make purchase decisions at grocery stores, depending on the factors regarding "the increase of the produce price", "food categories", "the trade-offs between quality and price for the produce", "economic inflation", "price gouging", "personal interest", "locality", "environmental protection", "social equity", "food waste", and "the value, reliability, persuasion, and education of the TI".

4.2.0 Interview Findings

The semi-structured online interview was conducted from August 12 to August 16, 2022, targeting shoppers who were at least 18 years old and had shopped for produce at least once in the grocery stores in Phoenix metropolitan area, Arizona in the past 30 days. Five qualified individuals (N_2=5) participated in the 45-minute one-on-one online interview sessions on Zoom's video conferencing software. The recruitment information was distributed through emails, social media posts, social media text messaging, and the online questionnaires of the initial survey study. The convenience sampling strategy and snowball sampling strategy were used to recruit participants. Table 5 presents the demographic information of the interview sample.

Table 5

Demographic Information of The Interview Sample

Interviewee	Pseudonym	Background	Participation in Survey
A	Alice	Graduate student	Yes
B	Jane	Undergraduate student	Yes
C	Alissa	Scholar	No
D	Jason	Engineer	Yes
E	Susan	Scholar	Yes

Note. These results are from the online interviews of 5 people from the Phoenix metropolitan area, Arizona, with convenience and snowball sampling strategies.

Four of the five interviewees were recruited through the online survey and claimed that they had participated in the survey study. One interviewee was recruited through word of mouth.

4.2.1 Shoppers' Knowledge About FTI

RQ 1: Do shoppers have good knowledge about food traceability information?

Table 6

Highlighted Keywords from the Answers to RQ 1

Interviewee	Keywords	Level of Knowledge
A	• not that familiar with; • heard it once; • rarely hear them from my friends or from TV or other advertisement	Low
B	• know lots of the technical side of it on how to define it on labels; • have some knowledge (underpaying illegal immigrants; processors of making food; reassignment on real farmers; immigrant are taking their jobs; bad working conditions of people in the meat industry)	Medium
C	• know about all the labels; • all the ingredients; • know a lot about traceability…from the farmers like where they grow, and what pesticide was used	High
D	• -	-
E	• not a whole a lot; • know the general concept; • origin; • where the food comes from; • how far it travels	Medium

Note. Interview D's answer to this question was not recorded by accident.

Table 6 presents the interviewees' answers regarding their knowledge about FTI and their knowledge levels. As shown in Table 6, Interviewee A was categorized into the group of low-level knowledge of FTI; Interviewee B and E were categorized into the group of medium-level knowledge of FTI; Interviewee C was categorized into the group of high-level knowledge of FTI; Interviewee D was not categorized due to the missing data.

After the keywords in Table 6 were coded and themed, a typology of the interviewees' knowledge was formed as shown in Figure 14 below.

Figure 14

Typology of Interviewees' Knowledge About FTI

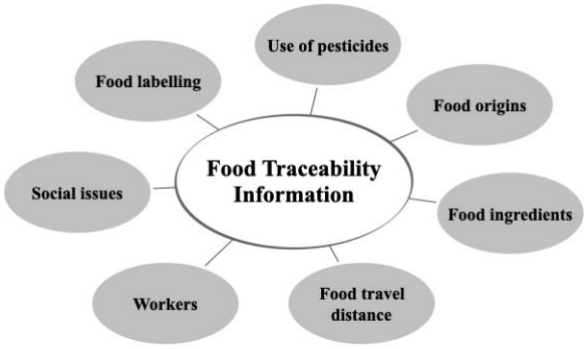


Figure 14 demonstrates that the interviewees' knowledge about FTI involved the aspects of "food labeling", "use of pesticides", "food origins", "food ingredients", "food travel distance", "workers (e.g., farmers, processors)", and "social issues".

4.2.2 Shoppers' Behaviors and Motivations for Using TI on Produce

RQ 2: Do shoppers use traceability information on produce to make purchase decisions at grocery stores?

Table 7

Highlighted Keywords from the Answers to RQ 2

Interviewee	Keywords	Use TI?
A	• Yes, I did.	✓
B	• I guess the main one that I look at day-to-day is probably like the origin of packing, like expiration dates, like get to understand my ability to use it.	✓
C	• Yea, for sure.	✓

D	• Sometimes I do read labels and try to figure out that information. • …if I go to a farmer's market, I would go to talk to the vendor, and I would ask where they are getting their fruits and vegetables.	✓
E	• …not usually. If I see that something is local, I will try to buy it, assuming that it's still affordable as compared to another option.	✓

Table 7 presents the interviewees' answers regarding their behaviors of using TI on produce to make purchase decisions when purchasing produce at grocery stores. They all indicated that they used TI on produce to make purchase decisions when purchasing produce at grocery stores.

RQ 2.1: If yes, what are the shoppers' motivations for using traceability information on produce to make purchase decisions at grocery stores?

Table 8

Highlighted Keywords from the Answers to RQ 2.1

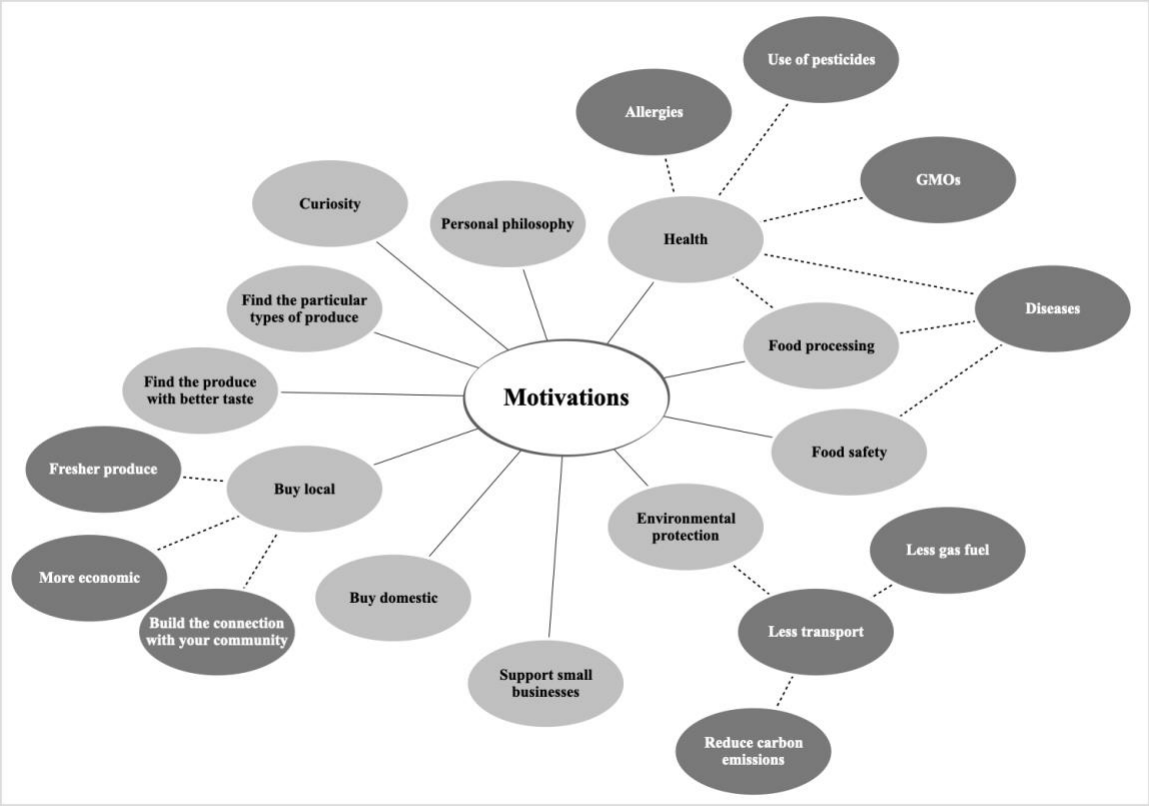
Interviewee	Keywords
A	• I have seasonal allergy, so my family recommend me to check those before I buy them; • I buy a lot of ethnic food…I would rather buy a produce from the origin or from the country who I'm more familiar with; • …if there is specific kind of fruits and vegetables that I want… I care…I need to have that one, then the whole traceable information is the decisive [unclear part] element for me to make a purchase; • …the groceries from original country is in a better taste than what is more locally.
B	• …that is claimed to be something that's fresher…
C	• …I have some allergies, so I need to be sure that I'm avoiding certain type of components in the food; • I don't want to buy something like just from the world. I know it can be produced here, or like in the close states; • because I have some allergy, so I need to check it out if it's safe; • …being in the US, I don't want to buy something going from like another continent like China, or Europe, because it's too far for me I think; • I want to buy local stuff… • …they did have some issue in the food processing, because you cannot have a lot of amount of searching, …material life in the food, which are very bad for your health for sure…known food induced many of the diseases.

D	• …knowing about what is going in my body is really important…; • "my body is my temple"; • I would like to know what is going in there (refer to the body); • …knowing that information of what practices for use to get that food is important to me; • I read a lot about health…; • …I've seen many incidents, where certain pesticides can have long-term effects of causing cancer… • …I really don't have a voice whether it's (GMO) beneficial for our health or not; • …for what I research and found out that, most of the GMO products has caused long-term effects on the health; • To trace like what exactly would be causing long-term health issues; …the high risk of that produce; • …buy local is not only that I know the distance, I know it's more fresh. It's more economic, but also it just builds that connection between your community I think.
E	• Less transport, so less gas fuels; • To try to reduce carbon emissions; • …support the small businesses.

The interviewees discussed their motivations for using TI on produce to make purchase decisions as summarized in Table 8.

Figure 15

Typology of Interviewees' Motivations for Using TI on Produce to Make Purchase Decisions at Grocery Stores



After the keywords in Table 8 were coded and themed, a typology of interviewees' motivations was formed as shown in Figure 15.

Figure 15 depicted that the interviewees' motivations involved the aspects of "health", "food processing", "food safety", "environmental protection", "support small businesses", "buy domestic (domestically grown produce)", "buy local (locally grown produce)", "find the produce with better taste", "find the particular types of produce", "curiosity", and "personal philosophy". Moreover, the sub-topics included "allergies", "use of pesticides", "GMOs", "diseases", "less gas fuel", "less transport", "reduce carbon

emissions", "build the connection with your community", "more economic", and "fresher produce".

4.2.3 Shoppers' Perceptions Towards Providing TI on Produce to Them at Grocery Stores

RQ 3: How do shoppers perceive providing traceability information on produce to them to make purchase decisions at grocery stores?

Table 9

Highlighted Keywords from the Answers to RQ 3

Interviewee	Keywords
A	• I do like how they provide the traceable information there…; • …the better options like the better. The more options the better; • I do like how they got the option to the package, so I can make a better decision, like among all kinds of different varieties of the single product; • I do believe the more traceable information the vendor produce… so the more information that I received, the more convinced that this product is in good quality.
B	• Overall, I think it would be good; • …it's not something that would be super important to me personally. • I do think that it would allow us more control of we want it or deciding what types of fruits and industries we are contributing to…; • Knowledge at the hands of consumers is always a good thing; • …food traceability information being accessible may not even… you know… be something everyday shopper such as myself looks at…; • …it might be something that the local journalist is looking at.
C	• …it's a key point…we really need to know as much as possible on each product; • …that way we know what we eat, where it comes from, how did it grow in the farm…; • …our own decision to: ok, I eat this, and I don't eat this; • …food is health; • So for me, really very important.
D	• I am actually in the neutral side on this; • having information is amazing, it's great for a person like me who would like to know; • …that information should be there, but then it should be upon the consumer to access that information.

E	• …that would be great; • …contributing more knowledge for people to use their purchasing power is a good thing; • …they can choose whether or not to use it but having it there is good.

Table 9 presents the interviewees' answers regarding their perceptions towards providing TI on produce to them to make purchase decisions at grocery stores. Table 10 presents the highlighted keywords of their perceptions.

Table 10

Highlighted Keywords of Perceptions from the Answers to RQ 3

Interviewee	Keywords
A	like
B	good
C	really very important
D	neutral
E	great

Table 10 demonstrates that Interviewees A, B, C, and E had positive perceptions towards providing TI on produce to them to make purchase decisions at grocery stores. They also recognized the benefits of FTI as discussed in Table 9. However, Interviewee D had a neutral perception and was quoted as saying, "I think having information is amazing. It's great for a person like me who would like to know. But I think a lot of people…they would just want to go to the store and get what they want to have on the list and get back home". In other words, Interviewee D felt that because TI on produce may not be that necessary for many people to purchase produce at grocery stores, so he had a

neutral perception towards providing TI on produce to them to make purchase decisions at grocery stores.

4.2.4 Shoppers' Perceived Important TI on Produce

RQ 4: What traceability information on produce may be important to shoppers when they purchase produce at grocery stores?

Table 11

Highlighted Keywords from the Answers to RQ 4

Interviewee	Keywords
A	• origin (country, farm); • expiration date; • how long has this thing being harvested, or processed, or operated before being put on the shelf; • whether they have been frozen before; • whether this one is fully fresh; • has been somehow like operated, something by the chemicals; • what kind of chemical to put on the products in order to keep it fresh. • It would be the best if you say I already put wax over it or not. • …when did they harvest this product…; • …when did they put them on the shelf…
B	• …where it's from; • When it was collected… • …methods of farming… • …all the information about like how this food was produced and shipped to where I live…; • …the work conditions (refer to minimum wage paid; safe; workplace accidents; workplace gaps; happy…stuff like that) of the people that were helping harvest and get it to my plate eventually; • GMO information; • safety of food;
C	• The variety of the seeds; • GMO; • What kind of soil was used; • What kind of chemical was used; • …when was it harvested; • …how it's transported to the grocery shop; • If it's a processed food, you need to know what's inside; • …more about what the origin, more about all the whole origin about the food;

	• …where it is going from…; • …how they are working…; • …which variety are they using…; • …why they are applying chemical and everything…
D	• GMO; • pesticides; • herbicides; • locally sourced; • radius • what community they come from…
E	• how far it travels; • if it is a small business or a big company

Table 11 presents the interviewees' answers regarding the TI on produce that might be important to them when they purchased produce at grocery stores. After the keywords in Table 11 were coded and themed, the specific kinds of TI on produce were listed and ranked based on the number of times mentioned by different interviewees as presented in Table 12 below.

Table 12

Highlighted Keywords of Specific TI on Produce from the Answers to RQ 4

TI on Produce	A	B	C	D	E	# of Interviewees
origin	•	•	•			3
GMO		•	•	•		3
harvest date	•		•			2
transportation		•	•			2
use of chemicals (e.g., preservation)	•		•			2
seed			•			1
soil			•			1
expiration date	•					1
production		•				1
on-shelf date	•					1
time of collection		•				1
the time from harvesting, processing, or operation to in-store shelving	•					1
freezing	•					1

travel distance						1
freshness						1
use of pesticide						1
use of herbicide						1
farming method						1
work conditions of workers						1
food safety						1
ingredient						1
local						1
radius from origin						1
the community of origin						1
small business or not						1

Table 12 presents the 25 kinds of traceability information on produce that might be important to the five interviewees when they purchased produce at grocery stores. Among the 25 kinds, “origin” (with similar concepts) and genetically modified organism (GMO) were mentioned with the most counts of 3; “harvest date”, “transportation”, and “use of chemicals” were mentioned with 2 counts; the rest of the kinds of information were mentioned with 1 count each.

4.2.5 Shoppers’ Behavior Intentions of Using Specific Ways to Access TI on Produce

RQ 5: In what ways might shoppers begin to use traceability information on produce to make purchase decisions at grocery stores?

Table 13

Highlighted Keywords from the Answers to RQ 5

Interviewee	Keywords
A	• …label their grocery or shelving or storaging (storing) their groceries based on the date…; • For example, they have 5 different shops, or 5 layers of different shops, or they have different the hierarchy of the shops, I do wish they can put their fruits or veggies…; • …for example, this whole closet or whole shelves are harvested in January, and that ones from February, and instead of putting the variety of… using categories as their criteria, instead of using that, if they use the dates as their shelving or storaging (storing) dependence, then that would address me…or that would push me to … pay more attention to the food or the grocery right here; • You don't necessarily have to put January on this section, or February on that section. You say: "Hey! This kind of grocery has been harvested for 2 days, and after a week, you don't necessarily have to switch them daily. Maybe after a week, you just switch them.; • …if you label them, or if you categorize on them, based on the length of processing, or the duration of that operation, then for me, that would be very helpful. And that would influence my willingness of purchase on this. • …some general public guiding monitor or touchable screen that I can check it, and it would be nice to have a sanitizer… • …grandmas and grandpas prefer having something printed, or having people next to them or talk to them… • …there can be… podium, or…kiosk, just explaining something to them.
B	• …keep up with news online about food; • …just having that information there; • … the the grocers can tell you about the fruits and vegetables as you're checking out…
C	• …either on signs or on packaging; • …ask people working there…
D	• …asking those questions (refer to asking store staff); • …already there, everywhere (refer to in the store), it's great; • I wanna see exactly some information on the front (refer to the front of food packaging); • label; • QR code; • website. • …a dedicated section in the grocery store, which I could ask a little more about the produce…
E	• sign; • the grocery store's website to have that information available/searchable • apps; • scanning QR code something like that…it's on like the price tag thing; …do a QR code that can take you directly to that informational layer in the store if you haven't had the time to do the research ahead of time; • board;

	• …if it is accessible on phone, and then make it even easier so I can look it up on the phone, say: this is what they have been stopped; here is what they have come from; here is how much it is.

Table 13 presents the interviewees' answers regarding how participants might begin to use TI on produce to make purchase decisions at grocery stores. After the keywords were coded and themed, the results are demonstrated in Figure 16.

Figure 16

The Ways in Which Interviewees Might Begin to Use TI on Produce to Make Purchase Decisions at Grocery Stores

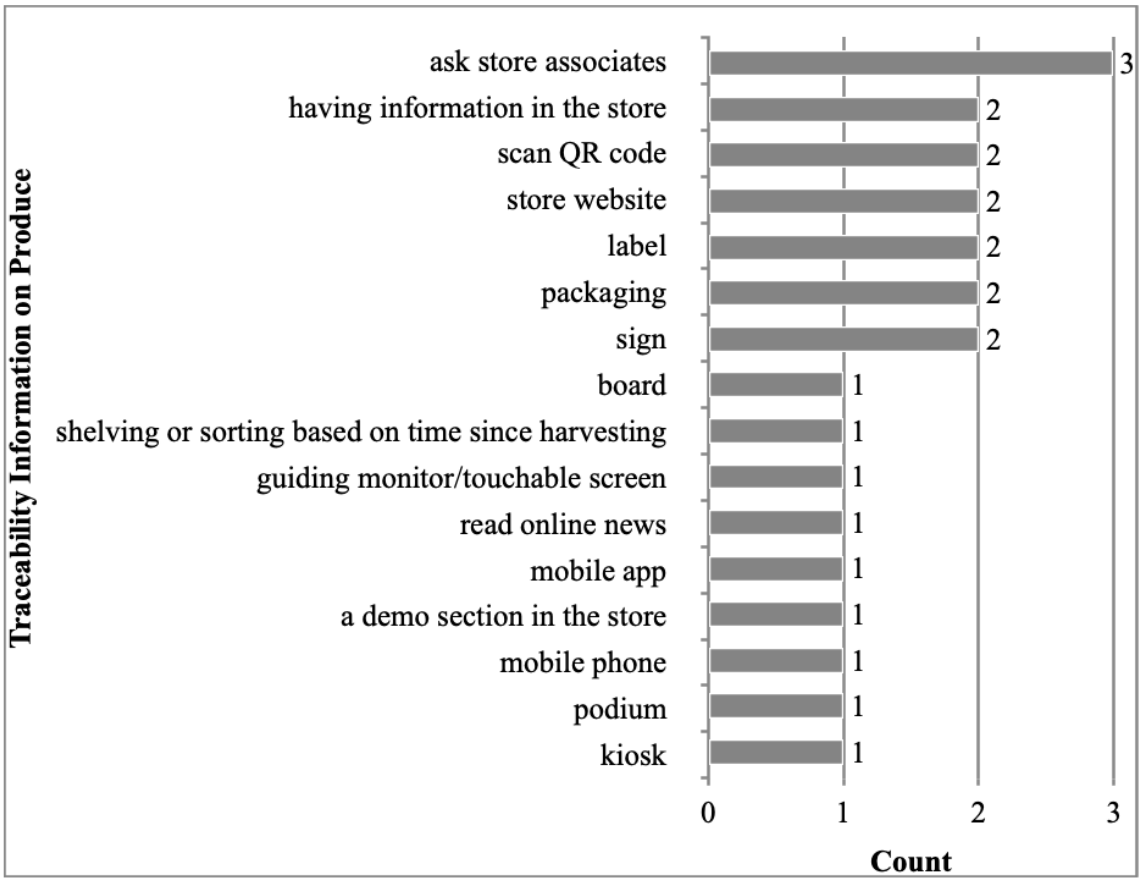


Figure 16 presents the 16 ways the interviewees mentioned in which they might begin using TI to make purchase decisions at grocery stores. “Asking store associates” was the most mentioned with 3 counts. “Having information in the store” (general), “scan QR code”, “store website”, “label”, “packaging”, and “sign" were mentioned with 2 counts, respectively. “Board”, “shelving or sorting based on time since harvesting”, “guiding monitor/touchable screen”, “read online news”, “mobile app”, “a demo section in store”, “mobile phone”, “podium” and “kiosk” were mentioned with 1 count respectively.

Since four of the five interviewees filled out the survey questionnaires before the interview study, their impression of the survey questions might have influenced their responses to this question, which could lead to bias.

RQ 5.1 Do shoppers have a positive attitude towards using a mobile phone to find traceability information on produce to make purchase decisions at grocery stores?

Table 14

Highlighted Keywords from the Answers to RQ 5.1

Interviewee	Yes or No	Keywords
A	X	• I personally not prefer; • Because of the Covid, the less that I touch my screen the better…it’s kind of wear gloves to pick up the groceries…But if need to use my phone frequently, after I touch all kinds of groceries, it’s a little bit unsafe for me; • …last semester, we have a chance to work with a senior community in Glendale here. And the residents there told us most of them are over 60, 70s, they do grocery shopping a lot too, but because they are mobilely unavailable sometime. So they usually they have a problem with the apps during grocery shopping. Yea, grandmas and grandpas prefer having something printed, or having people next to them or talk to them in terms of that, so I do wish if you guys want to do some products to help improve that kind of customer experience. Then maybe there can be less…guiding next to [unclear part], or podium,

		or… kiosk, just explaining something to them. So at least they can have better experience using that kind of service.
B	X	• I never use it to look specifically for one thing…
C	X	• Not al all; • That's not easy; • Definitely avoid; • …because if you forget your phone at home, you cannot have the information. Then if you don't have profile or data, or you cannot do it too; • The information is not available for everybody, because not everybody has smart phones.
D	✓	• …I support that. I agree to that idea; • …people will be more willing because they go to grocery stores nowadays people can… the barcode and check out using just like that. So if that the same information can be get it on mobile phone, why not? • …the same thing that use mobile phone is quite a lot when you do grocery shopping to scan for coupons or anything, or you wanna scan the product, and every stores totally try to going to that direction, but you can just scan it on your app, and then you check out, so it's something which is convenient…
E	✓	• …if it was a…like a website that has all the information that can be harder, but if it's a direct like somehow like…I think the QR code might make it easier to send directly to that particular piece of produce info, and further types of produce information.

Table 14 demonstrates interviewees' discussions regarding if they had a positive attitude towards using a mobile phone to find TI on produce to make purchase decisions at grocery stores. Based on their answers, Interviewees A, B and C expressed a negative attitude towards using a mobile phone to find TI on produce to make purchase decisions at grocery stores. Interviewee A mentioned that this approach might not be suitable for seniors with reduced mobility. Interviewee C strongly opposed this approach as quoted as saying that "if you forget your phone at home, you cannot have the information. Then if you don't have profile or data, or you cannot do it too," and "the information is not available for everybody, because not everybody has smart phones." She also stated that using a mobile phone to find TI was not easy.

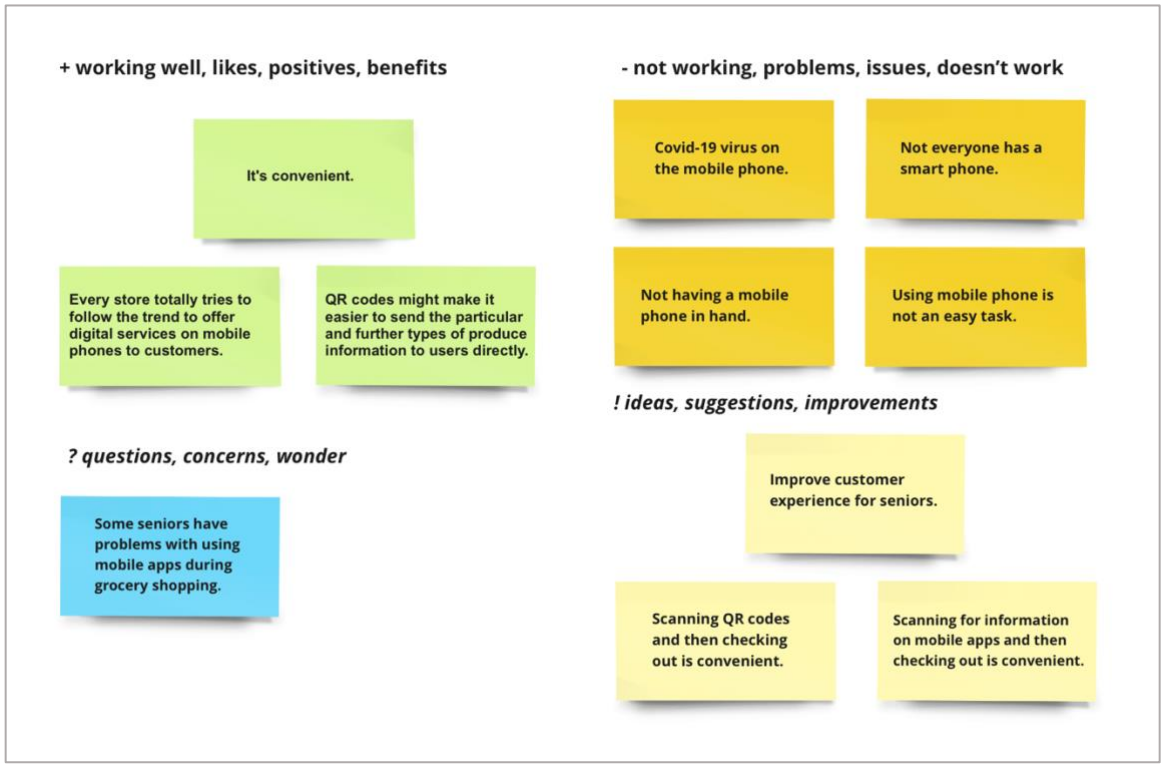
In contrast, Interviewees D and E expressed a positive attitude towards using a mobile phone to find TI. Interviewee D argued that "…the same thing that use mobile phone is quite a lot when you do grocery shopping to scan for coupons or anything, or you wanna scan the product, and every stores totally try to going to that direction, but you can just scan it on your app, and then you check out, so it's something which is convenient…". In other words, he observed the trend that grocery stores are utilizing mobile phones to provide services to shoppers (e.g., scanning for coupons), and he viewed that as a convenient approach. Interviewee E viewed using a mobile phone to scan QR codes of produce as a straightforward approach, as quoted as saying, "I think the QR code might make it easier to send directly to that particular piece of produce info, and further types of produce information".

As researchers have predicted smartphones as an important tool for consumers to access food product information to check food quality and safety status (Aung & Chang, 2014), the researcher analyzed the interviewees' feedback strategically. The results may help designers identify the pros and cons and relevant issues for shoppers to use mobile phones to access TI on produce at grocery stores.

Based on the results above, interviewees' opinions were themed into four perspectives of ideas, namely, "Working Well, Likes, Positives, Benefits," "Not Working, Problems, Issues, Doesn't Work," "Ideas, Suggestions, Improvements" and "Questions, Concerns, Wonder" (ASU, 2018) as shown in Figure 17.

Figure 17

Affinity Diagramming of the Interviewees' Opinions on Using a Mobile Phone to Find TI on Produce at Grocery Stores



4.2.6 Shoppers' Thresholds to Pay for TI on Produce

RQ 6: Would shoppers be willing to use traceability information on produce to make purchase decisions if this information leads to an increase in the price of the produce at grocery stores?

Table 15

Highlighted Keywords from the Answers to RQ 6

Interviewee	Yes or No	Keywords
A	✓	• …I need to keep myself healthy. I cannot take the risk to add food poison, just because I want 1 dollar cheaper; • …I would like to pay a little bit extra money, If you can get more traceable information there. Just something on the package; • Less than 10% of the price increase, the more the traceable information the better.
B	X	• …if I have one option that is a a lot cheaper, and one option that is a lot more expensive. Or I am right now, is college student. I'm gonna have to pay for the cheaper one; • …consumers are often faced what choices like that in produce, of like I mean just get the cheap option as I can, and I goes within one type of food and it also extends to like… just generally what kinds of fruits and vegetables you are consuming, right? And that's also sad because the variety is so important in the diet, and if we can afford to have that variety, and I do think that's important part of the life experience we missed out on.
C	✓	• I don't think I'm willing to increase the price, because those information are known by different person in the food chain; • We just need someone that collect all these data, and it should be mandatorily to do it by State or by the country. • …it should be at federal law. • …I don't think this should increase the price that much, like 1% or something like that. • …it's not going to the end in the pocket of the farmers or the producers. So I know that mine would just go to… I don't know… someone else. It shouldn't be that high.
D	✓	• …between 5-10% that shouldn't make a lot of difference, considering a lot of information.
E	✓	• Within limits, yes. • …small percentage of increases I'm fine with. If it becomes an issue of affordability for my paycheck versus what we will pay, then I would have to choose whatever is slightly less expensive. • Like up to 5% I think should be fine. Maybe even if it is a lower cost item up to like 10%.

Table 15 presents the interviewees' answers regarding their thresholds to pay for having TI on produce to make purchase decisions at grocery stores. Interviewees A, C, D, and E expressed that they were willing to use TI on produce to make purchase decisions

at grocery stores if this information leads to an increase in the price of the produce. Specifically, Interviewee A accepted a price rise of "less than 10%" with a particular condition as quoted as saying that "the more the traceable information the better"; Interviewee D accepted a price rise of "5-10%"; Interviewee E accepted a price rise of "up to 5%" and "up to 10%" for lower cost items; Interviewee C accepted a price rise of "1%"; In contrast, Interviewee B expressed unwillingness towards using TI on produce if this information leads to an increase in the price of the produce, due to the reason as quoted as saying that "…if I have one option that is a lot cheaper, and one option that is a lot more expensive. Or I am right now, is college student. I'm gonna have to pay for the cheaper one". In other words, the interviewee valued the affordability of the price of produce over the TI.

CHAPTER 5

CONCLUSION / DISCUSSION

5.0.0 Introduction

Food safety has been constantly challenged around the globe (WHO, 2022). The World Health Organization (WHO) (2022) estimated that around 600 million people suffer from consuming unsafe food, and young children take up 40% of foodborne diseases with 125 thousand deaths every year. Food safety and quality incidents have significantly impacted our society, economy, and environment (WHO, 2022; Fitzgerald et al, 2016; FSN, 2022; Interpol & Europol, 2021; Hoffmann et al, 2015; Ritchie & Roser, 2020; Dong et al, 2021).

To improve food safety and quality assurance, "traceability" has been developed as a tool by the food industry, governments, and companies (FDA, 2021; Qian et al, 2020; Badia-Melis et al, 2015; Aung & Chang, 2014), which enables consumers to access more food product information for making purchase decisions (Aung & Chang, 2014).

To design services for future food traceability systems that can provide FTI to consumers possibly through emerging technologies, this study investigated shopper insights into FTI on produce provided at grocery stores in the aspects of shoppers' knowledge about FTI, shoppers' behaviors of and motivations for using TI on produce, shoppers' perceptions towards providing TI on produce to them at grocery stores, important TI on produce perceived by shoppers, shoppers' behavior intentions of using various ways to access TI on produce, and shoppers' thresholds of using TI on produce.

The results of the survey study and the interview study provided answers to the research questions (see section 3.6.0) from the lens of user research. Summaries of

findings, design implications, discussion, and suggestion for future research are summarized in the following sections.

5.1.0 Summaries of Findings

The following sections summarize the main findings of the survey study and the interview study.

5.1.1 Shoppers' Knowledge About FTI

RQ 1: Do shoppers have good knowledge about food traceability information?

The survey study (see section 4.1.1) provided the insight that the shoppers of the sample (N_1=200) overall had a relatively low level of knowledge about FTI. The interview study (see section 4.2.1) provided the insight that shoppers of the sample (N_2=5) had low-, medium-, and high-level knowledge about FTI. Moreover, the interview study revealed that the shoppers' knowledge about FTI involved the topics of "food labeling", "use of pesticides", "food origins", "food ingredients", "food travel distance", "workers (e.g., farmers, processors)", and "social issues".

5.1.2 Shoppers' Behaviors and Motivations for Using TI on Produce

RQ 2: Do shoppers use traceability information on produce to make purchase decisions at grocery stores?

The survey study (see section 4.1.2) provided the insight that 59.5% of the shoppers in the sample (N_1=200) never used TI on produce to make purchase decisions when purchasing produce at grocery stores; 35.0% of the shoppers sometimes used TI on

produce to make purchase decisions when purchasing produce at grocery stores; 5.5% of the shoppers always used TI on produce to make purchase decisions when purchasing produce at grocery stores. The interview study (see section 4.2.2) provided the insight that all five interviewees in the sample (N_2=5) used TI on produce to make purchase decisions when purchasing produce at grocery stores.

RQ 2.1: If yes, what are the shoppers' motivations for using traceability information on produce to make purchase decisions at grocery stores?

For the shoppers who used TI on produce to make purchase decisions when purchasing produce at grocery stores, the survey sample (N_1=200) indicated that the shoppers' motivations were "consider environmental issues", "evaluate food freshness", "consider health, wellness and/or nutrition", "evaluate food safety", "evaluate food quality", "meet my curiosity", "consider social issues", "consider economic issues" and "other (e.g., support local farmers)" (see Figure 8 in section 4.1.2). Furthermore, the top motivations were "consider environmental issues" (48 counts), "evaluate food freshness" (44 counts), and "consider health, wellness, and/or nutrition" (41 counts). The interview sample (N_2=5) indicated that the shoppers' motivations involved the aspects of "health (regarding allergies, use of pesticides, GMOs and diseases)", "food processing (regarding diseases)", "food safety (regarding diseases)", "environmental protection (regarding less transport with less gas fuel, and reduced carbon emissions)", "support small businesses", "buy 'domestic'", "buy 'local' (regarding fresher produce, more economic, and building the connection with one's community)", "find the produce with better taste", "find the particular types of produce", "curiosity", and "personal philosophy" (see Figure 15 in section 4.2.2).

It can be highlighted that the survey study and the interview study found shoppers' common motivations for using TI on produce to make purchase decisions when they purchase produce at grocery stores regarding "food freshness", "health", "food safety", "curiosity", "environmental issues", "social issues", "economic issues", and "supporting the locals".

5.1.3 Shoppers' Perceptions Towards Providing TI on Produce to Them at Grocery Stores

RQ 3: How do shoppers perceive providing traceability information on produce to them to make purchase decisions at grocery stores?

The survey study (see section 4.1.3) provided the insight that the shoppers in the sample (N_1=200) held overall good perceptions towards providing TI on produce to them to make purchase decisions at grocery stores, with the measured perceptions of "somewhat relevant", "kind of positive", "kind of useful", "somewhat needed", "kind of interesting" and "kind of valuable". The interview study (see section 4.2.3) provided the insight that the shoppers in the sample (N_2=5) held overall good and neutral perceptions towards providing TI on produce to them to make purchase decisions at grocery stores. The shopper who held a neutral perception stated that TI on produce might not be necessary for many people to purchase produce at grocery stores.

5.1.4 Shoppers' Perceived Important TI on Produce

RQ 4: What traceability information on produce may be important to shoppers when they purchase produce at grocery stores?

The survey study (see section 4.1.4) provided the insight that the shoppers in the sample (N_1=200) perceived "freshness status", "safety status", "hygiene status", "quality status", "environmental impact", and "use of agricultural pesticides, herbicides or fungicides" on produce as the important kinds of TI on produce when they purchased produce at grocery stores (see Figure 10). The interview study (see section 4.2.4) provided the insight that the shoppers in the sample (N_2=5) perceived "origin", "GMO", "harvest date", "transportation", "use of chemicals (e.g., preservation)", "seed", "soil", "expiration date", "production", "on-shelf date", "time of collection", "the time from harvesting, processing or operation to in-store shelving", "freezing", "travel distance", "freshness", "use of pesticide", "use of herbicide", "farming method", "work conditions of workers", "food safety", "ingredient", "local", "radius from origin", "the community of origin" and "small business or not" as the important kinds of TI on produce when they purchased produce at grocery stores (see Table 12).

It can be highlighted that the survey study and the interview study found common kinds of important TI on produce for shoppers when they purchase produce at grocery stores in terms of "freshness/freshness status", "food safety/safety status", and "use of chemicals/agricultural pesticides or herbicides".

5.1.5 Shoppers' Behavior Intentions of Using Specific Ways to Access TI on Produce

RQ 5: In what ways might shoppers begin to use traceability information on produce to make purchase decisions at grocery stores?

The survey study (see section 4.1.5) provided the insight that the shoppers in the sample (N_1=200) may begin to use TI on produce to make purchase decisions at grocery

stores in ways of reading TI on “food labels or certifications”, “food packaging”, “signs near produce”, “digital displays near produce”, and using a mobile phone to “scan the produce codes (e.g., barcodes, QR codes)” and “get close to (sense) the smart tags of produce” to access TI on the phone. Among those approaches, reading TI on “food labels or certifications”, “food packaging”, “signs near produce”, and “digital displays near produce” received positive responses (see section 4.1.5.1). The interview study (see section 4.2.5) provided the insight that the shoppers in the sample (N_2=5) may begin to use TI on produce to make purchase decisions at grocery stores in ways of “asking store associates” (3 responses), “having information in the store” (2 responses), “scanning QR codes” (2 responses), “visiting store websites” (2 responses), “reading labels” (2 responses), “reading packaging” (2 responses), “reading signs” (2 responses), “reading boards” (1 response), “having produce shelved or sorted in stores based on time since harvesting” (1 response), “using a guiding monitor or touchable screen” (1 response), “reading online news” (1 response), "using mobile apps” (1 response), “having a demo in the store” (1 response), “using mobile phones” (1 response), or “having a podium or kiosk in the store” (1 response).

RQ 5.1: Do shoppers have a positive attitude towards using a mobile phone to find traceability information on produce to make purchase decisions at grocery stores?

The survey study (see section 4.1.5.2) provided the insight that 38.0% of the shoppers in the sample (N_1=200) overall had a positive attitude (50-100% chance of behavior intention) towards using a mobile phone to find TI on produce to make purchase decisions at grocery stores. In comparison, 62.0% of the shoppers overall did not have a positive attitude (less than 50% chance of behavior intention). The interview study (see

Table 14 in section 4.2.5) provided the insight that 2 shoppers in the sample (N_2=5) had a positive attitude towards using a mobile phone to find TI on produce to make purchase decisions at grocery stores. In comparison, 3 shoppers in the sample did not have a positive attitude. The reasons for their attitudes were further analyzed, as presented in Figure 17.

RQ 5.2: Do shoppers have a positive attitude towards using a mobile phone to search traceability information on produce on a webpage to make purchase decisions at grocery stores?

RQ 5.3: Do shoppers have a positive attitude towards using a mobile phone to search traceability information on produce through an application (app) to make purchase decisions at grocery stores?

RQ 5.4: Do shoppers have a positive attitude towards using a mobile phone to scan the product codes of produce to access traceability information on the phone to make purchase decisions at grocery stores?

RQ 5.5: Do shoppers have a positive attitude towards holding a mobile phone close to the smart tags of produce to access traceability information on the phone to make purchase decisions at grocery stores?

The survey study (see section 4.1.5.2) provided the insight that 33% of the shoppers in the sample (N_1=200) had a positive attitude (50-100% chance of behavior intention) towards using a mobile phone to search TI on produce on a webpage to make purchase decisions at grocery stores, while 67% of the shoppers did not have a positive attitude (less than 50% chance of behavior intention); 35.5% of the shoppers had a positive attitude (50-100% chance of behavior intention) towards using a mobile phone to

search TI on produce through an application (app) to make purchase decisions at grocery stores, while 64.5% of the shoppers did not have a positive attitude (less than 50% chance of behavior intention); 57.0% of the shoppers had a positive attitude (50-100% chance of behavior intention) towards using a mobile phone to scan the product codes (e.g. barcodes, QR codes) of produce to access TI on the phone to make purchase decisions at grocery stores, while 43.0% of the shoppers did not have a positive attitude (less than 50% chance of behavior intention); 59.5% of the shoppers had a positive attitude (50-100% chance of behavior intention) towards holding a mobile phone close to the smart tags of produce to access TI on the phone to make purchase decisions at grocery stores, while 40.5% of the shoppers did not have a positive attitude (less than 50% chance of behavior intention).

Compared to the survey result that 38.0% of the shoppers overall did not have a positive attitude towards using a mobile phone to find TI on produce to make purchase decisions at grocery stores, the survey results also indicated that the majority of the shoppers had a positive attitude towards using a mobile phone to scan the product codes of produce (57%) or holding a mobile phone close to the smart tags of produce (59.5%) to access TI on the phone to make purchase decisions at grocery stores. The reasons for this conflicting result need to be further investigated.

5.1.6 Shoppers' Thresholds to Pay for TI on Produce

RQ 6: Would shoppers be willing to use traceability information on produce to make purchase decisions if this information leads to an increase in the price of the produce at grocery stores?

The survey study (see section 4.1.6) provided the insight that 33% of the shoppers in the sample (N_1=200) were willing to use TI on produce to make purchase decisions at grocery stores if this information leads to an increase in the price of the produce; 35% of the shoppers of the sample were not sure if they were willing; 19% of the shoppers were not willing; 13% of the shoppers indicated that whether they were willing depending on the factors including the increase of the produce price, food categories, the trade-offs between quality and price for the produce, economic inflation, price gouging, personal interest, locality, environmental protection, social equity, food waste, and the value, reliability, persuasion, and education of the TI. The interview study (see section 4.2.6) provided the insight that four shoppers of the sample (N_2=5) were willing to use TI on produce to make purchase decisions at grocery stores if this information leads to an increase in the price of the produce, while one shopper was not willing due to the reason that he/she valued the affordability of the price of the produce over the TI.

5.2.0 Design Implications

This transdisciplinary user research study sheds light on a unique perspective on food traceability by investigating shopper insights into FTI on produce provided at grocery stores with a fusion of ideas from the disciplines of design and consumer behaviors. By revealing a series of shopper insights, potential design opportunities were identified for the service design of future food traceability systems, which are the features and the important components of a hypothetical service design model.

5.2.1 Features of Service Design Model

Based on the survey and the interview study results, a series of shoppers' needs and points of view (POVs) were summarized and categorized into five research-based themes in terms of health and safety, sustainability, local, special interest, and seniors. The results led to a series of proposed features of the service design model of future food traceability systems as presented in Table 16.

Table 16

A Summary of Research-based Themes, Shoppers' Needs and Points of View (POVs) With Proposed Features of The Service Design Model

Themes	Shopper Needs & POVs	Proposed Features
Health & Safety	I NEED to avoid certain ingredients in the produce BECAUSE they may cause allergies.	Services can inform shoppers what ingredients of the produce may cause specific allergies.
	I NEED to know more about processing information of the produce BECAUSE I am concerned about food safety.	Services can introduce processing information about the produce to shoppers from the food safety perspective.
	I NEED to know about the pesticide and GMO information of the produce BECAUSE they may cause long-term health effects.	Services can introduce educational information about the use of pesticides, GMOs, and other potential risks (if any) of the produce to shoppers from the health perspective.
	I NEED to know about the freshness, safety, hygiene, and quality of the produce BECAUSE they are important.	Services can indicate the produce's freshness, safety, hygiene, and quality status to shoppers when they move along the supply chains.

Sustainability	I NEED to know about environmental impact of the produce (e.g., gas fuel consumption, carbon emissions) BECAUSE I care about environment protection.	Services can introduce the environmental impacts of the produce to shoppers.
	I NEED to know about business information of the produce BECAUSE I can support local businesses or small businesses by buying their products.	Services can introduce the business information of the produce to shoppers.
	I NEED to know about workers' work conditions (e.g., minimum wages, safety, workplace accidents, workplace gaps, happiness) behind the produce BECAUSE I care about their lives and how they were treated.	Services can provide the worker information behind the produce to shoppers.
Local	I NEED to buy local produce BECAUSE they are fresher.	Services can provide the origin and freshness information of the produce to shoppers.
	I NEED to buy local produce BECAUSE they are more economic.	
	I NEED to buy local produce BECAUSE they can connect me with the local communities.	Services can introduce the community information about the produce to shoppers.
Special Interest	I NEED to buy ethnic produce from their original countries or particular regions BECAUSE those produce tastes better.	Services can introduce the origin information of the produce to shoppers to ensure it is the kind that he/she wants.

Seniors	I NEED to have easy access to the TI in grocery stores BECAUSE I have restricted mobility, and I need some help using mobile apps.	Services can provide TI to shoppers with easy access.
	I NEED to have someone next to me who can explain TI to me BECAUSE I prefer communicating with people.	Services can include in-person approaches to explain TI to shoppers in grocery stores.

5.2.2 Important Components of Service Design Model

To conceptualize the service design model of the future food traceability systems, four important components of the model were identified, including Important FTI, Education about FTI, Mediums to Present FTI, and Exposure to FTI as demonstrated in Figure 18.

Figure 18

Important Components of The Service Design Model

5.2.2.1 Important FTI

The research regarding the important TI on produce perceived by shoppers revealed that more than 20 kinds of FTI were perceived to be important (see section 5.1.4). Therefore, food traceability systems' services should convey this information to shoppers. Designers can work on information design to communicate the TI to shoppers.

5.2.2.2 Education about FTI

The research insight regarding shoppers' knowledge about FTI indicated that many shoppers might have a relatively low level of knowledge about FTI (see section 5.1.1). Therefore, education about FTI can be included in the services of food traceability systems by introducing the functions, values, and benefits of FTI and addressing shoppers' motivations and thresholds for using FTI according to the results of the study (see section 5.1.6). Designers can design user experiences or provide design strategies for creating education using various formats such as online tutorials, online articles, online courses, online forums, and social media campaigns. For example, designers can help design a website to provide information about FTI to shoppers and report the news about local food traceability situations to them.

5.2.2.3 Mediums to Present FTI

The research insight regarding shoppers' behavior intentions of using various ways to access TI on produce revealed that 17 kinds of mediums to present FTI were

endorsed by most survey and interview participants (see Figure 11, Figure 12, and Figure 16) as summarized in Table 17.

Table 17

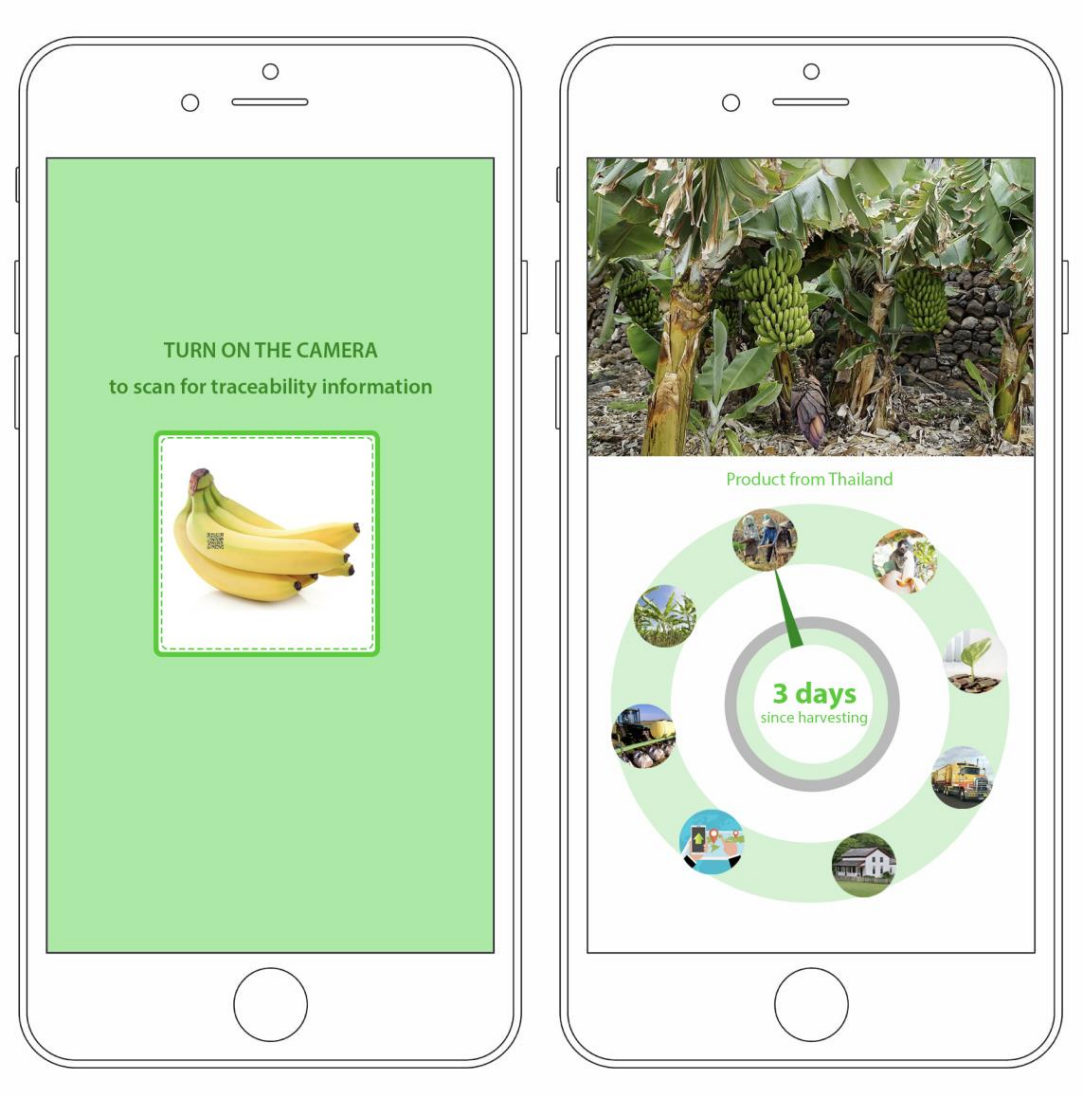
Mediums to Present FTI to Shoppers in Grocery Stores

MEDIUM					
Print	**Object**	**Organization**	**Media**	**Mobile Phone**	**Human**
sign	demo	product sorting	online news	application (app)	asking store associate
label	kiosk	product shelving	store website	scan product code	
board	podium			sense smart tag	
packaging	digital/ touchable display				
certification					

Among those mediums, digital devices, store websites and in-person interactions (asking store associates) can be considered top priorities to present FTI to shoppers, as those mediums can carry an abundance of information. Designers can design user experiences for shoppers to use these mediums to access FTI, or design new mediums that mainly serve the needs of providing FTI to shoppers. As an example, a User Interface (UI) prototype design for an interactive webpage or application (app) of mobile phones to present FTI is presented in Figure 19.

Figure 19

A User Interface (UI) Prototype Design for An Interactive Webpage or Application (App) of Mobile Phones to Present FTI to Shoppers



Note. The image elements used in this artwork were from the public domain. The artwork was designed by Yisha Wang, the author of this thesis.

The UI on the left side demonstrates that users would need to use the camera of a mobile phone to scan product QR codes to access FTI. Moreover, the UI on the right side

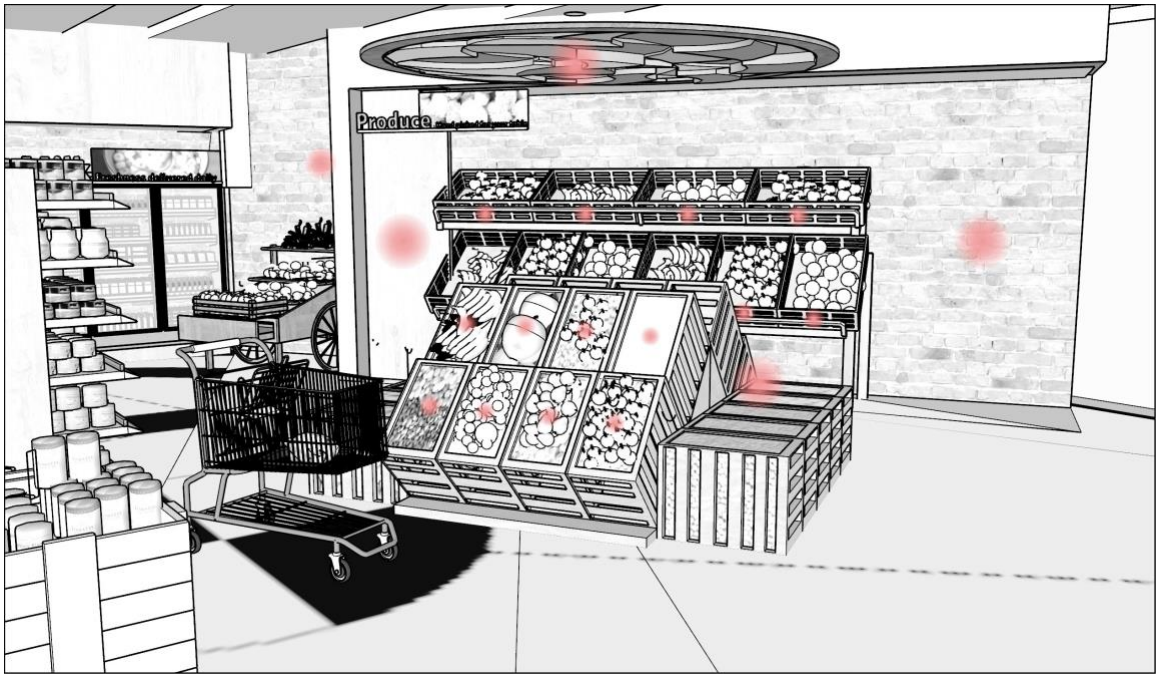
demonstrates the landing page of the product details with the categorized FTI. Then, the user could access detailed information by rotating the wheel with the arrow pointing to the desired FTI.

5.2.2.4 Exposure to FTI

The research insight regarding shoppers' perception towards providing TI on produce to them at grocery stores indicated a need to help shoppers get more exposure to FTI in stores so that shoppers may get more aware of the existence of FTI for making purchase decisions. To implement this idea, one potential strategy is to present FTI through multiple mediums, such as food labels, certifications, packaging, signs, digital displays, mobile phones through scanning product QR codes, and store websites. Figure 20 demonstrates the possible spaces (in red dots) near the produce section in grocery stores to present FTI to shoppers.

Figure 20

The Possible Spaces (in Red Circles) to Present FTI to Shoppers in Grocery Stores



Note. The background illustration was a derivative work based on a 3d model named "grocery" available on Trimble's SketchUp 3D Warehouse under Trimble Inc's 2015 License Agreement (https://3dwarehouse.sketchup.com/tos/#license).

5.3.0 Discussion

This research explored shopper insights into TI on produce provided at grocery stores from the shopper's perspective, and the study results provide implications for designers of food traceability systems and other stakeholders of food supply chains, including the grocers, producers, the farmers with the communities related to the them.

From the designer's perspective, designers have the particular skill sets to create a variety of experiences for users to access FTI through a wide range of mediums by either

physical touchpoints or virtual communications. In other words, designers could help improve the existing ways of presenting FTI to store shoppers. For example, they could redesign the visual TI on the labels, signs or packaging to improve readability, clarity, priority, and creativity. Alternatively, they could redesign the existing organization of food products on shelves with specific orders to indicate their expiration dates, as brainstormed by one interviewee. Moreover, designers could create new ways to present FTI to store shoppers. They can also use emerging technologies to innovate new interactive approaches between consumers and food traceability systems. For example, they could create tangible user experiences on mobile phones, webpages and applications to provide TI to shoppers. Moreover, they could create intangible user experiences including sensing product information with mobile phones or wearable devices such as smart watches and wireless earphones. If the costs of new technologies are not an issue, Virtual Reality (VR), Augmented Reality (AR), or Mixed Reality (MR) may all serve multi-dimensional information that other traditional digital devices could hardly offer. For example, the shoppers may use wearable VR to watch how the farm growing the produce looks like, and the conditions about the farm such as the weather, air humidity, and soil temperature. They may also watch how farmers operate the agricultural products on the farm in real-time from an angle of 360 degrees. Furthermore, they may watch how the produce is stored and handled inside a truck during transportation as long as a camera is installed inside. In brief, there may be limitations on the material conditions, but designers' creative thinking has no borderlines.

Based on the results regarding the important FTI perceived by shoppers in this study, grocers may realize that they already have some information available for

shoppers. They may utilize the existing resources to demonstrate more food information to shoppers including which farms or companies supplied the ingredients, and when they were delivered and put on shelves. If they know how to use an appropriate way to convey the information to shoppers, shoppers may be more willing to shop at the stores as they can get more informed about the food they buy from there.

From the producer's perspective, they may be willing to provide more FTI on the produce packaging, labels, wrapping paper or boxes because they understand the information that addresses shoppers' perceptions and thresholds of using FTI may arouse shoppers' attention towards their products so that their sales may be increased.

From the farm community's perspective, farmers with related communities may hold the foremost information about the produce they grow and have many stories to tell. According to the results of this study, many shoppers are not only interested in the produce they buy but also care about the farm workers' work and living conditions. Food traceability systems may offer services that connect the farm communities with shoppers so that TI can be exchanged at the farmer's or shopper's ends. Notably, the study revealed that some shoppers would like to buy food from local farmers or small businesses particularly.

Overall, the results of this study may create many opportunities for the service design of future food traceability systems and likely mpact other stakeholders in the food chains.

5.4.0 Future Research

This section provides the researcher's reflections on this study and advice for future research.

5.4.1 Challenges

The researcher conquered a series of challenges when conducting this research.

Initially, the researcher had the challenge of deciding on a good research topic even though she had a clear direction of research interest. However, she failed at the first attempt to do this research project due to a impropriate choice of research topic which had already been studied for two years. Interestingly, one day she was invited to visit a friend's family farm in Chandler, Arizona, and she offered to become a volunteer at the farm. Surprisingly, her path in life turned around, as her observations of the farm activities motivated her to redo the thesis with a clear vision of ideas. She wanted to put everything she learned and observed from society into a solid research study and contribute to society. This passion encouraged her to pursue her goal of study.

Secondly, she faced the Covid-19 pandemic like everyone else during this challenging time in human history, which caused many troubles in life. She could barely expect that she could finish this work. However, she was very fortunate to return to her family and get all the support she needed to pick up this work. The inspiration and passion she got in mind also motivated her to step on this path again. She learned that life and health were the most important, as there always be hope ahead as long as one stays alive and healthy.

Last but not least, she learned how much perseverance and persistence were needed to conduct a 1-year long research project.

5.4.2 Research Opportunities

As there is a lack of data about food traceability from the design perspective, while design is important for modern interactive systems (see section 2.2.2). Therefore, more design studies are needed on this topic. For example, how to present FTI to shoppers in their preferred ways may be necessary for grocers to know, as they can use this insight to work on solutions to demonstrate FTI to their customers.

Moreover, through literature reviews, the researcher found that the worldwide research efforts on food traceability involved a wide range of input from many disciplines, such as consumer behaviors, information technology, engineering, food safety and quality management and economics. It can be seen that the development of food traceability systems requires collaboration of many disciplines. Therefore, the collaboration between design and other disciplines such as engineering and information technology may be needed.

5.4.3 Improvements

As the limitation of this research involved sufficient time and funding, which were critical to the quality of the study. The researcher could have done better work on the time and funding planning so that 1) professional survey agencies could do the surveying and the statistical analysis parts for enhanced data results and sample demographics; 2) research assistants could be hired to do administrative works, literature reviews, and IRB submissions for time-saving purpose; 3) another informant interview study could be added to learn shopper insights from the perspective of food industry experts (e.g., grocery store managers) of the local grocery corporations.

Lastly, the results presented in Table 6 missed one interviewee's data because the audio was not recorded by accident. The researcher should have paid more attention to the technical setup before each interview session.

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APPENDIX A

ONLINE SURVEY QUESTIONNAIRE

SURVEY QUESTIONS

(Consent Page)

—-——————-————————————FORMAL QUESTIONS—-———-————-—————

1. How often do you shop for produce at grocery stores?

Daily __ Weekly __ Monthly __ Less than monthly __ Never __

2. Which grocery stores do you usually shop for produce?

Safeway __ Fry's Marketplace __ Target __ Walmart __ Costco __ Sprouts Farmers Market __

Food City __ Trader Joe's __ Whole Foods Market __

Other, please specify__

3. You may hold certain knowledge about Food Traceability Information (FTI). Please use the following statements to express your knowledge.

In the following matrix, you will see corresponding statements in pairs. Please choose the circle that best describes your knowledge regarding Food Traceability Information (FTI). Choose the circle that is close to the statement corresponding to your judgement.

For example, if you are of the opinion that you are extremely familiar with Food Traceability Information (FTI), choose the circle as follows:

I'm extremely unfamiliar with FTI. ○ ○ ○ ○ ⊗ *I'm extremely familiar with FTI.*

I'm extremely unfamiliar with FTI.	○ ○ ○ ○ ○	I'm extremely familiar with FTI.
I have had no exposure with FTI.	○ ○ ○ ○ ○	I have had a lot of exposure with FTI.
I have had no experience with FTI.	○ ○ ○ ○ ○	I have had a great deal of experience with FTI.

4. When purchasing produce at grocery stores, do you check traceability information on produce (if available) to make your purchase decisions?

("Traceability information on produce" can be understood as any or all information on produce from "farm to table" that can be traced, such as origin, growing information, date of harvesting, etc.)

Yes, always __ Yes, sometimes __ No, never __ (Skip to question #6)

5. Why did you use that traceability information? [Multiple answers]

Meet my curiosity ___

Evaluate food safety ___

Evaluate food quality ___

Evaluate food freshness ___

Consider health, wellness and/or nutrition ___

Consider environmental issues ___

Consider social issues ___

Consider economic issues___

Other, please specify ___

6. How do you perceive providing traceability information on produce to you at grocery stores for making purchase decisions? Please use the following terms to express it.

("Traceability information on produce" can be understood as any or all information on produce from "farm to table" that can be traced, such as origin, growing information, date of harvesting, etc.)

In the following matrix, you will see corresponding terms in pairs. Please choose the circle that best represents your opinions. Choose the circle that is close to the term corresponding to your judgement.

For example, if you are of the opinion that providing traceability information on produce to me at grocery stores for making purchase decisions is ***not needed****, choose the circle as follows:*

not needed ⊗ ○ ○ ○ ○ *needed*

If you are of the opinion that providing traceability information on produce to me at grocery stores for making purchase decisions is ***somewhat interesting****, choose the circle as follows:*

interesting ○ ⊗ ○ ○ ○ *uninteresting*

Providing traceability information on produce to me at grocery stores for making purchase decisions is…

relevant	○ ○ ○ ○ ○	irrelevant
negative	○ ○ ○ ○ ○	positive
useful	○ ○ ○ ○ ○	unuseful
not needed	○ ○ ○ ○ ○	needed
interesting	○ ○ ○ ○ ○	boring
worthless	○ ○ ○ ○ ○	valuable

7. Certain traceability information on produce may be important to you when you purchase produce. Please indicate how important each of the following traceability information on produce is to you when you purchase produce at grocery stores? (Select the number that best represents your opinion: 1 = not important and 5 = very important)

Traceability Information	Not important				Very important
Origin	1	2	3	4	5
Farm	1	2	3	4	5
Farmer(s)	1	2	3	4	5
Seed	1	2	3	4	5
Growing soil	1	2	3	4	5
Farming methods	1	2	3	4	5
Date of harvesting	1	2	3	4	5
Use of fertilizer	1	2	3	4	5
Use of agricultural pesticide, herbicide or fungicide	1	2	3	4	5
Genetically Modification (GM)	1	2	3	4	5
Safety status	1	2	3	4	5
Quality status	1	2	3	4	5
Hygiene status	1	2	3	4	5
Freshness status	1	2	3	4	5
Food transportation	1	2	3	4	5
Food storage	1	2	3	4	5
Food processing	1	2	3	4	5
Food packaging	1	2	3	4	5
Food handler(s)	1	2	3	4	5
Food travel distance	1	2	3	4	5
Food travel time	1	2	3	4	5
On-shelf time	1	2	3	4	5
Environmental impact	1	2	3	4	5
Social impact	1	2	3	4	5
Economic impact	1	2	3	4	5

8. If Traceability Information (TI) on produce can be provided to you in certain ways at grocery stores, in which of the following ways are you likely to begin to use TI on produce for making purchase decisions? (Check the box that represents your opinions.)

Types of Ways	**Definitely Would Consider Using** (90-100% chance)	**Probably Would Consider Using** (50-89% chance)	**Probably Would Not Consider Using** (10-49% chance)	**Definitely Would Not Consider Using** (less than 10% chance)

Read TI on food labels or certifications	☐	☐	☐	☐
Read TI on food packaging	☐	☐	☐	☐
Read TI on signs near produce	☐	☐	☐	☐
Read TI on digital displays near produce	☐	☐	☐	☐
Ask sellers or store associates	☐	☐	☐	☐
User your mobile phone to find TI	☐	☐	☐	☐
Use your mobile phone to search TI on a webpage	☐	☐	☐	☐
Use your mobile phone to search TI on an app	☐	☐	☐	☐
Use your mobile phone to scan the product codes (e.g. barcodes, QR codes) of produce to access TI on phone	☐	☐	☐	☐
Hold your mobile phone close to the smart tags (e.g. NFC tags) of produce to access TI on phone	☐	☐	☐	☐

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9. Would you be willing to use traceability information on produce at grocery stores for making purchase decisions if this information leads to an increase on the price of the produce?

Yes____ No_____ That depends. ____ I'm not sure. ____

10. You have the chance to win a $5 Starbucks/Amazon eGift Card by completing this questionnaire. We will compensate one of the participants randomly. You may TYPE YOUR EMAIL below so that we could email you the eGift Card once you win it.

We are also recruiting 5 participants for 45-minute one-on-one online interviews to discuss further about traceability information on produce. Each participant will be compensated with a $5 Starbucks/Amazon eGift Card by completing the entire interview. If you are willing to participate, please also TYPE "YES" below along with your EMAIL above so that we could contact you. Otherwise, please leave it blank.

This is the final part of the survey. We would like to have some background information about you, as this is a critical part of our analysis. This is an anonymous survey and your name is in no way linked to your responses. In addition, all of this information will be treated as confidential. Results of the survey will be in aggregate form and for research purposes only.

11. What is your gender: Female_____ Male_____ Other (specify)_____

12. Which category below includes your age?

18-34 _____ 35-49 _____ 50-64 _____ 65 or above_____

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

High School Diploma _____

Some college _____

Technical School Diploma _____

Bachelor's Degree _____

Master's Degree _____

Doctorate _____

Other: _____

Thank you for your participation!

We would very appreciate it if you could share the link of this questionnaire (_____) to any persons that you think who are qualified for this study.

For any questions or comments, please feel free to reach out to the research team by emailing us at ywang508@asu.edu.

APPENDIX B

INTERVIEW GUIDE

INTERVIEW QUESTIONS

45-min session

I. BACKGROUND

1. Are you responsible for produce shopping in your household?

2. How often do you shop for produce at grocery stores?

3. Which grocery stores do you usually shop for produce?

II. TOPIC SPECIFIC

4. What do you know about food traceability information?

(In the following discussion, we could understand "traceability information on produce" as any or all information on produce from "farm to table" that can be traced, such as origin, growing information, date of harvesting, etc.)

5. When purchasing produce at grocery stores, do you use any traceability information on produce (if available) to make your purchase decisions?

   Sub-questions:

   If answered "yes":

   5.1 What is the traceability information that you use?

   5.2 How do you use that traceability information on the produce you purchase?

   5.3 Why that traceability information is useful to you in making purchasing decisions on produce?

   5.4 How do you find that information in stores?

   If answered "no":

   5.5 Why not use the traceability information?

6. How do you perceive providing traceability information on produce to you at grocery stores for making purchase decisions?

   Sub-questions:

   6.1 Why do you perceive providing traceability information on produce to you at grocery stores for making purchase decisions is ____ (mentioned) to you?

7. When you purchase produce at grocery stores, what traceability information on produce might be important to you (if any) for making purchase decisions?

Sub-questions:

If answered any information:

7.1 Why that traceability information is important to you in making purchasing decisions on produce?

7.2 How important that information is to you? (If rating 1-5, please give a number.)

7.3 How would you use that traceability information on the produce you purchase?

7.4 Would you be willing to use the traceability information on produce (mentioned) if it didn't raise the price of produce? Why or why not?

7.5 What if the traceability information (mentioned) did raise the price of the produce, would you still be willing to use it? Why or why not?

If answered "yes",

7.5.1 How much would you be willing to pay for the traceability information on produce (mentioned)? (You may add a percentage to the original price of the produce: up to __ %.)

7.6 If cost wasn't an issue, what traceability information would you want to know about for purchasing produce at grocery stores?

8. If your desired traceability information on produce (if any) can be provided to you at grocery stores, in what ways might you begin to use this information for making purchase decisions?

Sub-questions:

8.1 Why might you begin to use traceability information on produce for making purchase decisions in such way(s) at grocery stores?

8.2 How do you like using a mobile phone to find certain traceability information for making purchase decisions on produce at grocery stores?

8.3 If there were no limits, what would your ideal way(s) (if any) to access traceability information on produce at grocery stores look like?

III. CLOSING

9. Is there anything you think we should have asked you but we didn't?

10. Is there anything else that you would like to share with us? Ask us?

APPENDIX C

INTERVIEW TRANSCRIPTION

Interviewee A
Pseudonym: Alice

Background: Graduate student of Visual Communication

Participation in Online Survey: Yes

Transcription:

Interviewer: May I ask are you responsible for produce shopping in your household?

Alice: Hmm… like both of my husband and I…we share the responsibility of doing shopping things, because we have different club member[ships] from different grocery stores. Yes, but I usually go with him or he come[s] together with me, so I think it's … I'm pretty familiar with different grocery store[s] in the community I guess.

Interviewer: That's great to know. Ok, may I ask how often do you shop for produce at grocery stores?

Alice: Sorry to interrupt. Do you need to video record this meeting?

Interviewer: No need. Just audio.

Alice: Oh, just the audio. Oh so you have like the separate audio recording turned on already, right?

Interviewer: Yes, so later on, I'd just type it to become the text. And we would only use the text and we will erase the audio.

Alice: Ah, I see. I mean if it's for your convince, cause I've taken Prof. Takamura's class before, so I am already familiar …. [unclear part].

Interviewer: Ok, good to know.

Alice: I can request for a web transcript, so maybe….[unclear part] from Zoom if that helps.

Interviewer: Oh, ok. Good.

Alice: And then the grammar makes no sense, but it's better than just listening …haha

Interviewer: Yea, it's great. I didn't know about this feature [refers to the feature of Auto Script on Zoom app].

Alice: My native language is Chinese, if you can tell from my appearance or something. So my grammar would be like not that correct as I'm not a native speaker. So, stop me if you want me to re-address my sentence.

Interviewer: Oh, thank you. Me too. I have the same issue with you too, so if you have any questions about communication, feel free to ask me again.

Alice: Ok, sure. Yes, please go ahead and… What was the question again? I'm sorry.

Interviewer: No worries. Thank you [Alice]. May I ask how often do you shop for produce at grocery stores?

Alice: Hmm…you mean monthly, something like bi-monthly or something…?

Interviewer: Yea, average.

Alice: I think usually that depends on what kind of grocery it is. If it is small scales, just like daily groceries, like shampoo or something, basically bi-monthly. But if you buy some ingredients like cooking ingredients, cause I cook a lot at home, probably 2-3 days weekly. So that depends. So sometimes weekly sometimes bi-weekly. And for large-scale groceries, that would be monthly.

Interviewer: Ok, that's good to know. May I ask which grocery stores do you usually shop for produce? The produce we are talking about is fruits and vegetables, mainly.

Alice: Ok, hmm… I think the one that I visited the most is Costco.

Interviewer: Oh, Costco.

Alice: Yes. Because we live here as a family. Even though we don't have kids yet. But we visit friends sometimes. So we did the cooking together. So as a person cook a lot at home, I do prefer the grocery stores that have large amount of things like, how can I say, and sometimes it has discount. And they have all variety of things in Costco. So I went there the most. And the second the most is the 99 Ranch. It's newly opened. And when I was in California like 5 years ago or something, I knew the brand from California. And then after I moved here, it's nice to know they have a new restaurant opened here [unclear part]. So I go there for some ethnic food, just like the traditional Chinese [unclear part] or something. So that are the two most visited stores.

Interviewer: Ok, that's amazing. May I ask what do you know about food traceability information?

Alice: Would you like to give more specific about that? Like what kind of things you'd like me to say. Cause I'm not that familiar with the food traceability.

Interviewer: It's ok. Just have you heard about this term food traceability information, or just traceability information. Have you heard about it at all?

Alice: I think I have heard it once [unclear part] before, just because I have seasonal allergy, so my family recommend me to check those before I buy them. But I rarely hear them from my friends or from TV or other advertisement.

Interviewer: Ok, it's fine. It's pretty new topic. So it's really good to know about your experience. Ok, in the following conversations, we will understand TI on produce (the produce means fruits and vegetables here) as any or all information about produce from "farm to table" that can be traced, such the origin information of the produce, growing information, date of harvesting, the transportation, the packaging, everything from the seed to the food, before you eat it. The whole thing we were understanding this concept in the following conversation. Is that ok?

Alice: Yea, that's ok. That's great. But I do have a question… In terms of the region of the produce, the product, I'm pretty familiar with that concept. But for the rest of the things, do you mean… cause sometimes I really see the instructions on the labels or on the package. Do you mean that… is part of traceability information? Or something more of that?

Interviewer: Yea, that's definitely included in our topic. So basically we are just trying to have a concept what's going on after… for example, an apple or a vegetable is grown in the soil, and when it's harvested…and all the way to the retail store, to the grocery store before you purchase it. The whole thing, the whole information that we can explore more about it.

Alice: Hmm…Ok. Well, yes, thank you for clarification. Now I think I have better idea than before.

Interviewer: Ok, that's great. Do you have any other questions?

Alice: Nope, so far.

Interviewer: Ok, great. Feel free to ask me any questions at any time.

Alice: Ok, sure.

Interviewer: This is not the only definition to that term. But in our study, we just try to understand this concept in this way. You may have different understanding as well. But for our study, we are just a little bit limited to this idea.

Alice: Ok, great. I just want to make sure this communication is under the same concept or definition.

Interviewer: Ok, good. Thank you. May I ask when purchasing produce, I mean fruits and vegetables at grocery stores, do you use any traceability information of the fruits and the vegetables, if they are available to you to make your purchase decision. For example, the origin, if they are organic, free of pesticide, free of chemicals, or how they transport here… For any information that they already have, have you ever used any traceability information on fruits and vegetables to make your purchase decision?

Alice: Yes, I did. How should I address that… Cause I buy a lot of ethnic food. I do understand part of the imported from like other part of the world, most of the from China,

Japan, Korea, something, etc. So when I do the shopping, I would rather buy a product from the origin or from the country who I'm more familiar with. For example, when we talk about fish, or shrimp, shrimp is the one that I shop the most here. However, in comparison, my friends they don't shop that kind of food often. So when I shop for shrimp, I rarely check the origin, and how do they operate them. Do they get refrigerated after finishing, or they got it fresh delivered and then refrigerated, or they got defrozen locally, so there are products that needs to be fresh and like to shop for the ones, that I learn more about the origin, and the delivery process, and how they put on the shelves after they got delivered at local store.

Interviewer: Ok. So how about fruits and vegetables?

Alice: Hmm… that also depends. Just as I mentioned, I do buy a lot of vegetables, but that are not that common to the local people. So yes, as for the food and vegetables, if there are frequently seen and the vegetables and fruits in the common sense, I don't really care that much. For example, apples. That would be in no difference if there are no how it is supposed to be delivered or something. Now because it's apples after all. No matter which origin it is from, it may taste a little bit different, but in essence, there's no difference [unclear part] for me… I just personally think that. But if I shop for some vegetables or fruits that I'm not known or well-known…here locally…if I care about the origin, and I do make my decision depends how it's harvested, stored, delivered, etc. And from that perspective, price is not that matters to me. So just in conclusion, if I shop some commonly well-known fruits or fruits or vegetables in the common sense, then I think the traceable information doesn't influence my shopping decision that much. However, if there is specific kind of fruits and vegetables that I want…I care…I need to have that one, then the whole traceable information is the decisive [unclear part] element for me to make a purchase.

Interviewer: So what specially is the information about the fruits a vegetables that you used ever?

Alice: Hmm… so you can [unclear part] I miss that elements, cause I understand the concept of traceable information is very huge. But what I usually check is the origin of the fruits. Let me say what kind of fruits and veggie. So I will check the label, if it have one. Cause I do know some of them don't have the label or they don't have a [unclear part]. I really just check the label where it is from, hmm…the expiration date? Some of them have the expiration date. And if they are organic or not… that kind of traceable information. And what else… And also if they what kind of factory produce them, cause I'm kind of have seasonal allergies, so I wanna make sure they are from a place or from the factory that don't produce the same kind of things that I may be I allergy from.

Interviewer: So do you mean what kind of farms or factories?

Alice: Oh yes, exactly. What kind of farms or factories. But that's only a specific kind of foreign foods.

Interviewer: Oh, ok. Not for the local one.

Alice: Not for the local one. I do understand in some stores, they put a board inside, or they put a big sign inside:"Hey, it's from locally…It's harvested from locally" delivered or something, so for me, those are more for the advertising purposes. If I go to a farmer's market, not the grocery store, then yea, I will. Take that as my…how to say…it can be the reason why I purchase this, or why I'd like to buy them. But if you put that in the grocery, I would just say:"Hey, it's just advertising". Does it really that good? I'm not sure.

Interviewer: Ok, good to know. May I ask how do you find that information in store?

Alice: Oh, ok. I mentioned some of them before. One of them is from label, the label of the food. They have the ingredient for something. So that's the most common way that I check for personal information. Some of them from the big boards, the signing board, even hanging on the roof or just standing there. Just do introduction where is it from, where is it have a sales or anything. They usually put the traceable information next to the price. Just to tell us, just to convince us if it's good or not: this is good; this is not good. And some of them are from a digital screen or just a monitor. If they are… hmm… just like home depot shopping, they really just have a monitor next to the shelf … and they keep playing the short ads, introducing this sometimes. Sometimes they have like very attractive video made. Other than that, I do understand some of them have the QR code, so you can scan them, or they provide you with the receipt, and sometimes it says:"check the QR codes".

Interviewer: Oh, you already used the QR code in Phoenix?

Alice: Actually I have never used one before. I realized some of them have a QR code printed on the receipt. Or they attached the QR code or barcode or something on the package or got it printed. But for me, it's not worth my efforts to scan it and check it, cause I'm not an investigator. I'm just a shopper. I just want to make my purchase, and I just go to do my things. So I sent that, but I never used that. So for me, the most frequent one is check the label or just check the very brief introduction on the package. And then probably we just take a glance on the board, or just take a glance at the advertisement and monitor. And then make my decision.

Interviewer: Ok, that's fine. Good to know. May I ask how do you perceive, like do you understand, how do you perceive providing traceability information on produce to you at grocery stores to make purchase decisions? Like providing this information to you, the traceability information to you, about fruits and vegetables at grocery store to help you make purchase decisions? How do you think about this?

Alice: Oh, hmm… Just to clarify this question. Are you asking me my attitude towards it or do you prefer me to say whatever it's good or bad…

Interviewer: Yea, it's good or bad, or what do you think, you think it is useless, you think it's very good, it's very important or it's nothing. Probably…your attitude is fine as well.

Alice: Ok, got it. Let me see. Hmm… I think like based on my personal experience, I do like how they provide the traceable information there because of course, the better options like the better. The more options the better. So for me, I do wish they…How should I addressed it. Like I used them a lot. Like in brief, so I do like how they got the option to the package, so I can make a better decision, like among all kinds of different varieties of the single product. And for me, that's also one of the sign…or one of the indicator that this product or this grocery is in the quality. That sounds a bit idiot or something? I do believe the more traceable information the vendor produce… so the more information that I received, the more convinced that this product is in good quality.

Interviewer: Ok, understand.

Alice: Yes. So that's basically what I believe, cause I do caught on some situations, especially in the like Chinese grocery stores, Asian grocery stores. When they provide nothing in terms of the product name, the name of this product, for the label or on the price label. So I used it for the poisoned one just because of that. Because I didn't actually really realize that. Because they put no expiration dates. I think it's more than the traceable information is legal or not…For me, that becomes a sign that I need to check the traceable information before I paid the money for it. At least, I need to keep myself healthy. I cannot take the risk to add food poison, just because I want 1 dollar cheaper. For example, I bought an apple, I can't risk my health just because I can buy your apple 1 dollar cheaper. So I'm rather like…I would like to pay a little bit extra money, If you can get more traceable information there. Just something on the package. However, if you charge me, let's say, for example, more than 20% if it's just provide that information, then I won't buy that. So just in conclusion, from what I just express a lot… Less than 10% of the price increase, the more the traceable information the better. I like them. And somehow, it's required for me to get that. However, if you increase the price, just saying: "Hey we put extra effort on this, we hired like the whole team just to do that…you need to pay like 20 dollars more, or 30 dollars more.. sorry to put a bad extreme, I think I'm good.

Interviewer: Ok, that's great. Good to know. May I ask when you purchase produce at grocery stores, what traceability information on fruits and vegetables might be important to you if any, for making purchase decisions. No matter they already there, or they are not there yet.

Alice: Ok, let's see. The first one of those is origin. Like which country or at least, sorry which farm, or at least which country it's from. The second is the expiration date to address the traceable information, I don't think so, right? Then I would say like how long has this thing being harvested, or processed, or operated before being put on the shelf. I don't think I've sent that kind of information before it's especially when I shop for fruits and veggies. Because based on my knowledge, I know a lot of harvested and mature, and then get mature to in the delivering processed, and after putting on the shelf, just in the right status to give to the shopper. I understand that, but I would like to know how long has it been processed before, I buy it because I stored a huge amount of food in fridge. I don't want them to get like rotten just like a day after I purchase them. Hmm… so that's

the second one. And the third one: is if they have more specifics on the package, I would like to know which farm it comes from. And what else? And if whether they have been frozen before. Why not? Because [unclear part] concept of grocery shopping is vey huge, and different product has different way of storage, so if something has been frozen before and defrozen, then the quality of the food is totally different. I grew on the farm, but I was kind of brought up on the countryside before. So I do care whether this one is fully fresh, or has been somehow like operated, something by the chemicals, or not. So that the fourth thing, and the fifth is what kind of chemical to put on the products in order to keep it fresh. Or in order to make it more sellable, because I know for the apples, they could put wax on it. I know it's edible wax. But it doesn't bother if I just say it, like you need to wash it or something. But I would like to know if I want to get rid of it, what kind of product [unclear part] it to use. So please… It would be the best if you say I already put wax over it or not. Yes.

Interviewer: Good to know. May I ask for the five points you mentioned. First of all, can you give me a brief reason why origin of the fruits and vegetables matters to you?

Alice: Ok, sure. Hmm… well, maybe it's just because i'm just foreigner here, and this is specially true if I want to do the seafood shopping, wherefore it's ex- or imported products. I'm more familiar with the flavor from the origin or country. Like it's particularly true when I do the shopping. So I would like to purchase the one that imported from the original country. Cause I'm more familiar with the flavor, and I'm sure that about the product if get from that country, and hmm… if you talk about the food from like American-wide, the state-wide, then I don't care that much about the origin, if I purchase I think. I don't think that would make a big different if it's from the east coast or the west coast. So am I answer your question? Just because I'm more with ethnic food. I'm more often take from the original country. So yes, I think it's particularly true for foreigners or students… I have friends from Russia, Italy, some of those from India. So I think they kind of agree with me in terms of that one. So for us, the origin is not specially whether it's organic or not, or it's locally produced or not, its' about the flavor. We think the groceries from original country is in a better taste than what is more locally if it makes sense.

Interviewer: Yea, make sense. Ok. For the origin, if I give you the importance 1-5 (like 5 is the most important, 1 is the least important), which number will you rate it for the origin?

Alice: For the origin? In general?

Interviewer: Yea, like when you purchase fruits and vegetables at grocery stores, the origin information of the fruits and vegetables, how important that information is to you? Use 1-5 to express your feeling.

Alice: Ok. In general, I personally have to separate it to different situations. In general, I will say 3.

Interviewer: Ok, 3.

Alice: Yes, but that's only in general concept when I count everything together. After all, the grocery here is expensive compared to China, so of course the first one is worth of price and then the etc. maybe the…hmm.. some chemicals [unclear part] they put on and then this origin. Hmm…that's situation number one. However, if I put it in to ethnic food, I have to put that to address. I will say… make it 4 or 5, sometimes 5. So yea, that's just my personal opinion on that.

Interviewer: It's important. Ok, the processed time, you mentioned, does it mean after it's harvested to the time when you purchase it, did you mean that time frame is the processed time that you mentioned about?

Alice: Oh, yes. I would like to know simply when did they harvest this product…Sorry, let's just say if this just for fruit, like pineapple. When did you guys harvest it, and when did they put them on the shelf and that's it.

Interviewer: Ok. So if you use 1-5 to express the importance about the processed time, which number will you present?

Alice: Are we considering the previous origin together, or only this?

Interviewer: Only the processing time of the fruits or vegetables you mentioned from harvesting to the time you purchased it. How important that time is to you, 1-5?

Alice: I would say without concern the price, I would say that will be a 5.

Interviewer: A 5. Ok, got you. Hmm… why that time frame is important to you?

Alice: That is important for me because I usually do the grocery shopping weekly or bi-weekly, comparing to my daily shopping habits back in China, that's where I come from. So I know that the product that I buy daily in fresh, is not even from the grocery store, they are just from the local farmers' market, I know they are fresh. I can storage them in my way. For a week, or from a week to a month. But here I do weekly, sometimes weekly or monthly. I want to make sure that I use the right way to store these groceries, especially those fresh fruits and veggies. So knowing that processed time helped me to make my own decision and solution to that storage.That's why.

Interviewer: Ok, that's interesting to know. I think I came to our final questions. I will have 5 minutes left. So may I ask if your desired traceability information on produce, I mean fruits and vegetables, if any, can be provided to you at the grocery stores, in what ways might you begin to use this information for making purchase decisions?

Alice: In what ways. Do you mean, let me clarify before I give you the answer. Do you mean like put it on the labels or put it on the board? Is that what you mentioning?

Interviewer: Yes, it's kind like, if they present this information to you in certain ways, that you just don't care. But if they present some information to you in certain ways. You might begin to use that information. Do you have that preference?

Alice: Ha… Well, hmm… Yea, I mean if they can… either this is just my ideal situation or my something I want, if they can label their grocery or shelving or storaging (storing) their groceries based on the date, that would be the best for me. For example, they have 5 different shops, or 5 layers of different shops, or they have different the hierarchy of the shops, I do wish they can put their fruits or veggies …. for example, this whole closet or whole shelves are harvested in January, and that ones from February, and instead of putting the variety of… using categories as their criteria, instead of using that, if they use the dates as their shelving or storaging (storing) dependence, then that would address me…or that would push me to … pay more attention to the food or the grocery right here. Making sense?

Interviewer: Yea, making sense. You don't categorize them based on their kind, you categorized based on like the processing time.

Alice: Yea, the processing time also makes sense. You don't necessarily have to put January on this section, or February on that section. You say: "Hey! This kind of grocery has been harvested for 2 days, and after a week, you don't necessarily have to switch them daily. Maybe after a week, you just switch them. I don't know how they gonna do that in technical perspective. But for me, that would be really helpful to make a decision on which I like purchasing or not.

Interviewer: Ok, why that would be so helpful for you to make a purchase decision on the produce?

Alice: I think the most important reason is the freshness. Especially for grocery, if we only limited to the veggies, not frozen things, then of course, the fresher the better, right? And some of the non-fresh, I know they have this kind of policy in Japan. For these not that fresh, then:"Come on! Please give us a big discount". And that's not fresh, if I can get a triple price, then of course I will pay the money for it. So if you label them, or if you categorize on them, based on the length of processing, or the duration of that operation, then for me, that would be very helpful. And that would influence my willingness of purchase on this.

Interviewer: Ok, good to know. May I ask how do you like using a mobile phone to find certain traceability information about the produce for making a purchase decision at grocery stores?

Alice: Are we talking like about shopping in the store or shopping remotely?

Interviewer: In the grocery store.

Alice: In the grocery store, ok. Hmm… to be honest, I personally not prefer. I'm sorry to disappoint you. Because it's a project. Because of the Covid, the less that I touch my

screen the better. Yes, it's kind of wear gloves to pick up the groceries, [unclear part]. But if need to use my phone frequently, after I touch all kinds of groceries, it's a little bit unsafe for me. So touch screen… I know it's unhygienic somehow. But I can always sanitize my hand after I touch the screen there. But if I need to use my phone, very frequently, then I think it would be a better way. So if you ask me to my preferences, probably that would be some general public guiding monitor or touchable screen that I can check it, and it would be nice to have a sanitizer, I'm sorry or purer could be next to the edges. I would just use it to check it and pure on my hand. But for the mobile phone, yea, that's not the option I guess.

Interviewer: Ok, it's great to know. Thank you so much for sharing your honest opinions.

Alice: Oh, my pleasure. I hope I can help.

Interviewer: Yea, definitely. Thank you. Your contribution will make a lot of difference on this study. So do you have any other ideas or suggestions to me before we end up this interview?

Alice: Oh, hmm… I cannot say that it's a suggestion or something. I do feel like the concept of grocery shopping is super huge, especially for me. I do a lot of shopping every week. So for me, the concept of grocery is very big, so during our conversation, I'm more confused about which is the correct answer I should give you. Because something from like seafood is also part of grocery shopping. But my decision in terms of shopping the seafood is totally different from the veggies or fruits. So I understand this is just a pilot study or something, but if in the future, categorization… maybe it would be better if you can give a little more narrow down definition on the groceries, or maybe you can have two groups of study, then do the different variety on the groceries. Then definitely it would help me to understand better about what you guys want. Yes. And something I would like to share with you is that last semester, we have a chance to work with a senior community in Glendale here. And the residents there told us most of them are over 60, 70s, they do grocery shopping a lot too, but because they are mobilely unavailable sometime. So they usually they have a problem with the apps during grocery shopping. Yea, grandmas and grandpas prefer having something printed, or having people next to them or talk to them in terms of that, so I do wish if you guys want to do some products to help improve that kind of customer experience. Then maybe there can be less [unclear part] guiding next to [unclear part], or podium, or [unclear part] kiosk, just explaining something to them. So at least they can have better experience using that kind of service. I guess. Sorry about all the…

Interviewer: No, not at all. It's really great ideas. I really like these ideas. We really didn't think of using mobile phone, it's just to get general idea, and see if that's something most people would like. But I like your idea. Really. Thank you so much!

Alice: My pleasure. And let me know if you want to do some like afterward feedbacks, or something. I will be… cause I understand how much it's important to get the feedback or

the second round interview if you guys need. So don't worry about inconvenience or something…just feel free to email me if I can make more contribution to this study.

Interviewee B

Pseudonym: Jane

Background: Undergraduate student of Sociology

Participation in Online Survey: Yes

Transcription:

Interviewer: Are you responsible for produce shopping in your household?

Jane: Yea, so I live alone this year, I had roommates last year. But we would shop first, then I would shop for myself entirely currently. I have a meal plan, so I don't have to shop for a lot of produce here, but I still do shop for it, and then when I'm back home in Washington State for summer or winter breaks and all of that, I have a single mother so I help with the shopping a lot.

Interviewer: Oh, that's great. Ok, may I ask how often do you shop for produce at grocery store?

Jane: Hmm… probably about every other week.

Interviewer: Every other week. Ok, great. May I ask which grocery stores do you usually shop for produce?

Jane: Target, Walmart, Safeway, and occasionally Costco. Oh, and I like Trader Joe's.

Interviewer: Oh, that's great. Ok, so now we come to our core topic. May I ask Jane, what do you know about Food Traceability Information?

Jane: So, like as I said, I have a more of a social background. So I know lots of the technical side of it on how to define it on labels and all of that. But I do have some knowledge of like issues when underpaying illegal immigrants, and the processors of making food, and how lack of understanding and information on that can create reassignment on real farmers in that field, that immigrant are taking their jobs. Things like that I have more experience with. Hmm… then and also the bad working conditions of people in the meat industry, for example.

Interviewer: Ok, that's great to know. So in the following discussion, we will understand "traceability information on produce" as any or all information about produce from "farm-to-table" that can be traced, such as the origin, growing information, date of

harvesting, etc. You may have other understanding, but that is ok. This one is very general definition about it. So do you think that's ok with you?

Jane: Yes.

Interviewer: Ok, thank you. Do you have any questions about this topic, first of all?

Jane: Hmm… I guess I would like to understand like the general… the other people studying food traceability information.What is probably like the most important topic, and what's the topic that people have the most disagreement on?

Interviewer: Oh, that's really interesting. Maybe I can follow up with your questions, maybe after this general questions for you. Is that ok?

Jane: Ok, great.

Interviewer: Ok, great. May I ask when you purchasing produce at grocery stores, do you use any traceability information on produce if they are available to make your purchase decisions?

Jane: I guess the main one that I looked at day-to-day is probably like the origin of packing, like expiration dates, like get to understand my ability to use it. Hmm… I don't take a whole a lot of time to look at it both on my day-to-day life. I understand the importance of it. I just find it's not something that I consistently practice.

Interviewer: Ok, that's great. So the origin and expiration date is probably the most important one for you to look at if they are available, right?

Jane: Implied "yes".

Interviewer: Ok, great. May I ask how do you use that information to make your purchase decisions? For example, how would the origin information would influence your purchase decision?

Jane: Well, I think that… a recent origin that says a lot, you know. Because so many things in the grocery store like pre-packaged and have a lot of like the fillers and things that would keep the shelf life longer. But if I find something that has more recent origin date, that usually to me and the case that is claimed to be something that's fresher…

Interviewer: Ok, interesting. So how about the expiration date? What are your requirement about the expiration date?

Jane: See it's interesting because it's almost the opposite to what I just said. Because you know it has a recent origin date and a more soon expiration date. You would assume it's very brush. You know you get it and you eat it, right then. But I in practice really value an expiration date that's not going to happen for a while, especially living on my own, I

have to have food, you know, but it's just me eating it. And I don't know the all necessarily get to something within the next a few days, you know.

Interviewer: Ok, that's good to know. May I ask how do you find that traceability information at stores?

Jane: Yea, the main they have the guy is the container. You know. So kind of the area around the food nutrition label, because I know that information that they put like on the front of the packaging, the marketing, is less regulated, than nutrition packs and things like that. And they can kind of like use slightly different words to have very different meanings. You know. So I put little way in the information they tell me on the front of the package.

Interviewer: Ok, that's great. So what about the produce, like the fruits and the vegetables?

Jane: Yea, for fruits and vegetables, it's kind of the opposite. So I get most of the information from the sign. And I'm not spending much time, you know, picking up banana and then looking at the logo sticked on it. I'm not spending in much time like looking at the individual fruits. It's really what the grocery stores are putting on those big signs above the fruits. That's how I know what type of fruit it is. You know. If it's like grande smith apple, or like a red [unclear part], whatever… you know that's how I know. Hmm maybe what that tastes like is they have just fruit jars. But I don't usually notice much food traceability information on those signs.

Interviewer: Oh, it's ok. Totally fine. How do you perceive providing traceability information on produce to you at the grocery stores in making purchase decisions?

Jane: Overall, I think it would be good. If I'm being honest, it's not something that would be super important to me personally. But I do think that it would allow us more control of we want it or deciding what types of fruits and industries we are contributing to… you know. Knowledge at the hands of consumers is always a good thing. And I think that food traceability information being accessible may not even… you know… be something everyday shopper such as myself looks at…But it might be something that the local journalist is looking at. And they notice something funny and then decides I'm looking into that… you know… that type of thing.

Interviewer: Ok, that's interesting. So may I ask when you purchase produce at grocery store, what traceability information on produce might be important to you (if any) for making purchase decisions?

Jane: Yea, definitely things like where it's from. When it was collected, maybe some of the methods of farming, you know. Kind of just all the information about like how this food was produced and shipped to where I live. Because, you know, very few food items are made where we live. So one of a example, sometimes it can be a very positive thing if it's not even about…you know…maybe having a negative understanding about something you wouldn't buy because of food traceability information… like something

that I love is that all of the apples in Arizona have the little stickers that says they are from Washington State. And I'm from Washington State, so that's something that makes me happy, and allows me a sense of connection to my food, knowing where it is from and knowing I am from the same place. So that's a little bit a silly example, but just knowing where the food is from and how it may allow us to connect to it in a different way and we or just eating within the context.

Interviewer: Ok, that's great to know. So what about any other traceability information, even though they are not currently provided at grocery store now. If there is no limitations, like for example, from the seed of the fruits or vegetables to the actual fruits or vegetables that you are eating, for that whole information, is there anything that you wish to know?

Jane: I would be most interested in understanding the work conditions of the people that were helping harvest and get it to my plate eventually. Yea.

Interviewer: Ok, great. So why that information is important to you when making a purchase decision at grocery store?

Jane: I think it's a thing that I will pay the most attention to. You know, I don't know, and I think the general person doesn't know a whole lot like the actual nutrition facts. So like… for example, all the debate over GMO, right? So we had to put GMO on the label. And then everybody feel excited about it, without anyone including myself really have understanding what it is. Because we are all very disconnected from our food now. Where you know everyone used to know the farmer or be a farmer, or have to help to create the food in some way. That's just something we didn't experience anymore. And we don't understand the science goes along with it. So that might be what I might want to concern about food traceability information that people are getting the information that they can't understand. But if we treat that with responsibility, you know, and we have forces breaking down, what it means, and all of that. I think that would be good. But I think that one thing a lot of people care about, and can't misunderstand that necessarily, is like are these people that collecting strawberries being paid minimum wage? Are they safe? Have there been many workplace accidents, or workplace gaps? You know. Are they happy? Stuff like that. I think that people do care about. If not, again, looking at that information as presented to them in store. You know. Actually they might see a news articles about that. Things like that.

Interviewer: Ok. So what you mentioned is so important I think regarding the food safety and also the fair trade, the working gaps. So about this information, is there any very specific one that you care about? About the produce, specifically?

Jane: Which part of it, the working conditions?

Interviewer: I mean the factors that you just mentioned. Like the safety of the food, the fair trade, is there any other information about the produce that you care?

Jane: Hmm… No, on the top of my head. Like I said, the more information in the hands of the consumer, it's always good. And I also know that like I'm not part of that about farming and trade, to know what might need to go on that label… you know.

Interviewer: Ok, great. So for example, for the GMO information, if we use 1-5 (like one is the least important, 5 is the most important), if we can use a number to describe how important that is to you, which number would you rate it?

Jane: To me, personally, GMO information is like 2, maybe? I will say it's not super important to me personally. And honestly, I don't have that degree of understanding of it.

Interviewer: Ok, no problem. So how about the safety, if we use 1-5 to describe that? How important that is to you?

Jane: The safety of the food that I'm eating?

Interviewer: The produce, specifically.

Jane: That would be a 5 then.

Interviewer: Oh, 5. Ok. So how about the fair-trade that you just mentioned?

Jane: That would also be a 5 to me.

Interviewer: It's good to know. If we don't use the number, probably we just can't imagine how that is important to you. Thank you for providing this feedback. Ok. So may I ask would you be willing to use the traceability information on produce that you just mentioned if it didn't raise the price of the produce?

Jane: Yes.

Interviewer: Ok. Why?

Jane: Well, if it doesn't raise the price, just you know, more information is more expense to me, so you know, might end up just being something I kind of notice I won't buy… I don't know if that would be super intentional about it, but I do think that's something I would consciously take it, and consume.

Interviewer: Ok, sounds great. So what if the traceability information you mentioned that you hope to get did raise the price of the produce, would you still be willing to use it?

Jane: Yea, that's a hard one, because the honest answer is no, right? Hmm… but that's also interesting because in principle, I scored it, and just that I knew individually if I have one option that is a a lot cheaper, and one option that is a lot more expensive. Or I am right now, is college student. I'm gonna have to pay for the cheaper one. You know, and that sucks. It really does because I think that consumers are often faced what choices like that in produce, of like I mean just get the cheap option as I can, and I goes within one

type of food and it also extends to like… just generally what kinds of fruits and vegetables you are consuming, right? And that's also sad because the variety is so important in the diet, and if we can afford to have that variety, and I do think that's important part of the life experience we missed out on.

Interviewer: Ok, that's great to know. So if cost wasn't an issue, what traceability information would you want to know about for purchasing produce at grocery stores?

Jane: Everything that we already talked about.

Interviewer: Yea. Ok, sounds great. So may I ask if your desired traceability information on produce (if any) can be provided to you at the grocery stores, in what ways might you begin to use this information for making purchase decisions?

Jane: Definitely things all just try to notice it more. You know, I haven't been looking for anything. Maybe try to keep up with news online about food. And what's happening with it. I know a pretty relevant one with was like keeping up with the food shortage is the reason behind that. So I think that's something we are all having to learn, to do, and understand about our food in the information behind the produce.

Interviewer: Ok, so you prefer to look at the big news, like the big environment about it before you go to the grocery stores to make a purchase decision.

Jane: I would like to. The honest is that I don't do that as much as I should.

Interviewer: Ok. So is there any specific things at stores that might encourage you to start to use traceability information if they are presented to you?

Jane: Definitely just like having something there, read information about it, you know. Hmm… and I can be on the stores' end, or on the farmer's end, the company's end, you know, there are a million places that they can come from, but just having that information there, I think, would be a good thing.

Interviewer: Would be a good thing?

Jane: Implied "yes".

Interviewer: Ok, great. So how do you like using a mobile phone to find certain traceability information for making purchase decisions at grocery stores?

Jane: Yea, I never use it to look specifically for one thing, like I said I might notice like, general trends or news, with my phone.

Interviewer: Ok, that's great to know. So if there were no limits, what would your ideal ways to access traceability information of the produce at grocery stores?

Jane: Hmm… probably like, basically online, you know. Hmm…it could even be a type of thing of like, you know… how you are when… or when you are at a restaurant, right? With servers them tell you about the food you are about to eat, so they try to tell you on it… So then they might say like this crab is harvested fresh or like where the steak comes from, or like where the fruits and vegetables come from… things like that, if we, you know, practice this value on grocery enough, it could even be a type of thing we are like, there is a relationship between grocers and farmers, and the the grocers can tell you about the fruits and vegetables as you're checking out, and I think that would be a really good situation, because people are inclined to listen, maybe not so much to read, or to intentionally search out information.

Interviewer: Ok, sounds great. Is there anything else you think we should have asked you but we didn't?

Jane: No, I think that I have been rambling long enough.

Interviewer: Your ideas are very amazing to me. So is there anything else that you would like to share with us? Or ask us?

Jane: Oh no, I feel good.

Interviewer: Ok, great.

Interviewee C

Pseudonym: Alissa

Background: Postdoctoral Research Scholar in Biodesign

Participation in Online Survey: Yes or referred by colleague

Transcription:

Interviewer: Are you responsible for produce shopping in your household?

Alissa: Yea, yes I am.

Interviewer: That's great. May I ask how often do you do produce shopping at grocery stores?

Alissa: Hmm…normally once a week. Yea. On average, it's once a week.

Interviewer: Ok. Which grocery stores do yo usually shopping for produce ?

Alissa: Most of the time, it is Trader Joes. And hmm…either Fry's or Safeway, or some additional stuff.

Interviewer: Ok, sound good. May I ask what do you know about food traceability information?

Alissa: Hmm… I know about all the labels, but actually I'm from Belgium in the Europe. And like the labels are kind of different here in the US. So I had to learn more about that. Again, more about the labels, and the all the ingredient, like the listing [unclear part] of each product… that's why I look when I do shopping.

Interviewer: Ok, good to know. So in the following discussion, we may understand traceability information on produce as any or all information on produce, from farm to table that can be traced, such as the origin, the growing information, the date of harvesting, etc. From the seed to the food. Do you have any questions about this topic?

Alissa: Hmm… I'm curious about how you… cause I know a lot about about traceability from yea… from the farmers like where they grows, and what pesticide was used. But I don't know how you can do that with even tracing seeds. How can you imagine that?

Interviewer: How can I imagine that tracing the information from the seed?

Alissa: Yea.

Interviewer: Oh yes, so this study involves in the shopper insights on whether this information…any particular traceability information is needed by the shopper, and how they think about which are useful, and how do they perceive providing this information to them at the grocery stores. This study does not involve the technology side about how to make this information feasible to use. But currently there are some trendy studies and technologies that has been implemented in America, and also other country, particularly like in Europe, in Canada, in Korea, in Asian countries and also China. They have different ways to trace different information. So all this information are actually known to particular handlers, or farmers but this information is not connected. So some technologies like the Blockchain Chain technology, I don't know have you heard about that. Some technologies have already been developed and implemented in different field in the food industry to provide those information to different kind of users, either the companies, or the government, or the actual shoppers, but in the United States, this technology has not been widely implemented so far. So now this is a front-ended study to understand the perspectives from the shoppers. Do you think I answered your questions?

Alissa: Yea, kind of.

Interviewer: OK. We can discuss more if we have more time after the study if you have more interest. That's just very limited part that I know of.

Alissa: OK.

Interviewer: Ok, thank you. So may I ask when you purchase produce at grocery stores, do you use any traceability information on produce if available to make your purchase decisions?

Alissa: Yea, for sure. For me, it has to be organic. So I'm really… as the first thing I look. And then I look at all the listing [unclear part], because I have some allergies, so I need to be sure that I'm avoiding certain type of components in the food. And then I look where it comes from. I don't want to buy something like just from the world. I know it can be produced here, or like in the close states. That's what I look.

Interviewer: Ok, so you use the origin information.

Alissa: Yea.

Interviewer: The ingredient information?

Alissa: And is it organic or not?

Interviewer: So it's kind like farming method.

Alissa: Yea.

Interviewer: Sorry seems that I forgot the second one you mentioned.

Alissa: Yes, so where it's coming from? Is it organic or not? Like which method was used, and the ingredient because I have some allergy, so I need to check it out if it's safe.

Interviewer: Ok. Do you have any allergy from the produce as well?

Alissa: Yea.

Interviewer: Oh, ok. May I ask how do you use that traceability information about the produce are you purchasing? How do you use that information? How do you make the decision with this information?

Alissa: Sorry, I just had the issue with the audio. Can you repeat the sentence, please?

Interviewer: Oh, no problem. How is now? The internet is…

[Fixing internet connection issue…]

Interviewer: How do you use that traceability information on produce you purchase?

Alissa: I don't get it. Like how?

Interviewer: Yea, for example, if you see the origin information, how do you make your purchase decision?

Alissa: Oh, yea, for example, probably from I don't know, being in the US, I don't want to buy something going from like another continent like China, or Europe, because it's too far for me I think. I want to buy local stuff, so I'm trying to… yea… that's my decision.

Interviewer: Oh, that's interesting to know.

Interviewer: Ok, where do you find that information about produce at grocery store?

Alissa: Mostly on the packaging, and sometimes it…hmm…I don't know how to say that. It depends on something like that, next to the produce?

Interviewer: The sign?

Alissa: Yea, that's it. Sorry.

Interviewer: It's ok. From the packing and the sign.

Alissa: Yea.

Interviewer: Ok, got you. May I ask how do you perceive providing traceability information on produce to you at the grocery stores to make purchase decisions?

Alissa: How do you what?

Interviewer: How do you perceive providing traceability information to you at the stores for making purchase decisions?

Alissa: I think it's a key point like we really need to know as much as possible on each product.

Interviewer: Oh, on each product?

Alissa: Yea.

Interviewer: Ok. Why do you think that's very important for you to know information about each product?

Alissa: Because yea, that way we know what we eat, where it comes from, how did it grow in the farm, and how.. yea…[unclear part] on it. And our own decision to: Ok, I eat this, and I don't eat this. Yea, food is health. So for me, really very important.

Interviewer: Ok, so you mainly consider about your health.

Alissa: Yea. And also after that, hmm… I don't want to buy things coming across the world, because for environmental reasons, so…

Interviewer: Oh, ok. So you prefer local because you consider about the environmental issues.

Alissa: Yea, for sure

Interviewer: Ok. So you think the fruits and vegetables from other countries may create more environmental impact.

Alissa: Oh, they are.

Interviewer: They are. Ok. Can you tell me more about that?

Alissa: Hmm…Yea, basically, it's like we can't grow things here or at least like in closer state in California everything. We don't need fruits coming from South America, or from Canada, because it's crossing thousands of miles just for them. We can't grow them in other states, or it's just the same in Europe. I don't need like… I don't know… strawberries coming from Spain to be delivered in Germany. Makes no sense. We can't grow strawberries in Germany. And…yea, just we need to …have a way to…like: Ok, this is just maybe not available now at that moment of the year, because of the season. Ok, we have other fruits we can switch and eat more with like the seasons as fruits. We need to do. If we like…the fuel consuming is…yea…we are using…hmm…How will you say that? How? God. I forgot my words…Hmm…Green houses! They are using green house to grow stuff. And it doesn't make any sense because those are growing normally in the summer, or stuff like that.

Interviewer: Ok, that's interesting to know. May I ask when you purchase produce at grocery stores, what traceability information on produce might be important to you (if any) for making purchase decisions, if there is no limitations, no matter what's already there, and what's not there.

Alissa: Yea, if I can have information… the variety, like the seeds? The variety of the seeds. Like is it GMO? Or is it…hmm…What kind of soil was used? What kind of chemical was used? Or when was it harvested? Then how it's transported to the grocery shop? And yea, I feel like all reasons. If it's a processed food, you need to know what's inside. That's really available. So more about what the origin, more about all the whole origin about the food.

Interviewer: All the origin about the food?

Alissa: Yea.

Interviewer: Ok. So you mentioned about the origin, the seed, the date of harvesting, the transportation, and the processing.

Alissa: Yea.

Interviewer: OK. So that's all the specific traceability information you are interested to know about.

Alissa: Yea.

Interviewer: So if we use 1-5, like from the least important to the most important to describe how important this information to you. How would you rate, for example, first the seed, the seed information from 1-5, which number would you like to rate?

Alissa: I would give it a four. Because it's really important.

Interviewer: Ok. For the origin information (1-5), which one would you like to rate?

Alissa: 5. I really want to know where it comes from.

Interviewer: Where it comes from. So you want to know the specific farm information, or the seed information?

Alissa: Yea. Everything.

Interviewer: Everything!

Alissa: Yea.

Interviewer: Well, how much in-depth? Do you want to know? The soil? Do you want to know about the weather?

Alissa: Yea. If I have to compare our case in Europe, like we have a lot of food shops that provides all those information already, like… I'm really missing that here.

Interviewer: I understand.

Alissa: Like everything about which farm was…where it is going from…and how they are working… and which variety are they using…and why they are applying chemical and everything…yea.

Interviewer: Ok, that's so interesting to know. So how about the date of harvesting if use 1-5? Which number you would like to give?

Alissa: I would say 3, cause there is a lot of different way to harvest things. So I know they won't have a lot of possibility to change, like… ok, they need machine to do that… and they cannot change…for sure. I know.

Interviewer: I know. Sounds great. And also, you mentioned the transportation. How important that's to you?

Alissa: 5, yea.

Interviewer: Oh 5. It's very important.

Alissa: Yea.

Interviewer: So how is the processing?

Alissa: Same 5. Super important.

Interviewer: Ok. Why is this information that important to you?

Alissa: Yea, we need to know what did they do to the products? Yea, because some… they did have some issue in the food processing, because you cannot have a lot of amount of searching, [unclear part] material life in the food, which are very bad for your health for sure. [unclear part], yea… known food induced many of the diseases. So I really want to know what happened to the food before eating it.

Interviewer: Ok, that's interesting to know. Ok, may I ask would you be willing to use traceability information on produce you mentioned that you just said you want if it didn't raise the price of the produce?

Alissa: Yea, of course.

Interviewer: Ok, so why?

Alissa: It's obvious. I want those information. So…of course I will use them.

Interviewer: Ok. So what if the traceability information you mentioned did raise the price of the produce, would you still be willing to purchase the produce?

Alissa: If it raise the price?

Interviewer: Depend on the price.

Alissa: I don't think I'm willing to increase the price, because those information are known by different person in the food chain. We just need someone that collect all these data, and it should be mandatorily to do it by State or by the country. I think it's really…Yea. It's a [unclear part] issue for all people from the country. I think it should be at federal law.

Interviewer: Ok, federal law. Ok, interesting. If you use a percentage to describe how much increase of the produce you would like to have about the traceability information you mentioned, like the origin, the seed, the transportation, the processing. Which percentage increase you would like to have?

Alissa: On the price?

Interviewer: Yes, like, if the traceability information increases the price of the produce, how much percentage of the increase you are likely to still purchase this produce?

Alissa: Ha, wow. This is a tricky question, because we are facing the majoring price increasing, it's pretty high inflation. I don't think this should increase the price that much, like 1% or something like that. If we really need to do it. But it's already a lot. Like 1% of the price. And it's not going to the end in the pocket of the farmers or the producers.

So I know that mine would just go to… I don't know… someone else. It shouldn't be that high.

Interviewer: Ok, understand. Good to know. May I ask if your desired traceability information on produce can be provided to you at grocery stores, in what ways might you begin to use this information for making purchase decisions?

Alissa: I didn't understand the first part of the question, sorry?

Interviewer: Ok. I mean if your desired traceability information you mentioned can be provided to you at the grocery stores, in what ways might you begin to use this information for making purchase decisions? For example…

Alissa: This will help me buy this or not this.

Interviewer: Ok, if the store holds this information, what do you think how the store should present this information to you?

Alissa: Oh. Yea, either on signs or on packaging.

Interviewer: Ok, great. Good to know. Why might you begin to use this traceability information with signs or packaging?

Alissa: Why?

Interviewer: Why.

Alissa: I don't really understand the question, sorry.

Interviewer: Sorry. So my question is not clear. I'm sorry to confuse you. So I mean why might you begin to use this traceability information on produce through signs or packaging for making purchase decision?

Alissa: Yea. I just to make my decision on what should I pay.

Interviewer: Ok. Good to know. So how do you like to use a mobile phone to find traceability information for making purchase decisions on produce?

Alissa: Not at all. Haha…

Interviewer: You don't like to use it at all?

Alissa: That's not easy.

Interviewer: That's not easy. Ok, so you don't like to use it.

Alissa: No. Definitely avoid. Yea.

Interviewer: Ok. May I ask why not?

Alissa: Hmm…Yea, because if you forget you phone at home, you cannot have the information. Then if you don't have profile or data, or you cannot do it too. So it's tricky. Yea. The information is not available for everybody, because not everybody has smart phones.

Interviewer: Oh, ok. Got you. If there were no limitation, what would your ideal ways (if any) to access this traceability information on produce at grocery stores look like?

Alissa: Yea, so…as mush as possible on signs and packaging, and then I would say… yea, people working there have known what they are selling. If you want to have more information like… I think most of them should be on the sign or on the packaging, and like for some extra information… you just need to ask people working there, but they really need to know what they are working on.

Interviewer: Ok, understand. Thank you. So as the closing part of this interview, may I ask is there anything you think we should have asked but we didn't?

Alissa: Hmm…I did everything, yea. Yep. I don't have any suggestions, sorry.

Interviewer: No, no worries. Thank you! So is there anything else you would like to share with us or ask us?

Alissa: Yea, if you can further inform us of this study would be very cool.

Interviewer: Oh, so you mean further study about this topic?

Alissa: Yea. If you like publishing something on that, I will be very interesting in reading your work.

Interviewer: Oh, really. Thank you so much.

Interviewee D

Pseudonym: Jason

Background: Application Engineer

Participation in Online Survey: Yes

Transcription:

Interviewer: May I ask when you purchase produce at grocery stores, do you use any traceability information on produce (if available) to make your purchase decisions?

Jason: Sometimes I do read labels and try to figure out that information. Hmm…and sometimes I do [unclear part]. There are source from like Starbucks…they would sometimes source that they have their beans coming from a certain place, so I try to get that information on the label. Or if I go to a farmer's market, I would go to talk to the vendor, and I would ask where they are getting their fruits and vegetables. Yea, I think that's all how I approach.

Interviewer: Ok, that's interesting. May I ask what traceability information on produce like specifically about fruits and vegetables do you use to make your purchase decisions at grocery stores?

Jason: Yea, I would like to know basic stuff like whether they use any kind of GMO, genetically modified, or they would use any harmful pesticides or herbicides or practices they have been placed, or whether they have any kind of obligation or [unclear part] initiatives. And then also I would like to know when did they have this harvested, so that would answer how fresh or old the food is as well.

Interviewer: Ok, sounds interesting. In the following discussion, we could understand the traceability information on produce as any or all information on produce from "farm to table" that can be traced, such as what you mentioned about like origin, or growing information, or harvesting information, etc. So do you have any questions about this topic?

Jason: I actually find it's very fascinating that you are doing this research, so I think I would like to know more about this as well, but I would rather stick to the survey for now.

Interviewer: Ok, thank you so much. We can keep that later. For sure.

Jason: Implied "yes".

Interviewer: Ok, sounds great. When you shop for produce at grocery stores, where did you find the traceability information normally?

Jason: So if I go to a grocery store, like Walmart or Safeway, it's kind of difficult, I just rely on the labels most of the times, I sometimes know some companies and their practices. So for example, kind is a brand, I know how to resource them [unclear part] where to get it. But mostly, rely on the labels. But if I go to the farmer's market, I know the person who is selling them, so I would talk to the farmer did they [unclear part] know where it comes from.

Interviewer: Oh, ok. Could you please explain more about why the origin information is important to you? Or is useful to you?

Jason: Yea, I think many reasons to that. And honestly, I feel knowing about what is going in my body is really important, and it's a very old…it's a lying that "my body is my temple". I would like to know what is going in there. So I think knowing that

information of what practices for use to get that food is important to me. I read a lot about health and [unclear part]. And I've seen many incidents, where certain pesticides can have long-term effects of causing cancer, [unclear part] and all that. So I think I'm more aware since past few years about getting that information.

Interviewer: Ok, that's very interesting to know. So you mentioned you also look at the origin and also the GMO. Why GMO is important to you?

Jason: There is a very conflicting research about that. And I really don't have a voice whether it's beneficial for our health or not. But for what I research and found out that, most of the GMO products has caused long-term effects on the health. So I just used that as one of the parameters. I know that there are maybe more than what I know… To trace like what exactly would be causing long-term health issues, but GMOs are sounding very well…hmm…written on many products that I shop. They mostly have [unclear part] it's non-GMO produce or not. So it's easy to get that information, basically.

Interviewer: Ok, interesting. So you mentioned that you care about the origin information, and the GMO information, pesticide, herbicide information, what else you mentioned… Sorry, I just forget.

Jason: Yea…no, I think you used to say most of them, and just when the high risk of that produce

Interviewer: Ok. That's great to know. So how do you use that information to make purchase decisions? Like how this information were influenced your purchase decisions making?

Jason: Honestly, it does in fact, but most of the times, it kind of gets off the head, use sometimes that I'm not really sure about this kind of index, and I would sometimes go with buying that. Hmm… so it just kind of depends. I think it depends on where I'm going. So if I'm going to shop at Walmart , I don't expect that information to be there…for food traceability. But if I'm going to a farmer's market, I really would like to understand what's going on there. So…

Interviewer: Ok, interesting. May I ask how do you perceive providing traceability information on produce to you at the grocery stores for making purchase decisions.

Jason: Could you explain that question a little bit, sorry.

Interviewer: Sure. What do you think about providing traceability information about produce to you at the grocery stores for you to make purchase decisions?

Jason: I think…so what I understand is like if they have more information on the food labels, that would make me more aware?

Interviewer: Maybe not only the labels. Just more information about… For example, if the grocery stores hold more information about the produce, and they want to provide this

information to you for you to make purchase decisions. What do you think about this. Is it good, bad?

Jason: Hmm…I am actually in the neutral side on this. I think having information is amazing. It's great for a person like me who would like to know. But I think a lot of people might [unclear part] would like to know that information, they would just want to go to the store and get what they want to have on the list and get back home. So I think it could be some information like, for example, I'm [unclear part] a lot of stuff. So when I go to a place and I would ask them does it have eggs specifically, and they would have their sheet where they would be ready to find their eggs or not. So I think that information should be there, but then it should be upon the consumer to access that information.

Interviewer: Ok. So it should be depending on the consumer to access that information?

Jason: Right, like if how willing they are to…you know…to get that information. Maybe they are a lot interested than in just exhaust the purpose.

Interviewer: Ok, I understand. So you keep as neutral.

Jason: Yea, like… If I go to say the store should keep information? Yes. But then how accessibly it should be should depend on the consumer.

Interviewer: Ok, that's interesting to know. So may I ask if there is no limitations, when you purchase produce at grocery store, what traceability information on produce might be important to you (if any) for making purchase decisions. That includes what's already there, you mentioned before. And also what is not available now? Like what information should be provided for you?

Jason: Yea, I'm not really an expert like what information could be. But I [unclear part] make a guess, like the GMO stuff is one side of thing. But just recently I was reading about this pesticides called Life or [unclear part]. I think if I said it correctly. And I have seen quite a lot of research we just [unclear part] a lot about, it cause long-term issues in your bodies. And it could significantly impact on the future of your body as well as wellness. And that information is something I really want to know. Where can I find that? So what type of pesticides or herbicides are use of? I would also like to know if it's local or not. I'm almost [unclear part] some sections [unclear part] says it's locally sourced? And that's another piece of information whether it's within 1-15 miles of the radius that I'm living in, if it has been produced there or not. So I would say the radius, the herbicides, and if it's GMO or not.

Interviewer: Oh, interesting. Why you think local is important to you?

Jason: That's what I'm trying to do like in another project I'm working on. We are trying to implement that…hmm…and I think the reason change my mind if there is something we should learn in the past two years is how global pandemic could affect the whole supply chain completely. And if there is some kind of an issue in the supply chain, you

just get cut off from the whole supply. Because you reply on big chains or big companies to provide that. So having local systems make us more independent. You don't rely on those big companies or franchises to provide our day-to-day food. As well as the locally economy. So farm land reservation is a big issue. And everyday we are like talking about how many acres of land is getting used for commercialization, so I think having local food system not only helps everyone to get fresher food, but also sustain the local food economy in the long term.

Interviewer: Ok, that's really interesting topic. So just assuming fruits or vegetables from "farm to table" through the whole chain, you mentioned GMO pesticides, herbicide, and also the local. You mean the local understand it as the distance, maybe the distance from the farm to the consumer, that's something you think is important. Is there anything else that might be important to you? (You don't need to say if you have anyone, I just try to ask.)

Jason: Haha…No, yea. I think you addressed it all. I think I may not be not aware of some of other factors, but maybe when I know them I will be able to voice that as well.

Interviewer: Ok. That's interesting. If we use the number maybe from 1-5 (1 is the least important, 5 is the most important), which number will you give to the GMO issues?

Jason: Hmm…I would say 4 out of 5. Like the higher the number, the more important, right?

Interviewer: Yes, to you.

Jason: Yes. 4.

Interviewer: Ok, 4. So about the pesticide and herbicide, 1-5? Which one do you rate? How important to you?

Jason: I would say 5 out of 5 on me to know that.

Interviewer: Oh, it's very important to you.

Jason: Yes. Because I'm more aware about it, if I [unclear part]…, I wouldn't have. But now I'm more aware. So…

Interviewer: Ok, I understand. So how about the local?

Jason: Local is another important information. I would say 4 out of 5, but I would take out the 1 point, because sometimes because of the growing season in Arizona, it's not feasible. I talked to a few restaurant owners where there do…for examples, they get apples from Washington. They can't really do anything about it. So I think that information I would rate it to 4 out of 5.

Interviewer: Ok, so could you please specify what information about local that you care about? You mentioned about economic issues, the travel distance, what else about the local?

Jason: Hmm… I think local food is important, because firstly when you know it's coming like nearby your location, you are more likely to purchase that, rather than something this is not local. I don't know if this is just a kind of connection you feel and something is locally grown, and just doing an example again…Sorry if I'm taking too much time on this… But I went to [unclear part], which is about an hour from here. And they have amazing architecture and infrastructure they have along with agriculture. And I went to their cafe, and they had their own [unclear part] and menu based on what they are growing. So I was just to the cafe and I was seeing all the watermelon being harvested. And I've seen that they were using it for making juices, salads, etc. So that connection…what I feel when I saw that is beyond like anything that I ever felt when I was at the grocery store. So this makes me buy local is not only that I know the distance, I know it's more fresh. It's more economic, but also it just builds that connection between your community I think.

Interviewer: Ok, that's interesting. So you hope to get the produce at grocery stores from local. Or I mean if they are from local, they should let you know they are from local.

Jason: Right. Yea. And I think it's Sprouts (where) I've seen a couple of time the melons are locally produced. So I buy it from there.

Interviewer: Ok, so do you think if the produce are from other states, not from local, or from other countries, do you think they should let you know this information as well?

Jason: I think yea. I think that's important to know, if it's local or international. It may not really affect, because something is unavailable locally, so you have resource from different places. I think they try to do that. They have whole section… is not really say it's like not from here. But it's just kind of you can figure it out that those foods are not like from here.

Interviewer: Ok. How do you define the distance of local, within the states or within the town, or city?

Jason: I think from what I read of anything within 15 miles radius would be considered local. I know that definition may not be true [unclear part], but that's the understanding.

Interviewer: Ok, that's interesting to know. May I ask how would you use this traceability information you mentioned on the produce you purchase to make a purchase decision, how will you use this information?

Jason: I think yea, the point to be the same that it would influence me to buy more locally produce. I feel more connected to the community, and then I'm not entirely sure, but every time I buy local food, it's more expensive. Like if I'm going to a farmer's farmer, I know I'm not going to pay like 50 cents for a corn. It could be more than that. So I think

the food is ever more expensive. So that's another way I can feel it is local. And then just the fact that I… And I always visit farmer's market for a reason, because I know the person who are doing this. So this just makes me more aware who is doing my food. Hmm…and just have that relation again to the community.

Interviewer: Ok, that's interesting to know. Ok, may I ask would you be willing to use the traceability information on produce you mentioned if it didn't raise the price of the produce?

Jason: If it didn't raise the price?

Interviewer: Yea, didn't.

Jason: Oh, yea. Absolutely. For sure.

Interviewer: Why?

Jason: Hmm… I think for me, it may not be that [unclear part] if prices go like 20 cents higher. But I know a lot of people, a lot of communities who don't have access to fresh food. They are very price sensitive. So for them, it's more about the price, rather than knowing that information. So I think if you are able to give them the same information, we make the level, maybe make the plain fee level. I think the same price would be helpful for them.

Interviewer: Ok, that's interesting to know. So what if the traceability information you mentioned did raise the price of the produce. Would you still be wiling to use it?

Jason: Yes, I would still participate in that. I actually went to a conference in 2020, January, CES. And I think it is just related to something what you told. They had the QR code there. They were having a coffee, like a coffee bar. And it wasn't a coffee like manufacturing, but that the coffee and then you had the QR code there. When you are getting the coffee, you just scan the QR code and it tells you where this coffee comes from, like the bean, what distances does it travel, how much carbon food print it had. I think this is a lot of information, and me as an engineer knows it's difficult to collect so much information, maintain all that… So it's bound that the cost is gonna go high. But if it has my purchasing decision, I know there will be a segment of people who will be willing to appreciate that information.

Interviewer: Ok. So how about yourself? You are willing to pay if that increased the price of the produce?

Jason: Yes. Personally, I would say, yea.

Interviewer: Ok. If we use the percentage to describe your willingness to pay on top of the original price of the produce? How many percentage you would be willing to pay for the traceability information adding to the cost of the produce. Like up to 5%, up to 10%, something like that.

Jason: Yea, I think between 5-10% that shouldn't make a lot of difference, considering a lot of information. Yea, 5-10% I would say.

Interviewer: Ok, 5-10%. If cost wasn't an issue, what traceability information would you want to know about for making purchase on produce at grocery stores. Particularly in grocery stores.

Jason: What are other information?

Interviewer: If cost wasn't an issue, what traceability information do you want to know about on produce?

Jason: Do I have any options that I can select from? Ha…

Interviewer: Yea, did you fill out the survey?

Jason: Yes, I did.

Interviewer: Yes. So there is a lot of information. You can think of any from there or beyond there. That's ok. Just don't think about any cost…

Jason: Ok. Hmm.. yea I think… when it was harvested…the produce, if that information is there? Then how if it is locally sourced or not? Or if it's from other places. Hmm…I would also like to know who the farmer is, honestly. They can provide that information. I know some cosmetic products do share who is the person who maybe made these products. So if they can show who the farmer is; where it is coming from; what community they come from; That would be something I would look forward for as well.

Interviewer: Ok, interesting to know. Ok, great. Our final topic. If your desired traceability information on produce (if any) can be provided to you at the grocery stores, in what ways might you begin to use that information for making purchase decisions?

Jason: This information was provided. How would it influence my purchasing decision?

Interviewer: It's like… Sorry about my question, maybe it's a little bit confusing. So in what ways might you begin to use that information. For example, if the grocery stores hold all the information you need about the produce, in what ways might you begin to access that information?

Jason: Hmm… I think… Slowly I become more aware when I go and purchase… I think it depends on the store also. Saying if I'm going to the Walmart, there is nobody sort of cares about. And they may not even know all the information. But if I'm going to the Sprouts, I know that the person I ask questions will know quite a lot, about where the produce is coming from, what supply issues they are facing right now, and… So yea, I think asking those questions, sort of just depends where I am in. So that information is available without me going to [unclear part] that [unclear part] in every time, spending

time to find someone who is available to provided. If it's already there, everywhere, it's great. And I can access that information more.

Interviewer: Ok, so you mentioned two points: one is asking the sellers or the associates, another thing is information available in the store for you. Ok, in what ways they should present this information to you?

Jason: I have this bag [a bag of snack] next to me is…It's from Costco. It's [unclear part]. Now, I'm reading this. I don't know if you can see this. It says… showing me what's inside, and what brand it presents of. It doesn't tell me anything about where it comes from, when, who harvested, or like what pesticides or anything was used. And this is the thing I would like to see… When I look at something, I wanna see exactly some information on the front. Sometimes difficult write in the back, and in this case, it's just a small of nutritional values and all. So if there provided on the label, or they could have something like a QR code maybe, which tells a little bit about that…

Interviewer: Ok, that's great to know. Why do you prefer to get that information on the packaging or QR code, or asking sellers, or associates?

Jason: Hmm… honestly, every time it's difficult. Sometimes I was in a rush, I don't really have like 30 minutes for grocery shopping everything. So because of time, I think it is better if that information is there. Of course, once I talk to an associate, I'm more familiar with that product and produce. So the next time I go there, I actually know what about it a little bit more. So I wouldn't really spend more time on that. But if I'm buying a new product, it's helpful to have that on the label itself.

Interviewer: Ok, that's interesting to know. So how do you like using a mobile phone to find certain traceability information for making purchase decision on produce in store?

Jason: I think I support that. I agree to that idea.

Interviewer: So you like to use a mobile phone to find that information?

Jason: Yea, I think people will be more willing because they go to grocery stores nowadays people can… the barcode and check out using just like that. So if that the same information can be get it on mobile phone, why not?

Interviewer: Ok, that's great to know. So why? Can you explain why you would like to use mobile phone?

Jason: Yea, I think the same thing that use mobile phone is quite a lot when you do grocery shopping to scan for coupons or anything, or you wanna scan the product, and every stores totally try to going to that direction, but you can just scan it on your app, and then you check out, so it's something which is convenient, and if you can use that same tool to get the same that information insight, that whole experience, it would be [unclear part] as well.

Interviewer: Ok, that's interesting to know. So may I ask…

Jason: But that may not be the only option. Sorry, that may not be the only option. There could be other options like…having some information there.

Interviewer: Yea, that's what I'm trying to ask you. If there is no limits, what would your ideal ways (if any) to access this traceability on produce at grocery stores

Jason: Well, unlimited, money raised? Haha… I think…yea, the labels practicing is very important. Maybe on that website, they can put more information or that could be a place, if there is like… if I have a question, for example, and this is just me thinking right now. If there is a place in the grocery store I can go, and I can just get every information I need, and dedicated to providing that information. So that could be another way, because not every company would be capable of having that luxury of providing that information, so if there is really a dedicated section in the grocery store, which I could ask a little more about the produce, that would be fairly good.

Interviewer: Ok, that's interesting to know. Ok, as we come to the closing part of this interview. May I ask if there is anything you think we should have asked you but we didn't

Jason: I think.. you asked very very good questions, honestly. Hmm…yea, I'm just really like, is it a comment maybe not a question, how do you decide to provide the information or at the same time keeping the cost low? And I think that trade off something… I don't know how many people would be willing to go higher on the cost with more information, or would rather stick to the low information low cost, that type of model. I don't know. Yea. Sorry, that may not be a question. But yea.

Interviewer: Understand, that's a very important part. This study is trying to collect the ideas from the shoppers. So we haven't really developed to that far. So I think that's definitely important considerations to put it realistically, right? How many people would really accept that? Ok, so is there anything else you would like to share with us or ask us?

Jason: Yea… I think I would start asking about this: how did you come up with this idea? Like how did you decide to do this as your thesis? How did you come up with this idea?

[As the rest of the topic was out of the interviewee's personal interest regarding this study, which content did not contribute to the data collection of this interview. So no further recorded information was provided in this document.]

Interviewee E

Pseudonym: Susan

Background: Scholar in Biology and Society

Participation in Online Survey: Yes

Transcription:

Interviewer: Are you responsible for produce shopping in your household?

Susan: Yes

Interviewer: How often do you shop for produce at grocery stores?

Susan: About weekly or so.

Interviewer: Which grocery stores do you usually shop for produce?

Susan: Costco, Fry's and Sprouts.

Interviewer: May I ask what do you know about food traceability information?

Susan: Not a whole a lot, actually. I learned it more from merely a survey that I knew before.

Interviewer: Ok, so you knew this information from this survey, mostly.

Susan: Yes, I know the general concept, just being able to know like the origin, and where the food comes from, and how far it travels, that sort of thing. But that's about it.

Interviewer: Oh, that's interesting. In the following discussion, we may understand "traceability information on produce". Or this is just one version of the concept. You may have other ideas, but that's ok as well. So here we just provide a general idea about what this term means, ok?

Susan: OK.

Interviewer: It is about "any or all information on produce from "farm to table" that can be traced, such as origin, growing information, date of harvesting and so on. Do you have any questions?

Susan: No. Not yet.

Interviewer: Good to know. May I ask Susan when you purchase produce at grocery stores, do you use any traceability information on produce (if available) to make your purchase decisions?

Susan: Hmm, not usually. If I see that something is local, I will try to buy it, assuming that it's still affordable as compared to another option.

Interviewer: Oh ok. So how do you use the "local information" to make a purchase decision?

Susan: Usually I don't see it very often, but every once in a while there will be a sign. So just keep an eye up for those but it's where I usually see them.

Interviewer: Oh ok. May I know why you prefer to choose the local produce?

Susan: Less transport, so less gas fuels.

Interviewer: Oh interesting. If the transportation information or the gas fuel information could be directly provided to the produce that you are purchasing at grocery store, would you be prefer to read this information directly, or you still prefer the general information about the term "local"?

Susan: Eh.. I would love to have more information. But I might be I will be lier that…[laugh]

Interviewer: Oh, it's fine. Ok, good, interesting. So why the transportation and the gas and fuel information is important or useful to you in making purchase decisions?

Susan: To try to reduce carbon emissions.

Interviewer: Ok. So it is for the environmental concerns.

Susan: [Implied "yes"]

Interviewer: Ok, interesting. So you mentioned you will find the local information by reading the signs.

Susan: Yea. I've seen it a ton, but…[laugh]

Interviewer: OK. Interesting. Is there any other traceability information that you are using now (if available)?

Susan: That's totally seen or interacted with, so…[laugh].

Interviewer: Ok. That's interesting. Ok, great. May I ask Susan, how do you perceive providing traceability information on produce to you at grocery stores for making purchase decisions?

Susan: Eh… I don't understand that question. Do you want to know what I think could be the most effective approach?

Interviewer: Oh, sorry about the confusion. So my question is more like what do you think about providing this information to you at grocery stores for you to make purchase decisions?

Susan: I think that would be great. I think, contributing more knowledge for people to use their purchasing power is a good thing. And they can choose whether or not to use it but having it there is good.

Interviewer: Ok. Interesting. May I ask when you purchasing produce at grocery stores, what traceability information on produce, specifically about fruits and vegetables, might be important to you (if any) to make purchase decisions?

Susan: For me, so the travels, hmm…and then…hmm… I also like to know if there are small farms or the companies. And support the small businesses if that's an option. So…

Interviewer: Ok. I see. Sorry, the internet was a little bit unstable when you mentioned the first word. So you mean the produce is how long it travels?

Susan: Yea, how far it travels, and also if it is a small business or a big company.

Interviewer: Ok. So the company information and traveling information, right?

[Implied "yes"]

Interviewer: Ok, good. So may I ask why the traveling information is important to you?

Susan: That's [unclear part] environmental. So…yea.

Interviewer: Ok. So why the company or the business information is important to you?

Susan: Because I like to support small businesses if I have the option.

Interviewer: Ok, that's interesting. Ok. May I ask if we use 1-5 to show the importance to you about this information. For example, 1 is the least important, 5 is the most important, how would you rate the travel distance about the produce.

Susan: Eh…that's probably…Hmm..say…And is this of the two things that I've listed or of all of the concerns that I have about the produce in the world?

Interviewer: Oh, ok. It's a great question. So specifically about the traceability information you just mentioned, which you indicated that is important to you.

Susan: Hmm… it is the distance traveled, so basically the carbon that goes into pretty [unclear part] particular piece of produce, that would be a "5".

Interviewer: Oh, it's really important to you. Ok, so how about the business information?

Susan: Hmm…3 or 4. [unclear due to unstable internet connection] Yea.

Interviewer: 3 or 4. Ok. Thank you so much. May I ask how would you use that traceability information on produce you purchase?

Susan: Hmm… if I know that something is [unclear part], I will look for alternatives. Hmm… assuming it again …they are affordable. Hmm…and then, if I know that there is an alternative that has lower carbon footprint and there is a small business, and you know, if it is a little more expensive, that's worth to me to spend the extra money. It's

[unclear] expensive then there is nothing I can do about it. But [laugh] I like having being able to look and see like…what my options are, and how I can try to contribute to creating a better world, pretty much [laugh].

Interviewer: Ok, that's interesting. Would you be willing to use the traceability information on produce that you just mentioned if it didn't raise the price of the produce?

Susan: So the information is there and the price is the same?

Interviewer: Yea.

Susan: Oh, yea. Definitely. I will use that [laugh].

Interviewer: Ok. Why?

Susan: Because you can use your purchasing power to support what you believe in, and pretty much, so I will use my purchasing power to support…you know…lower impact way of eating.

Interviewer: Oh, ok. So you are using the purchasing power to lower the impact of eating.

Susan: Yea.

Interviewer: What specific impact?

Susan: The environmental like carbon impact.

Interviewer: Ok, understand. So what if the traceability information you mentioned did raise the price of the produce, would you still be willing to use it?

Susan: Within limits, yes.

Interviewer: Ok, interesting. How much would you be willing to pay for the traceability information on produce you mentioned if there it can be listed on the produce?

Susan: It would be… It's hard to get exact numbers. But you know small percentage of increases I'm fine with. If it becomes an issue of affordability for my paycheck versus what we will pay, then I would have to choose whatever is slightly less expensive.

Interviewer: I understood. So the small percentage you mean is kind like less than 5% or up to 5%, or up to 3% something like that?

Susan: Like up to 5% I think should be fine. Maybe even if it is a lower cost item up to like 10%.

Interviewer: Ok, that's interesting to know. Ok, thank you. So if cost wasn't an issue, what traceability information would you want to know about for purchasing it at grocery stores?

Susan: I'm not sure what all the options are. So the things I've already mentioned, also, hmm… I don't know. What other options are there?

Interviewer: Ah… So we are just assuming any information "from farm to table".

Susan: Hmm… I mean pretty much the information I would be interested in, you know, how long has it been there, how long does it take to process, what is there cleaning process for the produce if any. Hmm… that sort of things I guess.

Interviewer: Ok, interesting. Ok, great. May I ask if your desired traceability information on produce (if any) can be provided to you at grocery store, in what ways might you begin to use this information for making purchase decisions?

Susan: Hmm… what do you mean by what ways?

Interviewer: For example, if the grocery stores have all the information they have about produce on the shelf, how would you like them to provide this information to you? I mean how do you like to access the information. In what ways?

Susan: Hmm…so I guess sign would be fine or if they have… a lot of grocery stores have websites now or apps that putting that information there we find, or doing I guess scanning QR code something like that. Hmm… it's on like the price tag thing. So making it super easy for people. And that would be a good way to do it.

Interviewer: Ok, so why might you begin to use like the sign, the apps or the QR code to access this information?

Susan: Why?

Interviewer: Yea.

Susan: Because for me, it's easier, hmm… if it is something we have to go to a particular area in the store, I'm in a rush, I would be able to go and like look up on the board and then figure out what the order applies to. But if you have the information right there with the produce, hmm… and if it is accessible on phone, and then make it even easier so I can look it up on the phone, say: this is what they have been stopped; here is what they have come from; here is how much it is. This is what I want to get there. Hmm…So having that convenience, makes the extra research a little bit easier.

Interviewer: Ok, good to know, interesting. So you are kind of like using a mobile phone to find certain traceability information in stores?

Susan: Yea, especially, hmm…if it was a like a website that has all the information that can be harder, but if it's a direct like somehow like…I think the QR code might make it easier to send directly to that particular piece of produce info, and further types of produce information. Yes, it's easier to have it there and signs, because especially the practicality of sign in the area that is missing, or make it more difficult.

Interviewer: Yea, understood. Ok. So may I ask if there were no limits, what would your ideal ways (if any) to access traceability information on produce at grocery stores?

Susan: Hmm… I would love to do…Hmm. to have the websites on the… the grocery store's website to have that information available/searchable, hmm… by type of produce, and then also by what produce is in what store, so you know like you are going to the store: hey, they have what you need, and then be there have these options. Hmm… but also to do a QR code that can take you directly to that informational layer in the store if you haven't had the time to do the research ahead of time.

Interviewer: Ok, that's interesting. Ok. So now, we come to the closing part of this interview. So may I know if there is anything you think we should have asked you but we didn't?

Susan: Not that I can think of.

Interviewer: Ok, sounds good. Is there anything else you would like to share with us, or ask us?

Susan: Eh…what is the goal of the project…the end goal of the project?

Interviewer: Yes. So basically the results of the study would provide some insights from the shoppers to the designers and developers who may be able to design the service of food traceability system. So currently in the United States, the government is working on building a food traceability system. If you are interested, you may search "food traceability US" on the government website, or on Google actually. It will show you there is a blueprint. They try to learn from the European, because they have kind like a pretty established food traceability system. And also other countries like in Asia (in Korea, in China), also in Canada. So this study is at the front end. So the food traceability system can provide all the information about the food from the beginning to the end can provide all this information to all the stakeholders, not only the shoppers, but also like the government, the food management, the producers, so they can communicate through this system. So we just specifically focus on the user's needs of the shopper, and try to develop some services to present this information to the people they need.

Susan: Cool! That sounds great.

Interviewer: Ok, thank you. Is there any other question you would like to share or ask us?

Susan: Nope, that was it.

Interviewer: Thank you so much for your time, Susan. So, yeah, that's about it for this interview.

APPENDIX D

INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL LETTER

ASU Knowledge Enterprise Development

APPROVAL: MODIFICATION

John Takamura
HIDA: The Design School
480/965-7171
John.Takamura@asu.edu

Dear John Takamura:

On 8/4/2022 the ASU IRB reviewed the following protocol:

Type of Review:	Modification / Update
Title:	FROM SEED TO FOOD: A User Research for Shoppers' Insights on Traceable Food Information Provided at Grocery Store with a Focus on Produce
Investigator:	John Takamura
IRB ID:	STUDY00016074
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• 1. IRB Protocol_01-08-2022.docx, Category: IRB Protocol; • 1. recruitment_survey_email_personal contacts_01-08-2022.pdf, Category: Recruitment Materials; • 10. recruitment _interview_email_ASU Affiliations_01-08-2022.pdf, Category: Recruitment Materials; • 11. recruitment_survey & interview_email_personal contacts_01-08-2022.pdf, Category: Recruitment Materials; • 12. recruitment_survey & interview_email_ASU Affiliations_01-08-2022.pdf, Category: Recruitment Materials; • 2. recruitment _survey_email_group_01-08-2022.pdf, Category: Recruitment Materials; • 3. recruitment_survey_social media post_01-08-2022.pdf, Category: Recruitment Materials; • 4. recruitment_survey_social media text message_01-08-2022.pdf, Category: Recruitment Materials; • 5. recruitment _survey_email_ASU Affiliations_01-08-2022.pdf, Category: Recruitment Materials; • 6. recruitment_interview_email_personal contacts_01-08-2022.pdf, Category: Recruitment Materials; • 7. recruitment_interview_email_groups_01-08-2022.pdf, Category: Recruitment Materials; • 8. recruitment_interview_social media post_01-08-2022.pdf, Category: Recruitment Materials; • 9. recruitment_interview_social media text message_01-08-2022.pdf, Category: Recruitment Materials; • Consent for interview_01-08-2022.pdf, Category: Consent Form; • Consent for survey_01-08-2022.pdf, Category: Consent Form; • Interview Questions_1-8-2022_FINAL.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Survey Questions_1-8-2022_FINAL.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);

The IRB approved the modification.

When consent is appropriate, you must use final, watermarked versions available under the "Documents" tab in ERA-IRB.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

REMINDER - Effective January 12, 2022, in-person interactions with human subjects require adherence to all current policies for ASU faculty, staff, students and visitors. Up-to-date information regarding ASU's COVID-19 Management Strategy can be found here. IRB approval is related to the research activity involving human subjects, all other protocols related to COVID-19 management including face coverings, health checks, facility access, etc. are governed by current ASU policy.

Sincerely,

IRB Administrator

cc: Yisha Wang

APPENDIX E

COPYRIGHT LICENSING FOR FIGURE 1

Copyright
Re: Copyright Question
To: Yisha Wang,
Cc: CFS-HLPE, Copyright, Thulo, Pulane (FAOLS)

May 4, 2022 at 6:01 PM

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Patrizia

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See More from Yisha Wang

APPENDIX F

COPYRIGHT LICENSING FOR FIGURE 3

Permissions Helpdesk May 10, 2022 at 6:43 AM

Re: Request instructions on how to cite an figure [220507-012267]

To: Yisha Wang

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RE: Food traceability system from governmental, corporate, and consumer perspectives in the European Union and China: A comparative review, Trends in Food Science & Technology, Volume 99, May 2020, Pages 402-412, Qian et al

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APPENDIX G

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APPENDIX I

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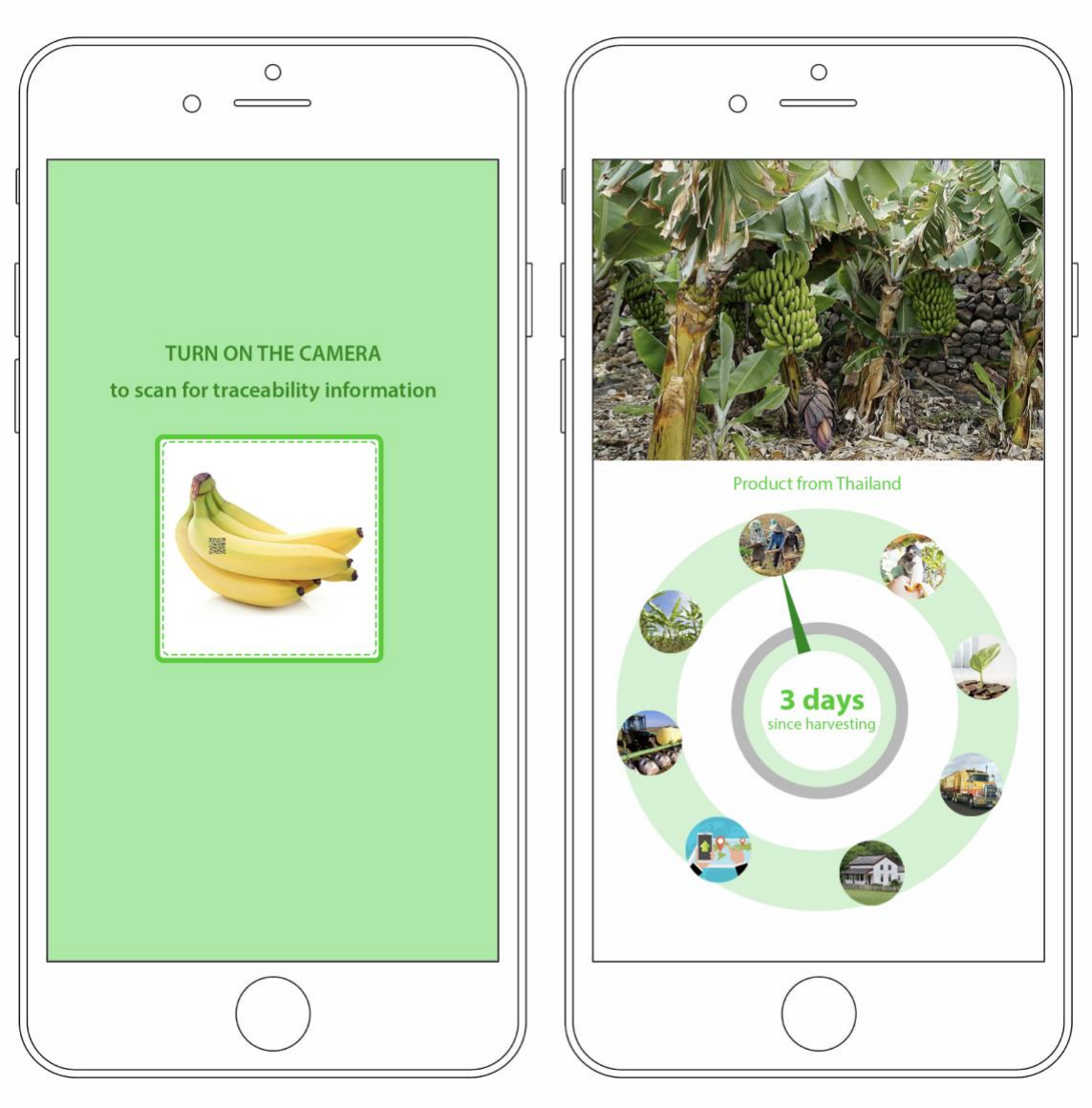

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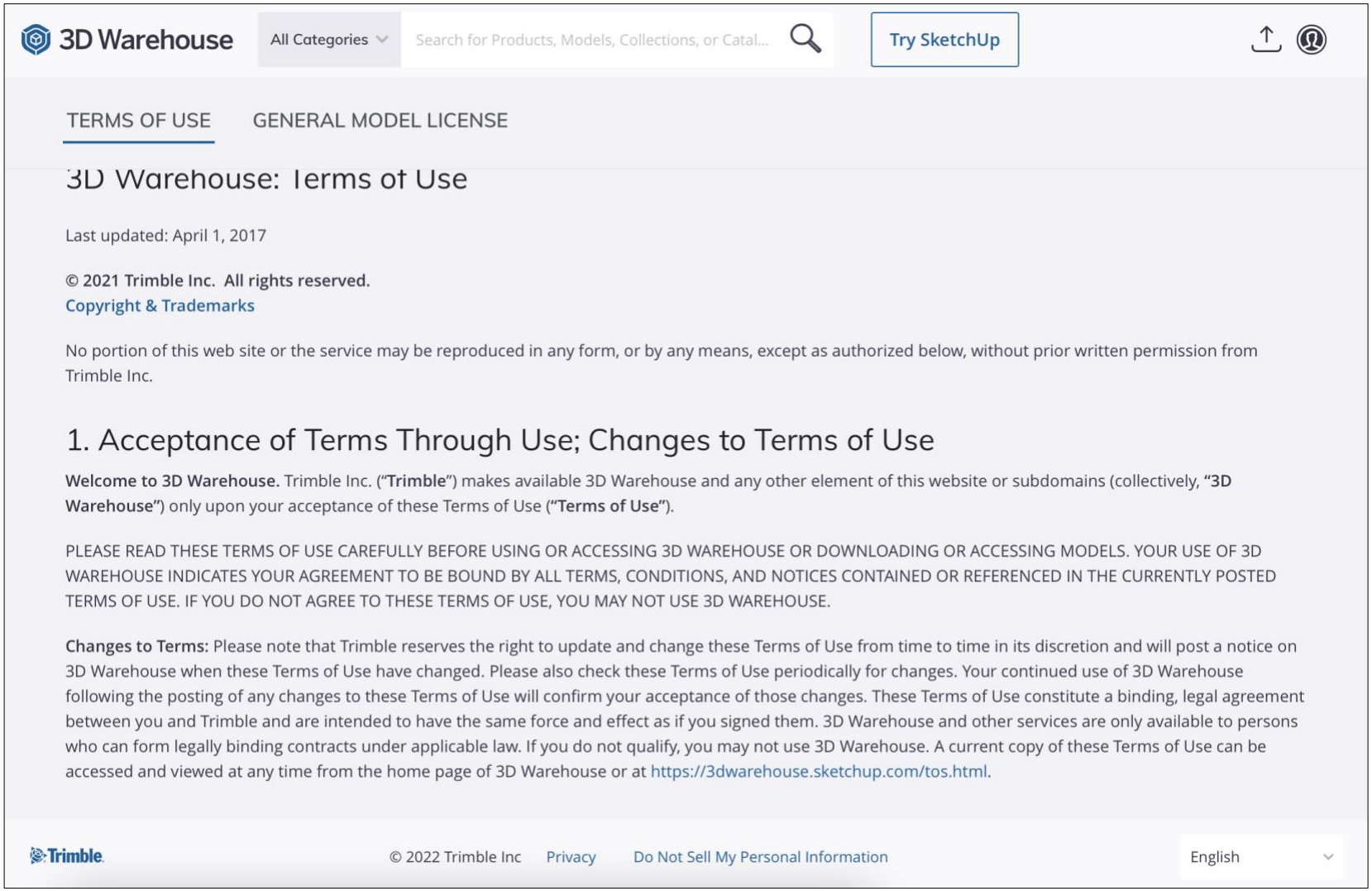
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BIOGRAPHICAL SKETCH

Motto: Use the power of design and research to build a sustainable future.

Yisha (Anne) Wang is a professional design researcher, artist and writer. She studied Industrial Design and Design Research at Arizona State University from 2013-2022. She earned a Bachelor of Science degree in Design in 2017, majoring in Industrial Design and minoring in Japanese language. She completed her Master's studies in Design Research with a full mark in 2022. Her studies focused on design, food traceability, consumer behaviors, and sustainable food systems. She devotes herself to bird protection.