# Evaluating antecedents of food waste behavior and reducing college students' plate waste through an intervention of weighing and displaying the amount of waste with emotional messaging

by

Wenhao Zhang

B.S., Kansas State University, 2013
M.S., Kansas State University, 2015

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Hospitality Management
College of Health and Human Sciences

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# Abstract

College dining services generate a large amount of food waste, and researchers have explored ways to reduce the waste in these operations. This project included two distinctive studies with the following purposes. First, an online survey was conducted to assess variables affecting self-reported food waste behaviors. Second, a plate waste study was conducted before, during, and after the one-week intervention to evaluate the effectiveness of an intervention of weighing and displaying plate waste amounts while showing factual and emotional food waste related messages. The target population was college students who utilize the on-campus dining facilities, and the study sample included patrons who dined at a large university dining center, located in the Midwest region of the U.S. The study facility was an all-you-care-to-eat dining center where an average of 2,000 diners eat daily. The online survey (Study 1) occurred one week before the plate waste study (Study 2) to minimize the influence of the intervention on psychosocial measurements.

Study 1 utilized the modified theory of reasoned action (TRA) including attitudes, subjective norms, behavioral intention, and self-reported food waste behavior with emotions toward food waste as an additional antecedent. The questionnaire was developed based on the TRA and emotions-as-feedback theory, pilot tested, and distributed to all patrons in the facility. Descriptive statistics and structural equation modeling were utilized to analyze the data. Results from 450 college diners' responses indicated that diners' intention toward food waste reduction fully mediated the three pathways from attitudes ($b=.07$, $p<.01$, CI 90% [.04, .10]), subjective norms ($b=.05$, $p<.05$, CI 90% [.01, .10]), and emotions ($b=.15$, $p<.01$, CI 90% [.11, .21]) to self-reported food waste behaviors. Diners who reported strong attitudes, subjective norms, and emotions toward food waste also reported higher scores on food waste reduction behaviors

through the indirect effects of high intention to reduce food waste. By adding emotions to the model, this study more adequately evaluated the psychological antecedents of food waste behavior, providing additional theoretical supports to existing literature.

In Study 2, the amount of edible plate waste was collected at baseline without patrons' knowledge, followed by a week-long intervention where researchers weighed individual plate waste, livestreamed average and accumulated plate waste amounts, and displayed food waste related messages with an intention to influence diners' awareness, attitudes, subjective norms, and emotions toward reducing food waste. Post-intervention data was collected after a one-week break. Descriptive statistics, an ANOVA, and cross-tabulation analysis were conducted to analyze the data. The total numbers of trays evaluated before, during, and after the intervention were 2,220, 1,927, and 2,017, respectively. The results indicated that the amount of food waste in grams was significantly reduced during and after the intervention (i.e., before: 47.03±68.15, during: 37.06±68.63, and after: 38.88±68.40, $F=12.76$, $p<.05$). Furthermore, more diners left no plate waste during (60.3%) and after the intervention (48.1%) than at the baseline (31.6%, $\chi 2(8)=391.49$, $p<.05$). By implementing the intervention, this study successfully documented improvements in college diners' plate waste behavior and provided practical implications for university foodservice operators for reducing food waste.

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Major Professor
Dr. Junehee Kwon

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In Study 2, the amount of edible plate waste was collected at baseline without patrons' knowledge, followed by a week-long intervention where researchers weighed individual plate waste, livestreamed average and accumulated plate waste amounts, and displayed food waste related messages with an intention to influence diners' awareness, attitudes, subjective norms, and emotions toward reducing food waste. Post-intervention data was collected after a one-week break. Descriptive statistics, an ANOVA, and cross-tabulation analysis were conducted to analyze the data. The total numbers of trays evaluated before, during, and after the intervention were 2,220, 1,927, and 2,017, respectively. The results indicated that the amount of food waste in grams was significantly reduced during and after the intervention (i.e., before: 47.03±68.15, during: 37.06±68.63, and after: 38.88±68.40, $F=12.76$, $p<.05$). Furthermore, more diners left no plate waste during (60.3%) and after the intervention (48.1%) than at the baseline (31.6%, $\chi 2(8)=391.49$, $p<.05$). By implementing the intervention, this study successfully documented improvements in college diners' plate waste behavior and provided practical implications for university foodservice operators for reducing food waste.

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# Dedication

To my parents and grandmother, for their unconditional love.

And in memory of my grandfather, Maoquan Zhang.

# Chapter 1 - Introduction

## Background

Environmental sustainability, which focuses on maintaining and improving the integrity of the earth's life supporting systems, has become more challenging due to the society's infinite pursuit of economic development (Moldan, Janouskova, & Hak, 2012). Climate change, resulting from increasing methane, carbon dioxide, and nitrous oxide emission is one of many examples of how human activities have influenced the environment (Environmental Protection Agency [EPA], 2010). Methane is one of several green-house gases that contributes to global climate change, and one of the largest sources of human-related methane emissions is derived from municipal solid waste (MSW) in landfills (EPA, 2018). More than 52% of 262 million tons of municipal solid waste generated in the U.S. ended up in landfills in 2015, causing a significant amount of methane emission as biodegradable waste, such as food waste, decomposes (EPA, 2018).

The hospitality industry, one of the biggest employers and fastest-growing sectors in the U.S., has a significant impact on environmental sustainability. It was estimated that first-class hotel generates an average of 3.2 pounds of waste per room and 2.0 pounds per meal served, a midclass hotel generates 1.7 pounds per room and 1.2 pounds per meal served (Pirani & Arafat, 2014). Quick-service restaurants generated 200 pounds of waste per $1,000 of sales, cafeterias generate one pound per meal served, and restaurants 1.5 pounds per meal served (Abdulredha et al., 2018). Commercial and onsite foodservice operations are one of the biggest contributors to food waste in the U.S. (Whitehair, Shanklin, & Brannon, 2013). Approximately 40 million tons of food waste was generated in 2015, which made up over 15% of total municipal solid waste in the U.S. (EPA, 2018). Globally, approximately one third to one half of the total food produced

for consumption, amounting to 1.3 billion tons per year, is lost or wasted (Food and Agriculture Organization of the United Nations, 2014).

University dining facilities generate a large amount of food waste each year due to its large-scale food production and the massive number of patrons. The large amount of food waste generated by these operations has inspired many university dining managers to address food waste issues, including educating diners (Whitehair et al., 2013), reducing portion sizes, (Freedman & Brochado, 2010), and adopting trayless dining (Aramark, 2008; Thiagarajah & Getty, 2013; Whitehair et al., 2013).

In order to effectively reduce food waste, it is important to understand the contributing factors to consumers' food waste behavior. Previous studies used the theory of reasoned action (TRA) and revealed that an individual's behavioral intention, which ultimately influences their actual behaviors, is determined by their attitudes and subjective norms (Fishbein & Ajzen, 1975; Fiske & Taylor, 1991). The more favorable an evaluation of performing a certain behavior, the stronger the intention will be to perform the behavior (Fishbein & Ajzen, 1975; Ajzen, 1991). Also, subjective norms, accounting for consumers' perceived social pressure to engage in a certain behavior, is perceived to be a strong indicator toward behavioral intention (Fishbein & Ajzen, 1975; Ajzen, 1991). Later, the theory of planned behavior (TPB) was adopted when predicting consumers' food waste behavior and researchers found that food waste behavior was significantly influenced by perceived behavioral controls, in addition to attitudes, subjective norms, and intention toward food waste reduction (Stancu, Haugaard, & Lahteenmaki, 2016; Stefan, Herpen, Tudoran, & Lahteenmaki, 2013).

This study adopted the TRA as the theoretical support, even though the TPB includes an additional variable that explains behavioral intention and subsequent behavior. The rationale for

such decision was that perceived behavioral control accounts for the influence of external resources or barriers on performing a certain behavior. Because the dining center where data collection took place offers an all-you-care-to-eat buffet service, and diners have the liberty to select the types and the amount of food and to leave any amount of plate waste on their plates; it was determined that perceived behavior control has very limited role explaining the target behavior. Therefore, based on the nature of the dining facility where customers have complete control over the quantity of food they choose to consume with limited influences of external barriers on food waste behavior, the TRA was selected as the theoretical framework.

Previous studies utilized attitudes, subjective norms, and intention to predict self-reported food waste behaviors and suggested that consumers' food waste behavior was negatively associated with their attitudes against food waste, their strong subjective norms, and intention toward food waste reduction (Stancu et al., 2016; Stefan at al., 2013). In addition to the aforementioned variables, a number of researchers postulated that human emotions may also play an important role in influencing their sustainable behavior (Baumeister, Vohs, DeWall, & Zhang, 2007; DeWall, Baumeister, Chester, & Bushman, 2016; Lindsey, 2005). It is suggested that people conduct certain behaviors to gain favorable emotion and circumvent certain behaviors to avoid experiencing undesirable emotion (Baumeister et al., 2007). However, research on how emotions influence consumers' food waste behavior is limited (Russell, Young, Unsworth, & Robinson, 2017). Therefore, the influence of emotions on food waste behavior needs to be further examined. By adding emotions as an extra antecedent, consumers' food waste behavior may be more thoroughly understood.

In addition, many researchers who examined the influences of different antecedents on food waste behavior used self-reported food waste data instead of measuring actual food waste

(Russell et al., 2017; Stancu et al., 2016; Stefan at al., 2013). Limitations of using self-reported data include researcher bias, social desirability bias, as well as potential discrepancy between self-reported data and actual behavior (Belanger & Kwon, 2016).

Although a number of researchers implemented a variety of interventions to influence food waste and quantified food waste amounts, the majority did not provide or specify theoretical structure used in their interventions, resulting in a lack of theoretical support (Aramark, 2008; Freedman & Brochado, 2010; Kallbekken & Salen, 2013; Thiagarajah & Getty, 2013). In addition, detailed intervention or methodology were not provided in these studies, resulting in difficulty in replicating the interventions. Therefore, more research is needed to understand factors that contribute to plate waste behavior, to expand the existing interventions with details on methodology, and to quantify changes in plate waste in order to demonstrate the effectiveness of the intervention in university dining centers.

## Statement of Problem

On-site foodservice operations including university dining centers generate a large amount of food waste (Whitehair et al., 2013). Although some foodservice operators have reduced the amount of food being discarded in landfills by composting (Hobart Center for Foodservice Sustainability, 2009), reducing generation of post-service food waste (e.g., plate waste) may be a more proactive sustainable strategy. To prevent food waste generation, variables that may have potential influence on food waste behavior need to be identified and evaluated.

Previously, a few studies utilized variables such as attitudes, subjective norms, and behavioral intention to evaluate consumers' food waste behaviors (Stancu et al., 2016; Stefan et al., 2013). However, human emotions, which are also known as an important variable in influencing consumer's sustainable behavior (Baumeister et al., 2007; DeWall et al., 2016;

Lindsey, 2005), have not been well studied to understand food waste behavior. In addition, out of a few known studies that examined the influence of emotions on self-reported food waste behavior (Russell et al., 2017; Stefan et al., 2013), the associations and directions of emotions predicting behavioral intention and behaviors varied in these studies, raising questions on how emotions influence behaviors under different circumstances. Therefore, more research is needed to further understand potential influence emotions have on behavioral intention and behaviors.

In addition, the majority of studies that examined associations among food waste antecedents and food waste behaviors used self-reported food waste data (Russell et al., 2017; Stancu et al., 2016; Stefan at al., 2013). Using self-reported data may result in researcher bias, social desirability bias, as well as a potential discrepancy between self-reported data and actual behavior. Furthermore, most of studies that implemented interventions to influence actual food waste (Aramark, 2008; Freedman & Brochado, 2010; Kallbekken & Salen, 2013; Thiagarajah & Getty, 2013) referenced no theoretical frameworks that support or explain the basis for their interventions. Additionally, details of their interventions or methodology were not available, making replication of the interventions difficult. As a result, theoretical frameworks to support the design and detailed methodology of an intervention are needed to more adequately support and explain the study.

## Justification

Consumers' attitudes, subjective norms, and behavioral intention have been shown to significantly influence self-reported food waste behaviors (Russell et al., 2017; Stancu et al., 2016; Stefan et al., 2013). However, emotions have not been thoroughly examined in relation to food waste behaviors. Even in a few studies that have examined the associations between emotions and food waste behaviors, results were conflicting and inconsistent (Russell et al.,

2017; Stefan et al., 2013). Therefore, by adopting the TRA and emotions-as-feedback theory, the first component of this research project evaluated the associations among attitudes, subjective norms, behavioral intention, and self-reported food waste behavior with an additional antecedent of emotions. With adoption of a modified TRA model, associations among different variables and consumers' food waste behaviors may be more thoroughly examined and understood.

Previous research focused on influencing consumers' food waste behaviors by adopting trayless dining (Aramark, 2008), reducing portion sizes (Freedman & Brochado, 2010), and educating diners about food waste issues (Thiagarajah & Getty, 2013). Although these studies successfully documented food waste reduction, theoretical support of the intervention and detailed information on the implementation of the intervention were not available. Therefore, the second component of this research project implemented an intervention with the theoretical support of the TRA and emotions-as-feedback theory to influence diners' attitudes, subjective norms, and emotions toward food waste. To evaluate the effectiveness of the intervention, patrons' individual plate waste was weighed and analyzed before, during, and after the intervention, where patrons were verbally informed of the amount of individual plate waste, while the average and accumulative plate waste amounts and food waste related messages and pictures were displayed in the dining room.

## Purpose and Objectives

The purposes of this study were to explore the associations of attitudes, subjective norms, emotions, and intentions toward food waste, as well as self-reported food waste behaviors and to assess the effectiveness of an intervention of weighing individual plate waste and displaying average and accumulative plate waste with factual and emotional messages related to food waste. The goal of the intervention was to increase the awareness of food waste among diners, influence

their attitudes, subjective norms, and emotion toward food waste; and help them be self-motivated to reduce food waste in the future.

The specific objectives of this study are to:

1. Assess associations among diners' attitudes, subjective norms, emotion, and intention toward food waste reduction, as well as self-reported food waste behavior.
2. Develop an intervention to influence college diners' food waste behavior.
3. Evaluate the effectiveness of the intervention by comparing food waste amounts and diners' plate waste behaviors before, during, and after the intervention.

To achieve the purpose and objectives of this research, two separate studies (i.e., a self-administered survey and an intervention to influence food waste behavior) were conducted. The study utilized an online survey to assess participants' attitudes, subjective norms, emotions, and intention toward food waste reduction as well as their self-reported food waste behavior. Associations of the aforementioned variables were examined and directions of the independent variable predicting the dependent variables were evaluated. The second study implemented an intervention which aimed to influence the participants' food waste behavior by weighing individual plate waste and displaying average and accumulative plate waste with factual and emotional messages related to food waste. The effectiveness of the intervention was examined by comparing food waste amounts before, during, and after the implementation of the intervention.

## Hypotheses

To test the associations among attitudes, subjective norms, emotions, and intentions toward food waste reduction, as well as the self-reported food waste behaviors, the following null hypotheses are developed:

*$H_0$1: There will be no association between diners' attitude and intention toward food waste reduction.*

*$H_02$: There will be no association between diners' subjective norms and intention toward food waste reduction.*

*$H_03$: There will be no association between diners' emotions and intention toward food waste reduction.*

*$H_04$: There will be no association between diners' intention toward food waste reduction and self-reported food waste behavior.*

*$H_05$: Diners' intention toward food waste reduction will not mediate the association between attitude toward food waste and self-reported food waste behavior.*

*$H_06$: Diners' intention toward food waste reduction will not mediate the association between subjective norms toward food waste and self-reported food waste behavior.*

*$H_07$: Diners' intention toward food waste reduction will not mediate the association between emotions toward food waste and self-reported food waste behavior.*

*$H_08$: There will be no difference among diners' plate waste amounts before, during, and after the implementation of intervention.*

## Assumptions of the Study

There were several assumptions established before conducting this study. First, it was assumed in Study 1 that participants responded to questions on the online survey to the best of their knowledge with the understanding that there was no right or wrong answer on the questions. Second, it was assumed that all items and scales used in the survey were appropriate and accurately captured information for variables of interest.

For Study 2, the following assumptions were considered. The data collection occurred on Monday, Wednesday, and Friday throughout the four weeks period in order to control menu variations. On Tuesday and Thursday of each week, the menu concepts were different from the other days, so by selecting Monday, Wednesday, and Friday, the variation of food selection and waste behaviors due to differences in menu concepts between and among different weeks (i.e., baseline, intervention, and follow-up) was minimized. Even so, it was assumed that three days of

food waste behaviors were not significantly different from days when data collection has not occurred (i.e., Sunday, Tuesday, Thursday, and Saturday).

In addition, because portion sizes of food items served in the study facility were very well controlled, it was assumed that portion sizes of entrées and side dishes were consistent throughout the data collection period. In other words, it was assumed that the amount of food waste among participants due to varying portion sizes were insignificant.

Finally, it was assumed that changes in the amount of plate waste and diners' behaviors that were observed during and after the intervention were resulted from the intervention (i.e., weighing individual plate waste and displaying average and accumulative plate waste with factual and emotional messages related to food waste). It was assumed that all other contributing factors including individual differences were consistent during the four-week data collection period.

## Limitations of the Study

This research was conducted with identified delimitations as described below. First of all, using self-reported data from a single time assessment in Study 1 might have resulted in social desirability bias. Although participants were assured the anonymity and confidentiality of the data were assured before the online survey to keep social desirability bias low, participants might have felt the pressure to answer questions in a socially acceptable manner regardless of their true feelings toward an issue or topic.

In addition, even though a quasi-experimental design is effective when establishing internal validity and possibly causality (Handley, Lyles, McCulloch, & Cattamanchi, 2018), because data collection occurred at one dining facility in a university, the findings of this study need to be interpreted with caution. Due to different characteristics of foodservice operations

(e.g., targeted clientele, mission and vision, company culture), the results may not be generalizable to other types of foodservice operations (e.g., K-12 school, healthcare, and commercial foodservice operations).

Furthermore, data collection occurred at one dining facility in a Midwestern university during dinner times only, and results may need to be interpreted with caution. The plate waste behavior is often different for breakfast or lunch meals due to external factors such as time available for meals and the number of food items available. College students in different regions of the U.S. may be influenced by different cultural norms in terms of food waste behavior.

Finally, although this study targeted to influence factors that have potentials to improve diners' plate waste behaviors (i.e., awareness, attitudes, subjective norms, and emotions), the distinct effect of each factor on college diners' food waste behaviors was not identifiable.

## Definition of Terms

**Environmental Sustainability:** practices that ensures biodiversity, clean air, water and land, and reduces emission and waste (Gilbert, Stevenson, Girardet, & Stren, 2013).

**Plate Waste:** the quantity of edible portions of food served that is uneaten (Buzby & Guthrie, 2002).

**Attitudes:** a person's perceived positive or negative perceptions of performing a behavior and the person's evaluations of the consequences (Ajzen, 2015).

**Subjective Norms:** the reflection of both the perceived social pressure of engaging in a certain behavior which are beliefs about the normative expectations of others and the motivation to comply with these expectations (Fishbein & Ajzen, 1975, 2011).

**Emotion:** a conscious mental reaction subjectively experienced as strong feeling, which usually is directed toward a specific object and accompanied by physiological and behavioral changes in the body (Mulligan & Scherer, 2012).

**Intention:** the capture of motivational factors that influence a behavior, and indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior (Ajzen, 1991).

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# Chapter 2 - Review of Literature

## The Three Pillars of Sustainability

Sustainability is a broad and complex term, and there are social, environmental, and economic aspects when considering sustainability (Hart, 1997). According to Hart, the core of mainstream sustainable development should be a balanced approach among three dimensions which include social development, environmental protection, and economic growth. Social sustainability ensures there is societal cohesion that interacts efficiently to reach common goals, while economic sustainability aims to generate income and employment to sustain the population, economic growth, and innovation, as well as to maximize profits, expand markets, and externalize costs (Zhou, 2010). The primary focus of this study is environmental sustainability, which refers to the practices that ensure clean air, water, and land as well as biodiversity (Gilbert, Stevenson, Girardet, & Stren, 2013).

## The Impact of the Hospitality Industry on Environmental Sustainability

Environmental sustainability has become an important and challenging issue with the development of society and the economy. While the hospitality industry has a significant impact on the country's economy, being the largest private-sector employer in the U.S., and generating more than $899 billion in sales (National Restaurant Association [NRA], 2020), it also has a significant impact on the environment. Natural Resources Defense Council (2011) contends that the restaurant industry uses large amounts of water and energy and generates significant amounts of packaging and food waste.

While the hospitality industry contributes greatly to the nation's economic growth and social development, it also impacts the well-being of the natural environment and environmental sustainability. Solid waste, including food waste, water and air pollution, and excessive energy

and water usage are common issues that negatively affect the environment. For example, it was estimated that hotels generate an average of 1.22kg of solid waste, including food waste, plastic, and paper waste per guest per day (Abdulredha et al., 2018). In addition, on average, each restaurant uses five times more energy per square foot per year than other commercial operations (Jeong, 2010), making the restaurant industry the largest energy user among retail operations (NRA, 2019). Because 90% of electricity produced in the U.S. comes from non-renewable sources such as coal, petroleum, natural gas, and nuclear power, consuming these non-renewable materials has become the number one cause of industrial air pollution around the globe (Natural Resources Defense Council, 2012). Considering the large scale and influence the hospitality industry has on the environment, more actions and initiatives may be needed for hospitality operations to pursue environmental sustainability.

## Municipal Solid Waste in the Hospitality Industry

In 2015, approximately 262 million tons of municipal solid waste (MSW) was generated in the U.S., of which more than 137 million tons (52.5 %) ended up in landfills (Environmental Protection Agency [EPA], 2018). Landfills have a negative impact on the environment because they require a significant amount of water, chemical treatments, fuel, labor, energy and land (EPA 2018). Therefore, they should be used as the last resort for MSW management. The EPA (2018) suggested that instead of landfills, waste prevention to reduce waste at the source, also known as source reduction, is the most preferred environmentally strategy. The less preferable methods of dealing with waste are recycling, composting, and energy recovery, followed by the least preferable method of landfills (i.e., incineration). One of the biggest contributors of MSW in the U.S. is the hospitality industry, which generates a significant amount of plastic, metal, fats, oils, and greases, and food waste on a daily basis (NRA, 2017).

### Plastic and Metal

Waste of plastic and metal are common materials that could be reused or recycled, but most end up in the landfill. In 2017, a significant amount of plastic (81%) and metal (58%) waste generated in the U.S. ended up in the landfill, with a small percentage being reused or recycled (EPA, 2019). The hospitality industry generates nearly 8 million tons of liquor, wine, and beer bottles per year, but only 20% is recycled, while most end up in landfills or incinerators (Natural Resources Defense Council, 2011). Other byproducts of beverage consumption are plastic cups, bottles, and containers. On average, each American discards 100 polystyrene cups each year, and the expected time for polystyrene to decompose is over 500 years (Greenseal, 1999). Currently, over 13% of landfills and over 60% of marine debris in the U.S. are plastic (EPA, 2018). Marine plastic pollution has severely threatened the balance of the ecosystem because 260 species, including 86% of sea turtle species, 44% of seabird species, and 43% of marine mammal species, are considered at-risk for extinction due to marine plastic pollution (Natural Resources Defense Council, 2011).

Another major type of waste generated by the hospitality industry that often ends up in landfills is metal, which accounts for 9.1% of all MSW (EPA, 2018). The foodservice industry uses and discards a significant amount of metals, which are generated from production equipment, serving utensils, and canned food and beverages. The EPA (2018) reported that only 32% of metal waste is recycled.

### Fats, Oils, and Greases (FOG)

Restaurants produce a massive amount of FOG from their operations that pollutes water, air, and soil (NRA, 2017). A typical full-service restaurant is estimated to wash 9-20 pounds of grease down the drain for every 150 meals served (Natural Resources Defense Council, 2011).

FOG waste has the potential to severely impact the operation because FOG discarded through the drain can solidify and accumulate, thus eventually narrowing the internal opening of the pipe (NRA, 2017). Eventually, the buildup of FOG can completely clog the inside of the pipe, causing sewage to back up into the business or onto the streets and into storm drains (NRA, 2017). Such overflows can contaminate rivers, lakes, and streams; cause foul odors; and decrease customer satisfaction. It could also generate and release pathogens, spreading disease and endangering public health (NRA, 2017).

Because inappropriately disposing of FOG can create a hardship for both the operation and environment, recycling grease has become a common practice (NRA, 2014). With more restaurants attempted to recycle their FOG under the United States Department of Agriculture Bio-energy Program, 91 million gallons of biodiesel was produced annually from FOG in the U.S. (NRA, 2014). The NRA (2017) recommends restaurateurs to work with a local hauler or biodiesel producer to recycle grease waste for biodiesel production to prevent environmental contamination. Furthermore, biodiesel is more beneficial than conventional petro-diesel for the environment as it emits 78% less carbon dioxide.

### Food Waste

Food waste occurs at the end of the food chain. It is measured only for products that are directed to human consumption, excluding feed and parts of products which are not edible (Food and Agriculture Organization of the United Nations, 2012). Approximately 40 million tons of food waste was generated in 2015, which made up over 15% of total MSW in the U.S. (EPA, 2018). Globally, about one third to one half of the total amount of food produced for human consumption (approximately 1.3 billion tons per year) is lost or wasted (Food and Agriculture Organization of the United Nations, 2014). This massive amount of lost and wasted food

represents a missed opportunity to feed the growing world population. It also comes at a steep environmental expense because land quality, water quantity, and biodiversity are adversely affected (EPA, 2018). Not using one third to one half of the food produced globally means that soil is unnecessarily pressured, and the decreased soil quality leads to further use of synthetic materials that exacerbate environmental pollution (Food and Agriculture Organization of the United Nations, 2013). In addition, food waste places a massive amount of burden on the ecosystem because discarded food waste in a landfill decomposes anaerobically, creating methane emissions, a gas more than 25 times as potent as carbon dioxide at trapping heat (Food and Agriculture Organization of the United Nations, 2013).

There are several sources of food waste throughout the supply chain, from initial agricultural production to final consumption in households and retails. The amount of food wasted in developed countries is much higher than that in developing countries due to management practices and consumption habits (Department of Economic and Social Affairs, 2013). In developed countries, sales agreements between producers and retailers may contribute to the large quantity of food wasted due to quality standards not being met. In fact, as much as 30% of total harvested food did not reach the retail level as a result of quality selection and cosmetic considerations. In addition, of the 70% of harvested food that reaches the retail level, 30-50% is wasted by consumers (Department of Economic and Social Affairs, 2013). The NRA (2019) reported that 133 billion pounds of food from retailers and restaurants was wasted in 2010. On average, the amount of uneaten food was estimated as $390 per consumer per year (NRA, 2019).

Unlike in developing countries where inadequate harvesting methods contribute to a large amount of food waste, in developed countries, food wasted by retailers and consumers more

significantly contributes to the food waste challenges (Department of Economic and Social Affairs, 2013). In developed countries, which include Europe, North America, and industrialized Asia, more than 40% of food waste occurs at the retail and consumer level (Gustafsson, Cederberg, Sonesson, & Emanuelsson, 2013). A recent estimation shows that the weight of food wasted by consumers in Europe and North America is 95-115 kg per capita per year, compared to sub-Saharan Africa and South/South-East Asia, it is estimated to be only 6-11 kg per capita per year.

In developed countries, retail and consumption patterns of food will require profound cultural changes especially in the preventative notion of food waste and in the handling of post-consumer waste (Gustafsson et al., 2013). For example, the foodservice industry in the U.S. attempts to reduce the amount of waste discarded in landfills by composting, an effective way of recycling organic material into soil (EPA, 2018). It not only reduces the methane emissions significantly, but aids reforestation, wetland restoration, and habitat revitalization efforts by improving contaminated, compacted, and marginal soils (EPA, 2018). Unfortunately, out of the 40 million tons of food waste generated in the U.S. in 2015, only 5% was composted (EPA, 2018).

**Plate Waste**

Plate waste is defined as the quantity of edible portions of food served that is uneaten and is a common reason for food loss at the consumer and foodservice levels (Buzby & Guthrie, 2002). Researchers contend that plate waste is among the largest sources of avoidable food waste (Roe, Apolzan, Qi, Allen, & Martin, 2018). Foodservice establishments, including restaurants, catering companies, hospitals, sports stadiums, and schools, are the biggest contributors to food waste due to large meal portion sizes and a large amount of consumer plate waste (Vogliano &

Brown, 2016). The United States Department of Agriculture estimated that 86 billion pounds of food were lost in 2008 in foodservice operations (Vogliano & Brown, 2016). Plate waste studies conducted in schools that participate in the National School Lunch Program (NSLP) reported that more than 20% of calories served in NSLP meals were discarded in the form of plate waste (Roe et al., 2018).

Plate waste generated by universities alone is estimated to be over 1 billion pounds per year (Vogliano & Brown, 2016) and over 60% of total plate waste was estimated to be generated in the traditional buffet-style setting in university dining facilities (Whitehair, Shanklin, & Brannon, 2013). Many universities offer buffet-style dining services to satisfy diverse customers in colleges and universities. However, this system often leads to a significant amount of plate waste due to an over estimation of food that patrons think they can consume (Whitehair et al., 2013). Therefore, understanding the amount, composition, and patterns of plate waste in foodservice operations may provide insights for addressing the issue of avoidable consumer-level food waste.

There are a number of studies examined different strategies to reduce plate waste in university foodservice operations. For example, some university dining facility managers attempted to reduce post-consumer food waste by educating diners (Manomaivibool, Chart-asa, & Unroj, 2016; Whitehair et al., 2013). For example, the simple to-the-point prompt-type message, “All Taste No Waste” followed by the statement “Eat What You Take, Don’t Waste Food” developed by Whitehair et al (2013) stimulated a 15% reduction in food waste. The effective plate waste reduction was achieved by showing simple messages and allowing students to process the information quickly without requiring the use of logic or genuine consideration.

Manomaivibool et al. (2016) suggested effective strategies to reduce college students' plate waste, including informing students by placing stickers with food ordering tips, placing information cards on dining tables about resources used in food production, reminding diners to finish what they had ordered, and placing posters and banners with messages and images to elicit a pro-environmental norm. Based on comparisons of photographed food waste, these researchers reported that the amounts of wasted rice, noodles, and meat decreased after the comprehensive food waste campaign (Manomaivibool et al., 2016). However, because the intervention used by these researchers was very comprehensive, it was difficult to delineate which of the multiple approaches influenced customer behaviors and how much.

Other studies found that by providing nutritional information, reducing portion sizes, and plate sizes successfully reduced consumer food waste. Freedman (2011) found that providing point-of-selection nutrition information with matching pictures of different portion sizes and corresponding nutrition information effectively decreased food selection, which ultimately decreased food waste. Freedman and Brochado (2010) indicated that by reducing portion sizes, consumers' food waste was reduced. These researchers revealed that diners were not aware of the portion size changes when the changes were gradual. Similar to reducing portion sizes, reducing plate sizes also resulted in food waste reduction by up to 20% in a hotel foodservice environment (Kallbekken & Salen, 2013). Because a smaller plate size may influence consumers to take a smaller amount of food, it may allow them to finish what they have taken.

Researchers also indicated that allowing consumers to submit their entrée preferences before meal service might help to reduce food waste (Mirosa, Munro, Mangan, & Pearson, 2016). These researchers suggested that food waste amount was reduced by an intervention that allowed consumers to pre-order their entrées the night before meal service. In doing so,

customers chose food items based on rationalization of their preferences, not on an impulse. Knowing the type and the number of entrées being pre-ordered, the operation did not have to prepare everything on the menu but what was being ordered. As a result, they were able to focus on improving quality of fewer items, and consequently, customers reported enhanced satisfaction (Mirosa et al., 2016). In other words, because more effort was being put into fewer options to ensure high-quality service, customers' pleasure of the meal was enhanced, and at the same time, their plate waste was reduced (Mirosa et al., 2016). In addition, food waste was also reduced in the pre-consumer level because the kitchen production was more effective by knowing the amounts of food that needed to be prepared.

There are also a few studies that evaluated the effectiveness of trayless dining on reducing food waste (Aramark, 2008; Thiagarajah & Getty, 2013, Whitehair et al., 2013). Traditionally, university dining centers have provided trays to patrons for carrying food items they selected. By removing trays, patrons are forced to carry plates or food containers by hand, making it difficult to select multiple items at one time. Researchers postulated that by preventing customers from selecting more food than they can carry and subsequently consume, food waste would be reduced by trayless dining implementation. Specifically, Aramark (2008) reported that food waste was reduced by 1.2 to 1.8 ounces per person per meal, a 25 to 30% reduction after trayless dining implementation. Furthermore, trayless dining reduced food cost and promoted sustainability awareness of diners (Babich & Smith, 2010; Thiagarajah & Getty, 2013; Wansink, Just, & Shimizu, 2011), suggesting a positive impact on environmental sustainability.

However, there were potential concerns for trayless dining implementation. Researchers found that without trays, diners were less likely to take salads, while few diners gave up desserts, contributing to less healthy food choices (Wansink et al., 2011). Other concerns of trayless

dining included reduced customer satisfaction, frequent cleanups required due to tables getting dirty quickly without trays, and increased breakage of glassware (Thiagarajah & Getty, 2013). Therefore, even though some of the interventions, including trayless dining, showed effectiveness in reducing food waste, researchers should be mindful for the concerns that were raised.

Furthermore, many previous studies used self-reported data for food waste behaviors and did not quantify the amount of plate waste. Specifically, a few studies applied the theory of planned behavior to predict food waste behavior (Stancu, Haugaard, & Lahteenmaki, 2016; Stefan, Herpen, Tudoran, & Lahteenmaki, 2013). However, the lack of assessing actual behaviors in these studies presented questions on how effective the interventions were in decreasing the amount of plate waste. The researcher and social desirability bias were identified as limitations when using self-reported data for assessing actual consumer behaviors. Therefore, it was recommended that future studies expand existing interventions and quantify changes in the amount of plate waste to better understand diners' food waste behaviors and to quantify food waste reduction.

## Understanding Sustainable Consumer Behavior

Throughout human history, environmental impact has largely been caused by human desires for physical comfort, mobility, convenience, enjoyment, power, and social status (Stern, 2000). Pollution, excessive energy use, and resource consumption have significantly impacted the well-being of social, economic, and natural environments. It was not until recently, however, that environmental issues have become an important concern in human decision making (Stern, 2000). Sociologists and psychologists tried to explore factors associated with sustainable

behaviors, aiming to explain and change human behaviors and minimizing negative impacts on the environment (Kaiser, Hubner, & Bogner, 2005).

## Theories Related to Altruism

Theories of altruistic behavior have been used to explain preservation behaviors (Heberlein, 2012). Particularly, the idea of altruism presumes that because environmental quality is a public good, altruistic motives are necessary for individuals to help preserve the environment (Heberlein, 2012). The norm-activation model treats environmental concern as altruism toward other human beings (Stern, Dietz, Abel, Guagnano, & Kalof, 1999). Schwartz's theory of altruism (1977) contends that pro-environmental behavior is more likely to take place when an individual is aware of harmful consequences to others, and the individual ascribes responsibility to him/herself for changing the deteriorating environmental condition. In other words, pro-environmental actions occur in response to personal moral norms, which are activated in individuals who believe environmental conditions pose threats to other people, species, or the biosphere and that the action they initiate could advert such negative consequences (Schwartz, 1977). Stern et al. (1999) also suggested that people have a general value orientation toward the welfare of others, meaning people value results of preventive behaviors that benefit others and are motivated to act to prevent others from getting harm.

Another similar altruism-related theory is the value-belief-norm theory, which suggests that moral and other altruistic considerations are the main elements for understanding sustainable behavior (Stern, 2000). It postulates personal norms, which is also known as a person's sense of obligation, to be the ultimate predictor of sustainable behaviors (Kaiser et al., 2005). Personal norms are seen as a function of a chain of three beliefs: self-ascribed responsibility, awareness of consequences of a behavior for the valued object, and ecological worldview (Kaiser et al., 2005).

For example, a person may consider that throwing away edible food will negatively impact the environment and views food waste as having a significant impact on landfills (i.e., awareness of the behavioral consequence) if he/she has negative views on food waste being discarded in landfills (i.e., ecological worldview). At the same time, based on the person's awareness of consequence and worldview, he/she may feel responsible to reduce food waste in order to help preserve the environment (self-ascribed responsibility and sense of obligation to act). Stern et al., (1999) reported that personal norms and sense of obligations to alleviate environmental problems accounted for 19% of the variance explained in consumer sustainable behaviors.

## Social-psychological Theories

In addition to altruism theories, other researchers examined stable but abstract values as well as more specific cognitions, such as attitudes, beliefs, and norms when explaining people's sustainable behaviors (Fishbein & Ajzen, 1975; Stern et al., 1999; Whittaker, Vaske, & Manfredo, 2006). Social-psychological theories suggested that attitudes, beliefs, and norms mediate the association between values and behaviors (Stern, 2000; Stern et al., 1999), arguing that specific belief, attitudinal, or normative variables are more likely to predict behaviors than more general measures such as values (Fishbein & Ajzen, 1975; Fiske & Taylor, 1991). However, values are believed to be the most fundamental, broad, and abstract social cognitions that provide guidance for people's behaviors (Rokeach, 1973). Values serve as the foundation for the cognitive hierarchy provides linkages to a more specific cognition such as value orientation which explores a pattern of beliefs about a broad class of objects (Manfredo, Teel, & Bright, 2004). For example, an individual holding the value of sustainability (abstract value) is likely to form a pattern of beliefs toward protecting the environment, preserving resources, and promoting sustainable actions (value orientation; Manfredo et al., 2004).

A more specific construct in the hierarchical model beyond value orientation is attitude and norms which involve positive or negative evaluation of related subjects, appropriate behaviors for a specific situation, and standards individuals use to evaluate whether a certain behavior or condition should occur (Wittman et al., 1998). For example, the theory of reasoned action (TRA) and the theory of planned behavior (TPB) examined attitudinal factors, personal, and social norms to explain a variety of behaviors and behavioral intention (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975, 2011). Both theories posit that behavioral intention, which is the immediate antecedent of behavior, is influenced by the individual's attitudes toward the target behavior and their subjective norms of what others think they should do and their motivation to comply to the norms (Ajzen, 1985, 1991). Furthermore, Fishbein and Ajzen (1975) explained that behavioral beliefs, defined as the beliefs and evaluation toward likely outcomes of a certain behavior, influence the individual's attitudes toward certain behavior. Normative beliefs, which are the beliefs about the normative expectations of others and motivation to comply with these expectations, influence the individual's perception on how others view or act toward a certain behavior (Ajzen, 1985, 1991). Both behavioral and normative beliefs have an influence on an individual's behavioral intention, which ultimately influence actual behavior (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975, 2011).

Building on the TRA which evaluates the impact of attitudes and subjective norms on behavioral intention (Fishbein & Ajzen, 1975), Ajzen (1985, 1991) added on perceived behavioral control as an additional antecedent to take the influence of resources and opportunities for performing a certain behavior into account, building the TPB. Several studies have used the TRA and the TPB for predicting pro-environmental behaviors (Ghani, Rusli, Biak, & Idris, 2013; Graham, Jessop, & Sparks, 2015; Stefan et al., 2013). For example, Ghani et al.

(2013) found that positive attitudes and intention toward food waste separation contributed to self-reported food waste separation behaviors. In another study by Graham et al. (2015), reported household food waste reduction was significantly influenced by attitudes, subjective norms, perceived behavioral control, and intention toward household food waste reduction.

This study adopted the TRA as the theoretical support, even though the TPB includes an additional variable that explains behavioral intention and subsequent behavior. The rationale for such decision was that perceived behavioral control accounts for the influence of external resources or barriers on performing a certain behavior. Because the dining center where data collection took place offers an all-you-care-to-eat buffet service, and diners have the liberty to select the types and the amount of food and to leave any amount of plate waste on their plates; it was determined that perceived behavior control has very limited role explaining the target behavior. The setting of the current study facility had limited influences of external barriers or resources on food waste behavior.

## Theory of Reasoned Action

Previous research suggested that general attitudes alone has a weak association with performing specific behaviors (Fishbein & Ajzen, 1975; Fiske & Taylor, 1991). Therefore, models of attitude–behavior associations attempted to explain this attitude–behavior discrepancy by suggesting to measure attitudes and behaviors at the same level of specificity and by explaining how attitudes combine with other factors to influence behaviors (Fishbein & Ajzen, 1975; Fiske & Taylor, 1991; Webb & Sheeran, 2006). For example, behavioral beliefs are believed to be the underlying influence on an individual's attitudes toward conducting certain behaviors (Fishbein & Ajzen, 1975). However, a favorable attitude toward a behavior may not be translated into action because of social pressure from significant others around them who do not

perform or approve the behavior. Therefore, subjective norms, which affect an individual's perception of whether or not a certain behavior will be approved by others, need to be taken into consideration to capture both social and personal influences on behaviors (Fishbein & Ajzen, 1975). In addition, attitudes and subjective norms affect behaviors by promoting the formation of a decision or intention to act, making behavioral intention the proximal determinant of behaviors (Fishbein & Ajzen, 1975). Therefore, at the most basic level of explanation, the TRA is formed by two beliefs antecedents, attitudes and subjective norms, which ultimately have the influence on behavioral intentions toward a certain behavior (Fishbein & Ajzen, 1975, 2011).

**Attitude**

In general, attitude toward a behavior is a person's overall evaluation of the behavior, which includes behavioral beliefs and the corresponding positive or negative evaluation of the behavior (Ajzen, 1991; Francis et al., 2004). In other words, behavioral beliefs are positive or negative feelings toward a certain behavior, and outcome evaluation is perceived benefits and costs of performing a certain behavior, (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975, 2011). Beliefs form the foundation of attitudes, which can be explained by expectancy-value model (Ajzen, 2015). According to expectancy-value model, beliefs are formed by associating performance of a certain behavior with specific outcomes, which will then be valued as positively or negatively (Ajzen, 2015). Consequently, individuals acquire an attitude toward a certain behavior. When assessing attitudes toward a certain behavior, researcher may directly ask about an individual's attitudes toward a certain phenomenon or indirectly ask about his/her behavioral beliefs and outcome evaluations (Francis et al., 2004).

For example, a sustainable diner may believe that by taking only the amount of food that can be finished (the behavior) helps to preserve the environment (an outcome). If the outcome

associated with the behavior is viewed positively, he/she would acquire a positive attitude toward this behavior. In other words, people generate positive attitudes toward certain behaviors that promote desirable outcomes and negative attitudes toward behaviors that lead to undesirable outcomes (Fishbein & Ajzen, 1975, 2011). Even though people may form different behavioral beliefs, it is understood that only a small section will influence an actual behavior at any given moment, and the already accessible beliefs that are considered to be prevailing have the greatest influence over a person's attitude (Ajzen, 2015).

### Subjective Norm

Subjective norms are determined by both injunctive and descriptive normative beliefs (Fishbein & Ajzen, 1975, 2011). Injunctive normative beliefs infer to what important others want them to do or what they would approve or disapprove of as well as the individual motivation to comply to the norms. Descriptive normative beliefs infer to the action of the social referents (Ajzen, 2015). Subjective norms, therefore, can be indirectly measured by both the perceived social pressure of engaging in a certain behavior which are beliefs about the normative expectations of others and the motivation to comply with these expectations. It can also be directly measured by the action of the social referents (Francis et al., 2004; Graham et al., 2015). People tend to be influenced by important others to whom they are close, which could be a spouse, a relative, a close friend, a coworker, or depends on the social context, a health professional or a superior (Fishbein & Ajzen, 1975, 2011).

### Intention

The dependent variable in the TRA is the intention to perform a certain behavior. Intentions are assumed to capture the motivational factors that influence a behavior (Ajzen, 1985, 1991). They are indications of how far a person is willing to go, how hard they are willing

to try, and how much time and effort they are planning to exert in order to perform the behavior (Ajzen, 1991). As a general rule, the stronger the intention to engage in a behavior, the more likely a person would perform the target behavior (Fishbein & Ajzen, 1975, 2011).

### Feedback Loop and Other Factors

In addition to the three main components that form the TRA, the one component that is not frequently discussed is the feedback loop (Ajzen, 1985, 1991, 2015). Depending on the feedback of consequences, the reaction of important others, and the ease or difficulty of performing the behaviors, this information provides feedback to the performer and is likely to influence behavioral and normative beliefs, which further influences intentions and future behaviors (Ajzen, 1985, 1991, 2015). In addition, other external factors such as demographic characteristics are not included in the TRA model. Depending on situations and target behaviors, some researchers added situational factors and other antecedents such as moral values, self-identity, and anticipated regrets into their study model (Ghani et al., 2013; Graham et al., 2015).

Putting all the constructs of the TRA together, researchers argued that a behavior is a function of behavioral and normative beliefs relevant to the behavior (Fishbein & Ajzen, 1975, 2011). These salient beliefs determine a person's intention to act, and intention serves as an immediate antecedent of an overt behavior. In general, the stronger the intention, the more likely the behavior will be performed (Ajzen, 1991; Fishbein & Ajzen, 1975, 2011).

## Emotions-as-feedback Theory

Previous research explored the possible influence of emotions on an individual's social behaviors, including sustainable behaviors. However, the impact of emotions on human behaviors remains inconclusive. Some researchers have suggested that emotions directly cause behaviors (Baumeister, Vohs, DeWall, & Zhang, 2007), while others believed anticipated

emotions guide behaviors and judgments (DeWall, Baumeister, Chester, & Bushman, 2016). Although the emotion-as-direct-causation perspective was frequently tested, only 22% of tests were significant. However, the emotion-as-feedback perspective has been rarely tested, but 87% of tests were significant (DeWall et al., 2016).

One of the arguments researchers make in support of the emotion-as-direct-causation perspective is the "fear makes you flee, anger makes you fight" statement (Baumeister et al., 2007, p. 168). This direct causation theory has advantages beyond parsimony, including commonsense appeal. People like to interpret others' behaviors based on their emotional reaction such as "he fled because he was scared" (Baumeister et al., 2007, p. 168). Although it is undeniable that emotion can occasionally have direct effects on behaviors, under many situations emotions do not directly transfer to behaviors (Lindsey, 2005). For example, while fear may make some people to take an initial action of fleeing (i.e., running away when encountered a bear on a hike, which is likely to trigger the bear's prey instinct to chase after), it could make a person go through an analysis process to properly deal with the situation that causes fear when he/she encounters a similar situation again (i.e., remembering to stay calm and remain grounded when encountered a bear, instead of instantly running away). With this logic, while it is possible that some emotion causes direct reactions to a situation, it could also serve as feedback to an individual's future behaviors (Baumeister et al., 2007).

In other words, conscious emotional experiences stimulate cognitive processing, which is learned from the first experience after certain outcomes or behaviors (Baumeister et al., 2007). These emotional experiences facilitate learning lessons and forge new associations between experienced emotion and behavioral outcomes, and subsequently these associations will help individuals to shape their future behaviors (Baumeister et al., 2007). Ultimately, and crucially,

because individuals have acquired the associations between certain emotions and behaviors, they learn to anticipate emotional outcomes and behave so as to pursue the emotions they prefer (Baumeister et al., 2007).

There are different emotions that researchers explored when trying to understand motivators and deterrents for certain behaviors. For example, an unpleasant emotion may motivate the person to act in ways that make them avoid such emotion. In some cases, this phenomenon could create the false appearance that emotion directly causes behaviors (Baumeister et al., 2007). However, Bushman, Baumeister, and Phillips (2001) showed that a mood-freezing pill manipulation reduced the increase in aggression that was otherwise found among people who were angered by an insult. Moreover, the increase in aggression in response to anger was only found among people who believed that releasing anger was a good way to make themselves feel better (Bushman et al., 2001). In other words, anger causes some people to become more aggressive only when the person believes that the aggressive activity will repair their mood; when such belief is eliminated, aggression lost its appeal (Bushman et al., 2001). The mood freeze conditions clearly illustrate that what appeared to be an emotion-causing behavior was in fact based on behaviors pursuing emotion (Bushman et al., 2001). Bushman et al. contended that most of these scenarios that triggered immediate responses and actions were, in fact, the performer's pursuit of a better emotional state.

For an additional example, a person may feel guilty and regretful when he/she behaves in a way that causes distress to a friend. This feeling of regret prompts the person to consider what he or she did to cause such a feeling and think of ways to avoid the negative outcome in the future. When a similar situation arises again, the acquired association between guilt and inappropriate conducts will help the person to choose a course of action that will not bring

distress to the friend and more regrets to him/herself (Lindsey, 2005). Based on this logic, a person feels bad after causing a friend to feel distressed, associates his/her behavior with the emotion of regret. The reflection of the acquired association will guide the person to reevaluate his/her behavior in response to social norms and obligations, and possibly to extract lessons and conclusions about how a different course of action may yield a better emotional outcome (Lindsey, 2005). The lesson that is stored in the person's memory, along with the acquired association will later become activated in a similar situation and guides the person in subsequent behaviors. In other words, the emotion-as-feedback perspective proposes that people engage in a certain behavior and gain emotional feedback afterward, and based on the emotional feedback gained, they will choose to avoid or to continue these behaviors in order to avoid undesirable emotion or pursue desirable emotion (DeWall et al., 2016).

### The Feeling of Guilt

The feeling of guilt is a form of emotional distress or an aroused, unpleasant, emotional state that stems from the belief that one may have done something wrong or that others may perceive they have done something wrong (Baumeister, Heatherton, & Tice, 1994). Feelings of guilt, therefore, may motivate someone to make amends, wish they have acted differently, and fix what has already been done (Lindsey, 2005).

Because guilt as a form of emotional distress is based on social relationships that motivate and encourage prosocial behaviors (Lindsey, 2005), the basis for feeling guilty is in the capacity to feel or anticipate suffering and distress of others (Baumeister et al., 1994). Furthermore, such guilt may also be associated with the acknowledgment of his/her own responsibility for that suffering (Hoffman, 1982). In addition, perceptions of responsibility or controllability have been found to be a predictor of guilt (Weiner, Graham, & Chandler, 1982),

because guilt provides information about one's behavior and serves to motivate actions that reduce such feelings.

If people perceive that they have control over a situation, believe that they can expiate guilt through an action, and feel assured that engaging in these behaviors will attenuate the feelings of guilt; they are likely to engage in guilt-reducing behaviors (Lindsey, 2005). In other words, guilt has the potential to exert a strong effect on behavioral intention and an actual behavior because people learn what makes them feel guilty and how to change their behavior accordingly to avoid those negative feelings (Baumeister et al., 1994). Thus, by anticipating guilt and changing behaviors to prevent guilty feelings, people can bring their behavior to align with socially desirable norms that they value.

An experimental evidence of how anticipated guilt influence behavior intention and actual behavior has been established by Lindsey (2005). Lindsey manipulated the anticipation of guilt in connection with a campaign for bone marrow donors by telling a story about a child who died waiting for a bone marrow donation. The results confirmed that such manipulations led to anticipated guilt, which in turn increased behavioral intention to donate and actual bone marrow donations.

## The Use of Structural Equation Modeling in Consumer Behavior Research

Structural equation modeling (SEM) is a technique that is used for specifying, estimating, and evaluating models of linear relationships among variables (MacCallum & Austin, 2000). One of the goals of SEM analysis is to provide a quantitative test of theoretical models that hypothesized how sets of variables define construct and how these constructs are related to each other. In addition, SEM analysis also provides support in determining the extent to which the theoretical model is supported by sample data (Schumacker & Lomax, 2004).

Unlike regressions, correlations, or other statistical analyses, variables in SEM do not have to be directly measured or observed. Instead, a structural equation model may include both observed variables and hypothetical constructs that cannot be directly measured, known as the latent variables. Therefore, a structural equation model can also be understood as a hypothesized pattern of directional and nondirectional linear relationships among a number of observed and latent variables (MacCallum & Austin, 2000).

When latent variables are not included in a model or when multiple indicators of a latent variable are unavailable, path analysis is used. On the other hand, when latent variables are included, confirmatory factor analysis is used when researchers test associations among the latent variables (Schumacker & Lomax, 2004). One of the concerns of not using latent variables in a model is that path analysis treats observed variables as error free representations of the construct of interests, which may lead to the estimation of effects in the model being highly biased due to measurement error (Bollen, 1989; Maruyama, 1997). In a study conducted by MacCallum and Austin (2000) where they reviewed 500 published studies that utilized SEM in the psychological research, they specified that 25% of the studies used path analysis with no latent variables. By using only observed variables, it was difficult for the researchers to provide adequate justification of their proposed models because of the high measurement errors in the observed variables. Therefore, to reduce measurement errors, latent variables should be used and multiple indicators should be obtained to define each latent variable (Bollen, 1989; Maruyama, 1997).

SEM has been widely applied in the field of hospitality management. For example, a study conducted by Ali and Omar (2014) found that physical and social environments of hotel resorts were significant predictors of customer satisfaction and their revisit intentions. The study

results from SEM indicated that customer satisfaction contributed positively to customer revisit intentions among participants in Malaysian hotel resorts. Another study conducted with staffs in full-service hotels in the U.S. revealed that employees' polychronic time use preferences negatively predicted their intention to leave their hotels via its indirect effect of employee job satisfaction (Zhang, Roberts, Jang, & Durtschi, 2018). In this study, four latent variables of employee polychronicity, job satisfaction, work engagement, and turnover intention were used to build a hypothesized model, and the indirect effects of job satisfaction and work engagement were tested by SEM. SEM has also been used to test associations among leader-member exchange, task motivation, creativity, and performance in tourist hotels in Taiwan. Wang (2017) revealed that task motivation and creativity fully mediated the associations between leader-member exchange and performance.

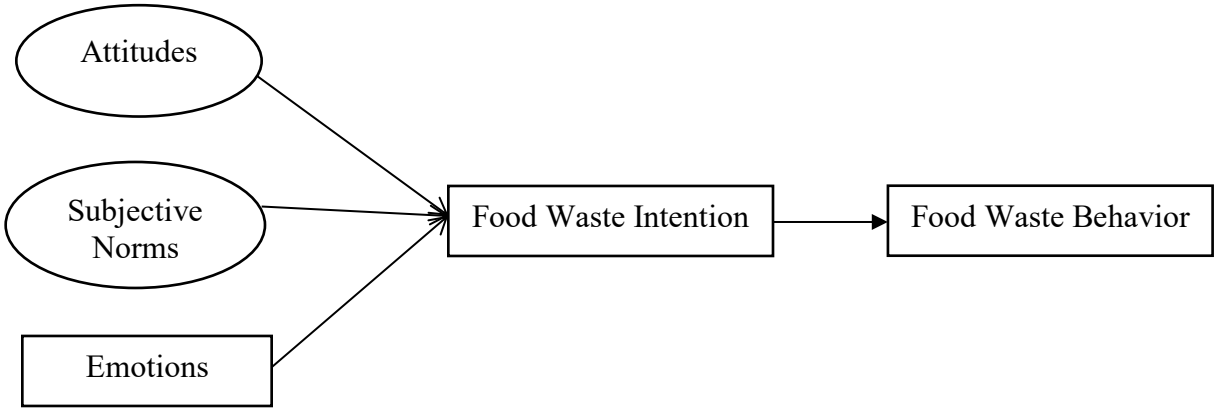
In studies related to consumer behavior in the hospitality industry, SEM has also been applied to evaluate variables in the TRA and the TPB to predict food waste behaviors. A study that evaluated food waste generated at household level revealed that perceived behavioral control and routines related to shopping and reuse of leftover foods were the main contributors to food waste behaviors in a household (Stancu et al., 2016). Also, in this study, consumers' injunctive norms and attitudes toward food waste had a significant impact on their food waste behaviors. Another study evaluated the association between attitudes and behavioral intention suggested that consumers' attitudes as lack of concerns toward food waste and moral attitudes (i.e., feelings of guilt when discarding food) positively predicted their intention not to waste food (Stefan et al., 2013). SEM was also utilized to evaluate the associations among habits and emotions toward food waste, intention toward food waste reduction, and food waste behavior (Russell, Young, Unsworth, & Robinson, 2017). Their study showed that negative emotions were associated with

greater intentions to reduce food waste. In addition, participants with a greater sense of control, and more normative support for reducing food waste also showed stronger intentions to engage in food waste reduction behaviors.

## Current Study

Based on previous studies (Baumeister et al., 2007; Fishbein & Ajzen, 1975; Fiske & Taylor, 1991; Lindsey, 2005; Russell et al., 2017; Webb & Sheeran, 2006; Stancu et al., 2016; Stefan et al., 2013), foodservice customers' food waste behaviors may be influenced by their attitudes, subjective norms, emotions, and intention toward food waste reduction. Even though emotions may have an impact on food waste behavior (Russell et la., 2017; Stefan et al., 2013), inconsistent results were found. The associations between antecedents of food waste and food waste behavior have not been fully explored. Therefore, this study unitized the TRA and the emotion-as-feedback theory as theoretical support to explore the associations among the independent variables of attitudes, subjective norms, and emotions, as well as the depending variables of intention toward food waste reduction and self-reported food waste behavior. The hypothesized model of this study is shown in figure 2.1. The associations of the aforementioned variables were evaluated by using SEM. In addition, an intervention to influence consumers' attitudes, subjective norms, and emotions toward food waste was implemented in order to affect their actual food waste behavior. Food waste amounts before, during, and after the implementation of an intervention were used to evaluate the effectiveness of the intervention.

**Figure 2.1.** The impact of attitudes, subjective norms, emotions, and intentions toward food waste reduction on self-reported food waste behaviors (A modified TRA model).



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# Chapter 3 - Methodology

## Introduction

The purpose of this study was to 1) explore the associations of attitudes, subjective norms, emotions, and intentions toward food waste, as well as self-reported food waste behavior and 2) evaluate the effectiveness of an intervention, which included weighing individual plate waste and displaying average and accumulative plate waste with factual and emotional messages related to food waste, on the amount of food waste in a college dining facility. This study has two phases. First, a self-administered survey was conducted to examine associations among aforementioned variables (Study 1). Then, a quasi-experimental design was utilized to influence diners' attitudes, subjective norms, and emotions toward food waste, which aimed to ultimately influence the actual amount of plate waste (Study 2). This study was conducted at a university dining center located in the Midwest region of the U.S.

Prior to data collection, the approval to use human subjects in research was obtained from the Institutional Review Board (IRB) at Kansas State University (Appendix A). This chapter discussed detailed methodology for Studies 1 and 2.

## Study 1: Assessment of College Diners' Attitudes, Subjective Norms, Emotions, and Intention toward Food Waste and Self-reported Food Waste Behavior

### Study Setting and Participants

The target population of this study was college-age adults (18 years or older) who attend colleges or universities in the U.S. and eat most of their meals in on-campus dining facilities. The study sample included college students who consumed most of their meals at a dining center

of a university, located in the Midwest region of the U.S. during the four weeks of data collection.

The facility where the intervention occurred, operates as an all-you-care-to-eat cafeteria. The total number of residents who have access to the study facility is approximately 2,000, and the average number of residents who dine in for the evening is 1,150. Diners are offered a tray to collect their entrees and side dishes from one of the four serving lines including Classic, Boarders (Mexican and Chinese), Italian, and Deli concepts. As students go through each serving line, entrees and side dishes are served by employees, and diners are free to re-enter the serving lines multiple times to collect extra entrées and side dishes. Additional food items, such as salads, cereals, soups, and deserts, are available at the self-service stations at the center of the dining center. After diners finish with their meals, they return their trays with any leftover food on plates. Due to the voluntary nature of the survey, not everyone would participate in the survey. Therefore, the target sample size for the survey was 440 diners to conduct structured equation modeling.

## Instrument Development

To assess college diners' attitudes, subjective norms, and emotions toward food waste as well as food waste behavioral intention and self-reported behavior, the survey instrument was developed based on a literature review and focus groups. Specifically, focus groups explored diners' attitudes and emotions toward food waste. Once developed, the instrument was reviewed by foodservice and sustainability researchers and pilot-tested prior to data collection.

### Focus Groups

The purpose of the focus groups was to assess diners' different emotions and attitudes toward food waste for the purpose of constructing reliable survey questions. A total of 24

individuals were recruited to participate in one of three focus groups. They were at least 18 years old, lived in the surrounding resident halls, and consumed most of their meals at the dining center where data collection was conducted.

The focus group participants were recruited purposefully to include diners who had no edible plate waste and diners who had a large amount of edible plate waste. Two researchers recruited 24 participants in the dish return area based on the amount of plate waste left on their trays. Each potential participant was approached by one of the researchers and was asked if they would be willing to participate in a focus group. Participation was encouraged by a $20 cash payment upon completion. Purposefully, 12 participants with no plate waste and 12 with over half a plate of food waste were recruited and assigned to one of the three groups based on their availability. Each focus group included eight individuals, and each group convened in a section of the dining center that was reserved for meetings and events.

Prior to the focus groups, the participants were provided a written informed consent form that included the purpose of the study, confidentiality of their responses, and contact information of the researchers and IRB (Appendix B). They were also informed that they could leave at any time, if they felt they were unable to continue the discussion. Each participant was asked to sign an informed consent form and received a copy of the same information. Permission was sought to record the audio of the focus group discussion. Both semi-structured and open-ended questions were asked during the focus groups, and to protect participants' identity during the focus groups, participants were not called by their given name.

Focus group questions were developed and evaluated by the researcher's supervisory committee members, comprised of hospitality, sustainability, and methodology faculty experts

for content validity and pilot-tested before data collection. Final questions for focus groups included nine questions in two constructs.

Emotion:

1. Tell us your thoughts about food waste issues in the U.S.
2. How much are you concerned about food waste challenge in the U.S.?
3. Have you had situations when you left a lot of food uneaten in a university dining hall or a buffet restaurant? How did this situation make you feel?
4. What does it make you feel when you see others throw away a large amount of food at the end of their meal?

Attitudes:

5. What are consequences of having a large amount of food waste? (If environmental consequences are not mentioned) Tell us your beliefs about impact of food waste on our environment.
6. Who do you think are most responsible for food waste challenges in the U.S.? Why?
7. How much do you think you, individual consumers, are responsible for food waste challenges in the U.S.?
8. How important is it for individuals and foodservice operators to try reducing food waste in the U.S.? Why?
9. What are some strategies that may reduce the food waste challenge in the U.S.?

The focus group discussions were transcribed verbatim and were used to extract themes and sub-themes based on the number of appearances of key words related to attitudes and emotions toward food waste.

## Survey Questions under Each Construct

Based on the literature review and the findings from the focus groups related to attitudes and emotions toward food waste, the survey questions were developed to measure the following variables: participants' emotion, attitudes, and subjective norms toward food waste; food waste behavioral intention; and self-reported food waste behavior. The overall survey followed the framework and question development protocols specified in the theory of reasoned action (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975, 2011) and the emotion-as-feedback theory (Baumeister, Vohs, DeWall, & Zhang, 2007).

All questions measuring emotions, intention, and self-reported food waste behaviors were asked using a five-point Likert-type scale, which ranged from 1 strongly disagree to 5 strongly agree. The same Likert-type scale was used for all direct measures of attitudes and subjective norms. For indirect measures of attitudes and subjective norms, a scale ranging from -2 to 2 was used for outcome evaluation (attitudes) and motivation to comply (subjective norms). Detailed question development procedures are explained below, and the final questionnaire is included in Appendix C.

### *Attitude toward Food Waste*

In general, attitude toward the behavior is a person's overall evaluation of the behavior, which includes behavioral beliefs and the corresponding positive or negative evaluation of the behavior (Ajzen, 1991; Francis et al., 2004). In other words, behavioral beliefs are positive or negative feelings toward a certain behavior and outcome evaluation are perceived benefits and costs of performing a certain behavior, (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975, 2011). For instance, if a person realizes that wasting a large amount of food could negatively influence the environment, he/she may acquire a negative attitude toward food waste behavior.

When measuring attitudes, participants may be asked directly about their attitudes toward a certain phenomenon or indirectly about their behavioral beliefs and outcome evaluations. It is recommended to include both direct and indirect measures within the same construct to increase internal reliability of the measurement (Francis et al., 2004). Therefore, four direct measure questions and three sets of indirect measure questions were asked for participants' attitudes toward food waste. For example, a sample direct measure question asked how much participants agree/disagree that "Food waste is a major issue in the U.S." on a 5-point Likert-type scale.

For indirect measures, three sets of questions toward behavioral beliefs and outcome evaluation were developed. For example, a behavioral belief question, "The food I waste could be used to feed those who are hungry in my community." was paired with an outcome evaluation question, which asked how desirable to feed those who are hungry in their community, on a scale from -2 (extremely undesirable) to 2 (extremely desirable). Each set of indirect measures (the corresponding behavioral belief and outcome evaluation) was used to calculate the attitudes by multiplying the behavioral belief score by the outcome evaluation score. For example, if an individual answered strongly agree (5 points) to behavioral belief question and extremely desirable (2 points) to outcome evaluation question, then he/she will get a score of 10 on that set of indirect measure (5 x 2 = 10). Therefore, the indirect measure of each set of questions ranged from -10 to 10. A positive score represents attitudes in favor of the behavior and a negative score represents attitudes against the behavior while a score of zero represents a neutral attitude (Francis et al., 2004).

***Subjective Norms regarding Food Waste***

Subjective norms are determined by both injunctive and descriptive normative beliefs which infer to what important others want an individual to do or what they would approve or

disapprove of. It also refers to the action of the social referents and the individual's motivation to comply to the norms (Ajzen, 2015). For example, a person's subjective norm regarding food waste may be influenced by what his/her social group approves or disapproves of leaving food waste, the behavior of the social group itself toward food waste, and how motivated this individual is to comply with what others think he/she should do.

Similar to the attitude measurements, subjective norms were also assessed with both direct (six questions) and indirect measurements (three sets of questions) to increase internal reliability (Francis et al., 2004). A direct measure of opinions on food waste from important people was phrased as "It is expected of me that I eat all my food on my plate and not being wasteful.", which was answered on a 5-point Likert-type scale.

Indirect measures included three sets of questions in regards to injunctive or descriptive norms and motivation to comply. A sample question measuring injunctive norms was phrased as "My friends think I should not waste food." or descriptive norm as "My friends do not waste food". An injective or descriptive norm question was paired with a motivation to comply question, which asked how important the individual's friends' opinion is to the individual, from a scale of -2 (strongly disagree) to 2 (strongly agree). Similar to the calculation to attitudes, if an individual answered strongly agree (5 points) to an injunctive/descriptive question and strongly disagree (-2 points) to motivation to comply, a score of -10 was assigned to the particular set of indirect measure. Therefore, the indirect measure of subjective norm ranged from -10 to 10.

It is possible that an individual's friends think he/she should not waste food while this person do not care about that he/her friends think. Under this circumstance, he/she will get a negative score, indicating that even social pressure is strong, the individual's motivation to comply is low. It is only when important others' opinion of food waste is strong and that the

individual cares about what the others think that he/she will receive a high and positive score in the measure of social norms.

***Emotions toward Plate Waste***

Emotion, defined as a mental feeling or affection as distinct from cognitions or volitions (Lindsey, 2005), was used as an additional independent variable to influence diners' plate waste behaviors. People experience different emotions after engaging in different behaviors, and when an unpleasant emotion was experienced, this unwanted emotion may deter people from repeating the same behavior that caused such emotion in the first place (Baumeister et al., 2007). For example, people may feel embarrassed when they throw away or when others see them throw away a large amount of edible food. Therefore, to avoid feeling embarrassed in the future, this individual may change his/her behavior of food waste.

Based on focus groups' findings, we identified specific emotions (i.e., embarrassed, worried, self-conscious, frustrated, annoyed, disappointed, and concerned) toward plate waste and developed eight questions to assess emotions toward plate waste. A sample question was phrased as "When I throw away a large amount of food at the end of my meal, I am embarrassed.", which was answered on a 5-point Likert-type scale, which ranged from 1 being strongly disagree to 5 being strongly agree.

***Behavioral Intention toward Leaving No Plate Waste***

Ajzen (1991) indicated that the measures of behavioral intention need to be compatible with the behavior of interest, and the specified context must be the same as the target behavior. For example, if the target behavior is "to have no plate waste at the end of the meal," then the questions that would need to be asked is "I plan to have no plate waste at the end of the meal," instead of "I plan to not waste food" or "I plan to help preserve the environment". Also, intention

needs to be measured with behavior without the interference of external influencers because interventions (e.g., introducing new information) can lead to changes in behaviors such that the original measure of intention may no longer predict the target behavior (Ajzen, 1985). For example, if an intervention aiming to influence food waste behavior is implemented at the same time as when a survey is launched, it is possible that a participant's intention toward plate waste can no longer predict his/her self-reported plate waste behavior. Therefore, to alleviate this potential issue, a survey assessing food waste intention along with other variables was collected before the intervention week to ensure the measurements were not influenced by external influencers. A total of three questions were developed to measure intention toward plate waste reduction. A sample questions stated "I plan to have no plate waste at the end of my meal.", which was answered on a 5-point Likert-type scale from 1 strongly disagree to 5 strongly agree".

***Self-reported Plate Waste Behaviors***

To evaluate the participants' plate waste behavior, four questions directly asked toward the frequency and amount of an individual's plate waste. Osbaldiston (2013) indicated that questions that ask about general extent or frequency of performing behaviors are too subjective. Researchers do not have any information about what participants are comparing with, or criteria that participants are using when they indicate general frequency. Therefore, responses can be less ambiguous, if the questions were dichotomous and specific. For example, instead of asking "How frequently do you leave food on your plate?" this study asked "Do you always have food left on your plate after finishing your meal?". In addition, to accurately assess how much edible food participants discard at the end of each meal, one question asked diners to indicate "Normally, I have: no plate waste, ¼ of plate waste, ½ of plate waste, ¾ of plate waste, more than one plate of food waste".

### *Demographic Information*

Demographic information including age, gender, academic colleges and major, length of residency in the resident halls, dining frequency in the dining hall, and type of meal plans (14 meals per week or unlimited meals) were asked at the end of the survey. Some of these variables (i.e., gender, academic colleges and major, and length of residency at the resident halls) were used as control variables in model testing.

Once developed, the entire questionnaire was reviewed by a panel of foodservice and sustainability researchers for content validity and usability of the instrument. The questionnaire was revised, as appropriate, based on experts' suggestions prior to the pilot study.

## Pilot Study

One week prior to data collection, a pilot study of the questionnaire was conducted with 20 diners. Participants were approached while they were dining, informed of the pilot study, and asked if they would participate in the pilot study. Pilot study participation was encouraged by providing a free dessert coupon at the university bake shop. Upon agreement, participants received a written statement describing the purpose, importance, and contact information of the researcher and the IRB. Pilot study participants complete the survey and made comments for the researcher regarding clarity of directions, ease of completion, and the flow of the questionnaire. Changes were made on the survey instrument based on the participants' feedback. For example, one of the participants pointed out that the questions asking "I usually think about how much food I can finish and only take what I can eat" was unclear and was potentially asking two different questions. Therefore, the study divided the question into "I usually think about how much food I can finish" and "I usually do not take more food than I can eat". Another participant pointed out that too many questions on one page made it difficult to read and navigate.

Therefore, the longer pages in the survey were broken down with fewer questions per page to ensure ease of completion.

## Data Collection

After the pilot study, survey information (i.e., URL and QR Code) was distributed in the study facility one week prior to the plate waste study. Students were offered a small piece of paper with the information at the checker stands when they checked in to the dining center. They were informed that their participation was voluntary and anonymous and were instructed to either type in the survey URL or to scan the QR code to access the survey online. Participation on the survey was encouraged with a one-dollar cash payment, which was provided to those participants who showed their completed survey confirmation page to the researcher.

## Data Analysis

Before analyzing survey responses, all negatively worded questions such as "Throwing away food at the end of my meal does not bother me" were reverse coded into the largest number (5) reflecting the most positive emotion toward food waste reduction. The scores of each set of indirect measures were computed using SPSS (version 26), by multiplying the two scores within each set of indirect measure. Then, descriptive statistics were computed to identify the participants' demographic characteristics and correlations among variables using SPSS. Cronbach's alpha reliability coefficient was utilized to determine the consistency of each scale ($\alpha > .7$).

Mplus was utilized to conduct structural equation modeling (SEM) among the exogenous variables (attitudes, subjective norms and emotions), an endogenous variable (self-reported food waste behavior), and a mediator (intention). A good model fit was determined with RMSEA value smaller than .05, CFI and TFI values above .95, SRMR values below .1, and $\chi^2$ being

nonsignificant. A path analysis was then used to test the hypothesized associations among different variables with a significant level setting at $p < .05$. Bootstrapping procedures were used to test the indirect effects from emotions, attitudes, and subjective norms, to self-reported food waste behavior, via its effect through the proposed mediator of behavioral intention. A total of 2,000 bootstraps were conducted on this model. Significant indirect effects were interpreted when the 90% confidence interval for the bootstrapped indirect effects did not include a zero (Preacher & Hayes, 2008).

## Study 2: Assessment on Food Waste Amounts and An Intervention of Weighing Individual Plate Waste and Displaying Average and Accumulative Plate Waste with Factual and Emotional Messages Related to Food Waste

### Intervention

A quasi-experimental design was applied to evaluate the impact of the intervention on plate waste behavior by 1) weighing individual plate waste 2) displaying average and accumulative plate waste amounts, and 3) displaying factual and emotional messages related to food waste. This intervention aimed to influence diners' attitudes, awareness, subjective norms, and emotions toward food waste with the ultimate goal to reduce food waste.

During the intervention week, a digital scale was introduced at the tray return area to weigh edible plate waste to the nearest gram. This step was intended to influence diners' awareness and subjective norms. The amount of beverage waste was not assessed in this study due to the fact that beverages are not discarded in landfills like other solid waste. Before placing trays on the tray belt, diners were asked to separate edible food from non-edible food items such as fruit peels, bones, napkins, and food packages. The edible food was then discarded to a

collection bucket which was placed on a scale, while the rest was discarded to another collection bucket without assessing the weight.

Each participant was verbally informed of the weight of their individual plate waste, and another researcher entered the weight of the plate waste into a Google spreadsheet, which automatically calculated the average and total plate waste amount for the evening. The calculated average and total weights of the plate waste were updated immediately and livestreamed on a projected screen in the dining room, which was highly visible to the rest of the diners. This step intended to influence diners' awareness and subjective norms related to food waste. However, the amount of individual plate waste was not displayed publicly to make sure participants were not embarrassed by letting others know about the specific amount of individual plate waste.

Next to the display of plate waste amounts, several rotating informative messages with pictures intending to influence the diners' awareness, emotions, attitudes, and subjective norms toward food waste were also displayed (Appendix D). The examples of factual messages were "Derby donates unconsumed leftover foods to local breadbasket" (attitude), "Collectively, Derby wasted X lbs. of food during dinner yesterday (awareness), which was enough to feed at least X people" (attitude), "Over X% of Derby diners have zero edible plate waste" (subjective norm), and "You can help Derby to reduce food waste by only taking the amount you can finish" (attitudes). In addition to the rotating messages, a hungry child's picture or pictures of food waste in landfill were shown on the screen to influence diners' emotions toward food waste (Figure 3.1).

**Figure 3.1.** Screenshots of plate waste amounts and messages displays

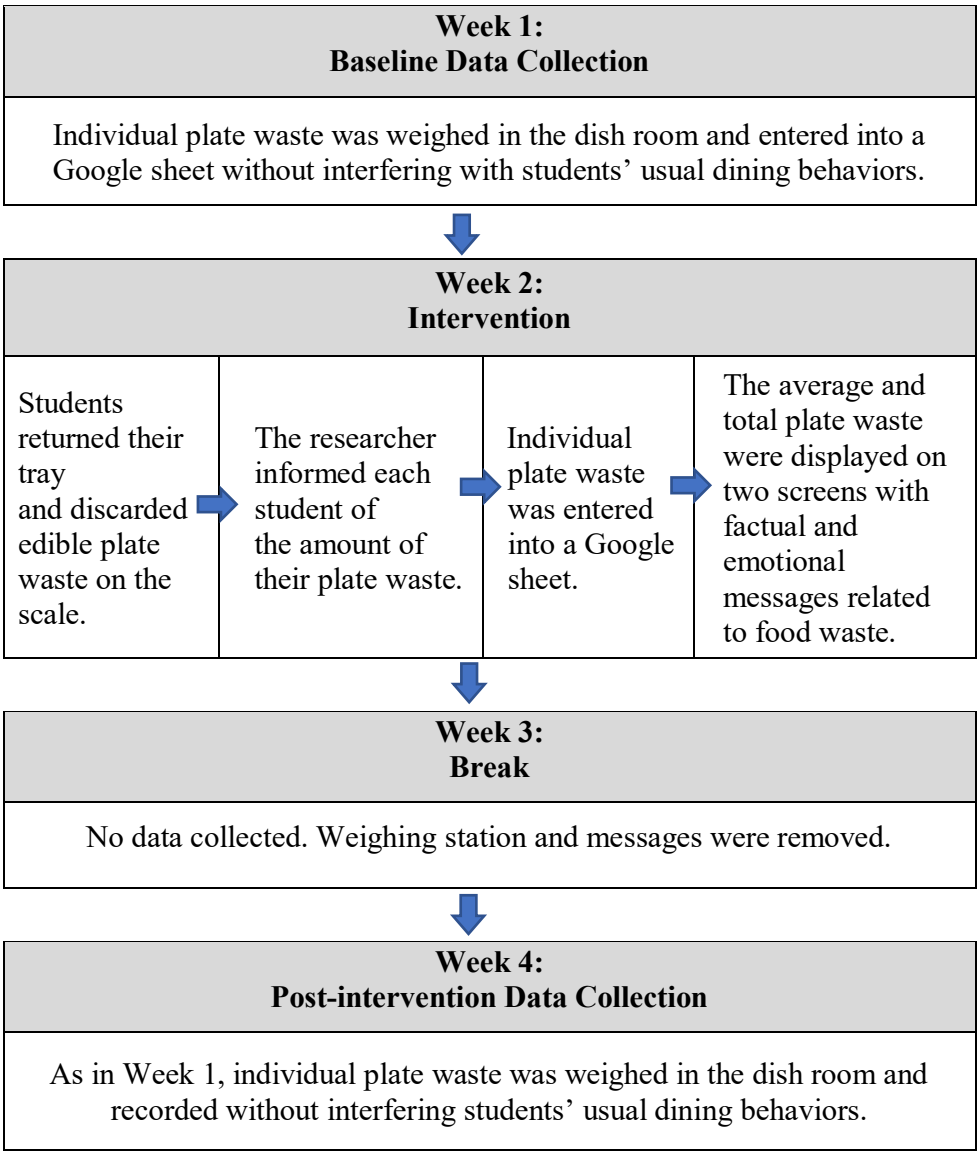


## Overall Data Collection Plan

A data collection protocol was developed to evaluate the influence of the intervention, which targeted college diners' attitudes, subjective norms, and emotions on actual plate waste behaviors. The study was conducted over a 4-week period in April 2019. In the first week, the researcher and an assistant weighed the plate waste in the dish room without letting college diners know about the data being collected. In the second week, the aforementioned intervention

was implemented and plate waste data was collected in front of diners. A week-long break was taken in the third week to test the lasting effect of the intervention. Finally, data collection resumed in week four, similar to the week one, when plate waste data was collected in the dish room without notifying patrons. The overall data collection protocol is depicted in Figure 3.2.

**Figure 3.2.** Data collection procedures



## Pilot Study

The logistics of data collection and intervention implementation was examined to ensure the efficiency of logistics and feasibility. One week before the data collection, two researchers set up a weighing station and collected plate waste in the dish room to establish plate waste recording protocols. To avoid disclosing the methodology to diners and to keep the purpose of the study confidential, no intervention was set up in front of students for pilot testing. Instead, electronic systems (a digital weighing scale, two computers, and one projector) were set up and tested for weighing and message displaying before the dining center opened. Other logistics (e.g., wait time at the tray return area, the visibility of the projecting screen, and the cooperation of multiple researchers at the data collection site) were discussed and evaluated by hospitality management professors and foodservice professionals in the dining center prior to finalizing the protocol.

## Data Collection

After verifying the logistics through the pilot study, data collection began in the week of April 8th, 2019. Following the aforementioned data collection protocols, plate waste data were collected either in the dish room without participants' knowledge or at the tray return area during the intervention. Data collection was conducted during a four-week period on Monday, Wednesday, and Friday when the menu patterns were consistent, with a one week break between the weeks 2 and 4.

### Baseline Plate Waste Data Collection (Week 1)

During Week 1, students dined in the facility as usual without the presence of researchers and assistants, and all dining procedures remained unchanged. Students finished their meals and returned their trays to the tray return area as usual. Individual plate waste and accumulated plate

waste were measured in the dish room without interfering with the students' usual dining activities or tray return procedures.

**Intervention and Data Collection (Week 2)**

A quasi-experimental design was applied to evaluate the effectiveness of the intervention that was intended to reduce edible plate waste. The intervention was implemented following the aforementioned intervention protocol. To briefly summarize the intervention, diners discarded edible plate waste in a bucket placed on top of a weighing scale and were verbally informed by a researcher of his/her plate waste amount. In addition, the average and total amounts of plate waste as well as food waste related messages were livestreamed on two large screens, highly visible to all diners.

**A Week-long Break from Data Collection (Week 3)**

To test the lasting effect of the intervention, no data collection or intervention occurred during Week 3. It was assumed that diners' plate waste behavior was significantly influenced by the presence of researchers, the weighing station, and the messages displayed during intervention week. Without the influence of the external stimulation, diners may return back to their usual plate waste behavior in the weeks to come. To examine the lasting impact of the intervention, instead of collecting post-intervention data soon after the intervention, a week-long break was placed between intervention week and post-intervention data collection. During week 3, all researchers, computers, projectors, the digital scale, and the plate waste collection buckets were removed and all dining procedures returned to its usual setting.

**Post-intervention Data Collection (Week 4)**

The post-intervention plate waste study for both individual and collective plate waste was conducted behind the scenes in the dish room, similar to Week 1 of data collection. All dining procedures remained usual and diners were not informed about their plate waste being recorded.

## Data Analysis

To analyze actual plate waste amounts, Microsoft Excel was used to clean and compile all plate waste data collected. All individual plate waste amounts, which were recorded in grams, before, during, and one-week after intervention was compiled into a single file in Excel before being imported into SPSS (version 26). Descriptive statistics of plate waste amounts were computed by using SPSS. Differences in plate waste amounts before, during, and after the intervention (weeks 1, 2, and 4) were analyzed using ANOVA with Tukey's post hoc analysis. To identify patterns and compare patrons leaving various amounts of plate waste before, during, and after the intervention, different amounts of plate waste were divided into five categories with a hundred grams increment per category (0g, 1-100g, 101-200, 201-300g, 300g or more). Then, cross-tabulation with $\chi^2$ analysis was conducted to evaluate the differences in distribution of diners discarding varying amounts of plate waste among the four-week period. The significance of statistical analyses was set at $p < .05$.

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# Chapter 4 - Exploring College Students' Plate Waste Behavior: An Application of the Theory of Reason Action and Emotion


## Abstract

This study explored the associations among attitudes, subjective norms, emotions, and intention toward food waste reduction, as well as self-reported food waste behavior in a college dining facility. A total of 450 college diners were recruited for an online survey. Descriptive statistics and structural equation modeling were utilized to analyze the data. The results indicated that diners' intention toward food waste reduction fully mediated the three pathways from attitudes ($b$ = .07, $p$ < .01, CI 90% [.04, .10]), subjective norms ($b$ = .05, $p$ < .05, CI 90% [.01, .10]), and emotions ($b$ = .15, $p$ < .01, CI 90% [.11, .21]) to self-reported food waste behaviors. Diners who reported strong attitudes, subjective norms, and emotions toward food waste also reported high scores on food waste reduction behaviors through the indirect effects of high intention to reduce food waste. The findings of this research contributed to existing consumer behavior literature by examining human emotions as a determinant of sustainable behavior. Researchers and practitioners may use these results to better understand and influence consumer food waste behavior to reduce edible food waste.


## Introduction and Literature Review

### The Challenge of Environmental Sustainability

Environmental sustainability, which focuses on maintaining and improving the integrity of the earth's life supporting systems, has become a challenge due to the society's infinite pursuit of economic development (Moldan, Janouskova, & Hak, 2012). The climate change resulting from increasing methane, carbon dioxide, and nitrous oxides emission is one of many examples

of how human activities negatively influence the environment (Environmental Protection Agency, 2010). More than 52% of the 262 million tons of municipal solid waste generated in the U.S. ended up in landfills in 2015, creating the third biggest source of methane emission as they are decomposed (Environmental Protection Agency, 2018; Food and Agriculture Organization of the United Nations, 2013).

## Hospitality Industry's Impact on Environmental Sustainability

The hospitality industry, one of the biggest employers and fastest-growing sectors in the U.S., has a significant impact on environmental sustainability. The foodservice industry alone generates more than $899 billion in sales and offers over 15 million positions for the labor market (National Restaurant Association, 2020). While the foodservice industry contributes greatly to the nation's economic growth, it also impacts the well-being of the natural environment.

The generation of food and water waste and air pollution, along with excessive usage of energy and water are common issues that affect the environment negatively. For example, hotels generate an average of 1.22kg of solid waste including food waste, plastic, and paper waste per guest per day (Abdulredha et al., 2018). In addition, a restaurant uses five times more energy per square foot per year than other commercial operation (Jeong, 2010), making the restaurant industry the largest energy user among retail operations (National Restaurant Association, 2019). Also, commercial and onsite foodservice operations are one of the largest sources of food waste in the U.S. (Food and Agriculture Organization of the United Nations, 2013). Approximately, 40 million tons of food waste was generated in 2015, which made up over 15% of total municipal solid waste in the U.S. (Environmental Protection Agency, 2018). Considering the significant impact that the hospitality industry has on the environment, more actions and initiatives may be

needed for hospitality operations to pursue environmental sustainability.

## Food Waste Challenges

Food waste related to retailers' and consumers' behavior occurs at the end of the food chain in retail operations and final consumption by consumers. It is measured only for products that are directed to human consumption, excluding feed and parts of products which are not edible (Food and Agriculture Organization of the United Nations, 2012). Globally, about one third to one half of the total amount of food produced for human consumption is lost or wasted, which amounted from 0.4 to 0.65 billion tons, yearly (Food and Agriculture Organization of the United Nations, 2014). The significant amount of lost and wasted food comes at a steep environmental expense because land and water quality and quantity are adversely affected (Environmental Protection Agency, 2018).

Food waste generated from commercial and onsite foodservice operations made up a significant portion of total food waste in the U.S. (Food and Agriculture Organization of the United Nations, 2013). It was estimated that plate waste in university foodservice facilities is estimated to be over 1 billion pounds per year (Vogliano & Brown, 2016). University dining facilities generate a large amount of food waste partially due to its large scale of food production and the patrons' over estimation of the amount of food they can consume (Vogliano & Brown, 2016). Many of these dining facilities offer an all-you-care-to-eat buffet dining service, which may cause patrons to take more food than they can finish. As a result, the large amount of food waste has inspired many management teams in university dining facilities to take actions to address food waste issues. Some of these actions taken to reduce food waste include educating diners (Whitehair, Shanklin, & Brannon, 2013), reducing portion sizes, (Freedman & Brochado, 2010), and adopting trayless dining (Aramark, 2008; Thiagarajah & Getty, 2013; Whitehair et

al., 2013).

## Understanding Consumers' Food Waste Behaviors

It is important to understand the contributing factors to consumers' food waste behavior in order to effectively reduce food waste. A number of theories have been used in the past to understand sustainable behaviors. For example, Schwartz's theory of altruism (1977) contends that pro-environmental behavior is more likely to take place if an individual is aware that his/her lack of actions to protect the environment may negatively affect other people, and the individual ascribes responsibility to him/herself for the deteriorating environmental conditions. In other words, pro-environmental behavior is likely to occur in response to the awareness of consequences and personal moral norms. Other social-psychological theories suggested that attitudes, beliefs, and norms had a significant impact on behaviors (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975, 2011; Stern, 2000; Stern, Dietz, Abel, Guagnano, & Kalof, 1999). For example, the theory of reasoned action (TRA) and the theory of planned behavior examined attitudinal factors, personal and social norms to explain a variety of behaviors and behavioral intention. Both theories posit that behavioral intention, which is the immediate antecedent of behavior, is influenced by the individual's attitudes toward the target behavior and the subjective norms the individual experiences (Ajzen, 1985, 1991). Perceived behavioral control, added by Ajzen (1985, 1991) as an additional behavioral antecedent in the theory of planned behavior, took the influence of resources and opportunities for performing a certain behavior into account. This study adopted the TRA as the theoretical support, even though the theory of planned behavior includes an additional variable that explains behavioral intention and subsequent behavior. The rationale for such decision was that perceived behavioral control accounts for the influence of external resources or barriers on performing a certain behavior. Because the dining center where

data collection took place offers an all-you-care-to-eat buffet service, and diners have the liberty to select the types and the amount of food and to leave any amount of plate waste on their plates; it was determined that perceived behavior control has a very limited role explaining the target behavior. The setting of the current study had limited influence of external barriers or resources on food waste behavior.

## Theory of Reasoned Action

Previous studies reported that consumers' food waste behavior (Stancu, Haugaard, & Lahteenmaki, 2016; Stefan, Herpen, Tudoran, & Lahteenmaki, 2013) was predicted by attitudes, subjective norms, and intention toward food waste reduction behaviors. The TRA suggested that people's behavioral intention is determined by their attitudes and subjective norms, which ultimately influences their actual behaviors (Fishbein & Ajzen, 1975; Fiske & Taylor, 1991). The following section explains each component is the theory in detail.

### *Attitudes*

Fishbein and Ajzen (1975) explained that behavioral beliefs, defined as the beliefs and evaluation toward likely outcomes of a certain behavior, influenced the individual's attitudes toward the target behavior. Beliefs form the foundation of attitudes, which can be explained by the expectancy-value model (Ajzen, 2015). According to the expectancy-value model, beliefs are formed by associating performance of a certain behavior with specific outcomes, which will then be valued as positively or negatively (Ajzen, 2015). Consequently, individuals acquire a positive or negative attitude toward a certain behavior; and the stronger the attitude, the stronger the intention to perform or not to perform the behavior (Fishbein & Ajzen, 1975; Ajzen, 1991).

For example, a sustainable diner may believe that not wasting food and taking only the amount of food that can be finished (the behavior) helps to reduce food waste and protect the

environment (an outcome). If the outcome associated with the behavior is viewed positively by an individual, he/she would acquire a strong positive attitude toward the behavior. In other words, people generate positive attitudes toward a certain behavior that promotes desirable outcomes and negative attitudes toward a behavior that leads to undesirable outcomes (Fishbein & Ajzen, 1975, 2011).

### *Subjective Norm*

Subjective norms are determined by both injunctive normative beliefs and descriptive normative beliefs (Fishbein & Ajzen, 1975, 2011). Injunctive normative beliefs infer to what important others want an individual to do or what they would approve or disapprove of, while descriptive normative beliefs infer to the action of social referents (Ajzen, 2015). Subjective norms, therefore, reflect both the perceived social pressure of engaging in a certain behavior and the individual's motivation to comply with the social pressure, as well as the behaviors of this social group (Graham et al., 2015). People tend to be influenced by important others to whom they are close, which could be a spouse, a relative, a close friend, a coworker, or depends on the social context, a health professional or a superior (Fishbein & Ajzen, 1975, 2011).

To illustrate, a person's food waste behavior could be influenced by what his/her important social group thinks about the food waste behavior, the food waste behavior of the social group, and this individual's motivation to comply under the pressure of the social norms. An individual's motivation to comply to the norms is crucial in the effect of subjective norms upon food waste behavior. An important reason why sustainable behavior sometimes does not take place may be that the individual lacks the motivation to comply, even if his/her social group thinks engaging in sustainable behavior is important.

### *Intention*

One of the dependent variables in the TRA is the intention to perform a certain behavior. Intentions are assumed to capture the motivational factors that influence a behavior (Ajzen, 1985, 1991). They are indications of how far a person is willing to go, how hard he/she is willing to try, and how much time and effort he/she plans to exert in order to perform the behavior (Ajzen, 1991). As a general rule, the stronger the attitude and subjective norms, the stronger the intention to engage in a behavior, and the more likely a person would perform the target behavior (Fishbein & Ajzen, 1975, 2011). According to the TRA, an individual's intention not to waste food depends on his/her attitudes toward food waste, the food waste norms of an individual's social groups, and his/her motivation to comply to the social pressure.

## Emotions

One of the biggest assumptions of the TRA is that individuals make rational and reasoned decision (Fishbein & Ajzen, 1975, 2011). However, people sometimes engage in behaviors before rationalization. Therefore, non-cognitive determinants of behaviors such as emotions may also play an important role in influencing consumers' behaviors. As a result, in addition to attitudes and subjective norms, emotions should be considered to better understand consumer behavior (Baumeister, Vohs, DeWall, & Zhang, 2007; DeWall, Baumeister, Chester, & Bushman, 2016; Lindsey, 2005; Russell, Young, Unsworth, & Robinson, 2017).

Emotion is defined as a mental feeling or affection as distinct from cognitions or volitions (Lindsey, 2005). People conduct certain behaviors to gain favorable emotion and avoid behaviors to eliminate experiencing undesirable emotions (Baumeister et al., 2007). For example, people may feel embarrassed when others see them throw away a large amount of edible food. Therefore, to avoid feeling embarrassed in the future, this individual may change his/her

behavior toward food waste. A study conducted in the UK (Russell et al., 2017) reported that participants who experienced more negative emotion when thinking about food waste show stronger intention to reduce their food waste. Based on previous studies, this study applied the TRA and added an extra behavioral antecedent of emotions to better understand consumers' food waste behaviors.

## Current Study

It is postulated that consumers' food waste behaviors may be influenced by their attitudes, subjective norms, emotions, and intention toward food waste reduction (Baumeister et al., 2007; Fishbein & Ajzen, 1975; Fiske & Taylor, 1991; Lindsey, 2005; Stancu et al., 2016; Stefan et al., 2013; Webb & Sheeran, 2006). However, the settings of these studies mainly took place in retail operations (Baumeister et al., 2007; Webb & Sheeran, 2006) or in individual households (Stancu et al., 2016; Stefan et al., 2013), which have different characteristics from the setting of onsite foodservice operations, such as university dining centers. In addition, although there are a handful of studies examined food waste behaviors in university dining centers (Aramark, 2008; Freedman & Brochado, 2010; Kallbekken & Salen, 2013; Thiagarajah & Getty, 2013), limited studies provided or specified theoretical structure used in their study, resulting in a lack of theoretical support. Therefore, this study adopted a modified TRA model which utilized attitudes, subjective norms, as well as emotions toward food waste to predict diners' intention toward food waste reduction and their self-reported food waste behaviors (Figure 4.1).

<Insert Figure 4.1 Here>

While variables in the TRA were used to understand consumer behaviors, the associations of these variables toward food waste in a university dining setting, as well as

specific associations between emotion and food waste behaviors have not been fully explored. Therefore, this study examined behavioral intention as well as self-reported food waste behaviors (dependent variables) and factors that might affect these dependent variables including attitudes, subjective norms, and emotions toward food waste in a university dining setting. In specific, the following null hypotheses were tested to explore associations among the aforementioned variables:

*$H_0$1: There will be no association between diners' attitude and intention toward food waste reduction.*

*$H_0$2: There will be no association between diners' subjective norms and intention toward food waste reduction.*

*$H_0$3: There will be no association between diners' emotions and intention toward food waste reduction.*

*$H_0$4: There will be no association between diners' intention toward food waste reduction and self-reported food waste behavior.*

*$H_0$5: Diners' intention toward food waste reduction will not mediate the association between attitude toward food waste and self-reported food waste behavior.*

*$H_0$6: Diners' intention toward food waste reduction will not mediate the association between subjective norms toward food waste and self-reported food waste behavior.*

*$H_0$7: Diners' intention toward food waste reduction will not mediate the association between emotions toward food waste and self-reported food waste behavior.*

# Methodology

## Population and Sample

The target population of this study was college students who attend colleges or universities in the U.S. and eat most of their meals in on-campus dining facilities. The study sample included college students who consumed most of their meals at a dining center of a university, located in the Midwest region of the U.S. The facility where data collection took place, operates as an all-you-care-to-eat cafeteria. Diners are offered a tray to collect their entrees

and side dishes. The total number of residents who have access to the study facility is approximately 2,000. The survey was conducted on a voluntary basis, and to conduct structural equation modeling with variables of interest, the target sample size for the survey was determined to be 440 diners.

## Instrument Development

To assess college diners' attitudes, subjective norms, emotions, and intention toward food waste reduction, as well as self-reported food waste behavior, the survey instrument was developed based on a literature review and data collected from focus groups. Once developed, the instrument was reviewed by foodservice and sustainability researchers and pilot tested prior to data collection. Prior to data collection, the approval to use human subjects in research was obtained from the Institutional Review Board (IRB) at Kansas State University.

### Focus Groups

The purpose of the focus groups was to assess diners' different emotions and attitudes toward food waste for the purpose of constructing reliable survey questions. A total 24 individuals were recruited to participate in one of three focus groups. They were at least 18 years of age, lived in the surrounding resident halls, and consumed most of their meals at the dining center where data collection was conducted.

The focus group participants were recruited purposefully to include diners who had no edible plate waste and diners who had a large amount of edible plate waste in the tray return area. Three focus groups with eight individuals each took place in a section of the dining center that was reserved for meetings and events. During the focus groups, the participants were not called by their given name to protect their identity and confidentiality. They were also informed that they could leave at any time if they felt they were unable to continue the discussion.

Permission was sought to record the audio of the focus group discussion and both semi-structured and open-ended questions were asked during the focus groups.

### Survey Questions under Each Construct

Based on the literature review and the findings from the focus groups, the survey questions were developed to measure specific constructs: participants' emotion, attitudes, and subjective norms toward food waste; intention to reduce food waste; and self-reported food waste behavior. The overall survey followed the framework and question development protocols specified in the theory of reasoned action (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975, 2011) and the emotion-as-feedback theory (Baumeister et al., 2007).

All questions directly measuring attitudes, subjective norms, emotions, intention, and self-reported food waste behaviors were asked using a five-point Likert-type scale from 1 (strongly disagree) to 5 (strongly agree). For indirect measures of attitudes and subjective norms, a scale ranging from -2 (extremely undesirable) to 2 (extremely desirable) was used for outcome evaluation (attitudes) and motivation to comply (subjective norms). The scores of each set of indirect measures were computed by using SPSS (version 26), multiplying the two scores within each set of indirect measures. All negatively worded questions were reverse coded into the largest number 5 reflecting the strongest attitudes against food waste, the strongest subjective norms and emotions toward food waste reduction, the highest intention to reduce food waste, or the most positive self-reported food waste reduction behavior. Detailed question development procedures are explained below, and the final questionnaire is included in Appendix C.

#### *Attitude toward Food Waste*

In general, attitudes toward the behavior is a person's overall evaluation of the behavior, which includes behavioral beliefs and the corresponding positive or negative evaluation of the

behavior (Ajzen, 1991; Francis et al., 2004). In other words, behavioral beliefs are positive or negative feelings toward a certain behavior, and outcome evaluation is perceived benefits and costs of performing a certain behavior, (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975, 2011). For instance, if a person realizes that wasting a large amount of food could negatively influence the environment, he/she may acquire a negative attitude toward food waste behavior.

When measuring attitude, participants may be asked directly about their attitudes toward a certain phenomenon or indirectly about their behavioral beliefs and outcome evaluations. It is recommended to include both direct and indirect measures within the same construct to increase internal reliability of the measurement (Francis et al., 2004). A total of four questions were used to directly measure attitudes toward food waste, and a sample question was phrased as "Food waste is a major issue in the U.S.", which was answered on a 5-point Likert-type scale. In addition, three sets of indirect measurement questions toward behavioral beliefs and outcome evaluation were asked. For example, a behavioral belief question, "The food I waste could be used to feed those who are hungry in my community." was paired with an outcome evaluation question, which asked how desirable to feed those who are hungry in their community, on a scale from -2 (extremely undesirable) to 2 (extremely desirable). Each set of indirect measures (the corresponding behavioral belief and outcome evaluation) were used to calculate the attitudes by multiplying the behavioral belief score by the outcome evaluation score. For example, if an individual answered strongly agree (5 points) to the behavioral belief question and extremely desirable (2 points) to the outcome evaluation question, then he/she will get a score of 10 on that indirect measure (5 x 2 = 10). Therefore, the total range of the indirect measures was from -10 to 10. A positive score represents attitudes in favor of the behavior and a negative score represents attitudes against the behavior, while a score of zero represents a neutral attitude (Francis et al.,

2004). Because attitudes toward food waste were measured with both direct and indirect questions, this variable was evaluated as a latent variable to reduce measurement errors under statistical analyses.

***Subjective Norms toward Food Waste***

Subjective norms are determined by both injunctive and descriptive normative beliefs, which infer to what important others want an individual to do or what they would approve or disapprove of. It also refers to the action of the social referents and the individual's motivation to comply to the norm (Ajzen, 2015). For example, a person's subjective norm of food waste could be influenced by what his/her social group approves or disapproves of related to food waste, the behavior of the social group itself toward food waste, and also how motivated this individual is to comply with what others think he/she should do.

Similar to the measurement of attitude, subjective norms were also assessed with both direct (six questions) and indirect measurements (three sets of questions) to increase internal reliability (Francis et al., 2004). A direct measure of opinions on food waste from important people was phrased as "It is expected of me that I eat all my food on my plate and not being wasteful.", which was answered on a 5-point Likert-type scale. Indirect measures included injunctive or descriptive norms and motivation to comply. A sample question measuring injunctive norms was phrased as "My friends think I should not waste food." An injunctive or descriptive norm question was paired with a motivation to comply question, which asked how important a friend's opinion is to the individual, from a scale of -2 (strongly disagree) to 2 (strongly agree). Similar to indirect attitude measurement calculation, the value from the 5-point scale for an injunctive/descriptive question was multiplied by the value from motivation to comply, ranging from -10 to 10. A positive score represents a strong social pressure and the

likelihood of an individual to comply and a negative score represents an individual either experiences a weak social pressure, or his/her unwillingness to comply, while a score of zero represents an insignificant social pressure (Francis et al., 2004). It is possible that an individual's friends think he/she should not waste food while this person does care about that his/her friends think. Under this circumstance, he/she will get a negative score, indicating that even social pressure is strong, the individual's motivation to comply is low. It is only when important others' opinion of food waste is strong and the individual cares about what the others think that he/she will receive a high and positive score in the measure of social norms. Similar to attitudes toward food waste, subjective norms were also measured with both direct and indirect questions. Overall subjective norms toward food waste was evaluated as a latent variable to reduce measurement errors under statistical analyses.

***Emotions toward Plate Waste***

Emotion, defined as a mental feeling or affection as distinct from cognitions or volitions (Lindsey, 2005), was used as an additional independent variable to determine its influence on diners' plate waste behavior. People experienced different emotions after engaging in different behaviors, and when an unpleasant emotion was experienced, this unwanted emotion may deter people from repeating the same behavior that caused such emotion from the first place (Baumeister et al., 2007). Based on focus groups' findings, we identified specific emotions (i.e., embarrassed, worried, self-conscious, frustrated, annoyed, disappointed, and concerned) toward plate waste. For example, some participants identified the emotion of embarrassment when they threw away or when others saw them threw away a large amount of edible food. Therefore, to avoid feeling embarrassed in the future, they changed their behavior of food waste so that they would not feel embarrassed. Eight questions to assess emotions toward plate waste were

developed based on the feedback from the focus groups. A sample question was phrased as "When I throw away a large amount of food at the end of my meal, I am embarrassed."

***Behavioral Intention toward Leaving No Plate Waste***

Ajzen (1991) indicated that the measures of behavioral intention need to be compatible with the behavior of interest, and the specified context must be the same as the target behavior. For example, if the target behavior is "to have no plate waste at the end of the meal", then the questions need to be stated as "I plan to have no plate waste at the end of the meal" (instead of "I plan to not waste food" or "I plan to help preserve the environment"). Also, intention needs to be measured with behavior without the interference of external influencers because such influencers (e.g., introducing new information) can lead to changes in behaviors such that the original measure of intention may no longer predict the target behavior (Ajzen, 1985). For example, if an intervention aiming to influence food waste behavior is implemented at the same time when a survey is delivered, it is possible that a participant's intention toward plate waste no longer predicts his/her self-reported plate waste behavior. Therefore, the researchers made sure the survey data was collected prior to any food waste reduction intervention. Three questions were developed to measure intention toward plate waste reduction and one of the sample questions was "I plan to have no plate waste at the end of my meal."

***Self-reported Plate Waste Behaviors***

To evaluate the participants' plate waste behavior, four questions asked directly toward the frequency and amounts of an individual's plate waste. Osbaldiston (2013) indicated that questions that ask about general extent or frequency of performing behaviors are too subjective. Researchers do not have any information about what participants are comparing with or criteria that participants are using when they indicate general frequency. Therefore, responses can be less

ambiguous, if the questions were dichotomous and specific. For example, instead of asking "How frequently do you leave food on your plate?" this study asked "Do you always have food left on your plate after finishing your meal?". In addition, to accurately assess how much edible food participants discard at the end of each meal, one question asked diners to indicate "Normally, I have: no plate waste, ¼ of plate waste, ½ of plate waste, ¾ of plate waste, more than one plate of food waste".

***Demographic Information***

Demographic information including age, gender, academic colleges and major, length of residency at the resident halls, dining frequency in the dining hall, and type of meal plans (14 meals per week or unlimited meals) were asked at the end of the survey. Some of these variables included gender, academic colleges and major, and length of residency at the resident halls were used as control variables in the model testing.

## Pilot Study

One week prior to survey data collection, a pilot study of the questionnaire was conducted with 20 diners. Participants were approached while they are dining, informed of the pilot study, and asked to participate. Participation in the pilot study was encouraged by a free dessert coupon at the university bake shop. Upon agreement, participants received a written statement, which described the purpose, importance, and contact information about the study. They completed the survey and provided the researcher with comments on clarity, ease of completion, and the flow of the questionnaire. Changes such as the sequence of questions and choice of words were made on the survey instrument based on the participants' feedback.

## Data Collection

To assess diners' emotions, attitudes, subjective norms, and intentions toward food waste reduction, as well as self-reported food waste behaviors, a survey was distributed in the study facility. Students were offered a small piece of paper with a survey URL and a QR code at the checker stands when they checked in to the dining center. They were informed about the voluntary basis of the survey and assured of the anonymous nature of the survey. Participation on the survey was encouraged with a one-dollar cash payment, which was provided to those participants who showed their completed survey confirmation page to the researcher.

## Data Analysis

Descriptive statistics were computed to identify the participants' demographic characteristics and summarize the data. Pearson bivariate correlations among variables were run using SPSS (version 26). Cronbach's alpha reliability coefficient was utilized to determine the internal consistency of each construct, where acceptable alphas were interpreted when $\alpha > .70$.

Structural equation modeling (SEM) among the exogenous variables (attitudes, subjective norms and emotions), endogenous variables (self-reported food waste behavior), and a mediator (intention) were run using Mplus. Good model fit was determined with RMSEA value < .05, CFI and TLI values > .95, SRMR values < .1, and $\chi^2$ being insignificant. A path analysis was then used to test the hypothesized associations among different variables with a significance level setting at $p < .05$. Bootstrapping procedures were used to test the indirect effects from emotions, attitudes, and subjective norms, to self-reported food waste behavior, via its effect through the proposed mediator of behavioral intention. A total number of 2,000 bootstraps were conducted in this model. Significant indirect effects were interpreted when the 90% confidence intervals for the bootstrapped indirect effects did not include zero (Preacher & Hayes, 2008).

# Results

## Descriptive Statistics

A total of 450 university diners participated in the self-administered survey. On average, the participants were 19 years old with the majority (84%) between 18 to 20 years. More female patrons participated in the survey (54%) compared to the male participants (44%). Most of these diners had either a 14-meals-per-week meal plan (48%) or an unlimited access meal plan (43%), while only a few (9%) held off-campus meal pass because they did not live in the residence halls. For the majority of the participants (64%), it was their second semester dining in the facility when data collection took place. In addition, a total of 267 (59%) participants reported that they ate twice a day in the dining center (Table 4.1).

<Insert Table 4.1 Here>

## Measurement Reliability and Correlations between Variables

Pearson bivariate correlation coefficients between two of all variables and Cronbach's alpha are presented in Table 4.2. The correlations between direct and indirect measure of attitudes ($r = .61$, $p < .01$) and subjective norms ($r = .54$, $p < .01$) were high, indicating close associations of including both direct and indirect measures under these two constructs. Participants' intention to reduce food waste had a high correlation with their emotions toward food waste ($r = .62$, $p < .01$), indicating the stronger the emotions they experienced toward food waste, the more likely they present positive behavior intention toward reducing food waste. Participants' intentions to reduce food waste also was moderately correlated with their attitudes (direct: $r = .39$, $p < .01$; indirect: $r = .49$, $p < .01$) and subjective norms (direct: $r = .37$, $p < .01$; indirect: $r = .40$, $p < .01$) toward food waste.

<Insert Table 4.2 Here>

Participants who reported high frequencies of not wasting food had also reported a moderate to strong intention to reduce food waste ($r = .55$, $p < .01$), moderate attitudes (indirect, $r = .35$, $p < .01$), social norms (direct, $r = .33$, $p < .01$), and emotions ($r = .44$, $p < .01$) toward food waste. All associations among evaluated variables showed a statistically significance level of $p < .01$. Consistent with previous studies that evaluated the associations among attitudes, subjective norms, and intention toward food waste reduction behavior, as well as self-reported food waste behavior (Stancu et al., 2016; Stefan at al., 2013), we found that the participants' attitudes, subjective norms, and emotions toward food waste was significantly associated with their intention not to waste food. Also, participants' food waste reduction intention was significantly associated with their self-reported food waste behaviors.

Cronbach's alpha scores for all the scales, except self-reported food waste behavior, were greater than 0.7, indicating good internal consistencies. The high Cronbach's alpha scores among attitudes, subjective norms, and emotions toward food waste as well as intention to reduce food waste showed consistent responses across different participants on the scales that measured the aforementioned variables. On the other hand, to evaluate the reliability of the self-reported food waste behavior measurement, an exploratory factor analysis was conducted. All questions under this construct showed as one factor with an average inter-item correlation of $M = 0.3$. This is an acceptable range of inter-item measure, where a correlation from 0.15 to 0.50 is the acceptable level (Piedmont & Hyland 1993). This result indicated that, even though Cronbach's alpha was < 0.70, the questions under this construct were considered measuring the same construct and complemented each other in determining different aspects of self-reported food waste behavior.

After the examination of measurement reliability, the overall means of each variable were computed. The mean score of direct measure for attitude was 3.89 ($SD = 0.89$), indirect measure

for attitude 5.61 (*SD* = 3.60), direct measure for subjective norms 3.34 (*SD* = 0.75), indirect measure for subjective norms 1.88 (*SD* = 3.73), emotions 3.68 (*SD* = 0.74), intention toward food waste reduction 4.08 (*SD* = 0.86), and self-reported food waste behavior 3.96 (*SD* = 0.63).

All the direct measures had a scale from 1 (strongly disagree) to 5 (strongly agree), with 3 being neutral. Therefore, the means from direct measures indicated that the participants held a somewhat strong attitude against food waste, experienced somewhat strong emotions and social norms toward food waste, had high intentions to reduce food waste, and reported high frequencies of not wasting food themselves. Meanwhile, all indirect measures had a range from negative 10 to positive 10, with high negative scores indicating strong attitudes in favor of food waste, weak social norms and the individual's unwillingness to comply to the norms, while a high positive score indicating strong attitudes against food waste, strong social norms and a high likelihood of the individual complying to the norms. The results from the indirect measures indicated that participants had medium to strong attitudes against food waste, experienced low to medium social norms, but lacked motivations to comply to the norms. Detail information on means scores regarding each survey question is included in Appendix C.

## Model Fit

This study used the construction of two latent variables of attitudes and subjective norms toward food waste, and three observed variables of emotions and intentions toward food waste reduction, as well as self-reported food waste behavior to test structural equation modeling. This model was created with latent and observed variables predicting one another and included control variables of gender, affiliated colleges, and length of dining experience entered to all endogenous variables. The proposed model was a good fit to the data [$\chi 2(178) = 450.19$, $p < .05$; RMSEA = .05 (90% CI .05, .06); CFI = .93; SRMR = .05]. Standardized factor loadings of

attitudes toward food waste ranged from .43 to .84, and subjective norms toward food waste ranged from .26 to .71, indicating both of these variables could be measured adequately as latent variables (Figure 4.2).

<Insert Figure 4.2 Here>

## The Test of the Structure Model

Results from the structural equation modeling indicated that a higher score on diners' attitudes toward food waste was significantly associated with a higher score on intention to reduce food waste ($b = .21$, $p < .01$, $\beta = .24$). A higher score on diners' subjective norms toward food waste was significantly associated with a higher score on intention to reduce food waste ($b = .15$, $p < .01$, $\beta = .14$). Also, a higher score on diners' emotions toward food waste was significantly associated with a higher score on intention to reduce food waste ($b = .49$, $p < .05$, $\beta = .42$) while controlling for gender, college affiliation, and length of dining experience for the aforementioned variables. Therefore, null hypotheses 1 to 3 were rejected. In addition, null hypothesis 4 was also rejected because a higher score of intention to reduce food waste was significantly associated with a higher score on self-reported food waste reduction behavior ($b = .32$, $p < .05$, $\beta = 43$).

The pathway from subjective norms to intention toward food waste reduction had a small effect size while the pathway from attitudes to intention toward food waste reduction had a medium effect size. Also, the pathways from emotions to intention toward food waste reduction and from intention toward food waste reduction to self-reported food waste behavior had a large effect size (Cohen, 1992; Table 4.3). Attitudes, subjective norms, and emotions toward food waste along with control variables explained 47.6% of the variance in intention toward food

waste reduction, and the aforementioned variables explained 37.1% of the variance in self-reported food waste behavior.

<Insert Table 4.3 Here>

The bootstrapped indirect effects from attitudes to self-reported food waste behavior via its effect through intention to reduce food waste was significant ($b$ = .07, $p$ < .01, CI 90% [.04, .10]), indicating that one unit increase in attitudes toward food waste was associated with a .07 unit increase in self-reported food waste reduction behavior. Also, indirect effects from subjective norms to self-reported food waste behavior via its effect through intention to reduce food waste was significant ($b$ = .05, $p$ < .05, CI 90% [.01, .10]), indicating that one unit increase in subjective norms toward food waste was associated with a .05 unit increase of self-reported food waste reduction behavior. The indirect effects from emotions to self-reported food waste behavior via its effect through intention to reduce food waste was also significant ($b$ = .15, $p$ < .01, CI 90% [.11, .21]), indicating that one unit increase in emotions toward food waste was associated with a .15 unit increase of self-reported food waste reduction behavior (Table 4.4). Diners' intention toward food waste reduction fully mediated all three indirect effect paths. Therefore, null hypotheses 5 to 7 were rejected.

<Insert Table 4.4 Here>

## Discussion

By evaluating both traditional cognitive factors such as attitudes and subjective norms and a less studied factor of emotions in relation to food waste reduction intention, the current study evaluated a comprehensive model of self-reported food waste behavior. The results of this study showed that university diners' attitudes, subjective norms, and emotions toward food waste

predicted their intention toward food waste reduction, which ultimately predicted their self-reported food waste behavior.

### Attitudes

Diners' attitudes including their behavioral beliefs and outcome evaluation toward food waste positively associated with their intention to reduce food waste. These associations indicated that participants who had better realization of their behavioral outcome and were more in favor of food waste reduction also had a higher intention to reduce their food waste. There findings were consistent with the theory of reasoned action model (Fishbein & Ajzen, 1975; Fiske & Taylor, 1991) and previous studies on food waste behaviors (Stancu et al., 2016; Stefan at al., 2013), which reported significant association among consumers' attitudes and intention toward food waste reduction.

### Subjective Norms

Diners' subjective norms including injunctive and descriptive norms, as well as motivation to comply were also positively associated with their behavioral intention. Even though the overall subjective norms showed significant associations with intention to reduce food waste, the coefficient and significance level was not as high compared to other predictors of behavioral intention. This could be explained by evaluating the direct and indirect measure of subjective norms. Participants in this study reported high expectation of them to not waste food from their social groups (direct measure $M = 3.34$). However, when taken participants' motivation to comply with these social norms in consideration, the overall score of the indirect measure was relatively low ($M = 1.88$). For example, one of the direct measure questions asked "My family think I should not waste food." ($M = 4.08$) and an indirect corresponding question asked whether the family of the participants' opinion is important to them ($M = 0.68$). The result

of these corresponding questions indicated that the participants might have experienced a somewhat strong social pressure toward not wasting food from their family. However, the participants of this study lacked the motivation to comply with the norms or considered the expectations from their family irrelevant or unimportant.

This result may explain why SEM analysis showed significant but weak association between subjective norms and intention to reduce food waste. The weak association could be due to the relatively low scores on indirect subjective norm measures being even out by the higher scores on direct subjective norm measures. Similar findings between subjective norms and intention were reported in previous studies. Several researchers (Armitage & Conner, 2001; Conner & Armitage, 2002) suggested that the normative construct of subjective norms in the theory of reasoned action was often not as a strong predictor of intention compared to other antecedents, especially in the food research domain. Another research examining consumers' food waste behavior at home even reported that the subjective norms of disapproval toward food waste did not show significant results toward food waste reduction intention and behavior (Stefan at al., 2013).

Emotions toward food waste were positively associated with diners' intention toward food waste reduction. Participants in this study reported strong emotions such as the feeling of embarrassment, frustration, and disappointment toward leaving food waste. Strong emotions toward food waste has showed to be highly correlated and significantly predicted the participants' intention to reduce food waste. Only a handful of research has examined emotions in regard to consumers' food waste behavior and different direction of associations were found among emotions, behavioral intention, and self-reported behavior. For example, a study conducted with British consumers (Russell et al., 2017) reported that negative emotions toward

food waste had a positive association with the intentions to reduce food waste, consistent with results from this study. However, negative emotions, which resulted in a greater intention to reduce food waste in Russell et al. (2007) did not lead to improving the subsequent food waste behavior, indicating that negative emotional experiences did not translate into food waste reduction behavior despite participants' intention to do so. This finding was different from the current study, which reported a significant and positive association between emotions and self-reported food waste reduction behavior via full mediation of food waste reduction intention.

Other studies examined moral attitudes which were similar to emotions and reported different findings in terms of the association among moral attitudes, behavioral intention, and self-reported behaviors. Stefan at al., (2013) reported that consumers' moral attitudes, such as the feeling of guilt when consumers discard food, showed significant associations with intention not to waste food and self-reported food waste reduction behavior. However, a later study conducted by Stancu et al., (2016) found that moral attitudes and norms were not significantly associated with food waste reduction intention. These varying results of emotions toward food waste reduction intention and behavior indicated the need for further research.

### Intention to Reduce Food Waste

As many researchers assumed, diners' intention to reduce food waste significantly predicted self-reported food waste behavior. Participants who reported high intention to reduce food waste had also reported that they wasted less food. This result was consistent with our expectation based on the theory of reasoned action (Fishbein & Ajzen, 1975; Fiske & Taylor, 1991). However, a handful of studies failed to reveal significant associations between intention and behavior (Stefan at al., 2013), and some even reported negative associations between intention and self-reported behavior (Russell et al., 2017) or intention and actual behavior

(Belanger & Kwon, 2016), indicating the inconsistency between people's behavioral intention and self-reported behavior or actual behavior.

In this study, diners' intention to reduce food waste was found to be fully mediating all three indirect effect paths from attitudes, subjective norms, and emotions to self-reported food waste behavior, suggesting the significant impact of behavioral intention on behavior. This result indicated that diners' attitudes, subjective norms, and emotions did not directly influence their self-reported food waste behavior. Instead, the aforementioned variables were only able to impact food waste behavior through the effect of their intention to reduce food waste.

## Implications

The findings of this study contributed to both existing literature and the foodservice industry. First, only a handful of researches had examined emotions as a predictor of behavioral intention and behavior, and the predictability and directions of associations of emotions on behavioral intention and behavior varied. This study indicated that emotion was a significant predictor of self-reported food waste behavior via its fully mediated indirect effect of behavioral intention. Specifically, strong emotions toward food waste positively predicted consumers' intention to reduce food waste and their self-reported food waste reduction behaviors. Therefore, by adding in the antecedent of emotion, this study more adequately evaluated the psychological antecedents of food waste behavior and provided additional theoretical supports to existing literature related to consumer behaviors pertaining to food waste.

In addition, the significant findings of attitudes, subjective norms, and emotions toward intention to reduce food waste and self-reported food waste behavior provided guidance and support to practitioners who aim to influence their customers' food waste behavior and eventually to reduce food waste. Interventions target to influence consumers' attitudes, to apply

strong subjective norms, and to stimulate consumers' emotional reaction toward food waste may be effective in changing consumers' food waste behaviors. For example, foodservice operations may influence their consumers' attitudes toward food waste by putting out tables tents or posters to inform and educate about food waste. They may also apply strong social norms to consumers by weighing and showing individual and accumulative plate waste amounts in a public setting. To trigger strong emotional responses, foodservice operations may display messages and pictures related to food waste challenges.

## Limitations and Future Studies

Although this study included a variety of factors that may influence diners' food waste behaviors, other influencers such as knowledge of food waste challenges, motivation to avoid food waste, and food waste habit may also have potential influences on consumers' food waste behavior (Aschemann-Witzel, De-Hooge, Amani, Bech-Larsen, & Oostindjer, 2015; Russell et al., 2017). Furthermore, consumers' cultural backgrounds, genders, and perception on convenience to reduce food waste may also play a role in their food waste behaviors (Koivupuro et al., 2012). Therefore, future studies may evaluate the aforementioned factors along with variables in the TRA to examine interactions among different variables and different effects they may have on consumers' food waste behaviors.

In addition, because data collection occurred at only one university dining facility located in the Midwest region of the U.S., the findings of this study may not be generalizable to all university dining facilities due to differences in operational constructs and diversity of other communities. Future studies may recruit more participants from multiple university dining facilities that operate under different structures to overcome limited generalizability issues. For example, participants may be recruited from university dining centers that offer all-you-care-to-

eat dining services and dining facilities that offer order-off-the-menu dining services to compare and contrast different food waste behaviors under different dining settings.

Also, using self-reported data only from a single time assessment may result in researcher bias and social desirability bias. Although this study kept the participants anonymous and distributed surveys online to try and limit social desirability bias, participants might have felt pressure to answer questions in a socially acceptable manner regardless of their true feelings toward an issue or topic. Therefore, several strategies are suggested to reduce social desirability bias. First of all, researchers need to avoid phrasing survey questions in a way that reflect more socially desirable attitudes, behaviors, or perceptions (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). In addition, researchers could employ the technique of indirect questioning, which is asking the participants to answer questions from perspective of another person or group, to mitigate the effect of social desirability (Fisher, 1993). Also, asking participants to rate the desirability of each item or including a social desirability scale in the survey may help detect social desirability bias issues (Nederhof, 1985). Furthermore, pairing survey responses with actual behavior to capture a more accurate picture of consumer behavior may be beneficial rather than solely relying on self-reported data.

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## Tables and Figures

**Table 4.1.** Descriptive statistics of respondents (N = 450).

| | N | Percent (%) |
|---|---|---|
| **Age** | | |
| 18 years | 90 | 20 |
| 19 years | 214 | 48 |
| 20 years | 70 | 16 |
| 21 years | 38 | 8 |
| 22 years or over | 38 | 8 |
| **Gender** | | |
| Male | 197 | 44 |
| Female | 241 | 54 |
| Other | 6 | 1 |
| Prefer not to disclose | 6 | 1 |
| **Affiliated College** | | |
| Agriculture | 86 | 19 |
| Architecture, Planning, and Design | 10 | 2 |
| Arts and Sciences | 101 | 22 |
| Business Administration | 64 | 14 |
| Education | 35 | 8 |
| Engineering | 77 | 17 |
| Human Ecology | 61 | 14 |
| Veterinary Medicine | 4 | 1 |
| Other | 12 | 3 |
| **Type of Meal Plan** | | |
| 14 meals/week | 217 | 48 |
| Unlimited | 192 | 43 |
| Off-campus meal pass | 41 | 9 |
| **Frequency of Dining Experience** | | |
| Once a day | 68 | 15 |
| Twice a day | 267 | 59 |
| Three times a day | 95 | 21 |
| More than three times a day | 20 | 4 |
| **Length of Dining Experience** | | |
| One semester | 26 | 6 |
| Two semesters | 286 | 64 |
| Three semesters | 11 | 2 |
| Four semesters | 64 | 14 |
| Five semesters | 5 | 1 |
| Six or more semesters | 58 | 13 |

**Table 4.2.** Correlations and descriptive statistics among attitudes, subjective norms, emotions, and intention toward food waste reduction, as well as self-reported food waste behavior (N = 450).

| Variables | M (SD) | α | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|
| 1. Attitudes (Direct) | 3.89 (0.89) | .80 | – | | | | | | |
| 2. Attitudes (Indirect) | 5.61 (3.60) | .73 | .61** | – | | | | | |
| 3. Subjective Norms (Direct) | 3.34 (0.75) | .75 | .35** | .28** | – | | | | |
| 4. Subjective Norms (Indirect) | 1.88 (3.73) | .80 | .36** | .33** | .54** | – | | | |
| 5. Emotions | 3.68 (0.74) | .82 | .39** | .51** | .53** | .49** | – | | |
| 6. Intention | 4.08 (0.86) | .85 | .39** | .49** | .37** | .40** | .62** | – | |
| 7. Self-reported Food Waste Behavior | 3.96 (0.63) | .63 | .21** | .35** | .33** | .28** | .44** | .55** | – |

*$p < .05$. **$p < .01$. ***$p < .001$ (two-tailed).

**Table 4.3.** Unstandardized, standardized, and significance levels (standard errors in parentheses; N = 450).

| *Parameter Estimate* | *Unstandardized* | *Standardized* | *p* |
|---|---|---|---|
| Structural Model | | | |
| Attitudes → Intention | .21 (.06) ** | .24 | .00 |
| Attitudes → Food Waste Behavior | .04 (.04) | .06 | .37 |
| Subjective Norms → Intention | .15 (.09) ** | .14 | .00 |
| Subjective Norms → Food Waste Behavior | .08 (.06) | .10 | .19 |
| Emotions → Intention | .49 (.08) ** | .42 | .00 |
| Emotions → Food Waste Behavior | .08 (.06) | .10 | .17 |
| Intention → Food Waste Behavior | .32 (.05) ** | .43 | .00 |
| Gender → Intention | -.11 (.05) * | -.08 | .04 |
| Gender → Food Waste Behavior | -.10 (.04) * | -.11 | .02 |

*Note:* For all control variables including gender, affiliated college, and length of dining experience, only significant associations are shown here. ** $p < .01$. * $p < .05$ (one-tailed).

**Table 4.4.** Mediating effects with attitudes, subjective norms, and emotions as independent variables, intention as mediators, and food waste behavior as the outcome variable. Bootstrap analyses of the magnitude and significance of mediating pathways (standardized solution; N = 450).

| Predictor | Mediator | Outcome | *b* | CI | *β* |
|---|---|---|---|---|---|
| Attitudes → | Intention → | Food Waste Behavior | .07** | .04, .10 | .10 |
| Subjective Norms → | Intention → | Food Waste Behavior | .05 * | .01, .10 | .08 |
| Emotions→ | Intention → | Food Waste Behavior | .15** | .11, .21 | .18 |

*Note:* Indirect paths tested with 2,000 bootstraps. CI = 90% confidence interval, unstandardized. *$p < .05$. ** $p < .01$ (one-tailed).

**Figure 4.1.** The impact of attitudes, subjective norms, emotions, and intentions toward food waste reduction on self-reported food waste behaviors (A modified TRA model).

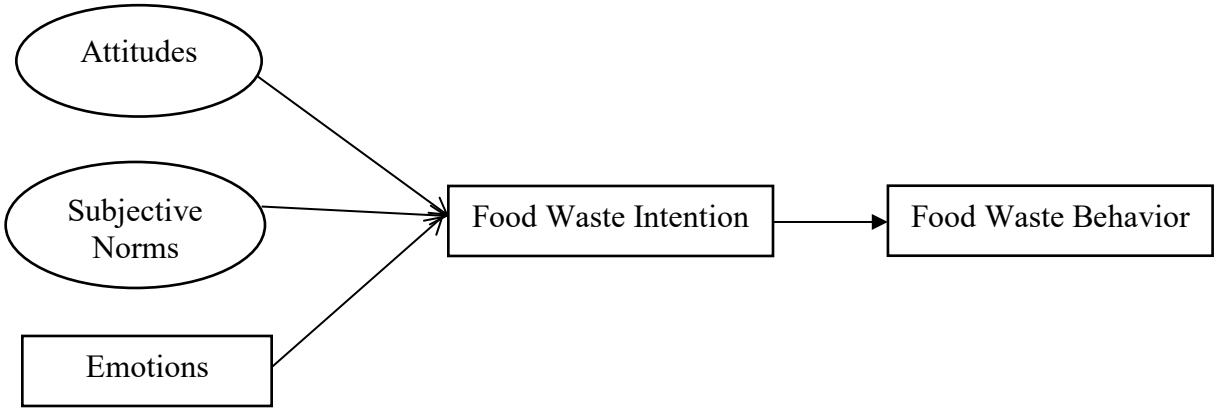
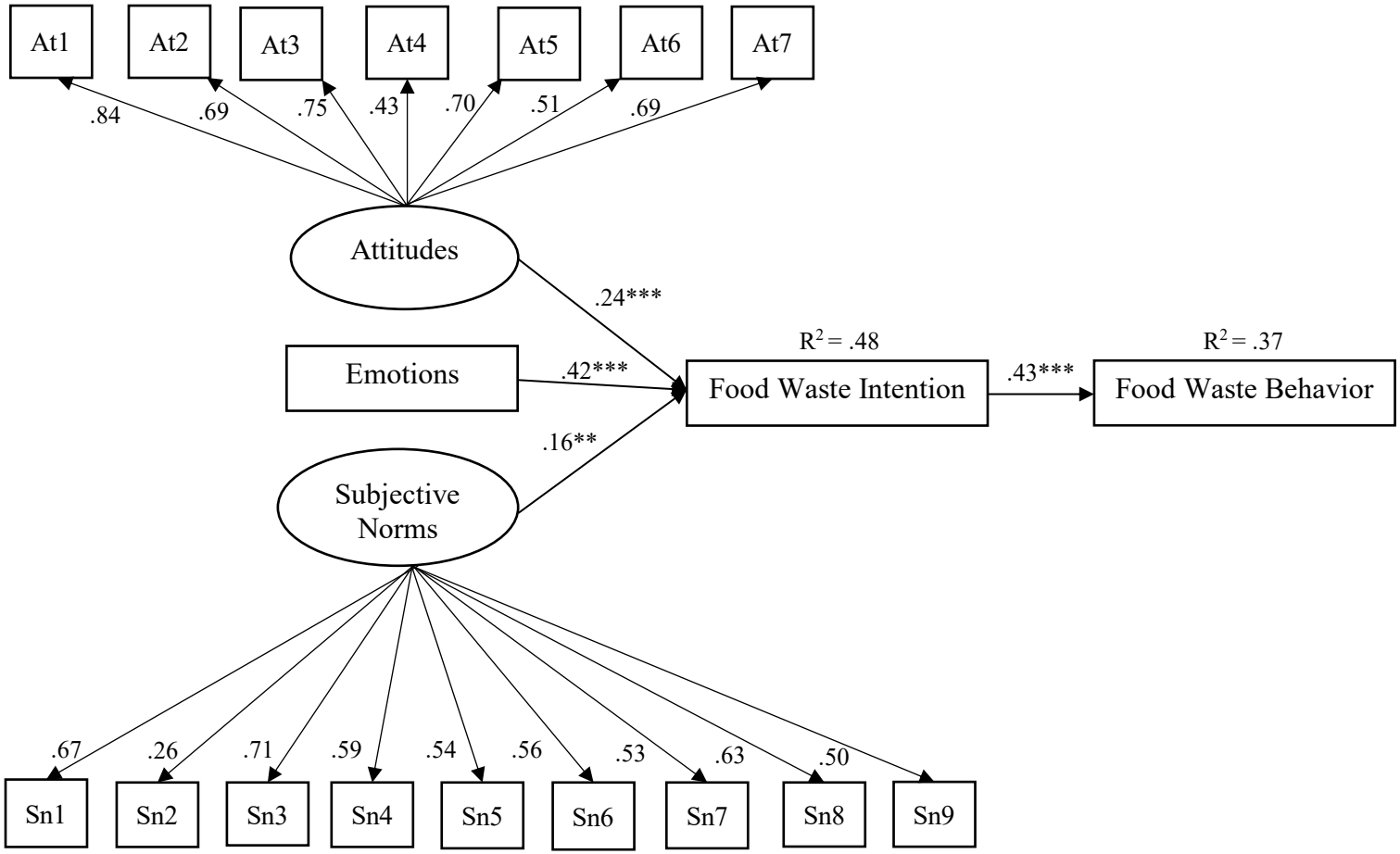


**Figure 4.2.** Structure model of attitudes, subjective norms, emotions, and intentions toward food waste on self-reported food waste behaviors.




*Note:* This analysis also controlled for several variables, including gender, affiliated college, and length of dining experience. These control variables are not shown here to ease the interpretation of the primary model. At1 to At7 are items from attitudes scale; and Sn1 to Sn9 are items from subjective norms scale. *$p < .05$. ** $p < .01$. *** $p < .001$ (one-tailed).

# Chapter 5 - Effectiveness of Plate Waste Reduction Intervention: Weighing Plate Waste and Displaying the Amounts of Waste and Food Waste Related Messages


## Abstract

This study assessed the effectiveness of displaying plate waste amounts and messages related to food waste challenges on college students' plate waste behavior. Baseline plate waste data was collected without notifying diners, followed by a week-long intervention where researchers weighed and verbally informed each diner the amount of his/her plate waste. Additionally, in the dining room, two digital projectors livestreamed the average and accumulated plate waste for each dinner period and displayed food waste related messages with an intention to influence diners' awareness, attitudes, subjective norms, and emotion. Post-intervention data was collected after a one-week break. Descriptive statistics, ANOVA, and cross-tabulation analysis were conducted to analyze food waste data. The total numbers of trays evaluated before, during, and after the intervention were 2,220, 1,927, and 2,017. The results indicated that the amounts of food waste were significantly reduced during and after the intervention (i.e., before: 47.03 ± 68.15, during: 37.06 ± 68.63, and after: 38.88 ± 68.40, $F = 12.76$, $p < .05$). Furthermore, more diners left no plate waste during (60.3%) and after the intervention (48.1%) than at the baseline (31.6%, $\chi^2(8) = 391.49$, $p < .05$). Although average plate waste increased after the intervention, the increase was insignificant ($p > .05$). By implementing the intervention, this study successfully documented improvements in college diners' plate waste behavior. Researchers and practitioners may use these results to better understand and influence diners' plate waste behavior to reduce edible plate waste.

# Introduction and Literature Review

## Food Waste Challenges in the U.S.

Each year, more than 250 million tons of municipal solid waste is generated in the U.S., and more than 50% of this waste is discarded in landfills (Environmental Protection Agency [EPA], 2018). One of the main components contributing to municipal solid waste is food waste, which amounted over 40 million tons and made up 15% of total municipal solid waste generated in the U.S. in 2017 (Environmental Protection Agency, 2019). On average, each American discards approximately 250 pounds of food per year or 0.7 pounds per day (Environmental Protection Agency, 2019). Globally, 30-50% of the total food produced for consumption, reaching 1.3 billion tons, is lost or wasted each year (Food and Agriculture Organization of the United Nations, 2014). This significant amount of lost and wasted food represents a missed opportunity to feed the growing world population. It also comes at a steep environmental expense such as the compromise of land and water quality and biodiversity (Environmental Protection Agency, 2018). Specifically, food waste places a severe burden on environmental wellbeing because biodegradable waste, like food waste in the landfill, produces a significant amount of methane, making methane emission from landfills the third largest human related methane emission (Food and Agriculture Organization of the United Nations, 2013).

## Interventions to Reduce Plate Waste

The United States Department of Agriculture estimated that 133 billion pounds of food, equivalent to about 141 trillion calories, were lost in 2010 at the retail and consumer levels in the U.S. (Buzby, Farah-Wells, & Hyman, 2014). Food loss represents the amount of edible food that is available for human consumption but is not consumed for reasons such as cooking loss, natural shrinkage, plate waste, and loss from mold, pests, or inadequate climate control (Buzby et al.,

2014). Commercial and onsite foodservice establishments including restaurants, caterers, hospitals, sports stadiums, and educational institutions contribute significantly to plate waste or edible portions of post-consumption food waste, partly due to customers being served more than they can consume (Vogliano & Brown, 2016). Many colleges and universities offer buffet-style dining to satisfy diverse customers. However, this system may lead to a significant amount of plate waste due to consumers' over estimation of the amount of food they can eat (Whitehair, Shanklin, & Brannon, 2013). The amount of plate waste in university foodservice facilities is estimated to be over 1 billion pounds per year (Vogliano & Brown, 2016), and it is considered one of the largest sources of avoidable food waste (Roe et al., 2018). Understanding the amount, composition, and patterns of plate waste in university dining centers may provide key insights for addressing the issue of large amount of avoidable consumer level food waste in universities.

To reduce plate waste, a variety of interventions, including increasing awareness of food waste, reducing portion sizes, and adopting trayless dining have been implemented at university dining facilities. For example, some university dining centers attempted to reduce plate waste by creating awareness of food waste (Manomaivibool, Chart-asa, & Unroj, 2016; Whitehair et al., 2013). A simple, to-the-point, prompt-type message ("All Taste No Waste" followed by the statement "Eat What You Take, Don't Waste Food") developed by Whitehair et al (2013) stimulated a 15% reduction in food waste. Similarly, Manomaivibool et al. (2016) found that informing students by placing stickers with food ordering tips, reminding diners to finish what they had ordered, and placing posters and banners with messages and images to elicit a pro-environmental norm, were effective in changing students' food waste behaviors.

Other researchers suggested that reducing portion sizes (Freedman & Brochado, 2010) resulted in reduced consumption and food waste. These researchers revealed that students were

not aware of the portion size changes when the changes were gradual and therefore, had consumed and wasted less food. Furthermore, reducing the portion sizes gradually did not negatively impact customer satisfaction (Freedman & Brochado, 2010).

There are also a number of researchers evaluated the effectiveness of trayless dining on reducing food waste (Aramark, 2008; Thiagarajah & Getty, 2013, Whitehair et al., 2013). Traditionally, cafeteria or buffet services, including university dining centers, have provided trays to patrons for carrying food items they selected. By removing trays, patrons were forced to carry plates or food containers by hand, making it difficult to select multiple items at one time. Researchers postulated that by preventing customers from carrying a large quantity of food which they may not be able to consume, implementing trayless dining would reduce food waste. Specifically, Aramark (2008) reported that after implementing trayless dining, food waste was reduced by 25-30%, which is equivalent to 1.2-1.8 ounces per person. Furthermore, trayless dining reduced food cost and promoted sustainability awareness of diners (Babich & Smith, 2010; Thiagarajah & Getty, 2013; Wansink, Just, & Shimizu, 2011).

## Factors Affecting Consumers' Food Waste Behavior

### Awareness

While some researchers explored mechanisms by which plate waste may be reduced, others aimed to influence consumers' sustainable behaviors (Heberlein, 2012; Kaiser, Hubner, & Bogner, 2005; Stern, 2000). Awareness, attitudes, subjective norms or social pressure, and emotions were associated with sustainable behaviors in previous studies (Fishbein & Ajzen, 1975; Stern, Dietz, Abel, Guagnano, & Kalof, 1999; Whittaker, Vaske, & Manfredo, 2006). Understanding these factors may help explain the reasons behind sustainable behaviors and therefore, allow researchers to develop specific interventions to reduce food waste.

To effectively reduce food waste, it is important to understand the contributing factors to consumers' food waste behavior. Awareness of consequences of a behavior is one of the ultimate predictors of sustainable behavior (Kaiser et al., 2005). A person's sense of obligation to protect the environment is triggered by his/her self-ascribed responsibility, awareness of consequences of a behavior, and his/her ecological worldview (Kaiser et al., 2005). For example, a person may consider throwing away edible food will negatively influence the environment (awareness of the behavioral consequence) if his or her view on food waste that goes into landfill being negative (ecological worldview). At the same time, based on the person's awareness of behavioral consequences and worldview, he/she may feel responsible to reduce food waste in order to help preserve the environment (i.e., self-ascribed responsibility and sense of obligation to act). Stern et al. (1999) reported that awareness and sense of obligations to alleviate environmental problems accounted for 19% of the variance explained in consumer sustainable behaviors.

In fact, researchers found that increasing diners' awareness about food waste challenges alone reduced the amounts of plate waste in university dining facilities (Manomaivibool, Chart-asa, & Unroj, 2016; Whitehair et al., 2013). By conveying information about the significance of food waste issues (i.e., utilizing table tents that contained food waste statistics) and suggesting ways for diners to help reduce food waste (i.e., informing diner to "take what you can eat, and eat all you take"), college dining researchers were able to reduce the amount of food waste by 15% (Whitehair et al., 2013).

**Attitude**

Behavioral beliefs and attitudes refer to a person's positive or negative perceptions about performing a behavior and the person's evaluations of the consequences (Ajzen, 2015). An individual acquires an attitude toward a certain behavior by associating performance of the

behavior with specific outcomes. For example, a sustainable diner may believe that taking only the amount of food that can be finished (the behavior) helps to preserve the environment (an outcome). If the outcome of the target behavior is viewed positively, he/she would acquire a positive attitude towardtoward this behavior. In other words, people generate positive attitudes toward certain behaviors that promote desirable outcomes and negative attitudes toward behaviors that lead to undesirable outcomes (Fishbein & Ajzen, 1975, 2011). In facts, a number of studies found that people who reported less food waste were also people who held a more positive attitude toward food waste reduction (Stancu, Haugaard, & Lahteenmaki, 2016; Stefan, Herpen, Tudoran, & Lahteenmaki, 2013).

**Subjective Norms**

Although personal beliefs and attitudes toward a certain behavior may play a role in a person's decision to engage in the behavior, a favorable attitude only may not be translated into action because of subjective norms (Fishbein & Ajzen, 1975). Consumers' perceived social pressure to engage in a certain behavior, known as the subjective norms, has been identified as a strong factor that impacts consumers' behavioral intention and subsequent behaviors (Fishbein & Ajzen, 1975; Ajzen, 1991). Subjective norms are determined by injunctive and descriptive normative beliefs (Fishbein & Ajzen, 1975, 2011). Injunctive normative beliefs infer to what important others want them to do or what they would approve or disapprove of, while descriptive normative beliefs infer to the action of social referents (Ajzen, 2015). In other words, an individual's decision to act or not to act could be influenced by whether or not their social group approves of the specific action and also the behavior of the social group. For example, a person's subjective norm of food waste could be influenced by what his/her social group approves or disapproves of food waste and the food waste behavior of the social group. People tend to be

influenced by important others to whom they are close, which could be the spouse, a relative, a close friend, a coworker, or a superior (Fishbein & Ajzen, 1975, 2011). Stancu et al., (2016) and Stefan et al., (2013) found that important social groups, as listed above, had direct impact on an individual's food waste behavior.

**Emotions**

When researching sustainable behaviors, researchers found that emotions played an important role in an individual's decision-making processes (Baumeister, Vohs, DeWall, & Zhang, 2007; DeWall, Baumeister, Chester, & Bushman, 2016; Lindsey, 2005). Because plate waste behavior is one type of sustainable behaviors, influencing diner's emotions may have a potential to influence their behaviors. Consumers acquire an association between a certain emotion they have experienced and a behavior they have conducted, and thus they learn to anticipate emotional outcomes and behave so as to pursue the emotion they prefer (Baumeister et al., 2007). Researchers suggested that people conduct or avoid certain behaviors to gain favorable emotions (e.g., joy and excitement) or avoid undesirable emotions (e.g., regret and guilt; Baumeister et al., 2007). An undesirable emotion, such as the feeling of guilt, is a form of emotional distress that stems from the belief that one may have done something wrong (Baumeister, Heatherton, & Tice, 1994). This feeling of guilt prompts the person to consider what he/she did and think of ways to avoid similar outcomes in the future (Lindsey, 2005). In other words, the feeling of guilt can serve as feedback to the individual so that the individual can avoid engaging in certain behaviors that may trigger the same type of unwanted emotion in the future. Therefore, an intervention which triggers diners' feeling of guilt on wasting food may be an effective strategy to reexamine their food waste behavior, leading them to avoid food waste in the future (Lindsey, 2005).

## Current Study

Although several studies explored different antecedents that may influence consumers' food waste behavior (Russell, Young, Unsworth, & Robinson, 2017; Stancu et al., 2016; Stefan et al., 2013), self-reported food waste behavior was assessed to measure food waste behavior. However, self-reported behaviors often are not consistent with actual observed behaviors (Belanger & Kwon, 2016), and therefore, examining only self-reported food waste behavior may lead to social desirability and other measurement biases. Furthermore, while some food waste studies quantified the amount of food waste reduction, the majority of them did not provide details about their intervention or specify a theoretical underpinning for their interventions (Aramark, 2008; Freedman & Brochado, 2010; Kallbekken & Salen, 2013; Thiagarajah & Getty, 2013), resulting in a lack of duplicability or theoretical support. In addition, only a few known studies examined emotion as a factor influencing consumers' food waste behaviors (Russell et al., 2017; Stefan et al., 2013). Therefore, this study aimed to evaluate the effectiveness of an intervention that was intended to create awareness of plate waste challenges and to influence attitudes, subjective norms, and emotions pertaining to plate waste issues. Specifically, this study (a) assessed actual plate waste behavior, (b) quantified the amounts of plate waste, and (c) evaluated the effectiveness of the intervention by comparing plate waste data at the baseline, during the intervention, and after the intervention.

# Methodology

## Population and Sample

The target population was college diners, and the sample was patrons who dined in a large university dining center, located in the Midwest region of the U.S. The facility where the intervention and data collection occurred was an all-you-care-to-eat cafeteria, serving an average

of 1150 diners each evening from 4:45 pm until 7:30 pm from Monday through Saturday. Historic data at the dining center showed that the majority of the diners consumed their evening meals between 5:00 pm and 6:30 pm (75%) and took an average of 30 to 45 minutes to finish their meals. Therefore, to collect plate waste data from the majority of diners at the facility, data collection was planned between 5:30 pm and 7:00 pm.

Under the usual dining setting, diners were offered a tray to collect their food and beverage items from one of the four serving lines including Classic, Boarders (Mexican and Chinese), Italian, and Deli concepts. As diners went through each serving line, entrees and side dishes were served by dining services employees. Diners were free to re-enter the serving lines as many times as they wish to collect more servings of entrée and side dishes. Additional food items such as salads, cereals, soups, and desserts were located at the center of the dining center, where diners can serve themselves.

## Intervention

A quasi-experimental design was applied to evaluate the effectiveness of the intervention that was intended to reduce edible plate waste by influencing diners' awareness, attitudes, and subjective norm while providing emotional stimuli. During the intervention week, a scale was introduced at the tray-return area to weigh edible plate waste to the nearest gram. Diners discarded edible plate waste in a bucket, placed on a scale, possibly in front of their social group, and each participant was verbally informed of the weight of his/her plate waste. Additionally, the researcher entered the amount (grams) of individual plate waste into a Google sheet, which was used to automatically calculate the average and total amounts of plate waste for the evening. The average and total amounts of plate waste were livestreamed on two large screens, one next to the weighing station and the other in the main dining room, highly visible to all diners. This step was

intended to increase awareness of plate waste amounts and to influence diners' subjective norms. Along with the plate waste amounts, several rotating messages (i.e., statistics of food waste) and photos (i.e., hungry child with impactful messages) were displayed on the same screens to influence attitudes toward food waste, and increase awareness of plate-waste problems and diners' emotional responses (Figure 5.1).

<Insert Figure 5.1 Here>

## Data Collection

Data collection was conducted during a four-week period on Monday, Wednesday, and Friday when the menu patterns were consistent. The data collection was conducted from 5:30 pm to 7:00 pm, when the dining center is busiest with the majority of its diners (75%) based on historical data. Data collection was paused for one week, between weeks 2 and 4 to test the lasting effect of the intervention.

Baseline plate waste data were collected during week 1 in the dish room without interfering with patrons. Patrons dined as usual and were not informed about their plate waste being recorded in the dish room. Two researchers collected and recorded plate waste in the dish room, with one discarding individual plate waste in a collection bucket placed on a digital scale, and the other recording the weight on a laptop computer using Microsoft Excel. The amount of plate waste was weighed to the nearest gram and was recorded in an Excel spreadsheet. The amount of beverage waste was not assessed in this study because beverages were not discarded in landfills like other plate waste.

The intervention took place during week 2, when a scale was introduced, and plate waste amounts and food waste related messages were shown as described in the previous section. Diners discarded their plate waste in a collection bucket and were verbally informed of their

individual plate waste amounts as the researcher entered the amount into the Google sheet. The recorded individual plate waste was used to calculate the average and accumulated plate waste, which were shown on two projecting screens in the dining center. In addition to real-time food waste average and total amount for each evening, five rotating messages with factual (n = 3) and emotional (n = 2) information related to food waste were displayed for seven seconds per each screen (Appendix D).

After the intervention, dining procedures returned to its usual setting in week 3, when no data collection was performed in order to test the lasting effect of the intervention on the amount of plate waste. Patrons dined as usual and all researchers, computers, and projecting screens, as well as the weighing station were removed.

The post-intervention data was collected during week 4 with similar settings compared to week 1. The dining center continued its usual dining procedure without notifying the patrons that their plate waste was weighed. No intervention was conducted, but two researchers weighed individual plate waste in the dish room with a laptop computer to record. A detailed diagram depicting the detailed data collection procedures is illustrated in Figure 5.2.

<Insert Figure 5.2 Here>

## Statistical Analysis

To analyze actual plate waste amounts, Microsoft Excel was used to clean and compile all collected plate waste data. All individual plate waste amount was recorded in grams before, during, and after the intervention and were compiled into a single file in Excel before imported into SPSS. Descriptive statistics of plate waste amounts were computed using SPSS (version 26). Differences in average plate waste amounts before, during, and after the intervention (weeks 1, 2, and 4) were analyzed using ANOVA with Tukey's post hoc analysis. To identify patterns

and compare the number of patrons leaving various amounts of plate waste before, during, and after the intervention, the amount of plate waste left by each patron was grouped into five categories, with a hundred grams increment per category (i.e., 0g, 1-100g, 101-200, 201-300g, 300g or more). The distribution of patrons who left varying amounts of plate waste was analyzed using cross-tabulation with $\chi^2$ analysis to evaluate the differences in distribution patterns among the four-week period. The significance of statistical analyses was set at $p < .05$.

## Results and Discussion

A total of 6,164 trays were collected during the four-week data collection period on Mondays, Wednesdays, and Fridays. The number of trays collected before, during, and after intervention were 2,220, 1,927, and 2,017, respectively. The total amount of plate waste for three days before, during, and after intervention were 230 pounds, 157 pounds, and 173 pounds, respectively. The average plate waste amount per person during the same periods were 47.03 grams ($SD$ = 68.15), 37.06 grams ($SD$ = 68.63), and 38.88 grams ($SD$ = 68.40), respectively.

### Differences in Plate Waste Amounts

To compare the means of plate waste throughout weeks 1, 2, and 4, an ANOVA with Tukey's post hoc analysis was conducted to examine if the average plate waste from these three weeks differed from each other. The results showed a significant difference in the average weight of plate waste throughout the three weeks of data collection ($F(2, 6161) = 12.76$, $p < .05$). Tukey's post hoc analysis revealed that the average plate waste was significantly lower during ($M_{befroe}$-$M_{during}$ = 9.97g, $p < .001$) and after intervention ($M_{befroe}$-$M_{after}$ = 8.15g, $p < .001$), compared to before intervention plate waste data. The reduction of plate waste during the intervention week represents a 21% decrease in the average plate waste during the intervention. On the other hand, the differences of average plate waste between during and after the

intervention was not significant ($M_{after}$-$M_{during}$ = 1.82g, $p > .05$). This result revealed that even though average plate waste had slightly increased after the intervention was removed, the difference was insignificant and negligible.

In summary, ANOVA with post hoc analysis suggested that the average plate waste was reduced during and after the intervention, compared to the baseline. This significant decrease of individual plate waste showed that diners' plate waste behavior was positively influenced by weighing their individual plate waste, showing average and accumulative plate waste amounts, displaying food waste challenges with factual information and emotional pictures.

Similar change of plate waste behaviors was found by previous researchers who adopted varying interventions to influence diners' plate waste behaviors. For example, by adopting trayless dining, Aramark (2008) reported a 25% to 30% reduction. Whitehair et al., (2013) successfully reduced plate waste by 15% by placing table tents to increase plate waste awareness. Freedman & Brochado (2010) decreased plate waste 40% after reducing portion sizes. The current study contributed to existing literature by presenting another potential intervention that may help to reduce plate waste in the future.

## Distribution of Diners Leaving Varying Amounts of Plate Waste

To evaluate potential changes in the patterns of diners leaving varying amounts of plate waste throughout the four-week data collection period, a cross-tabulation with $\chi^2$ analysis was conducted. The result of the analysis (Table 5.1) suggested significant differences in the proportion of diners leaving varying amounts of plate waste ($\chi^2(8) = 91.49$, $p < .05$). First of all, the percentage of diners who left no plate waste was significantly larger during intervention (60.3%), than the baseline (31.6%) and post-intervention (48.1%). Secondly, the percentage of diners who wasted less than 100 grams of food has reduced during intervention (25.6%),

compared to baseline (52.4%) and post-intervention (38.7%). Last, when reviewing the total percentages of diners who left no plate waste or less than 100 grams of plate waste, the percentages of these two categories combined had remained consistent throughout data collection period (84% before, 85.9% during, and 86.8% after). The distribution of diners leaving varying amounts of plate waste is shown in Figure 5.3. This finding postulated that those who were leaving small amount of waste on their plate may have reduced their plate waste to none.

<Insert Table 5.1 Here>

<Insert Figure 5.3 Here>

On the other hand, the cross-tabulation analysis also showed the percentage of diners who wasted 101 grams or more of food was also somewhat consistent before (16.0%), during (14.1%), and after intervention (13.1%). More specifically, an average of 20 trays (21 before, 22 during, and 17 after intervention) had more than 300 grams of edible plate waste, which contributed to the large standard deviations. One of the reasons why some people left a large amount of plate waste regardless of the intervention might be that diners might not be aware of the food waste challenges and continue taking more food than they can finish (Whitehair et al., 2013). Despite the fact that there was a small percentage of diners leaving a large amount of plate waste, the majority of the diners' food waste behavior positively improved.

## Conclusion

This study revealed that making college diners aware of their or their peers' plate waste amounts and significant food waste challenges influenced their plate waste behaviors. Not only has the average and total amount of plate waste reduced, more diners left no plate waste during and after the intervention. More particularly, the intervention included weighing individual plate waste and displaying average and accumulative plate waste with factual and emotional messages

related to food waste. By implementing the intervention designed to influence attitudes, awareness, subjective norms, and emotions toward food waste, this study successfully documented improvements in college diners' plate waste behavior.

This study contributed to current literature by providing theoretical and practical implications about reducing plate waste in university dining facilities. First, to the authors' knowledge, only one previous study has examined emotions as a motivator to understand diners' self-reported food behavior, and no known study utilized emotions to influence actual plate waste behaviors. Even though the direct and separate effect of emotions on plate waste was not solidified in this research, it is possible that the diners' food waste behavior was positively influenced by seeing pictures such as food waste in landfills and hungry kids that were designed to trigger their emotional response. In other words, the evaluation of emotions on plate waste behaviors may provide additional theoretical supports to existing behavioral theories when studying sustainable behaviors. Practitioners may adopt similar interventions to influence attitudes, subjective norms, and emotions toward food waste, as well as to increase the awareness of plate waste challenges and therefore, reduce the amounts of plate waste in their operations.

## Limitations and Future Studies

This research was conducted with identified limitations as described below. First of all, even though a quasi-experimental design is effective when establishing internal validity and possibly causality (Handley, Lyles, McCulloch, & Cattamanchi, 2018), because data collection occurred at one dining facility in a university during, the findings of this study may lack generalizability. Furthermore, due to different characteristics of foodservice operations (e.g., targeted clientele, mission and vision, company culture), the results may not be generalizable to other types of foodservice operations (e.g., K-12 school, healthcare, and commercial foodservice

operations). Future researchers may conduct the similar research in different types of dining facilities to overcome limited generalizability.

Also, data collection occurred at dinner times only, and plate waste behavior during dinner may be different from behavior during breakfast or lunch meals due to external factors such as time available for meals and the number of food items available. Therefore, future research may compare plate waste behaviors during different meal periods to provide a more thorough understanding of college diners' plate waste behavior.

Although this study targeted factors that might have potentials to improve diners' plate waste behaviors, the distinct effect of each factor (i.e., awareness, attitudes, subjective norms, and emotions) on college students' food waste behaviors was not identifiable. Future researchers may implement multiple experiments to evaluate effectiveness of each factor.

Finally, while this study may have successfully influenced diners' food waste behavior through weighing and messaging on food waste, future studies may also try to influence diners' food waste behavior at the point of customers' food selection and consumption. Interventions target to influence diners' food selection and consumption may be applied at the beginning of the meal, which may help reduce food waste in the end.

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## Tables and Figures

**Table 5.1**. Crosstabulation analysis: food waste amount pre-, during-, and post-intervention ($\chi^2(8) = 391.49$, $p < .05$).

| Food waste amount | Before Intervention | | During Intervention | | After Intervention | |
|---|---|---|---|---|---|---|
| | Count | % Within Phase | Count | % Within Phase | Count | % Within Phase |
| 0 g | 702 | 31.6% | 1162 | 60.3% | 971 | 48.1% |
| 1-100 g | 1163 | 52.4% | 493 | 25.6% | 780 | 38.7% |
| 101-200 g | 241 | 10.9% | 206 | 10.7% | 192 | 9.5% |
| 201-300g | 93 | 4.2% | 44 | 2.3% | 57 | 2.8% |
| 301g or more | 21 | 0.9% | 22 | 1.1% | 17 | 0.8% |
| Total | 2220 | 100% | 1927 | 100% | 2017 | 100% |

**Figure 5.1.** Screenshots of plate waste and messages displays


**Figure 5.2.** Data collection procedures

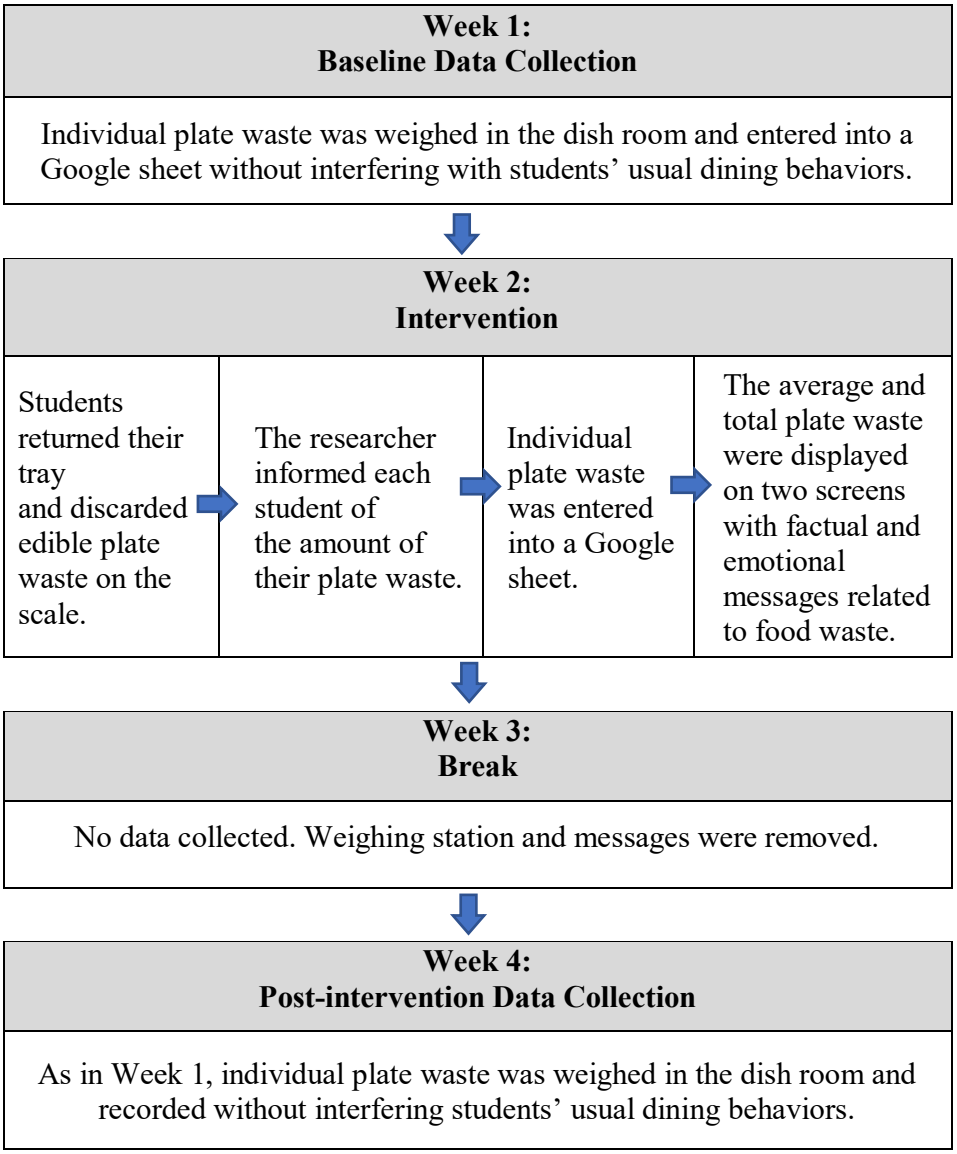
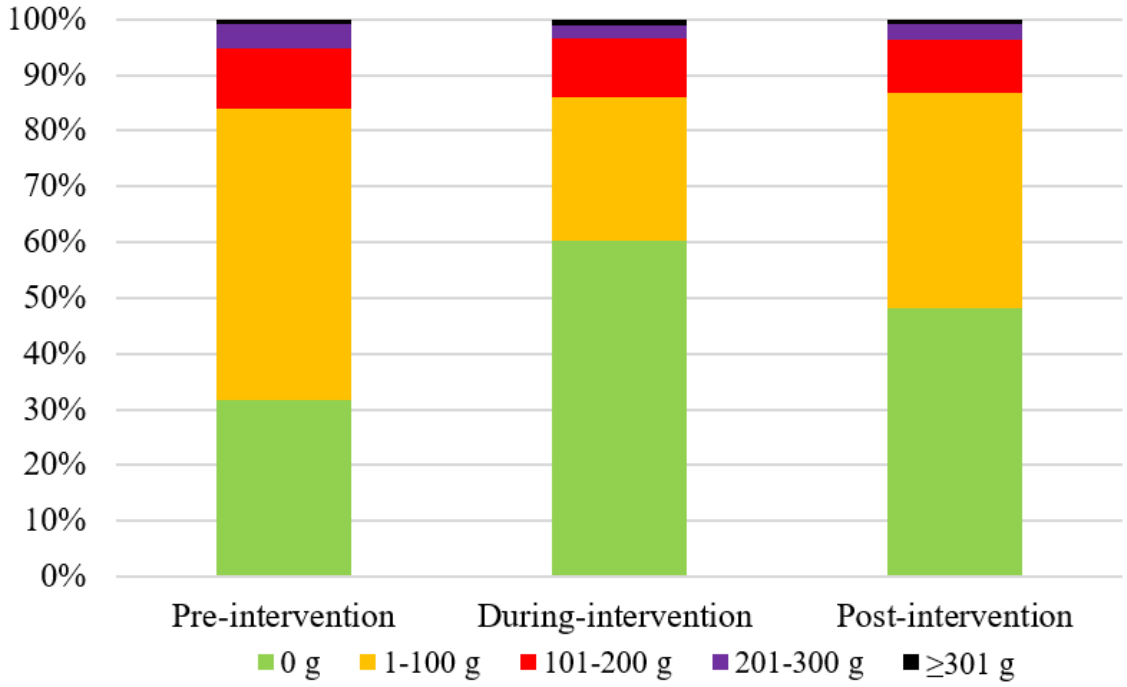


**Figure 5.3.** Amount of plate waste distribution pre-, during-, and post-intervention



# Chapter 6 - Summary and Conclusions

The purposes of this study were to assess variables affecting intention to reduce food waste and self-reported food waste behaviors and to assess the effectiveness of an intervention of weighing individual plate waste and displaying average and accumulative plate waste with factual and emotional messages related to food waste on food waste behavior. The intended goal of this study was to increase the awareness of food waste among diners, influence their attitudes, subjective norms, and emotion toward food waste, and help them be self-motivated to reduce food waste. The target population of this study was college students who attend colleges or universities in the U.S. and eat most of their meals in on-campus dining facilities. The study sample included college students who consumed most of their meals at a dining center of a university, located in the Midwest region of the U.S. This chapter summarized the major findings, discussed implications for foodservice operations leaderships and researchers, and concluded with limitations and recommendations for future research.

The first part of the study administered an online survey to assess factors affecting intention toward food waste reduction as well as their self-reported food waste behavior. Previously, the effect of emotions on food waste behavior was not well studied, and even the limited research that evaluated emotions, results were not consistent on how emotions influenced food waste behaviors (Russell, Young, Unsworth, & Robinson, 2017; Stefan, Herpen, Tudoran, & Lahteenmaki, 2013). Therefore, by adding emotions as an additional antecedent of behavioral intention, this study utilized the theory of reasoned action and emotions as theoretical foundation to explore the associations among participants' attitudes, subjective norms, emotions, and intention toward food waste reduction, as well as self-reported food waste behavior.

The survey instrument was developed based on current literature and the findings from the focus groups. The structure of the survey followed the framework and question development protocols specified in the theory of reasoned action (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975, 2011) and the emotion-as-feedback theory (Baumeister, Vohs, DeWall, & Zhang, 2007). The survey instrument was reviewed by professors in hospitality management before being pilot-tested with 20 participants in the study facility. A total of 10 questions were used to evaluate participants' attitudes toward food waste, 12 questions toward subjective norms, eight questions toward emotions, three question toward intention to reduce food waste, four questions toward self-reported food waste behavior, as well as seven questions toward demographic information. Collectively, 450 usable online surveys were collected, and key findings will be discussed in the following section, Summary of Major Findings.

In the second component of this study, an intervention which aimed to influence the participants' food waste behavior was implemented, and plate waste data were collected before, during, and after the intervention. Specifically, individual plate waste was measured and the amount of individual plate waste was informed to each participant. Concurrently, the average and accumulative plate waste amounts were showed in the dining room to inform the public along with pictures and messages related to food waste challenges.

The effectiveness of the intervention was examined by comparing food waste amounts before, during, and after the implementation of the intervention using ANOVA and Tukey's post hoc analysis. Data collection protocol to assess diners' actual food waste followed previous literature related to plate waste methods (Belanger & Kwon, 2016; Freedman & Brochado, 2010; Whitehair, Shanklin, & Brannon, 2013). Food waste collection protocols and procedures were reviewed by the foodservice management team in the study facility before data collection.

During data collection, 2,220, 1,927, and 2,017 trays were analyzed before, during, and after intervention in the second phase of the study, respectively.

## Summary of Major Findings

Major findings from this study with brief methodology were summarized in relation to the objectives and hypotheses of the study. Description and discussion of data were provided with the results from statistical analysis.

***Objective 1: Assess associations among diners' attitudes, subjective norms, emotion, and intention toward food waste reduction, as well as self-reported food waste behavior.***

The results indicated that the participants' attitudes (direct: $r = .39$, $p < .01$; indirect: $r = .49$, $p < .01$) and subjective norms (direct: $r = .37$, $p < .01$; indirect: $r = .40$, $p < .01$) toward food waste had moderate correlations with their intentions to reduce food waste. In addition, participants' emotions toward food waste had a high correlation with their intention toward food waste reduction ($r = .62$, $p < .01$), indicating the stronger the emotions they experienced toward food waste, the more likely they intended to reduce food waste.

Participants who reported a moderate to strong intention to reduce food waste had also reported high frequencies on food waste reduction behaviors ($r = .55$, $p < .01$). In addition, participants' attitudes (indirect, $r = .35$, $p < .01$), social norms (direct, $r = .33$, $p < .01$), and emotions ($r = .44$, $p < .01$) toward food waste were also found to be moderately correlated with their self-reported food waste behavior. All associations among evaluated variables showed a statistically significance at the level of $p < .01$ with indications of moderate to strong associations among all studied variables.

***Objective 2: Develop an intervention to influence college diners' food waste behavior.***

An intervention to reduce college diners' plate waste was developed based on the literature review. The implemented intervention intended to reduce edible plate waste by influencing diners' awareness, attitudes, and subjective norms while providing emotional stimuli. First, a scale was introduced at the tray-return area to weigh edible plate waste to the nearest gram. Diners discarded edible plate waste in a bucket, placed on a scale, possibly in front of their social group, and each participant was verbally informed of the weight of his/her plate waste. Additionally, the average and total amounts of plate waste were livestreamed on two large screens, one next to the weighing station and the other in the main dining room, highly visible to all diners. This step aimed to influence awareness of plate waste amounts and diners' subjective norms. Along with the plate waste amounts, several rotating messages (i.e., statistics of food waste) and photos (i.e., hungry child with impactful messages) were displayed on the same screens to influence attitudes toward food waste, awareness of plate-waste problems and diners' emotional responses.

The logistic and feasibility of this experimental design was reviewed by the management team in the study facility and pilot tested prior to data collection. One week before data collection, two researchers set up a weighing station and collected plate waste in the dish room to establish plate waste recording protocols. To avoid learning effect from the diners and keep the purpose of the study confidential, no intervention was set up in front of diners for pilot testing. Instead, a digital weighing scale, two computers, and one projector were set up and tested for weighing and message displaying during the time when the dining center was not opened. Other logistics (e.g., wait time at the tray return area, the visibility of the projecting screen, and the cooperation of multiple researchers at the data collection site) were discussed and evaluated by

hospitality management professors and foodservice professionals in the dining center prior to finalizing the protocol.

***Objective 3: Evaluate the effectiveness of the intervention by comparing food waste amounts and diners' plate waste behaviors before, during, and after the intervention.***

To evaluate differences on plate waste amounts before, during, and after the intervention, the means of plate waste amount were compared by using ANOVA. The results revealed a significant difference in the average weight of plate waste throughout the four weeks of data collection ($F(2, 6161) = 12.76$, $p < .05$). Tukey's post hoc analysis revealed that the average plate waste was significantly lower during ($M_{befroe}$-$M_{during}$ = 9.97g, $p < .001$) and after intervention ($M_{befroe}$-$M_{after}$ = 8.15g, $p < .001$), compared to before the intervention data collection. The average amount of individual plate waste decreased by 21% during the intervention week compared to the baseline plate waste amount. The differences of average plate waste between during and after intervention data was not significant ($M_{after}$-$M_{during}$ = 1.82g, $p > .05$). This result revealed that even though average plate waste has increased one week after the intervention was completed, the difference was negligible. The significant decrease of individual plate waste showed that diners' plate waste behavior may have been positively influenced by weighing their individual plate waste, showing average and accumulative plate waste amounts, and informing about food waste challenges by displaying food waste related messages and emotional pictures.

To evaluate the diners' plate waste behaviors, a cross-tabulation with $\chi 2$ analysis was conducted. The results suggested significant differences in the proportion of diners leaving varying amounts of plate waste ($\chi 2(8) = 391.49$, $p < .05$). First, the percentage of diners who left no plate waste was much larger during intervention (60.3%), compared to baseline (31.6%) and post-intervention (48.1%). Secondly, the percentage of diners who wasted less than 100 grams of

food was significantly smaller during intervention (25.6%), compared to baseline (52.4%) and post-intervention (38.7%). Lastly, the total percentages of diners who left no plate waste or less than 100 grams of plate waste had remained consistent throughout data collection period (84% before, 85.9% during, and 86.8% after). The cross-tabulation analysis also showed the percentage of diners who wasted 101 grams or more food remained somewhat consistent before (16.0%), during (14.1%), and after intervention (13.1%). More specifically, about 5% of patrons wasted more than 300 grams of edible food regardless the intervention. Despite the fact that there were small number of diners leaving a large amount of plate waste, the majority of the diners' food waste behavior has improved.

## Testing of Hypotheses: The Associations Among Variables

In addition to the objectives, the following null hypotheses were established and tested.

***$H_0$1: There will be no association between diners' attitude and intention toward food waste reduction.***

***$H_0$2: There will be no association between diners' subjective norms and intention toward food waste reduction.***

***$H_0$3: There will be no association between diners' emotions and intention toward food waste reduction.***

***$H_0$4: There will be no association between diners' intention toward food waste reduction and self-reported food waste behavior.***

Null hypotheses one to four were all rejected based on the results from structural equation modeling. The results indicated that a higher score on diners' attitudes toward food waste was significantly associated with a higher score on intention to reduce food waste ($b = .21$, $p < .01$, $\beta = .24$). A higher score on diners' subjective norms toward food waste was significantly associated with a higher score on intention to reduce food waste ($b = .15$, $p < .01$, $\beta = .14$). Also, A higher score on diners' emotions toward food waste was significantly associated with a higher

score on intention to reduce food waste ($b$ = .49, $p$ < .05, $\beta$ = .42) while controlling for gender, college affiliation, and length of dining experience for the aforementioned variables. In addition, a higher score of intention to reduce food waste was also significantly associated with a higher score on self-reported food waste reduction behavior ($b$ = .32, $p$ < .05, $\beta$ = 43). Attitudes, subjective norms, and emotions toward food waste along with control variables explained 47.6% of the variance in intention toward food waste reduction and 37.1% of the variance in self-reported food waste behavior.

***$H_0$5: Diners' intention toward food waste reduction will not mediate the association between attitude toward food waste and self-reported food waste behavior.***

***$H_0$6: Diners' intention toward food waste reduction will not mediate the association between subjective norms toward food waste and self-reported food waste behavior.***

***$H_0$7: Diners' intention toward food waste reduction will not mediate the association between emotions toward food waste and self-reported food waste behavior.***

Null hypotheses five to seven were also rejected based on the results from the bootstrapped indirect effects. The indirect effects from attitudes to self-reported food waste behavior via intention were significant ($b$ = .07, $p$ < .01, CI 90% [.04, .10]), indicating that one unit increase in attitudes toward food waste was associated with a .07 unit increase in self-reported food waste reduction behavior. Also, the indirect effects from subjective norms to self-reported food waste behavior via its effect through intention were significant ($b$ = .05, $p$ < .05, CI 90% [.01, .10]), indicating that one unit increase in subjective norms toward food waste was associated with a .05 unit increase of self-reported food waste reduction behavior. The indirect effects from emotions to self-reported food waste behavior via its effect through intention were also significant ($b$ = .15, $p$ < .01, CI 90% [.11, .21]), indicating that one unit increase in emotions toward food waste was associated with a .15 unit increase of self-reported food waste reduction

behavior. Therefore, it is concluded that diners' intention toward food waste reduction fully mediated all three indirect effect paths.

***$H_0$8: There will be no difference among diners' plate waste amounts before, during, and after the implementation of intervention.***

The result from ANOVA analysis revealed that there were differences on average plate waste amount before, during, and after the intervention ($F(2, 6161) = 12.76$, $p < .05$). Tukey's post hoc analysis revealed that the average plate waste was significantly lower during ($M_{befroe}$-$M_{during}$ = 9.97g, $p < .001$) and after the intervention ($M_{befroe}$-$M_{after}$ = 8.15g, $p < .001$), compared to before intervention data collection. The differences of average plate waste between during and after the intervention was not significant ($M_{after}$-$M_{during}$ = 1.82g, $p > .05$), suggesting that even though average plate waste has increased after intervention, the difference was negligible. Therefore, hypothesis eight was rejected.

## Implications

This study contributes to the foodservice research by providing theoretical implications about reducing plate waste in university dining facilities. First, only a handful of research studies have examined emotions as a predictor of behavioral intention and behavior and showed inconsistent results. This study found that emotion was a viable predictor for self-reported food waste behavior via behavioral intention. More specifically, participants' emotions toward food waste positively influenced their intention to reduce food waste which ultimately improved their self-reported food waste behavior. Therefore, by adding in the antecedent of emotion, this study demonstrated that emotion served as the psychological antecedent of food waste behavior and provided additional theoretical support for existing behavioral theories when studying sustainable behaviors.

In addition, previous studies reported subjective norms being a weak predictor of

behavioral intention and behavior, but did not specify the reasons behind these findings (Armitage & Conner, 2001; Stefan at al., 2013). Although the results in this research showed similar patterns, the added indirect measures of subjective norms may provide some explanations for such findings. This study measured subjective norms by directly asking important social groups' expectations of the participants' food waste behavior, which were consistent with previous studies. In addition to direct measures, this study also indirectly evaluated whether others' opinions were important to the participants. The results revealed an interesting finding of subjective norms where most participants agreed that their important social groups expected them to not waste food. However, they also reported low motivation to comply to these expectations and considered others' opinion unimportant. Such finding suggests that while it is important to account for others' expectations on an individual's certain behavior, it is crucial to evaluate whether the individual is motivated to comply to the norms. The direct and indirect evaluation of subjective norms may assist researchers to better understand the multiple layers of this construct and how it impacts behavioral intention toward food waste reduction and food waste behavior.

In addition, this study evaluated consumers' food waste behavior by quantifying the amount of food waste which offered a more accurate reflection of their true food waste behavior. It was reported that participants' self-reported behavior was not consistent with their actual observed behavior (Belanger & Kwon, 2016). Therefore, by quantifying plate waste amounts and evaluating plate waste behavior patterns, this research captured an accurate picture of food waste behavior of college diners.

Practically, this research showed significant behavioral changes of college diners and provided college and university foodservice practitioners with specific interventions and

procedural protocols on how to implement these interventions aiming to reduce food waste. First of all, the significant improvement of college diners' food waste behavior found in this research suggests that college and university foodservice operators may develop an intervention to influence food waste behavior of their patrons. The characteristics of today's college and university diners are unique, with the majority of them known as Generation Z, born between the year of 1995 and 2012 (Salleh, Mahbob, & Baharudin, 2017). Individuals in this generation are recognized as collaborative, opened-mined, compassionate, and willing to work with others to solve problems (Mohr & Mohr, 2017). Because of their flexibility and willingness to learn, they may be a group of individuals who are more likely to change their behaviors for the good of others and the environment. In fact, this study revealed that by making college diners aware of their or their peers' plate waste and significant food waste issues, the amount of plate waste has significantly decreased. Not only has the average and total amount of plate waste significantly reduced, 30% more diners left no plate waste during and after the intervention. Furthermore, the researcher suspected that the additional 30% of diners who left no plate waste during and after the intervention might have been those who left less than 100 grams of food waste before the intervention but not being aware of their behavior. These individuals may have had higher potential for changing their behavior than those who wasted large amounts of plate waste. Overall, by weighing individual plate waste and displaying average and accumulative plate waste with factual and emotional messages related to food waste, college diners' food waste behavior was improved. This study provided protocols and guidelines for practitioners who may be interested in adopting a part of or the entire intervention similar to this study to reduce food waste.

## Limitations and Recommendations for Future Research

This research was conducted with identified limitations as described below. First of all, using self-reported data from a single time assessment may result in researcher bias and social desirability bias. Although this study distributed the surveys online and kept the participants anonymous to try and keep social desirability bias low, participants might still feel the pressure to answer questions in a socially acceptable manner regardless of their true feelings toward an issue or topic. Therefore, it is important for future research to continue to keep participants anonymous and to avoid phrasing survey questions in a way that reflect more socially desirable attitudes, behaviors, or perceptions (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). It is also recommended to employ the technique of indirect questioning (Fisher, 1993) or to include a social desirability scale in the survey (Nederhof, 1985) to detect and mitigate the effect of social desirability.

Because data collection occurred at one university dining facility during dinner time, the results of this study may lack generalizability. Different foodservice operations have different characteristics such as different mission and vision and company culture. Therefore, the results may not be generalizable to other types of foodservice operations (e.g., K-12 school, healthcare, and commercial foodservice operations). In addition, data collection occurred at dinner times only, and plate waste behavior may be different for breakfast or lunch meals due to external factors such as time available for meals and the number of food items available. Therefore, future research may compare plate waste behaviors during different meal periods to provide a more thorough understanding of college diners' plate waste behavior.

Additionally, although this study targeted to influence factors that might have potentials in improving diners' plate waste behaviors, the distinct effect of each factor (i.e., awareness,

attitudes, subjective norms, and emotions) on college students' food waste behaviors was not identifiable. Future researchers may implement multiple experiments that evaluate effectiveness of each factor separately.

Finally, while this study may have successfully influenced diners' food waste behavior through weighing and messaging on food waste, future studies may also try to influence diners' food waste behavior through food selection, consumption, and external factors affecting food waste behaviors. Interventions target to influence diners' food selection and consumption may be applied at the beginning of the meal, which may help reduce food waste in the end. For example, nutritional information on entrees and side dishes and food waste reduction reminders may be provided to diners at the beginning of their meals to influence their food selection and consumption behavior. In addition, this study did not evaluate external factors that may affect their plate waste behaviors because the college diners in this facility did not have any considerable barriers that may prevent patrons from leaving no plate waste. However, in some foodservice facilities, there may be situations that make it difficult for their patrons not to leave any plate waste (e.g., large portion sizes). In such cases, researchers may consider evaluating perceived behavioral control toward food waste behaviors. Potential interventions may include providing different portions sizes, reducing plate sizes, and decreasing the variety of foods items available each meal.

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# Appendix A - Kansas State University IRB Approval

KANSAS STATE UNIVERSITY | University Research Compliance Office

TO: Dr. Junehee Kwon
Hospitality Management
108 Justin Hall

Proposal Number: 9722

FROM: Rick Scheidt, Chair
Committee on Research Involving Human Subjects

DATE: 04/16/2019

RE: Approval of Proposal Entitled, "Reducing College Students' Plate Waste through Displaying the Amount of Waste with Messaging on the Significance of the Plate-waste Problems."

The Committee on Research Involving Human Subjects has reviewed your proposal and has granted full approval. This proposal is **approved for three years from the date of this correspondence.**

APPROVAL DATE: 04/16/2019

EXPIRATION DATE: 04/16/2022

In giving its approval, the Committee has determined that:

☒ There is no more than minimal risk to the subjects.
☐ There is greater than minimal risk to the subjects.

This approval applies only to the proposal currently on file as written. Any change or modification affecting human subjects must be approved by the IRB prior to implementation. All approved proposals are subject to continuing review, which may include the examination of records connected with the project. Announced post-approval monitoring may be performed during the course of this approval period by URCO staff. Injuries, unanticipated problems or adverse events involving risk to subjects or to others must be reported immediately to the Chair of the IRB and / or the URCO.

203 Fairchild Hall, Lower Mezzanine, 1601 Vattier St., Manhattan, KS 66506-1103 | 785-532-3224 | fax: 785-532-3278
comply@k-state.edu | k-state.edu/comply

# Appendix B - Informed Consent Form and Interview Questions for Focus Groups

**A. Consent Form for Focus Group Study**

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**KANSAS STATE UNIVERSITY**

**INFORMED CONSENT**

**PROJECT TITLE:**

Reducing College Students' Plate Waste through Displaying the Amount of Waste with Messaging on the Significance of the Plate-waste Problems – Phase I: Focus Groups

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT APPROVAL DATE:** | April 12, 2019 | **PROJECT EXPIRATION DATE:** | April11, 2020 | **LENGTH OF STUDY:** | <60 minutes |

| | |
|---|---|
| **PRINCIPAL INVESTIGATOR:** | Dr. Junehee Kwon |
| **CO-INVESTIGATOR(S):** | Wenhao Zhang |
| **CONTACT DETAILS FOR PROBLEMS/QUESTIONS:** | Dr. Junehee Kwon: (785) 532-5369<br>Wenhao Zhang: (785) 226-6305 |
| **IRB CHAIR CONTACT INFORMATION:** | Rick Scheidt, (785)-532-3224 |
| **PROJECT SPONSOR:** | Arts, Humanities, and Social Sciences Fund |

**PURPOSE OF THE RESEARCH:**

The purpose of this focus group study is to assess diners' attitudes, emotion, and subjective norms regarding plate waste in order to develop reliable survey scale.

**PROCEDURES OR METHODS TO BE USED:**

Focus groups will be conducted to assess diners' attitudes, emotion, and subjective norms in order to develop reliable survey scales. Participants (5-8 individuals) in the focus groups will be asked a variety of open-ended questions. All discussion will be recorded using a digital recorder for verbatim transcription. The transcribed data will then be analyzed to identify themes and sub-themes regarding attitudes, emotion, and subjective norms related to personal plate waste behaviors and societal challenges regarding food waste. Data then will be used to create a quantitative survey instrument and used for research manuscripts.

**RISKS OR DISCOMFORTS ANTICIPATED:**

1. Potential uneasiness of sharing their emotions and attitudes about plate waste.
2. Social security number needs to be provided in a secure box in order to receive cash payment.

**BENEFITS ANTICPATED:**

1. Participants will receive $15 cash payment.
2. The college dining center management staff will be provided with information about plate-waste behaviors of their customers.
3. Participants and the university community may learn more about plate-waste behaviors of patrons and attitudes concerning plate-waste issues, ultimately identifying effective intervention(s) for future plate waste reduction.

**EXTENT OF CONFIDENTIALITY:**

No personal information will be revealed to researchers. The social security number provided for the cash payment will be collected in a secure box, which will be personally delivered to the accountants for their record-keeping. Researchers will not refer participants by names and participants will be discouraged to state their or their peers' names during the recorded discussion.

**Terms of participation: I understand this project is research, and that my participation is voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.**

**I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.**

| | | | |
|---|---|---|---|
| **PARTICIPANT NAME:** | | | |
| **PARTICIPANT SIGNATURE:** | | **DATE:** | |
| **WITNESS TO SIGNATURE: (PROJECT STAFF)** | | **DATE:** | |

## B. Focus Group Study Questions

**Questions to assess emotions:**

1. Tell us your thoughts about food waste issues in the U.S.
2. How much are you concerned about food waste challenge in the U.S.?
3. Have you had situations when you left a lot of food uneaten in a university dining hall or a buffet restaurant? How did this situation make you feel?
4. How does it make you feel when you see others throw away a large amount of food at the end of their meal?

**Questions to assess attitudes:**

1. What are consequences of having a large amount of food waste?
2. (If environmental consequences are not mentioned) Tell us your beliefs about impact of food waste on our environment.
3. Who do you think are most responsible for food waste challenges in the U.S.? Why?
4. How much do you think you, individual consumers, are responsible for food waste challenges in the U.S.?
5. How important is it for individuals and foodservice operators to try reducing food waste in the U.S.? Why?
6. What are some strategies that may reduce the food waste challenge in the U.S.?

# Appendix C - Questionnaire of Attitudes, Subjective Norms, Emotions, and Intention Affecting College Students' Plate Waste Behaviors and Mean Scores on Questions

Dear Derby Dining Center Patrons:

We are conducting a research about college students' attitudes, emotions, subjective norms, intentions towards plate waste, and plate-waste behaviors; and we need your input. This survey will take only 5-10 minutes of your time, and your participation is greatly appreciated.

It is understood that by completing this survey, you are giving the researchers informed consent to be in this study titled, "Assessment of college students' attitudes, emotions, and behaviors related to food waste in college dining facilities". Your participation is completely voluntary, and you may stop at any time without any drawback. Refusing to participate will no way incur any penalty, and you may discontinue participation at any time. Your identity will not be revealed, and your responses will be kept confidential. Only aggregated data will be reported in academic journal articles.

At the end of the survey, you will be asked to enter the last four digits of your student in order to match with the post-intervention survey which will be done in three weeks. By participating in both surveys, you will be entered into a drawing that gives you a chance to win one of five $50 cash gift. To be entered in the drawing, please click on the link provided in the survey and enter your eID. In addition, once you are done with THIS survey, show the researcher at the tray-return area the "custom end of survey message" to receive a $1 cash!

Your participation is essential to the study's success. We truly appreciate your time and assistance. If you have any questions about the study, please contact Dr. Junehee Kwon at (785) 532-5369 or Wenhao Zhang at (785) 226-6305. If you have any questions about your rights as the research subject or about the process of this study, you may contact the University Research Compliance Office at or Dr. Rick Scheidt, Chair, Committee on Research Involving Human Subjects at (785) 532-3224.

By continuing with this evaluation, you agree to participate in this study and that you are at least 18 years of age. Thank you very much for your participation in this research.

Sincerely,

Wenhao Zhang, MS
PhD Candidate
Graduate Assistant Manager, Derby

Junehee Kwon, PhD
Professor
Department of Hospitality Management

I agree to take this survey. I have read the above letter of informed consent, and I understand that all my answers are completely confidential. (If you prefer not to participate, please select the option and click "Continue" to end this survey.)

- I willingly agree to participate under the terms described above.
- I prefer not to participate.

## College students' attitudes, emotions, subjective norms, intentions, and plate-waste behaviors

**This is not a test, there are no right or wrong answers. Please answer honestly.**

| **Part 1. Attitudes**<br>***For each statement below, please indicate how much you agree or disagree by selecting the number that best represents your opinion.*** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Mean (SD) |
| 1.1 | Food waste is a major issue in the U.S. | 1 | 2 | 3 | 4 | 5 | 4.18 (1.19) |
| 1.2 | I am conscious about food waste challenges in the U.S. | 1 | 2 | 3 | 4 | 5 | 3.63 (1.10) |
| 1.3 | People in general take the availability of food for granted. | 1 | 2 | 3 | 4 | 5 | 4.27 (1.08) |
| 1.4 | Consumers should be the most responsible for food waste challenges in the U.S. | 1 | 2 | 3 | 4 | 5 | 3.50 (1.10) |
| 1.5 | Working together, reducing food waste will have a positive impact on the environment. | 1 | 2 | 3 | 4 | 5 | 4.25 (1.04) |
| 1.6 | Wasting food is wasting money. | 1 | 2 | 3 | 4 | 5 | 4.34 (1.06) |
| 1.7 | The food ***I*** waste could be used to feed those who are hungry in my community. | 1 | 2 | 3 | 4 | 5 | 4.17 (1.15) |
| | | Extremely undesirable | Undesirable | Neutral | Desirable | Extremely desirable | Mean (SD) |
| 1.51 | Working together to make a positive impact on the environment is… | -2 | -1 | 0 | 1 | 2 | 1.21 (1.02) |
| **1.61** | Wasting food that I paid for is… | -2 | -1 | 0 | 1 | 2 | 1.18 (0.98) |
| 1.71 | Feeding those who are hungry in my community is… | -2 | -1 | 0 | 1 | 2 | 1.27 (0.99) |

**Part 2. Subjective Norms**
***For each statement below, please indicate how much you agree or disagree by selecting the number on the scale that best represents your honest opinion.***

| | | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Mean (SD) |
|---|---|---|---|---|---|---|---|
| 2.1 | Most people who are important to me will disapprove of me when I throw away edible food on the plate. | 1 | 2 | 3 | 4 | 5 | 3.33 (1.17) |
| **2.2** | Most people who are important to me do not care how much food I throw away. | 1 | 2 | 3 | 4 | 5 | 3.24 (1.19) |
| 2.3 | It is expected of me that I eat all my food on my plate. | 1 | 2 | 3 | 4 | 5 | 3.69 (1.16) |
| 2.4 | I feel peer pressure not to throw away edible food on my plate. | 1 | 2 | 3 | 4 | 5 | 3.03 (1.15) |
| 2.5 | Most people who are important to me do not waste food. | 1 | 2 | 3 | 4 | 5 | 3.32 (1.03) |
| 2.6 | Most people who are important to me take only the amount of food they can finish. | 1 | 2 | 3 | 4 | 5 | 3.41 (1.07) |
| 2.7 | For this question, click neutral (3) for your answer. | 1 | 2 | 3 | 4 | 5 | 3.00 (0.00) |
| 2.8 | My friends think I should not waste food. | 1 | 2 | 3 | 4 | 5 | 3.64 (0.94) |
| 2.81 | My friends' opinion of me wasting food is important to me. | -2 | -1 | 0 | 1 | 2 | 0.25 (1.10) |
| 2.9 | My family think I should not waste food. | 1 | 2 | 3 | 4 | 5 | 4.08 (0.95) |
| 2.91 | My family's opinion of me wasting food is important to me. | -2 | -1 | 0 | 1 | 2 | 0.68 (1.09) |
| 2.10 | My fellow diners think I should not waste food. | 1 | 2 | 3 | 4 | 5 | 3.45 (1.02) |
| 2.11 | My fellow diners' opinion of me wasting food is important to me. | -2 | -1 | 0 | 1 | 2 | 0.07 (1.13) |

| **Part 3. Emotions**<br>***For each statement below, please indicate how much you agree or disagree by selecting the number on the scale that best represents your honest opinion.*** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Mean (SD) |
| **3.1** | Throwing away food at the end of my meal does not bother me. | 1 | 2 | 3 | 4 | 5 | 3.63 (1.14) |
| 3.2 | When I throw away a large amount of food at the end of my meal, I am embarrassed. | 1 | 2 | 3 | 4 | 5 | 3.76 (1.16) |
| **3.3** | I do not worry about the amount of food that I throw away. | 1 | 2 | 3 | 4 | 5 | 3.77 (1.02) |
| 3.4 | I feel self-conscious when I can't finish all of the food on my tray. | 1 | 2 | 3 | 4 | 5 | 3.35 (1.15) |
| 3.5 | I am frustrated when others throw away a large amount of edible food. | 1 | 2 | 3 | 4 | 5 | 3.81 (1.09) |
| 3.6 | It annoys me when others take more food than they can finish. | 1 | 2 | 3 | 4 | 5 | 3.77 (1.06) |
| 3.7 | It disappoints me when others don't care about food waste. | 1 | 2 | 3 | 4 | 5 | 3.78 (1.04) |
| **3.8** | I am not concerned about the amount of food waste generated daily. | 1 | 2 | 3 | 4 | 5 | 3.55 (1.16) |
| **Part 4. Intention**<br>***For each statement below, please indicate how much you agree or disagree by selecting the number on the scale that best represents your honest opinion.*** | | | | | | | |
| | | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Mean (SD) |
| 4.1 | I plan to have no plate waste at the end of my meal. | 1 | 2 | 3 | 4 | 5 | 3.98 (1.02) |
| 4.2 | I intend not to take more than I can finish in the future. | 1 | 2 | 3 | 4 | 5 | 4.10 (0.98) |
| 4.3 | In general, I try hard not to throw away edible food at the end of my meal. | 1 | 2 | 3 | 4 | 5 | 4.16 (0.95) |

| **Part 5. Plate-waste Behaviors**<br>***For each statement below, please indicate how much you agree or disagree by selecting the number on the scale that best represents your honest opinion.*** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Mean (SD) |
| **5.1** | I always have edible food left on my plate at the end of my meal. | 1 | 2 | 3 | 4 | 5 | 3.66 (1.09) |
| 5.2 | I usually think about how much food I can finish. | 1 | 2 | 3 | 4 | 5 | 3.76 (0.97) |
| 5.3 | I usually do not take more food than I can eat. | 1 | 2 | 3 | 4 | 5 | 3.90 (0.97) |
| **5.4** | Usually, I have: | No plate waste | 1/4 of plate waste | 1/2 of plate waste | 3/4 of plate waste | More than one plate of food waste | 4.45 (0.64) |
| **Part 6. Awareness of Plate-waste**<br>***For each statement below, please indicate how much you agree or disagree by selecting the number on the scale that best represents your honest opinion.*** | | | | | | | |
| | | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Mean (SD) |
| **6.1** | I usually do not pay attention to the amount of food I throw away. | 1 | 2 | 3 | 4 | 5 | 3.56 (1.18) |
| **6.2** | The issue of food waste has never occurred to me. | 1 | 2 | 3 | 4 | 5 | 3.99 (1.07) |
| 6.3 | I am aware how much food others throw away. | 1 | 2 | 3 | 4 | 5 | 3.50 (1.07) |

*Note:* Questions with question numbers in bold were negatively worded questions. They were reverse coded into the largest number 5 reflecting the strongest attitudes against food waste, the strongest subjective norms and emotions toward food waste reduction, the highest intention to reduce food waste, the most positive self-reported food waste reduction behavior, or the highest awareness of food waste behavior.

**Part 7. Demographic Information.**
*Please select the correct answer to the following questions.*

1. What is your gender?
    a. Male
    b. Female
    c. Other
    d. Prefer not to disclose

2. Which college are you affiliated with?
    a. Agriculture
    b. Architecture, Planning, and Design
    c. Arts and Sciences
    d. Business Administration
    e. Education
    f. Engineering
    g. Human Ecology
    h. Veterinary Medicine
    i. Other, please specify_____

3. What's your age? _____years

4. Which of the following meal plan do you have?
    a. 14 meals/week
    b. Unlimited
    c. Off-campus meal pass

5. On average, how many times per day do you eat at Derby Dining Center?
    a. Once a day
    b. Twice a day
    c. Three times a day
    d. More than three times a day

6. How long have you been dining at Derby, including this semester? _____ semester(s)

7. What are the last 4 digits of your student ID number?

# Appendix D - Messages Displayed During Intervention

| Types of Influence | Monday | Wednesday | Friday |
|---|---|---|---|
| **Attitudes** | "Riley county has one of the nation's highest food insecurity rates. 1 in 8 people struggles with hunger." | "On average, each American throws away 1.3lbs of food daily & 474lbs of food yearly." | "Collectively, Derby discards over 90lbs. of edible food each dinner, which is enough to feed 60 eight-year-olds." |
| | "Derby donates the majority of leftover foods to a local food bank." | "YOU can help us reduce food waste by taking only the amount you can eat." | "Reducing food waste by just 15% would be enough to feed more than 25 million Americans yearly." |
| **Subjective Norms** | "YOU helped Derby save over 33 lbs. of food waste last night!" | "60% of Derby Diners Do Not Have Plate Waste." | "YOU helped Derby saved over 123 lbs. of food waste for the past week!" |
| **Emotions** | "United States could fill a college stadium with the amount of food it wastes in a day." | "More than a third of food produced in America becomes food waste, which amounts over 50 million tons annually." | "If food waste were a country, it will be the world's third largest carbon polluter." |
| | A picture of a garbage truck discarding a truck full of edible food waste. | A picture indicating one in six people in America struggles with hunger. | A picture of hungry child eating dirty bread. |