Research Contribution

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EXPLORING COLLEGE STUDENTS' PLATE WASTE BEHAVIOR: AN APPLICATION OF THE THEORY OF REASONED ACTION AND EMOTION

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ABSTRACT
This study explored the associations among the variables of the theory of reasoned action with emotions, behavioral intention, and self-reported food waste behavior of 450 participants in a university dining center. The participants' intention toward food waste reduction fully mediated the three pathways from attitudes, subjective norms, and emotions to self-reported food waste behavior. The findings of this research contribute 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 consumers' food waste attitudes, subjective norms, emotions, and intentions and reduce consumers' food waste behavior.

Keywords: attitudes, subjective norms, emotions, intention, food waste behavior

INTRODUCTION

Environmental sustainability, focusing on maintaining and improving the integrity of the life-supporting systems of the earth, has become a challenge due to society's pursuit of infinite economic development (Moldan et al., 2012). Climate change resulting from increased greenhouse gas emissions is one of many examples of how human activities negatively influence the environment (Environmental Protection Agency [EPA], 2021). Landfills, where greater than 50% of municipal solid waste is deposited and decomposed, are the third most significant source of methane emission (EPA, 2020a; Food and Agriculture Organization of the United Nations [FAO], 2013). Food waste makes up one-fifth of the total municipal solid waste in the U.S., as each American discards an estimated 474.5 pounds of food annually (EPA, 2020b).

The foodservice industry generates over $997 billion in sales and offers over 15 million jobs in the U.S. labor market (National Restaurant Association, 2023). Thus, it has a significant impact on environmental sustainability. Concerning solid waste, commercial and onsite foodservice operations generate the largest sources of food waste in the U.S. (FAO, 2013). Approximately 63 million tons of food waste was generated in 2018, which made up over 21% of total municipal solid waste in the U.S. (EPA, 2020a). Considering the significant environmental impact of waste generation, it is imperative to promote sustainable business practices, for example, by reducing plate waste in the foodservice industry.

Literature Review and Hypothesis Development

Food Waste Challenges

Globally, 33 to 50% of the total food produced for human consumption is lost or wasted (FAO, 2014). The significant amount of lost and wasted food comes at a steep environmental expense as land and water quality are adversely affected (EPA, 2020b). More specifically, food waste generated from commercial and onsite foodservice operations represent a significant portion of total food waste in the U.S. (EPA, 2020b; FAO, 2013). The amount of plate waste in university foodservice facilities is estimated to be over 1 billion pounds per year, mainly due to their large-scale and the all-you-care-to-eat style of dining service (Vogliano & Brown, 2016). Recognizing their role in environmental sustainability, managers in university dining facilities have been working to reduce post-consumer food waste. They have taken various actions such as educating diners (Ellison et al., 2019; Whitehair et al., 2013), reducing portion sizes (Anderson et al., 2021; Richardson et al., 2021), and adopting trayless dining (Aramark, 2008; Rajbhandari-Thapa et al., 2018; Zhang & Kwon, 2022).

In particular, a straightforward messaging approach, exemplified by phrases such as "All Taste No Waste" and "Eat What You Take, Don't Waste Food," resulted in a 15% reduction in overall food waste, as observed by Whitehair et al. (2013). Studies conducted by Anderson et al. (2021) and Richardson et al. (2021) revealed a reduction of 16% and 35% in students' food waste, respectively, by introducing smaller or portioned plates. Furthermore, trayless dining has emerged as a viable method for enhancing the sustainability of university dining facilities, with several studies showing its positive impact on food waste reduction. For example, findings from Aramark (2008) indicated a significant (25–30%) decrease in individual plate waste following the removal of trays. Similarly, Rajbhandari-Thapa et al. (2018) reported that the number of dishes with at least a quarter of leftovers was reduced by almost 30% after the trayless dining implementation. Zhang and Kwon (2022) revealed that the amount of food selected and consumed was significantly reduced during trayless dining implementation. Previous research consistently underscores the effectiveness of educating diners, reducing portion sizes, and adopting trayless dining in mitigating food waste challenges within university dining centers.

Understanding Consumers' Food Waste Behavior

Understanding the contributing factors to consumers' food waste behavior is essential for reducing food waste. Social-psychological theories, such as the theory of reasoned action (TRA) and the theory of planned behavior(, suggest that attitudes, beliefs, and norms have a significant impact on behaviors (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975, 2011; Stern, 2000; Stern et al., 1999). The TRA and theory of planned behavior posit that behavioral intention, the immediate antecedent of behavior, is influenced by the individual's attitudes toward the target behavior and subjective norms (Ajzen, 1985, 1991). Perceived behavioral control, an additional behavioral antecedent in the theory of planned behavior (Ajzen, 1985, 1991), explains the influences of resources and opportunities or barriers to performing a specific behavior.

This study adopted the TRA as its predominant theoretical framework. While the theory of planned behavior incorporates perceived behavioral control to address potential external factors'

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influences on food waste behavior (e.g., reducing portion size), the selected dining center presented no such external influences to reduce food waste. In other words, the diners in the selected dining center had complete control over the amount of food they selected and left on their plates. Therefore, the impact of perceived behavioral control was considered limited, making the TRA a more suitable theoretical framework for this study.

Antecedents of Food Waste Behavior

Previous studies have reported that consumers' food waste behavior was predicted by attitudes, subjective norms, and intention toward food waste reduction (Stancu et al., 2016; Stefan et al., 2013; Zhang & Kwon, 2022). The TRA suggests that attitudes and subjective norms determine people's behavioral intention, which ultimately influences their actual behaviors (Fishbein & Ajzen, 1975). The following section includes a summary of antecedents of food waste behavior according to the TRA and the emotion-as-feedback theory.

Attitudes

Many researchers have confirmed that attitudes toward a target behavior influence behavioral intention (Stancu et al., 2016; Stefan et al., 2013; Zhang & Kwon, 2022). Such attitudes are measured directly or indirectly: directly by an individual's behavioral belief regarding the target behavior and indirectly by their evaluation of the outcome (Francis et al., 2004). For example, a diner concerned with sustainability may believe that taking only the amount of food that can be finished helps to reduce food waste (behavioral beliefs). Such behaviors and outcomes (i.e., reducing food waste) could be viewed as positive or negative to the individual (outcome evaluations). Taken together, the direct and indirect measures reveal a broader spectrum of an individual's attitudes, from strong negative to strong positive attitudes toward plate-waste behaviors (Francis et al., 2004). These arguments lead to the first hypothesis.

H1: Diners' attitudes toward food waste are positively associated with their behavioral intention toward food waste reduction.

Subjective Norm

Subjective norms are also measured directly by asking "what important people think an individual should do." Normative beliefs, which may be injunctive or descriptive, when paired with the motivation to comply, can indirectly measure subjective norms about the target behavior (Fishbein & Ajzen, 1975, 2011; Francis et al., 2004). Injunctive normative beliefs are the inferences individuals make about what essential others want them to do, while descriptive normative beliefs are individuals' inferences about the actions those social referents take (Ajzen, 2015; Graham et al., 2015). For example, a person's food waste behavior could be influenced by how their important social group would like them to behave and by the actual food waste behavior of the social group when paired with the individual's motivation to comply with these social norms. Generally, the stronger the subjective norms, the stronger the intention to perform or not to perform the behavior (Ajzen, 1991; Ajzen, 2015), which leads to the second hypothesis.

H2: Diners' subjective norms toward food waste are positively associated with their behavioral intention toward food waste reduction.

Emotions

One of the main assumptions of the TRA is that individuals make rational and reasoned decisions (Fishbein & Ajzen, 1975, 2011). However, sometimes, individuals engage in behaviors without rationalization, and non-cognitive determinants, such as emotions, may also play an essential role in consumers' behaviors. Therefore, in addition to attitudes and subjective norms, emotions may need to be considered to understand certain consumer behaviors better (Baumeister et al., 2007; DeWal et al., 2016; Lindsey, 2005; Russell et al., 2017).

Emotion is a mental feeling or affection distinct from cognition or volition (Lindsey, 2005). According to the emotion-as-feedback theory (Baumeister et al., 2007), people engage in certain behaviors to gain favorable emotions and avoid other behaviors to eliminate experiencing undesirable emotions. 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 (Russell et al., 2017), which leads to the third hypothesis.

H3: Diners' emotions toward food waste are positively associated with their behavioral intention toward food waste reduction.

Dependent Variables – Behavioral Intention and Self-reported Food Waste Behavior

The intention to perform a certain behavior, one of the dependent variables in the TRA, captures the motivational factors that ultimately influence the target behavior (Ajzen, 1985, 1991). It indicates how hard an individual is willing to try and how much time and effort they plan to exert to perform the behavior (Ajzen, 1991). Generally, the stronger the attitudes, subjective norms, and emotions, the stronger the intention to engage in a behavior, and the more likely a person would perform the target behavior (Fishbein & Ajzen, 1975, 2011), which leads to the following hypotheses.

H4: Diners' behavioral intention toward food waste reduction is positively associated with their self-reported food waste behavior.

H5: Diners' behavioral intention toward food waste reduction mediates the association between attitudes toward food waste and their self-reported food waste behavior.

H6: Diners' behavioral intention toward food waste reduction mediates the association between subjective norms toward food waste and their self-reported food waste behavior.

H7: Diners' behavioral intention toward food waste reduction mediates the association between emotions toward food waste and their self-reported food waste behavior.

Current Study

Previous studies that explored consumers' behaviors about their attitudes, subjective norms, emotions, and intention toward food waste reduction took place in retail operations (Baumeister et al., 2007; Webb & Sheeran, 2006) or in individual households (Russell et al., 2017; Stancu et al., 2016; Stefan et al., 2013). The contexts of these studies may have different characteristics from the onsite, buffet-style foodservice settings, such as university dining centers. In the retail or household settings, the predictability and directions of associations among emotions, behavioral intentions, and actual behavior varied from what we hypothesized would happen in the university dining centers. For example, previous studies reported that negative emotions were associated with greater intention toward food waste reduction but ultimately led to more significant amounts of self-reported food waste (Russell et al., 2017). Further research is needed to evaluate the influence of emotion on food waste behavior. On the other hand, studies that examined food waste behavior in university dining centers offered limited theoretical support (Anderson et al., 2021; Aramark, 2008; Kallbekken & Salen, 2013; Rajbhandari-Thapa et al., 2018; Richardson et al., 2021). Given the

limitations of these previous studies, theoretically driven findings about behaviors in university dining centers are needed to advance our understanding of what motivators can help to reduce food waste in general.

Therefore, this study aimed to 1) provide a theoretical framework for investigating food waste behavior in university dining centers; 2) predict diners' intention toward food waste reduction and their self-reported food waste behavior using the modified TRA model with attitudes, subjective norms, and emotions toward food waste as independent variables (Figure 1); 3) assess the associations among the variables above; and 4) test the indirect effects from attitudes, subjective norms, and emotions to self-reported food waste behavior, via the proposed mediator of behavioral intention toward food waste reduction.

METHODOLOGY

Population and Sample

The target population of this study was college students who attended colleges in the U.S. and consumed most of their meals in on-campus dining facilities. The study sample included college students who were 18 years or older and consumed most of their meals at a university dining center located in the Midwest region of the U.S. The selected dining center was an all-you-care-to-eat cafeteria for approximately 2,000 diners. Trays were made available to diners at the entrance to conveniently transport their selected food. Upon obtaining a tray, diners proceeded to one of the four service lines (Italian, Classic, Wok, or Grill) to receive an entrée served by kitchen staff. One entrée was served at a time; however, diners could queue for seconds as often as they desired. Self-serve stations for beverages, salads, and desserts were positioned either adjacent to the serving lines or at the center of the dining center. Participants consented to participate in the online survey, and the target sample size for the survey was 440 to conduct structural equation modeling with variables of interest (Wolf et al., 2013).

Instrument Development

To assess the study variables, the survey instrument was developed based on a literature review and focus groups. Results from three focus groups with 24 participants were summarized and used to create questions about attitudes and emotions. Once developed, the instrument was reviewed by foodservice and sustainability researchers and pilot-tested prior to data collection. The approval to use human subjects in research was obtained from the university's Institutional Review Board, where data collection occurred.

Survey Questions Under Each Construct

The overall survey followed the framework and question development protocols specified in the theory of reasoned action (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975, 2011; Francis et al., 2004) and the emotion-as-feedback theory (Baumeister et al., 2007). All questions directly measuring attitudes, subjective norms, emotions, behavioral intention, and self-reported behavior were asked using a five-point Likert-type scale from 1 to 5. 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; Francis et al., 2004). The scores of each indirect measure set were computed using SPSS (version 26). All negatively worded questions were reverse-coded with the largest number, 5, reflecting the strongest attitudes, subjective norms, emotions, and intention toward food waste reduction, and the most positive self-reported food waste reduction behavior.

Attitude Toward Food Waste

Both direct and indirect measures of attitude were used to increase the internal reliability of the measurement within the same construct (Francis et al., 2004). Four direct measure questions for attitudes toward food waste (e.g., "food waste is a major issue in the U.S.") were developed using a 5-point scale (from 1 strongly disagree to 5 strongly agree). Additionally, three sets of indirect measurement questions regarding behavioral beliefs and outcome evaluations were developed (e.g., "the food I waste could be used to feed those who are hungry in my community," from 1 strongly disagree to 5 strongly agree, was paired with an outcome evaluation question which assessed the level of desirability in the behavioral belief statements, from -2 extremely undesirable to 2 extremely desirable). Each set of indirect measures was used to calculate participants' attitudes by multiplying the behavioral belief score by the outcome evaluation score. For example, if an individual strongly agreed (5 points) to the behavioral belief question and perceived the outcome as extremely desirable (2 points), their attitude toward the indirect measure would be 10 (5 x 2 = 10). The range of each indirect measure was from -10 to 10. A positive score represents attitudes in favor of the behavior, a negative score represents attitudes against the behavior, and a score of zero represents a neutral attitude (Francis et al., 2004). Overall attitudes toward food waste were evaluated as a latent variable to reduce measurement errors under statistical analyses.

Subjective Norms Toward Food Waste

Similar to attitudes, subjective norms were also assessed with both direct (six questions) and indirect measurements (three sets of

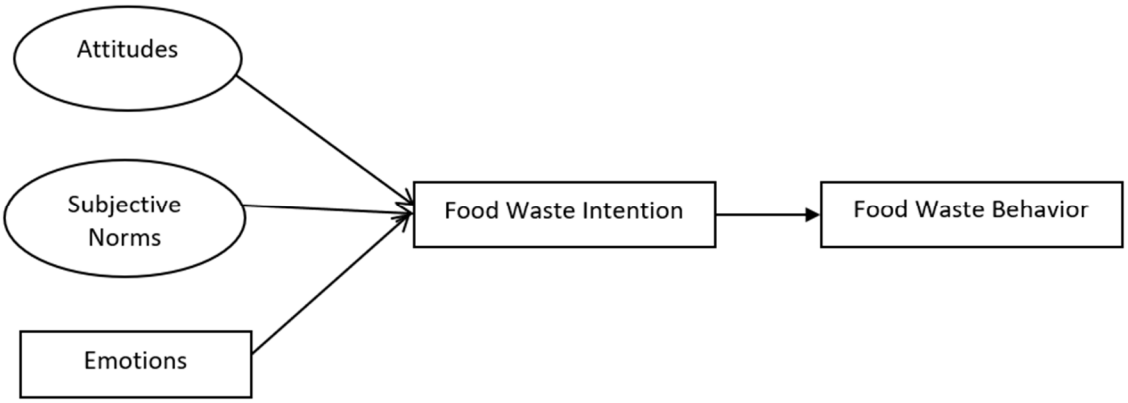

Figure 1. The Impact of Attitudes, Subjective Norms, Emotions, and Intention toward Food Waste Reduction on Self-reported Food Waste Behavior (A Modified TRA Model).

questions) to increase internal reliability (Francis et al., 2004). A direct measure of opinions on food waste from the social referents was phrased as "it is expected of me that I eat all my food on my plate and not be wasteful," from 1 strongly disagree to 5 strongly agree. Indirect measures included an injunctive norm question (e.g., "my friends think I should not waste food."), paired with a motivation to comply (e.g., "my friends' opinion of me wasting food is important to me.") from -2 not at all important to 2 extremely important. The range of each indirect measure was from -10 to 10. A positive score represents an individual's sense of strong social pressure and the likelihood of complying, and a negative score represents weak social pressure and an individual's lack of motivation to comply (Francis et al., 2004). Overall subjective norms toward food waste were evaluated as a latent variable to reduce measurement errors under statistical analyses.

Emotions Toward Food Waste

Emotion was used as an additional independent variable to determine its influence on diners' food waste behavior. Based on the focus group findings, we identified specific emotions (i.e., bothered, embarrassed, worried, self-conscious, frustrated, annoyed, disappointed, and concerned) toward food waste. Eight questions were developed to assess emotions toward food waste (e.g., "when I throw away a large amount of food at the end of my meal, I am embarrassed.").

Behavioral Intention Toward Food Waste Reduction

The researchers collected the survey data without the interference of external influencers or interventions (e.g., a food waste reduction campaign), which could have led to changes in behaviors such that the original measure of intention would no longer predict the target behavior (Ajzen, 1985, 1991). Three questions were developed to measure intention toward food waste reduction (e.g., "I plan to have no plate waste at the end of my meal.").

Self-reported Food Waste Behavior

Finally, four questions were asked directly about the frequency and amounts of an individual's plate waste to evaluate the participants' food waste behavior. Osbaldiston (2013) contended that asking about the general extent or frequency of behaviors is too subjective as researchers do not have any information about the criteria that participants used when they indicate general frequency. To overcome this challenge, researchers recommended asking dichotomous and specific questions. 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 assess how much edible food participants discarded at the end of each meal, they were asked 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 majors, length of residency at the resident halls, dining frequency in the dining hall, and the type of meal plans, were collected at the end of the survey. Some variables (e.g., gender, academic colleges and major, and length of residency at the resident halls) were used as control variables in the model testing. The rest of the demographic information was collected to describe the study participants.

Data Collection

A pilot study was conducted with 20 participants one week before survey data collection. Upon agreement, participants received a written statement describing the purpose, importance, and contact information about the study. They completed the survey and provided the researchers with comments on clarity, ease of completion, and the survey flow. Accordingly, changes were made to the survey instrument based on the participants' feedback.

After the pilot study, a URL and a QR code for the online survey were distributed to participants entering the selected dining center. They were informed about the confidentiality and voluntary nature of the survey, and each participant was offered a one-dollar cash payment after showing the confirmation page of the completed survey to one of the two researchers as they exited the dining center.

Data Analysis

SPSS (version 26) was used for data analysis. Descriptive statistics were computed to identify the participants' demographic characteristics and summarize the data. Cronbach's alpha coefficient was calculated to determine the internal consistency of each construct, where $\alpha > .70$ was considered appropriate. Pearson bivariate correlations were calculated to assess associations among variables of interest.

Structural equation modeling (SEM) among the exogenous variables (attitudes, subjective norms, and emotions), endogenous variables (self-reported food waste behavior), and a mediator (intention) was run using Mplus. Good model fit was determined with RMSEA value < .05, CFI and TLI values > .95, SRMR values < .1, and χ^2 being insignificant. A path analysis was then used to test the hypothesized associations among different variables with a significance level set at $p < .05$. Bootstrapping procedures were used to test the indirect effects of emotions, attitudes, and subjective norms on 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 accordance with 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 usable responses were included in the final data analysis. On average, the participants were 19 years old, with the majority (84%) between 18 to 20 years. More female participants took part in the survey (54%), and most of these participants had either a 14-meals-per-week meal plan (48%) or an unlimited access meal plan (43%). Most participants (64%) were in their second-semester dining in the facility when data collection occurred. In addition, 267 (59%) participants typically ate twice daily in the dining center where data collection occurred (Table 1).

Measurement Reliability and Correlations Between Variables

Pearson bivariate correlation coefficients and Cronbach's alpha are presented in Table 2. The correlations between the direct and indirect measure of attitudes ($r = .61$, $p < .01$) and subjective norms ($r = .54$, $p < .01$) were strong, indicating close associations of direct and indirect measures for these two constructs. Participants' intention toward food waste reduction correlated strongly with their emotions toward food waste ($r = .62$, $p < .01$), indicating that the stronger the emotions they experienced toward food waste, the more likely they presented positive behavioral intention toward food waste reduction. Participants' intention toward food waste reduction 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.

Table 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

Participants who reported moderate to strong intention toward food waste reduction (r = .55, p < .01), moderate attitudes (indirect, r = .35, p < .01), subjective norms (direct, r = .33, p < .01), and emotions (r = .44, p < .01), had also high reported frequencies of not wasting food. Consistent with previous studies (Stancu et al., 2016; Stefan et al., 2013), participants' attitudes, subjective norms, and emotions toward food waste were significantly associated with their intention toward food waste reduction. Also, participants' behavioral intention was significantly associated with their self-reported food waste behavior.

Cronbach's alpha scores for all scales, except self-reported food waste behavior (α = .63), were greater than 0.7, indicating good internal consistency. An exploratory factor analysis was conducted to evaluate the reliability of the self-reported food waste behavior measurement. All questions under this construct showed as one factor with an average inter-item correlation of M = 0.3, indicating an acceptable range of inter-item measures (Piedmont & Hyland, 1993).

All the direct measures had a scale from 1 to 5, with 3 being neutral. Therefore, the means from direct measures indicated that the participants (a) held moderately positive attitudes (M = 3.89, SD = 0.89), subjective norms (M = 3.34, SD = 0.75), and emotions (M = 3.68, SD = 0.74) toward food waste reduction, (b) had somewhat high intention toward food waste reduction (M = 4.08, SD = 0.86), and (c) reported somewhat positive food waste reduction behaviors, including low amount and frequency of food waste (M = 3.96, SD = 0.63). Meanwhile, all indirect measures had a range from -10 to 10. The results from the indirect measures indicated that most participants had strong attitudes against food waste (M = 5.61, SD = 3.60), and experienced moderate subjective norms, but had low motivation to comply with these norms (M = 1.88, SD = 3.73).

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, intention, and self-reported food waste behavior to test SEM, with control variables (i.e., gender, affiliated colleges, and length of dining experience). The proposed model was a good fit for 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 that both variables could be measured adequately as latent variables (Figure 2).

The Test of the Structural Model

SEM results indicated that higher scores of participants' attitudes (b = .21, $s.e$ = .06, β = .24, p < .01), subjective norms (b = .15, $s.e$ = .09, β = .14, p < .01), and emotions (b = .49, $s.e$ = .08, β = .42, p < .01) were significantly associated with higher scores on intention toward food waste reduction. Therefore, hypotheses 1 to 3 were accepted. Additionally, hypothesis 4 was also accepted because a higher score of intention toward food waste reduction was significantly associated with a higher score on self-reported food waste reduction behavior (b = .32, $s.e$ = .05, β = 43, p < .01).

The model using TRA variables only (i.e., attitudes, subjective norms) explained only 27.9% of the variance in intention (Table 3). When "emotion" as an antecedent was added, the percent variance

Table 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)	a	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 < .01. (Two-tailed).

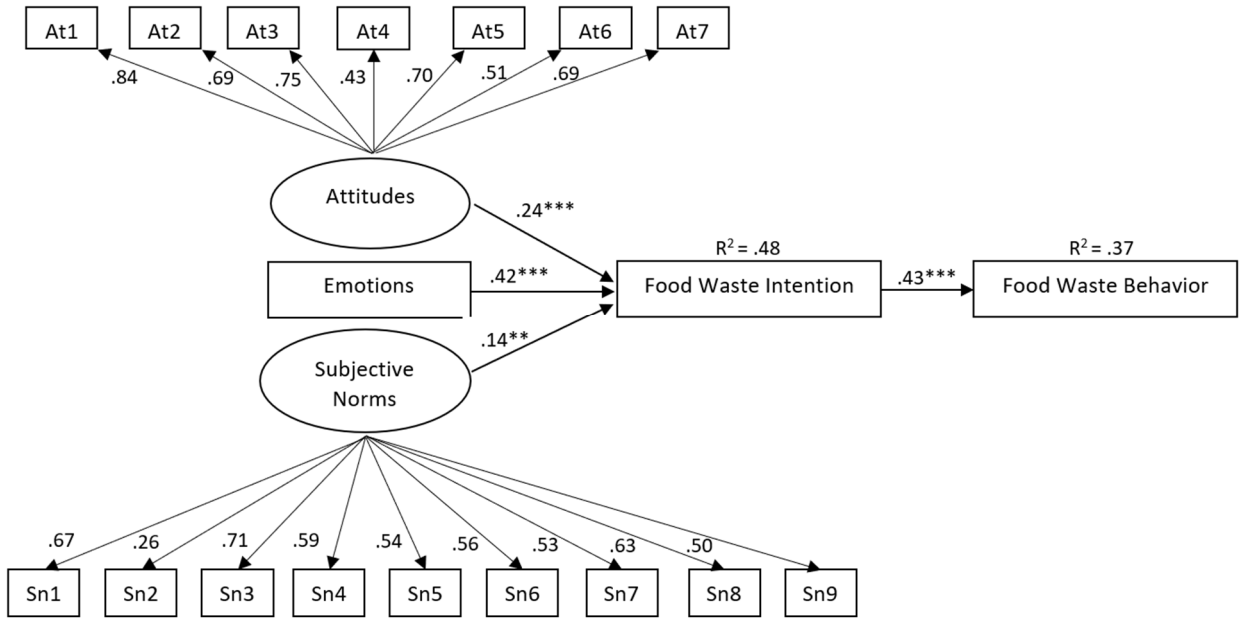

Figure 2. Structural Model of Attitudes, Subjective Norms, Emotions, and Intention Toward Food Waste on Self-reported Food Waste Behavior.

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

explained improved to 47.6%, showing a significant added effect of emotion. Attitudes, subjective norms, emotions, and intention, along with control variables, explained 37.1% of the variance in self-reported food waste behavior.

The bootstrapped indirect effects from attitudes to self-reported food waste behavior via its effect through intention toward food waste reduction 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, the indirect effects from subjective norms on self-reported food waste behavior via the intention toward food waste reduction behavior was significant ($b = .05$, $p < .05$, CI 90% [.01, .10]), indicating that one unit increase in subjective norms was associated with a .05 unit increase of self-reported food waste reduction behavior. The indirect effects of emotions on self-reported food waste behavior via the intention toward food waste reduction behavior was also significant ($b = .15$, $p < .01$, CI 90% [.11, .21]), indicating that one unit increase in emotions was associated with a .15 unit increase of self-reported food waste reduction behavior (Table 4). Participants' intention toward food waste reduction fully mediated all three indirect effect paths. Therefore, hypotheses 5 to 7 were accepted.

Table 3. Unstandardized, Standardized, and Significance Levels (standard errors in parentheses; n=450).

Parameter Estimate	Unstandardized	Standardized	p
Structural Model			
Attitudes à Intention	.21 (.06)	.24	<.01
Attitudes à Food Waste Behavior	.04 (.04)	.06	.37
Subjective Norms à Intention	.15 (.09)	.14	<.01
Subjective Norms à Food Waste Behavior	.08 (.06)	.10	.19
Emotions à Intention	.49 (.08)	.42	<.01
Emotions à Food Waste Behavior	.08 (.06)	.10	.17
Intention à Food Waste Behavior	.32 (.05)	.43	<.01
Gender à Intention	-.11 (.05)	-.08	.04
Gender à 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.

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 established a comprehensive model of self-reported food waste behavior at a university dining center. The results of this study showed that participants' attitudes, subjective norms, and emotions toward food waste predicted their intention toward food waste reduction, which ultimately predicted their self-reported food waste behavior.

Participants' attitudes were positively associated with their intention toward food waste reduction. These associations indicated that participants who had a better realization of their behavioral outcome and were more in favor of food waste reduction also had a higher intention toward food waste reduction. For example, participants who expressed strong behavioral beliefs regarding the potential use of edible food waste to help mitigate hunger challenges in the

Table 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	.06
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).

community also reported higher intention toward food waste reduction. These findings were consistent with the TRA (Fishbein & Ajzen, 1975; Fiske & Taylor, 1991) as well as previous studies on food waste behavior, which reported a significant association among consumers' attitudes and intention toward food waste reduction (Stancu et al., 2016; Stefan et al., 2013; Zhang & Kwon, 2022).

Participants' subjective norms were also positively associated with their behavioral intention. However, despite the overall subjective norms showing significant associations with the intention, the coefficient and significance levels were not as high as other predictors. This may be explained by the low scores on indirect measures of subjective norms. Participants in this study reported moderately high expectations of themselves not to waste food (M = 3.34). However, the indirect measure that took account of participants' motivation to comply was low (*M* = 1.88). One of the normative belief questions, "y family thinks I should not waste food." had a mean of 4.08, but the mean of motivation to comply was only 0.68. These results indicated that the participants might be aware of the strong social pressure toward food waste reduction, yet they lacked the motivation to comply with the norms.

These results may explain why SEM analysis showed a significant but weak association between subjective norms and intention toward food waste reduction. Researchers have suggested that the normative construct of subjective norms in the TRA is often not a strong predictor of intention compared to other antecedents (Armitage & Conner, 2001; Armitage et al., 2002), or they have found it an insignificant predictor of intention, and behavior (Stefan et al., 2013).

Emotions toward food waste were positively associated with participants' food waste reduction intention. In fact, the effect size of emotion toward intention was significantly larger than all other antecedents. Participants in this study reported strong emotions such as the feeling of embarrassment, frustration, and disappointment toward leaving food waste. Participants may label these feelings as undesirable emotions and, therefore, avoid behaviors (i.e., wasting food) that may lead them to feel these emotions. A study conducted with British consumers (Russell et al., 2017) reported that negative emotions toward food waste had a strong positive association with the intention toward food waste reduction, which was consistent with the results from this study.

The study's findings indicated a strong association between intention toward food waste reduction and self-reported food waste behavior. Specifically, participants who expressed a strong intention to leave no food waste at the end of their meals also reported lower frequencies and amounts of food waste. This result was consistent with our expectations based on the TRA (Fishbein & Ajzen, 1975; Fiske & Taylor, 1991). Furthermore, participants' intention toward food waste reduction fully mediated 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 the independent variables could only impact self-reported food waste behavior through the participants' intention toward food waste reduction.

LIMITATIONS AND FUTURE STUDIES

Although this study included a variety of factors that may influence participants' food waste behavior, other influencers such as knowledge of food waste challenges, motivation to avoid food waste, and food waste habits may also have potential influences on consumers' food waste behavior (Aschemann-Witzel et al., 2015; Russell et al., 2017). Furthermore, consumers' cultural backgrounds, genders, and perceptions of convenience to reduce food waste may also affect their food waste behavior (Koivupuro et al., 2012). Therefore, future studies could helpfully evaluate the factors above along with variables explored in this study to improve variance explained in food waste behavior.

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 other facilities of different types, their internal structures, or geographical locations. Future studies may consider collecting data at multiple dining facilities that operate under different structures to overcome limited generalizability issues. For example, participants may be recruited from university dining centers offering all-you-care-to-eat dining services and dining facilities offering order-off-the-menu dining services to compare different food waste behaviors under different dining settings to better inform dining hall practices that aim for reduced waste.

Finally, using self-reported data only from a single-time assessment may result in researcher and social desirability biases. Although this study kept the participants anonymous and distributed surveys online to limit social desirability bias, participants might have felt pressure to answer questions in a socially acceptable manner regardless of their true feelings toward a topic. To reduce the social desirability bias, researchers may need to avoid phrasing survey questions in a way that reflects more socially desirable attitudes, behaviors, or perceptions (Podsakoff et al., 2003). In addition, researchers may employ the technique of indirect questioning, which asks the participants to answer questions from the perspective of another person or group to mitigate the effect of social desirability (Fisher, 1993). Furthermore, asking participants to rate the desirability of each item, including a social desirability scale to detect social desirability bias issues (Nederhof, 1985), or pairing survey responses with actual behavior to capture more accurate consumer behavior may mitigate such biases.

CONCLUSIONS AND APPLICATIONS

The current study evaluated the associations among attitudes, subjective norms, emotions, intention, and self-reported food waste behavior in a university dining center. The results indicate that participants' intention toward food waste reduction fully mediated

the three pathways from attitudes, subjective norms, and emotions to self-reported food waste behavior. The findings contribute to the existing consumer behavior literature and may guide and support practitioners who aim to influence customers' food waste behavior.

First, few researchers have provided theoretical frameworks for food waste studies conducted in university foodservice operations. By adopting a modified TRA model and adding the less assessed variable of emotions, this study has provided theoretical support for future research in an onsite foodservice setting. In addition, only a few researchers have examined emotions as a predictor of behavioral intention and behavior. In those few studies, the predictability and directions of associations of emotions on behavioral intention and behavior varied (Russell et al., 2017). This study revealed that emotion significantly predicted self-reported food waste behavior. Specifically, strong emotions toward food waste positively predicted consumers' intention toward food waste reduction and their self-reported food waste reduction behaviors. Therefore, by adding the antecedent of emotion, this study more adequately evaluated the psychological antecedents of food waste behavior and provided additional theoretical support to existing literature on consumer behaviors about food waste.

Practically, this study guides practitioners who aim to influence their customers' food waste behavior and ultimately reduce the amount of food waste. Interventions seeking to influence consumers' attitudes, subjective norms, and emotional reactions toward food waste may effectively change consumers' intentions and food waste behavior. Specifically, university dining center operators may influence consumers' attitudes toward food waste by informing and educating them about its consequences. Table tents may be employed to display reminders about food waste reduction. Stickers may be posted with each serving line and at the self-serve station to remind consumers only to take the amounts they can finish. University dining operators may also apply findings regarding the strong subjective norms, with an intervention revealing the amount of their plate waste. To trigger strong emotional responses toward food waste, which we've shown to be a stronger antecedent toward intention than other antecedents from TRA, university dining center operators may utilize digital appliances such as TVs and projectors in the dining center to display messages and pictures related to food waste challenges or otherwise convey the consequences of food waste.

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