

Article

Can Climate Change Awareness Predict Pro-Environmental Practices in Restaurants? Comparing High and Low Dining Expenditure

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Abstract: The purpose of this study is to develop a better understanding of what makes consumers reduce waste in order to address climate change, particularly when dining out. To accomplish this goal, this research constructs an extended theory of planned behavior model, using four main constructs of attitude, subjective norm, perceived behavioral control, and behavioral intention and incorporating climate change awareness and mitigation pursuing actions, anticipated pride and guilt, and high and low levels of dining expenses. An online survey was conducted of 482 respondents aged 20 years old or over who had dined in restaurants in the previous month in 2019. A partial least squares-structural (PLS) equation modeling analysis has been utilized with multi-group analysis. Results reveal that climate change awareness has significant effects on attitude and behavior intention, and climate change mitigation pursuing actions positively influence attitude and behavioral intention to reduce waste. Consumers' anticipated emotions lead to their behavioral intention. Diners' behavioral intention to reduce waste is significantly influenced by their attitude, subjective norms, and perceived behavioral control on waste reduction in restaurants. The levels of dining expenses significantly moderate seven out of nine hypotheses. Research on consumers' waste reduction in relation to climate change is not sufficiently conducted in the foodservice sector. Using an extended theory of planned behavior (TPB) to understand diner behavior related to waste reduction and climate change, this study therefore makes an important contribution to improving sustainability in foodservices, especially in the Asian context.

Keywords: climate change; anticipated emotion; pro-environmental practices; waste reduction behavior; cost of dining; theory of planned behavior; restaurant consumers; restaurant waste; South Korea

1. Introduction

Consumers are becoming increasingly aware of the individual measures they can take to mitigate climate change, including waste reduction [1], dietary change [2,3], energy and resource conservation [4,5] and adopting a low-carbon lifestyle [6]. Climate change awareness overall positively encourages consumers' attitudes toward climate change mitigation and associated behaviors [7,8]. Individuals' climate change beliefs and concerns also influence their attitudes toward climate change mitigation actions [9,10].

Climate change mitigation is a significant challenge for the restaurant and foodservices sector given its relatively high energy and water use, often significant amounts of food waste, and supply chains that often carry a substantial carbon footprint [11]. To promote climate-friendly practices, long- and short-term behavioral and system interventions are needed, which can complement interest among consumers and restaurants for information on food carbon footprints and sustainability [12]. In South Korea (hereafter Korea), such a situation creates some substantial issues as restaurants traditionally serve various side dishes without extra charge per each meal, resulting in substantial food waste [13]. Food waste is expensive for restaurants, as it is calculated by weight and even small restaurants pay upwards of Korean Won (KRW) 800,000 a month (e.g., under a food waste tax of KRW 160 per liter) [14] (US\$1 was equivalent to KRW 1147 as of 1 May 2019). Although waste reduction in foodservices is critical for climate change mitigation as well as reducing environmental impacts in general, research has largely neglected examining consumers' attitude and behavior to waste reduction for climate change mitigation reasons in the foodservice industry, particularly in Asian contexts such as Korea.

In studies of consumer behavior, the theory of planned behavior (TPB) has the demonstrated capacity to assess the causes, effects, and consequences of individuals' thoughts and attitudes on behaviors [15,16]. In the foodservice and tourism domain, the TPB has proven substantial explanatory power with respect to green consumerism [17–20]. In particular, the extended TPB has been widely adapted to predict consumers' eco-friendly behavior in the restaurant and food delivery industry [21–23]. The TPB has successfully assessed the implications of a number of factors that affect consumer attitudes and behaviors in relation to sustainability, including anticipated pride and guilt [19,20,24] and expenditure levels [25]. Furthermore, studies on food waste behavior have also been widely applied using TPB, revealing that individuals' non-voluntary and voluntary aspects are important for their food waste reduction behavior [26–30].

A significant portion of food waste ends up in landfills or is incinerated, leading to greenhouse gas (GHG) emissions which contribute to global heating and climate change [31]. Therefore, climate-friendly consumer behavior in restaurants is of interest to the food and beverage sector as they seek to understand the implications of carbon footprints associated with food [13]. Due to the significances of consumer climate change mitigation behavior, this work attempts to construct and validate an extended TPB framework to predict consumer behavior on waste reduction for climate change mitigation in the Korean restaurant industry. Specifically, the extended TPB model tests the relationships among climate change awareness, mitigation actions, anticipated pride and guilt, four constructs of TPB, and high/low dining expense groups. This research therefore seeks to both improve theoretically informed understanding of the environmental practices of restaurants and diners as well as the very practical issue of restaurant waste reduction. As a result, this study contributes to the foodservice and sustainability literature by developing a new model and providing insights into waste reduction practices in the restaurant industry, which may reduce operational costs and contribute to the environment and human health. Furthermore, the Korean context is also very significant, since only limited research exists on Asian restaurant consumption behaviors in relation to sustainability.

1.1. Climate Change Awareness and Mitigation Pursuing Actions

Climate change awareness can be defined as the perceived concerns over threats to human society and natural ecosystems from climate change [4,8,32,33]. Climate change awareness is essential for the development of active initiatives to manage climate change risks [33], including waste reduction [4]. Moreover, growing awareness of climate change influences the adoption of low-carbon consumption patterns that can help mitigate climate change [2]. Climate friendly behavior is also influenced by climate change awareness and mitigation initiatives [34]. In this research, climate change awareness is conceptualized as the perceived concerns about the reasons, consequences, or risks of climate change. Such a definition also incorporates responses to climate change associated weather events or atmospheric conditions, such as fine dust and reductions in air quality [32].

Climate change mitigation pursuing actions are the seeking of practices that lessen greenhouse gas emissions [5,10,35]. Such actions can be undertaken by individuals, businesses, organizations, or government [10]. Activities such as waste reduction and recycling that reduce life-cycle energy use and industry emissions are undertaken by both organizations and individuals [1,36,37]. In contrast, the adoption of plant-based diets is more of an individual response to climate change, along with other potential factors such as animal welfare, health improvement, and biodiversity conservation [3]. Combining supply-side actions, such as efficient production, transport, and processing, with demand-side interventions, such as modification of food choices, and reduction of food loss and waste, reduces GHG emissions and enhances food system resilience [38]. Avoiding food loss and waste will have positive environmental effects because, for example, during 2010–2016 global food loss and waste equaled 8–10% of total GHG emissions from food systems and cost about USD 1 trillion per year (2012 prices) [38,39]. In this research, climate change mitigation pursuing actions are conceptualized as the seeking of appropriate behavioral and systemic actions for mitigating climate change and associated atmospheric and weather events.

1.2. Waste Reduction in Foodservices

According to the United States Environmental Protection Agency [40], waste reduction can be defined as a set of processes and practices intended to reduce, recycle, and reuse resources or use renewable energy sources. For the foodservice industry, waste reduction during the consumption stage has a significant sustainability role, including environmental conservation and promoting human health and wellbeing [41–43]. Providing information about the negative impacts of food waste at landfills to consumers significantly reduces more food waste than not providing the information to consumers [44]. Food waste reduction has become a global concern with the sustainable development goals aimed at halving food waste per capita at retail and consumer levels, with plate and portion size reduction, menu change, and menu information being effective interventions [36,37,45]. Meeting the Agenda 2030 sustainable development goals requires a termination of the current locked-in relationship between the desired poverty reductions that have contributed to improved health and nutritional status and the resulting increase in greenhouse gas emissions and food waste [46].

Reducing waste in the foodservice industry has been found to have a number of positive environmental and socio-economic consequences [23,47,48]. The foodservice sector is one of the largest food waste sectors based on food inputs, with sustainable measures potentially reducing waste and improving efficiency and thereby lowering costs [47]. The attitudes and behaviors surrounding food waste in the foodservice sector significantly influence the amount of food waste in restaurants [48]. The level of interest in protecting the environment is so substantial that some consumers actively seek restaurants that adopt sustainable practices e.g., food safety, improved energy efficiency, waste reduction, recycling, and low-carbon food [23]. As pro-environmental practices, waste reduction behavior in foodservices for sustainability and climate change mitigation reasons refers to practices for reducing, recycling, or reusing resources (e.g., food, energy, water, plastic, disposable products) and using renewable energy sources during dining.

1.3. TPB and Theory Extension

The TPB is a theory on the linkages between individuals' beliefs and behavior that states that perceived behavioral control, attitude toward behavior, and subjective norms lead to intention and behavior [15,16]. In order to predict pro-environmental behavior, incorporating significant variables, e.g., responsibility, personal norm, and anticipated pride and guilt, into the TPB has been found to substantially increased the explanatory power of environmentally friendly behavior for travelling [19,20]. With respect to sustainable tourism, an extended TPB has been applied by including green image, environmental awareness, and anticipated emotions, revealing that the extended TPB enables a better understanding of tourists' waste reduction intentions [17]. In the foodservice domain,

TPB constructs have enabled an improved understanding of the behavioral responses of green hotel guests [18].

In foodservices, extended TPBs have also improved understanding of consumer behavior in terms of sustainability [21–23]. Combining the three variables of environmental concern, collectivism, and perceived consumer effectiveness in an extended TPB has been found to accurately explain consumer intentions to visit eco-friendly restaurants [21]. With respect to diners' takeaway waste separation intention, an extended TPB incorporating environmental concern has highly predicted separation intention in relation to conditional factors of facilities and time pressure [22]. In an extended TPB, two added variables (perceived usefulness and curiosity attitude) and attitudes, perceived behavioral control and subjective norms have been found to influence the intentions of consumers who preferred sustainable restaurants with behavioral intentions affecting actual behavior [22]. Hence, in this study, the four constructs of climate change awareness, mitigation pursuing actions, and anticipated pride and guilt, have been incorporated into an extended TPB applied to better understand diner behavioral intention with respect to waste reduction.

2. The Proposed Research Model

2.1. Climate Change Awareness, Attitude and Behavioral Intention

The level of awareness of anthropogenic climate change is positively related to risk perception and the climate action that people take [8,34] refers to a “pro-climate friendly behavior.” There are numerous instances of the implications of awareness for climate change actions. For example, public awareness of heat waves influences attitudes towards the influences of heat waves on the society and the reframing and communication strategies [7]. Increasing climate change awareness brings greater use of eco-friendly food on the basis of reducing GHG emissions and mitigating climate change [2]. Public opinion on climate change concerns is also related to environmental attitudes and the adoption of energy efficient behavior to reduce emissions [4]. Hence, this research posits two hypotheses on waste reduction for sustainability in foodservices:

Hypothesis 1 (H1). *Consumers' climate change awareness has a positive effect on their attitude toward waste reduction.*

Hypothesis 2 (H2). *Consumers' climate change awareness has a positive effect on their behavioral intention on waste reduction.*

2.2. Climate Change Mitigation Pursuing Actions, Attitude, and Behavioral Intention

Although individuals may be engaged in pursuing climate change mitigation, they are constrained by structural, economic, and social barriers, including limited awareness of the problem, attitudes, and actions to improve the environment [5,35], which also influence consumer attitudes and behaviors [10]. People who acknowledge climate change mitigation practices usually have pro-environmental attitudes towards global heating, as well as being engaged in pro-climate behaviors [4]. Moreover, people who consider that anthropogenic climate change is taking place were more likely to show concern with the impacts and engage in mitigation [9], implying that climate change mitigation pursuing actions influence attitude and behavior. Hence, we postulate two hypotheses on waste reduction for sustainability in foodservices:

Hypothesis 3 (H3). *Consumers' climate change mitigation pursuing actions have a positive effect on their attitude toward waste reduction.*

Hypothesis 4 (H4). *Consumers' climate change mitigation pursuing actions have a positive effect on their behavioral intention on waste reduction.*

2.3. Anticipated Pride and Guilt and Behavioral Intention

Individuals' anticipated pride and guilt has been shown to have significant roles in their sustainability-related behavior [19,20,24,42]. Anticipated pride and guilt allow an individual to act for the environment in a manner that is consistent with the individuals' norms on the self-regulating function of the emotions [19]. Anticipated emotions of pride and guilt greatly enhance the explanatory power of the expanded TPB, leading to the intention of action [20]. For individuals in individualistic cultures, anticipated pride and guilt has been found to have had a greater impact on environmentally friendly choices than in collectivist cultures, and emotions are also more social in nature in collectivist than individualist cultures [49].

The anticipation of the positive future emotional state from green action by an individual just prior to making an environmentally-related decision was found to lead to higher pro-environmental behavioral intentions in comparison to the anticipation of a negative emotional state from inaction [50]. Tourists' anticipated emotions of pride and guilt also have positive effects on personal norms which, in turn, lead to eco-friendly behaviors of word of mouth, buying, and sacrifice [24]. Anticipated pride in this research is conceptualized as anticipating emotions of being proud of, being accomplished by, and/or being confident with respect to reducing waste at restaurants, while anticipated guilt is defined as anticipating emotions of being guilty, being remorseful, and/or being sorry for not reducing personal food waste at restaurants. Hence, we propose the following two hypotheses in foodservices:

Hypothesis 5 (H5). *Consumers' anticipated pride has a positive effect on their behavioral intention on waste reduction.*

Hypothesis 6 (H6). *Consumers' anticipated guilt has a positive effect on their behavioral intention on waste reduction.*

2.4. Attitude, Subjective Norm, Perceived Behavioral Control, and Behavioral Intention

Key variables of TPB, subjective norms, attitudes, and perceived control of behavior, have generally been found to predict behavioral intentions very accurately [15,16]. Tourists' attitude toward and subjective norm on waste reduction behavior have positive impacts on their waste reduction intentions [17]. Among green hotel guests, subjective norm, attitude, and perceived behavioral control significantly influence continued intention to stay in the hotel [18]. With respect to foodservice industry waste, consumers' attitude and perceived behavioral control have been found to influence takeaway waste separation in workplaces [22]. In the foodservice sector, diners' positive attitude, subjective norm, and perceived behavioral control on environmentally friendly actions substantially influence their behavioral intention to visit eco-friendly restaurants [21]. In the extended TPB model, consumers' subjective norm, attitude, and perceived behavioral control on sustainability directly influence the behavioral intention to dine at sustainable restaurants [22]. Hence, we suggest three hypotheses regarding waste reduction in foodservices:

Hypothesis 7 (H7). *Consumers' attitude has a positive effect on their behavioral intention on waste reduction.*

Hypothesis 8 (H8). *Consumers' subjective norm has a positive effect on their behavioral intention on waste reduction.*

Hypothesis 9 (H9). *Consumers' perceived behavioral control has a positive effect on behavioral intention on waste reduction.*

2.5. Moderating Role of High and Low Dining Expenses

An individual's income and level of spending can have significant implications for behavior. Compared to individuals with non-luxury goods, people with luxury goods (e.g., traveling by luxury vehicles or jets) are more likely to make decisions that benefit themselves rather than the environment [51]. For tourists, the association between destination image and satisfaction, traveler motivation and satisfaction, and cognitive quality and satisfaction is very different depending on whether expenditure is high or low [52]. In visitor economy crowdfunding, high and low investment amount groups moderate crowdfunders' relationships, i.e., uncertainty level, venture quality, word-of-mouth, participation, and re-participation [53]. Gender, age, language, occupation, group size, place of origin, and staying length have been found to be significantly different between high and low spenders in a South African wine festival. Visitors with higher expenditure placed greater importance on the inherent motivation to attend the festival than low-spenders [54].

In the foodservice industry, diners with high expenditure levels for a lunch considered that the nutritional elements of a menu were more important than low spenders, while low spenders think that taste is less important than high spenders [55]. In this study, high and low dining expenses are defined in relation to the average expenditure levels for a meal per person in the foodservice industry in Korea. Hence, this study anticipates that high and low levels of consumer dining expenses moderate nine relationships of the proposed framework in the foodservice industry:

Hypothesis 10a–i (H10a–i). *Consumers' high or low dining expenses moderates the nine hypotheses proposed above of relationships among climate change awareness and mitigation pursuing actions, anticipated pride and guilt, attitude, subjective norm, perceived behavioral control, and behavioral intention on waste reduction at restaurants.*

Based on all the hypotheses, the proposed research framework is presented in Figure 1.

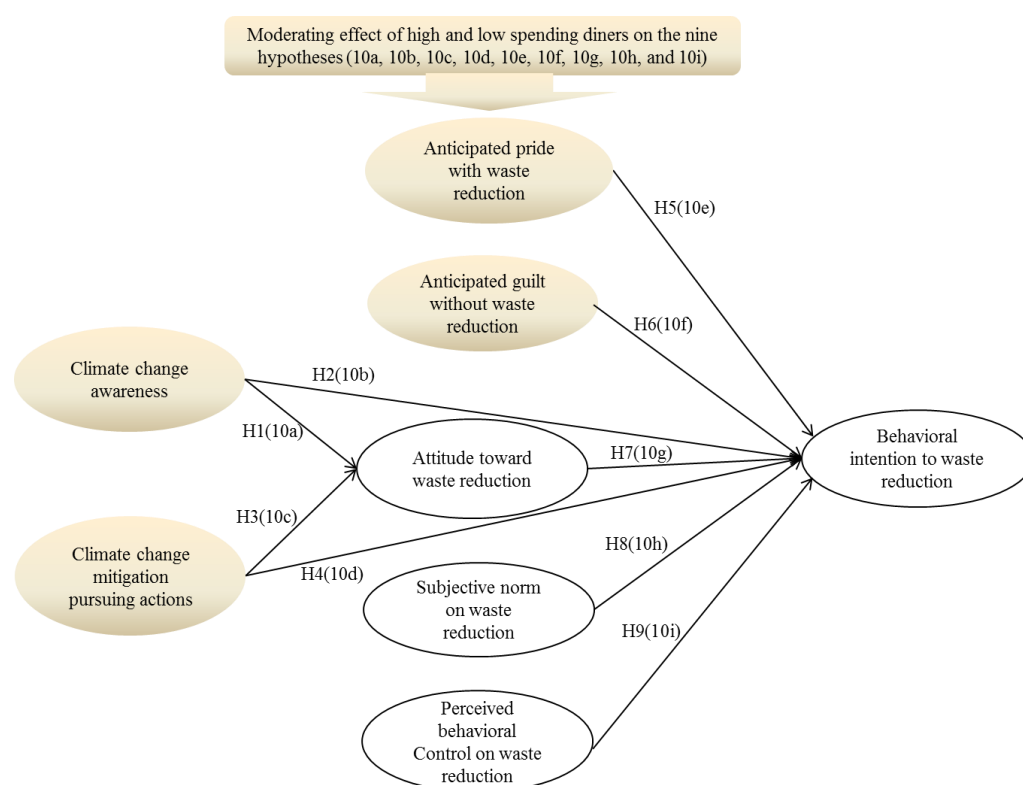


Figure 1. Proposed research model. Note: The shaded constructs denote the extended theory of planned behavior (TPB) and the white constructs denote the TPB.

3. Methods

3.1. Measurement

The online survey used in this study originally comprised 31 items for eight constructs. The constructs represented climate change awareness, climate change mitigation pursuing actions, anticipated pride, anticipated guilt, subjective norm, attitude, and perceived behavioral control, and intention. Six items addressing the construct of climate change awareness were generated from prior research [2,8,33]. Six items to assess the construct of climate change mitigation pursuing actions were adapted from the literature [5,10,35]. Three items for the construct of anticipated pride in undertaking waste reduction were identified in earlier work [19,20,53], along with three items to gauge the construct of anticipated guilt without participating in waste reduction [17,24]. To evaluate the construct of attitude toward waste reduction, four items have been generated from the research of Han et al. [17] and Onwezen, et al. [53]. Three items were drawn from Han et al. [56] and Onwezen et al. [19] to assess the construct of subjective norm on waste reduction. To measure the construct of perceived behavioral control on waste reduction, three items have been used from Ajzen [15] and Onwezen et al. [20]. Three items addressing behavioral intention to undertake waste reduction were generated by prior research [16,22,56]. Every item has been evaluated applying a seven-point Likert-type scale, consisting of the values strongly disagree (1), disagree (2), somewhat disagree (3), neither agree nor disagree (4), somewhat agree (5), agree (6), and strongly agree (7).

Eight general questions related to sustainable diner behavior were also added (Supplementary Materials). Finally, seven questions related to socio-demographics were incorporated in the survey. The survey tool was primarily prepared in English, which was accordingly converted into Korean version by three university specialists in both languages. The survey tool was then back-translated into English to resolve inconsistencies between expressions [57].

Four academics who are specialized in the research theme precisely evaluated the content validity of the questionnaire. Seven Korean restaurant managers assessed the survey to ensure that it suitably evaluated sustainable diner behavior in Korea. Based on the two processes, three items for climate change mitigation pursuing actions were added to the survey instrument in order to clearly capture the meaning of the construct. One item each for climate change awareness and anticipated pride with waste reduction and guilt without waste reduction were re-written due to overlapping meaning. The survey was piloted with five Ph.D. candidates with a semi-structured interview. Based upon their comments, several items addressing attitude toward, subjective norm, and perceived behavioral control on waste reduction were reworded and a screen question was revised. Another trial survey was undertaken with 50 individuals who had eaten out at restaurants in the previous month with subjects specifically requested to offer comments on questions as a pre-test. This procedure resulted in a final revision that clarified questions related to climate change mitigation pursuing actions and general information. The modified survey was then applied to the data collection instrument.

3.2. Data Collection

By selecting questions to participate in the research process, subjects who were not qualified were excluded by the survey system ("During the past month, have you eaten out at any restaurants?"). For this research project, all subjects were Koreans 20 years old or over and had dined in restaurants within the month prior to completing the survey. A quota sampling method has been utilized in terms of the total population by age and gender in Korea [58].

The survey guidelines stated that questions have no correct or incorrect answer in order to decrease subject anxiety. The key terms (e.g., waste reduction for sustainability at restaurants) were explained, along with their examples. The questionnaire had three sections: the first section incorporated definitions on key terms and general questions; the second included items associated with the research framework; and the third comprised socio-demographic characteristics.

Due to their speed and cost-effectiveness [59], online surveys are now popular in tourism studies in Korea [53,60]. The online survey firm Embrain was hired to collect the research sample. Embrain follows sample selection procedures thoroughly to ensure data quality and uses the panel identification number as well as the legal name of the individual to check the personal information of all subjects. Using Embrain's standard system, all surveys that were completed too soon were removed. All subjects had a different order of questions in order to avoid bias in response to any multiple-choice item. Participants were requested to state the name of a restaurant in which they experienced dining out in the month prior to the survey. The name of the restaurant that the respondent provided was then presented on each item in the survey for all questions.

The online survey was administered from 25 April–15 May 2019. To provide the research background and assure confidentiality, a personal email was extended to invite participation in this study. The definitions for 'climate change awareness' and 'climate change mitigation pursuing actions' were provided at the beginning of the questionnaire. A random invitation was sent to 18,245 of panelists on the Embrain database via email. The number of initial invitations was based upon several considerations. First, since typical samples for structural equation modeling (SEM) are about 200 cases [61], more than 400 cases were necessary for multi-group analysis (MGA) of the two groups of high and low environmental concern respondents. Second, the survey company [62] generally receives a 5% response from all total initial invitations from their panel database. Of them, 4441 respondents connected to the questionnaire. Every panelist was requested to respond to a screening inquiry intentionally created for the study: after this procedure, 985 participants experienced eating out at restaurants within the past month stated "yes," and then, 667 panel members completed the survey. If respondents answered the survey questions in a rapid fashion reflecting a short time frame spent on reading the statements, or if a subject's answers followed certain patterns, those subjects were excluded from the data set because rapid and patterned responses have been proven to be unreliable [63]. Accordingly, after removing some outliers, patterned responses (e.g., answering same numbers or patterns without thinking), and rapid answers (taking far less time than three seconds per question), 482 responses were used for the analysis. Following the criteria of the American Association for Public Opinion Research [64], this represents a response rate of 48.9%, with a dropout percentage of 32.3% (318/985).

3.3. Data Analysis

A partial least squares (PLS)-SEM method has been utilized to validate the proposed research model. According to Chin et al. [65], PLS-SEM needs minimum criteria to verify a research framework by a bootstrap re-sampling technique. In particular, for MGA and comprehensive framework, PLS-SEM is regarded as being more appropriate than traditional SEM [66]. Accordingly, SmartPLS 3.2.8 has been used to validate measurement and structural models as well as research relationships [67]. To verify the moderating effect of high and low spenders, this work applied MGA based on PLS-SEM algorithm [68]. To contrast differences in the nine hypotheses depending on high and low spending group, MGA has been applied, as recommended [65,69]:

Common method bias could be a potential problem, since subjects were requested to assess all survey items at the same time with the same subjects. Hence, to control for common method variance [70], protections were taken applying various methodical remedies. For choosing subjects who had experienced dining out within the past month, a selection inquiry was applied. Harman's single-factor test is performed as a post hoc statistical for determining whether the resulting data set was influenced by common method variance [70]. Exploratory factor analysis (EFA) was conducted with every self-administrated questionnaire item. Once a single factor reveals, common method bias can be a concern. According to EFA results, seven variables (eigenvalue > 1) indicating 77.4% by factors containing the first factor (41.3%) and follow-up factors (11.6%, 7.3%, 5.6%, 4.5%, 3.6%, and 3.4%). The comparison of EFA and confirmatory factor analysis (CFA) has been applied because Harman's single-factor checking includes weaknesses [70]. A comparison of the hypotheses (e.g., CFA)

and only one factor specified (e.g., EFA) was conducted based on [71]. The result reveals that the hypothesis framework is more suited to the data than the single factor framework. In addition, the hypothesis model was statistically significant as compared to the single factor framework. Specifically, the difference in chi-square statistics between the hypothesis and single factor frameworks is highly significant ($\chi^2 (5521.0)/df (23) = 240.0, p < 0.001$). Therefore, as the two statistical examinations show, common method bias is not a problem in this work.

3.4. Grouping Check

The high and low dining expense was assessed by a general question (i.e., “When you dine at restaurants, what is your average spend per person by Korean won?”). Grouping has been performed by a median-split (KWR 20,000) on average dining expenses per restaurant visit. There were 177 high- and 199 low-spending respondents. For more accurate analyses, the respondents on the median ($n = 106$) were excluded. To confirm validation of grouping, average difference in average spend was checked to see if the higher spend group (mean = KWR 45,903) was relatively higher than the low spending group (mean = KWR 11,648). This result indicates that there was a satisfactory difference in grouping [72].

3.5. Respondents' Profile

In terms of high and low dining expenses, the majority of the high spending diners are males (56.5%), while a majority of the low spending diners are female (57.3%). Approximately a third of high spenders were in the 30–39 category (31.6%) as well as 40–49 years old bracket (31.6%), with a third of low spenders falling in the 20–29 years old range (35.2%). The majority of subjects held a four-year degree or attended graduate school, although the level of education among high spenders (65.0%) was significantly lower than among low spenders (76.9%). Approximately half of the high spenders were married (54.8%), but half of the low spenders were single (51.3%). There was also little difference in monthly family income, as 61.1% of who earn KRW 4.00 million and over were high spenders and 58.3% low spenders. There was a larger difference with respect to the proportion of respondents in full time employment, with 83.1% of high spenders being in full time employment and 71.9% of low spenders. A majority of the sample were living in metropolitan areas with the percentage of high spenders (67.2%) being less than low spenders (71.8%) (see Table 1).

A majority of the subjects ate out more often than once a week, with high spenders (52.5%) eating out substantially less than low spenders (69.8%). A majority of both samples dined out for family gatherings. The high spending group of subjects spent over KRW 20,000, while the low spending group spent below KRW 20,000 per person for eating out on average. Slightly more vegetarians were represented in the high spending category (22.1%) than low spending category (21.6%). A majority of the respondents participated in waste reduction at work (high spenders: 58.8%; low spenders: 65.4%) as well as at home (high spenders: 67.7%; low spenders: 72.3%). More higher spenders (37.9%) had recently dined at environmentally friendly restaurants than low spenders (29.1%) and slightly more low spenders (70.8%) had dined at casual/family full-service restaurant than high spenders (68.3%) (see Supplementary Materials).

Table 1. Comparison of demographics of high and low dining expense groups.

Characteristics	High ^a (%)	Low ^b (%)
Gender		
Male	56.5	42.7
Female	43.5	57.3
Age		
20–29 years old	19.8	35.2
30–39 years old	31.6	32.7
40–49 years old	31.6	19.1
50–59 years old	13.0	9.5
60 years old and over	4.0	3.5
Educational level		
Less than or high school diploma	14.7	10.6
Two-year college	20.3	12.6
Four-year degree	56.5	61.3
Graduate school or higher	8.5	15.6
Marital status		
Single	42.4	49.8
Married	54.8	48.7
Other (divorce)	2.8	1.5
Monthly household income		
Less than 2.00 million KRW *	5.6	13.6
From 2.00 to 3.99 million KRW	33.3	28.1
From 4.00 to 5.99 million KRW	32.8	29.5
From 6.00 to 7.99 million KRW	14.7	16.6
8.00 million KRW and over	13.6	12.2
Occupation		
Professionals	13.6	12.6
Business owner	6.8	5.0
Service worker	6.8	6.5
Office worker	53.1	42.3
Civil servant	2.8	5.5
Home maker	7.3	7.5
Retiree	1.1	0.5
Student	4.0	11.1
Unemployed	1.7	4.5
Other	2.8	4.5
Residential district		
Metropolitan areas	67.2	71.8
Non-metropolitan areas	32.8	28.2

Note: * US\$1 = KRW (Korean Won) 1147 as of 1 May 2019. High ^a: high group ($n = 177$); Low ^b: low group ($n = 199$).

4. Results

4.1. Measurement Model

Confirmatory factor analysis (CFA) was performed with regard to the measurement framework [61]. Three items for climate change mitigation pursuing actions appeared to have less than 0.7 factor loadings and, thus, were eliminated [73]. As demonstrated in Table 2, the test was applied to the qualified 31 items, which all have normal distributions. As suggested by [74], assessment of reliability, discriminant validity, and convergent has been undertaken. As revealed in Table 3, the composite reliability and Cronbach's α of each variable showed values larger than 0.70, confirming the reliability as well as sufficient internal consistency [75]. Additionally, every construct's average variance extracted (AVE) were larger than 0.5 and each indicator's factor loading was higher than 0.7, thus supporting convergent validity [73].

Table 2. Confirmatory factor analysis and normality assessment.

Constructs	Factor Loading	Mean	Skew-ness	kurto-sis	VIF ^a
Climate change awareness					
1. I am concerned about climate change.	0.911	5.454	−0.517	0.222	4.666
2. I am alarmed about the reasons of climate change.	0.872	5.299	−0.272	−0.209	3.182
3. I am worried about the consequences of climate change.	0.913	5.456	−0.492	0.082	4.592
4. I am concerned about the threat of fine dust.	0.901	5.670	−0.598	−0.048	4.691
5. I am alarmed about the reasons for fine dust.	0.879	5.446	−0.529	0.045	3.406
6. I am worried about the consequences of fine dust.	0.902	5.690	−0.732	0.419	4.759
Climate change mitigation pursuing actions					
1. I prefer renewable energy sources to fossil fuel to mitigate climate change.	0.788	4.598	−0.468	0.103	2.322
2. I prefer vegetarian dishes to a meat diet in order to mitigate climate change.	-	-	-	-	-
3. I prefer vegan dishes to a vegetarian diet in order to mitigate climate change	-	-	-	-	-
4. I prefer artificially grown meat in order to mitigate climate change.	-	-	-	-	-
5. I prefer taking trains than aircraft to mitigate climate change.	0.776	3.712	−0.005	−0.464	4.948
6. I prefer walking than taking automobiles in order to mitigate climate change.	0.827	4.309	−0.265	−0.179	4.312
7. I prefer renewable energy sources to fossil fuel to resolve fine dust in the atmosphere.	0.793	4.618	−0.571	0.522	2.364
8. I prefer taking trains than aircraft to lessen fine dust in the atmosphere.	0.760	4.718	−0.081	−0.606	4.750
9. I prefer walking than taking automobiles in order to reduce fine dust in the atmosphere.	0.830	4.274	−0.305	−0.232	4.346
Anticipated pride with waste reduction					
1. I will be very proud of reducing waste while dining out.	0.948	4.608	−0.272	0.003	4.603
2. I will feel very accomplished by reducing waste while dining out.	0.948	4.550	−0.260	0.138	4.774
3. I will be confident that I am reducing waste at restaurants.	0.951	4.639	−0.356	0.331	4.545
Anticipated guilt without waste reduction					
1. I will be feeling guilty if I do not reduce waste while dining out.	0.943	4.114	−0.162	−0.317	4.232
2. I will be remorseful if I do not reduce waste while dining out.	0.937	4.207	−0.177	−0.318	3.770
3. I will be sorry if I do not reduce waste at restaurants.	0.913	4.351	−0.319	0.066	2.970
Attitude toward waste reduction					
1. Reducing waste during dining out is an affirmative behavior.	0.897	5.533	−0.594	−0.011	3.180
2. Reducing food waste during dining out is a beneficial behavior.	0.839	5.756	−0.774	0.418	2.194
3. Reducing water waste is an essential behavior at restaurants.	0.832	5.324	−0.535	0.138	1.934
4. Reducing natural resource waste is a legitimate behavior at restaurants.	0.903	5.398	−0.476	−0.003	3.142
Subjective norm on waste reduction					
1. Most people who are important to me think I should practice waste reduction activities while dining out.	0.940	4.429	−0.369	0.333	4.047
2. Most people who are important to me would want me to practice recycling activities while dining out.	0.931	4.417	−0.406	0.431	3.644
3. Most people who are important to me support my participation in waste reduction at a restaurant.	0.923	4.568	−0.429	0.704	3.065
Perceived behavioral control on waste reduction					
1. Whether or not I engage in waste reduction behaviors while dining at a restaurant is completely up to me.	0.844	4.996	−0.472	0.443	1.861
2. I am confident that if I want, I can reduce waste while dining at a restaurant.	0.897	4.788	−0.549	0.997	2.421
3. I have enough opportunities to reduce waste while dining at a restaurant.	0.907	4.734	−0.437	0.822	2.481

Table 2. Cont.

Constructs	Factor Loading	Mean	Skew-ness	kurto-sis	VIF ^a
Behavioral intention to waste reduction					
1. I am willing to participate in pro-environmental practices at restaurants.	0.885	5.083	−0.613	0.970	2.234
2. I try to participate in almost all pro-environmental practices at restaurants to reduce waste.	0.911	4.674	−0.452	0.239	2.869
3. I participate in reducing waste practices at restaurants.	0.921	4.807	−0.650	0.842	3.087

Note: Three items were deleted after factor analysis because their factor loadings were lower than 0.7. ^a Variance inflation factor.

Table 3. Convergent and discriminant validity.

Construct	1	2	3	4	5	6	7	8
1. Climate change awareness	0.897							
2. Climate change mitigation pursuing actions	0.346	0.796						
3. Anticipated pride with waste reduction	0.406	0.491	0.949					
4. Anticipated guilt without waste reduction	0.328	0.509	0.603	0.931				
5. Attitude on waste reduction	0.518	0.325	0.437	0.383	0.868			
6. Subjective norm on waste reduction	0.331	0.495	0.600	0.596	0.368	0.931		
7. Perceived behavioral control	0.346	0.365	0.407	0.350	0.445	0.379	0.883	
8. Behavioral intention to waste reduction	0.507	0.579	0.589	0.556	0.500	0.616	0.538	0.906
AVE > 0	0.804	0.634	0.901	0.867	0.754	0.867	0.780	0.820
Composite reliability (CR) > 0.7	0.961	0.912	0.965	0.951	0.924	0.951	0.914	0.932
Cronbach's alpha (α) > 0.7	0.951	0.886	0.945	0.923	0.891	0.923	0.858	0.890
Rho_A (internal consistency reliability) > 0.7	0.953	0.895	0.948	0.925	0.893	0.924	0.865	0.890

Note: The bold face in the metrics denotes the square root of average variances extracted (AVEs) for each construct.

In addition, because the square root of AVE of all concepts appears bigger than correlations of the matching concepts, discriminant validity is guaranteed [76]. For example, the lowest value of the square root of the AVE is 0.796 (climate change mitigation pursuing actions), which is higher than its corresponding construct correlations. The highest correlation is 0.616 between subjective norm on and intention to reduce waste, which is less than their square root of the AVEs of 0.931 and 0.906, individually [77]. Including all indicators, multicollinearity of every item was tested, applying the variance inflation factor (VIF). Because every VIF value of the items ranged from 1.861 to 4.948, multicollinearity appears not to be a problem in this study [66].

4.2. Structural Model

Results by PLS-SEM that appraised the research model are presented in Figure 2 [67]. The target variable for behavioral intention (60.9%) has been highly predicted by the R-square (R^2) in the extended TPB than behavioral intention (52.6%) in the TPB. The evidence implies that the research framework in this study is superior to the TPB in accounting for consumers' waste reduction intention while eating out. Path coefficients as well as t-statistics have been assessed for nine hypotheses by a PLS bootstrapping approach of 5000 re-samplings as recommended by Hair et al. [66] and Stevens [74]. Results show that climate change awareness has significant effects on attitude toward ($\gamma = 0.463$, t -value = 10.004) and behavioral intention to waste reduction ($\beta = 0.155$, t -value = 3.699). Additionally, climate change mitigation pursuing actions have significant effects on attitude toward ($\gamma = 0.138$, t -value = 2.732) and behavioral intention to waste reduction ($\beta = 0.193$, t -value = 4.347). In addition, behavioral intention to waste reduction is positively influenced by anticipated pride ($\gamma = 0.109$, t -value = 1.983) and anticipated guilt with waste reduction ($\gamma = 0.092$, t -value = 2.047). Furthermore, behavioral intention has been positively affected by attitude toward ($\gamma = 0.096$, t -value = 2.181), subjective norm on ($\gamma = 0.237$, t -value = 5.157), and perceived behavioral control on waste reduction ($\gamma = 0.205$, t -value = 4.638). Hence, all the nine hypotheses are supported, revealing that there is no rejected hypothesis.

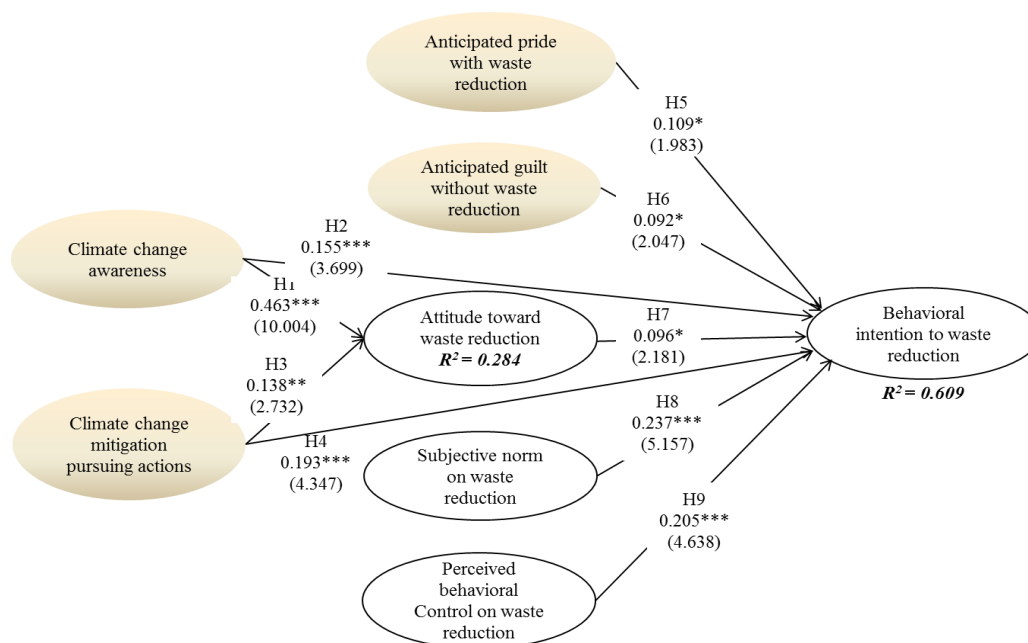


Figure 2. Path analysis results. Note: Figures in parentheses are *t*-value. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Regarding the moderating effect of high and low dining expenses, nine relationships were tested (Table 4). The results showed that the coefficients of seven relationships for the high and low spending respondents were significantly different, except for two hypotheses, 10e and 10h (anticipated pride on behavioral intention and subjective norm on behavioral intention). Thus, hypotheses 10a, 10b, 10c, 10d, 10f, 10g, and 10i are supported. The sizes of the impacts of climate change awareness on attitude as well as perceived behavioral control on behavioral intention for the high spenders were larger than for the low spenders. In contrast, the sizes of the impacts of climate change awareness on behavioral intention, climate change mitigation pursuing actions on attitude and behavioral intention, anticipated guilt on behavioral intention, and attitude on behavioral intention was shown to be larger in the low spenders than in the high spenders.

Table 4. Comparing high and low spending diner groups.

H10	Path	High Group (A)	Low Group (B)	<i>t</i> -Value (A–B)	<i>p</i> -Value (A–B)	Hypothesis Test
H10a	Climate change awareness → Attitude on waste reduction	0.605 ***	0.325 ***	38.227	<0.001	Supported
H10b	Climate change awareness → Behavioral intention to waste reduction	0.136 ns	0.173 **	−5.212	<0.001	Supported
H10c	Climate change mitigation pursuing actions → Attitude on waste reduction	0.003 ns	0.262 **	−32.362	<0.001	Supported
H10d	Climate change mitigation pursuing actions → Behavioral intention to waste reduction	0.143 *	0.190 **	−7.011	<0.001	Supported
H10e	Anticipated pride with waste reduction → Behavioral intention to waste reduction	0.108 ns	0.110 ns	−0.243	ns	Not supported
H10f	Anticipated guilt without waste reduction → Behavioral intention to waste reduction	0.093 ns	0.124 *	−4.188	<0.001	Supported
H10g	Attitude on waste reduction → Behavioral intention to waste reduction	0.070 ns	0.137 *	−8.593	<0.001	Supported
H10h	Subjective norm on waste reduction → Behavioral intention to waste reduction	0.230 **	0.242 **	−1.570	ns	Not supported
H10i	Perceived behavioral control → Behavioral intention to waste reduction	0.293 ***	0.159 **	18.930	<0.001	Supported

Note: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$. ns: non-significant.

4.3. Inclusion of Control Variables

To determine whether demographic variables influence the proposed framework, we analyzed gender, marital status, age, education, monthly household income, occupation, and residential district as control variables, applying bootstrap 5000 re-sampling. The seven demographic variables have been controlled to provide a precise evaluation of the hypothesis between anticipated pride and behavioral intention to waste reduction, which has the lowest *t*-value among the nine significant relationships. The data still supported the nine hypotheses when the control variables were added. Hence, the seven socio-demographic factors were not influenced in the present research model. Furthermore, all the path coefficients and *t*-values in the research model were very similar to the path coefficients and *t*-values included seven control variables (see Supplementary Materials).

4.4. Discussion

Food production, consumption, and waste are some of the greatest sources of anthropogenic GHG emissions [36,37,39]. Reducing food waste can therefore be a significant contribution to climate change mitigation, particular from foodservices, such as the restaurant sector, as more people eat out than ever before [1,10,12,36,37,45]. However, research on restaurant consumers' waste reduction attitudes and behaviors is relatively limited in the foodservice industry, which has tended to focus on technical means to reduce waste for mitigating climate change [5,38,46]. In responding to this knowledge gap, this study has sought to better understand through the application of the TPB model what makes diners reduce waste for the purpose of addressing climate change while eating out at restaurants. Thus, this work sought to verify an extended TPB framework incorporating climate change awareness and mitigation pursuing actions, anticipated pride related emotions, four main TPB constructs, and dining expenses as a moderator.

Results reveal that climate change awareness has significant effects on attitude and behavior intention to waste reduction for sustainability. Additionally, climate change mitigation pursuing actions positively influences attitude and behavioral intention to waste reduction. Consumers' anticipated emotions of guilt and pride is identified as leading to their behavioral intention. Regarding the key TPB variables, diners' attitude, subjective norm, and perceived behavioral control have an impact on their waste reduction behavior. Furthermore, levels of dining expenses significantly moderate seven relationships out of nine hypotheses in the research model. The following sections discuss the theoretical and managerial contributions as well as limitations and future research directions drawing upon the findings in detail.

5. Conclusions

5.1. Theoretical Implications

This work offers theoretical contributions to the tourism and foodservice literature by applying an extended TPB model in an Asian foodservice environment (Korea). Specifically, the significant effects of climate change awareness on attitude toward waste reduction and behavior in a foodservice context extend prior literature on associations among climate change concerns, attitudes to energy efficiency, and behavior in the context of renewable energy technologies and household energy efficient behavior (e.g., [4]). The influences of climate change mitigation pursuing actions on attitude and waste reduction behavior in foodservices expand previous research on relationships between interest in climate change mitigation, attitude toward willingness to act, and behavior with volunteers and barriers from industry, commerce, and government in the USA [10]. The influences of anticipated guilt and pride on behavioral intention to reduce waste in restaurants extend previous literature on relationships between anticipated pride/guilt and personal norm in tourist behavior in applying the norm activation process and value-attitude-behavior model [24] and the effects of anticipated pride and guilt on pro-environmental decision making [49]. The impacts of attitude, subjective norm, and perceived behavioral control on behavioral intention to reduce restaurant waste are consistent

with previous studies on the impact of the key TPB variables on consumer preference for sustainable restaurants from Campania region in Southern Italy in an extended TPB setting [23] and consumers' food waste behavior in the TPB context [26–30].

Another theoretical contribution is the observation of the moderating effects of high and low dining expenses with regard to waste reduction for climate change mitigation in the context of Asian restaurants. For example, the magnitudes of effects between climate change awareness and attitude as well as perceived behavioral control and behavioral intention are larger in high dining expense spenders than in low dining expense spenders. The findings extend prior literature on associations between consumers with high spending for organic products, with their strong eco-friendly attitude, and support for sustainability among wine consumers, comparing high and low household income levels [25]. In contrast, the magnitudes of effects between climate change awareness and behavioral intention, climate change mitigation pursuing actions and attitude/behavioral intention, anticipated guilt and behavioral intention, and attitude and behavioral intention are larger in low dining expense spenders than in high dining expense spenders. The results expand the findings of prior research on the relationship between individuals with non-luxury goods who are more likely to decide not to pollute and those with luxury goods who are less likely to concern the environment from the perspective of leisure and tourism-related behaviors [51].

5.2. Practical Implications

By 2030, sustainable development goal 12 (ensure sustainable consumption and reduction patterns) is to halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses [78–80]. In response to this challenge, this work provides a number of practical management contributions with respect to improving waste reduction practices and consumers' climate change mitigation behavior. For example, the effect of climate change awareness on attitude toward waste reduction and behavior suggests that foodservice businesses can stimulate consumers' perceptions of climate change issues, such as fine dust in the atmosphere, in order to improve pro-environmental attitude and behaviors, including waste reduction. This can be done by advertising and promotions as well as other behavioral interventions from the foodservice industry and governments. For example, this could be accomplished by adapting sustainable practices in their businesses and training their employees to communicate the relationships between sustainable restaurant practices and climate change mitigation to customers, i.e., by providing encouraging less waste at buffets. Additionally, the significant effects of climate change mitigation pursuing actions on attitude/behavior for waste reduction urge that foodservice marketers and governments should focus on boosting consumers' volunteer participation in waste reduction actions as a pro-social behavior. This could be done by applying appropriate augmented and virtual reality technology to advertise content that inspires the interest of restaurant customers in the environment in relation to where their food comes from and where waste goes.

The influences of anticipated pride and guilt on behaviors for waste reduction suggest that restaurants might practice strategies for increasing guests' emotions of pride and guilt on waste reduction in the context of eating out. These could be conducted by incentive programs, e.g., using recycling products, taking a leftover, bring own bags or containers, giving discounts or saving points when diners are involved in waste reduction practices at restaurants, and/or through positive-reinforcement by restaurant staff. In addition, when diners do not participate in waste reduction practices at restaurants, restaurant staff could provide advice about the consequences on the environment. Moreover, the positive impacts of attitude, subjective norm, and perceived behavioral control on behavioral intention imply that foodservice industries could encourage consumer participation in waste reduction practices in foodservices by stressing to guests the non-voluntary and voluntary aspects. This could be implemented by promotion to attract guests' attention via appropriate technologies as well as through personal recommendations by restaurants.

Furthermore, the greater influences of climate change awareness on attitude and perceived behavioral control on intention in high dining expense spenders than in low dining expense spenders suggest that restaurant practitioners might focus on market segmentation strategies by high and low levels of customers' dining expenses. That is, if restaurant marketers and policy makers want to target consumers with high dining expenses, marketers should potentially emphasize climate change concerns and self-efficacy in relation to waste reduction. In contrast, the influences of climate change awareness on behavior, climate change pursuing actions on attitude/behavior, anticipated guilt on behavior, and attitude on behavior in low dining expense spenders than in high dining expense spenders suggest that foodservice stakeholders may need to position waste reduction practices by highlighting pro-social actions on climate change and fine dust mitigation. Such specialized market strategies can therefore potentially reduce restaurants' operation costs and expenses, resulting in increasing profits as well as less waste.

5.3. Limitations and Future Research Directions

Even though this work provides a significant contribution to understanding restaurant waste reduction in relation to climate change mitigation, there are a number of limitations which provide opportunities for future work. For example, this study conducted the survey only in one country; hence, future study may need to be conducted in other nations and cultures in order to compare and generalize the findings of this research. Additionally, a quantitative method was applied to obtain and analyze data; future studies may need to adopt a qualitative approach to understand other dimensions of consumer behavior on waste reduction in foodservice industry. This survey also measured several items for atmospheric fine dust, which is a significant climate change related phenomenon in Korea and elsewhere in north-east Asia, together with climate change awareness and mitigation pursuing actions. Future research could measure these items separately in order to better understand differences of consumer behavior in relation to different dimensions of climate change. This is important, as although climate change is a global problem, it is experienced locally. For example, the climate change related issue of fine dust in the atmosphere may be more important for some jurisdictions than others; in Korea, it is a very important issue. In addition, surveys with consumers in different countries and locations and other types of research methods, such as observation or big data analytics, could be employed to better develop a stronger knowledge base on consumer behavior in terms of climate change and waste reduction in the foodservice industry. Furthermore, future research on individual consumers' pro-environmental practices at restaurants could directly measure attitudes towards specific waste-reduction practices in restaurants.

Although waste reduction in the foodservice industry is significant in climate change mitigation, research on pro-environmental practices in restaurants has been substantially overlooked. Hence, this study built and verified a theoretically comprehensive research model including climate change awareness and mitigation pursuing actions, anticipated pride and guilt with waste reduction, and the four key TPB concepts (attitude, subjective norm, perceived behavioral control, and behavioral intention), along with high and low dining expense groups. The findings of this study suggest that restaurants need to highlight the effects and consequences of waste reduction when dining out. It is also concluded that the foodservice industry should utilize the positive and negative emotions of consumers to increase and improve their pro-environmental practices as well as reduce business costs surrounding waste. Moreover, this study strongly urges restaurant entrepreneurs that they should seriously consider the main TPB constructs to enhance consumer waste reduction behavior. Finally, foodservice stakeholders need to develop their marketing strategies in terms of high and low dining expense groups to attract potential diners not only in terms of how much they spend on a meal but also with respect to pro-environmental practices such as waste reduction and climate change mitigation.

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