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Protection Motivation and Food Waste Reduction Strategies

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Abstract: "Ugly food" refers to agricultural products that are discarded because their appearance is not attractive, even though their nutritional content is unaffected. In this study, protection motivation theory (PMT) was applied to analyze whether an individual's awareness of food waste problems affects their "ugly food" purchase intention. Hence, the relationships between awareness of food waste problems, threat appraisal (severity and vulnerability), coping appraisal (response efficacy and self-efficacy), and ugly food purchase intention were analyzed. Additionally, a moderating effect analysis was conducted per consumer age. Descriptive statistical analysis, frequency, and SPSS reliability analysis were used, including confirmatory factor analysis, structural equation modeling, and multi-group analysis of the Amos program. For the final analysis, 361 samples were used. Results showed that awareness of food waste problems positively affected severity and vulnerability, response efficacy, and self-efficacy. Moreover, severity positively affected ugly food purchase intention and vulnerability did not. Response and self-efficacy positively affected ugly food purchase intention. In the moderating effect analysis per consumer age, the difference between severity and ugly food purchase intention and vulnerability and ugly food purchase intention was significant. This study has various academic and practical implications, and presents several strategies to reduce food waste to contribute to a sustainable future environment. It is also the first study linking the food waste problem, PMT, and ugly food purchase behavior.

Keywords: food waste problem; protection motivation theory; threat appraisal; coping appraisal; ugly food purchase intentions; waste reduction strategy

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1. Introduction

In 2015, the United Nations (UN) member states adopted the 2030 Agenda for Sustainable Development with the goal of sharing a blueprint for prosperity and peace between humanity and the planet in the present and future [1]. At its core are the 17 Sustainable Development Goals (SDGs), which include urgent actions to be implemented by all countries [1]. For example, all mankind should strive to fight climate change and preserve oceans and forests, reduce inequality, improve education and health, and at the same time pursue economic growth [1]. In order to make this 2030 agenda a reality, all of us need to make an effort [1].

Regarding the 17 major goals of the United Nations, food waste is also a prominent topic in each country. The food waste problem is an important global issue that affects the environment beyond a country's borders and has received attention not only from academia but also from various fields [2]. In addition, while the world's food resources are limited and the population continues to grow, ensuring the efficient consumption of these resources for a better future is a crucial task for humans [3]. Therefore, developing a sustainable distribution supply chain is essential and will play a significant role in strengthening the efficient distribution of agricultural products and food security [4].

According to the United Nations Food and Agriculture Organization [5], the amount of food waste left or thrown away in the production, distribution, and consumption of food is 1.3 billion tons per year. Methane and nitrogen dioxide generated during food waste

disposal are the primary causes of global warming [6]. In other words, approximately one-third of the world's food resources are discarded annually, causing enormous environmental, social, and economic losses [7,8]. Currently, food accounts for approximately 32% of household waste in the United States, representing a loss of USD 240 billion [9]. Additionally, the annual disposal of agricultural and food waste on farms and homes in the United States generates greenhouse gases equivalent to those emitted by approximately 42 coal-fired power plants [5]. In Korea, where the land area is relatively small, landfills in metropolitan areas could be saturated by 2026, and waste generation should be further reduced [10]. The United Nations announced that it aims to improve the distribution process of food ingredients and lower the food waste generated at the consumer level to 50% by 2030 [5].

As such, efforts are being made worldwide to reduce the generation of food waste, which is directly linked to future environmental problems [9]. Stancu et al. [11] stated that food waste disposal behavior is complexly affected by individual routines, psychological factors, and social environment. According to Elshaer et al. [12], a country's culture and religion have a great influence on the food waste problem, and, in particular, the food consumption culture has a significant influence on food waste disposal behavior. Fortunately, Rodgers et al. [13] stressed that amid the global pandemic situation, many people invested significant time in cooking and reduced their grocery shopping excursions as they spent more time at home than before the pandemic. In other words, the authors explained that COVID-19 had a rather positive effect on food waste discharge. In fact, COVID-19 has caused various changes in our daily lives. In addition, Principato et al. [7] emphasized that these food waste disposal issues should be addressed simultaneously at the personal and social levels through creating educational campaigns and transforming social norms. Although food waste is edible, if its marketability is poor, it may be removed in advance during the distribution supply process or thrown away by consumers [14]. As a food waste solution, "ugly food" consumption began to attract worldwide attention a few years ago [15]. Ugly foods are agricultural products thrown away just because they look ugly, although their nutrition and quality are unaffected. These foods are sold to consumers at low prices because of their poor marketability [16]. Hartmann et al. [17] explained that many consumers are aware of the seriousness of food waste problems but remain negative about purchasing ugly food, and that it is necessary to analyze what makes consumers reluctant to choose ugly food. Moreover, consumers tend to value the appearance of agricultural products. Qi et al. [18] emphasized the need for active promotional activities to sell more ugly food and explained that various marketing strategies are urgently needed. Recently, in seeking ways to reduce food waste, several studies on ugly foods have been conducted [8,15–18] (see Figure 1).

Figure 1. Ugly food [19].

Meanwhile, protection motivation theory (PMT), first introduced by Rogers [20], is evaluated as a model that best explains an individual's protection motivation and effective behavioral intention for a certain risk situation [21]. PMTs have been applied to various field studies on risk situations accompanied by human concern, and have derived meaningful results [21]. Therefore, this study attempts to predict an individual's behavioral intention by applying the PMT to concerns about environmental problems caused by food waste. In other words, it intends to provide meaningful basic data to related research fields by analyzing the significance of the effect of the environmental concerns caused by food waste problems on ugly food purchase intention presented as a solution. This attempt is consequential because it is the first study to link food waste problems, PMT, and ugly food purchase behavior.

Additionally, consumer age is considered a demographic variable that influences consumer behavior in various fields of study [16]. Based on previous studies showing that consumer age is a fundamental and critical variable in predicting purchase intention and that consumer behavior varies widely with age [16], this study intends to perform a moderating effect analysis of consumer age. These attempts could form the basis for suggesting various measures to reduce environmental pollution by minimizing food waste and aid in developing several waste reduction strategies in the future.

We summarize the purpose of this study as follows:

(1) To analyze concerns about food waste problems in threat appraisal (severity and vulnerability) and coping appraisal (response efficacy and self-efficacy).

(2) To analyze the influence of threat appraisal (severity and vulnerability) and coping appraisal (response efficacy and self-efficacy) on ugly food purchase intention.

(3) To analyze the moderating effect of consumer age on the relationships among all variables.

2. Theoretical Framework and Hypotheses

2.1. Food Waste Problem and Ugly Food

As of 2020, the average amount of food waste produced by one person worldwide per year is 65 kg, of which approximately 25% is vegetables, 24% cereals, and 12% fruits [3]. Dou and Toth [22] emphasized that it is essential to analyze and deeply understand why, where, and how these food wastes are generated to ensure a better future.

Regarding this food waste problem, Papargyropoulou et al. [23] studied the issue of oversupply of food and waste and emphasized that supply distributed through food supply chains should be fundamentally reduced to decrease food waste. Stancu et al. [11] studied Danish food waste behavior and revealed that routines are the most important factors affecting individuals' food waste behaviors. Chen et al. [3] studied 151 countries worldwide to determine various losses from food waste. Developed countries have shown several times higher food waste losses than underdeveloped countries, especially in East Asian countries, and the amount of vegetable loss is high [3]. Aldaco et al. [4] analyzed the problem of food waste in Spain during the COVID-19 pandemic and emphasized the need to improve the sustainable distribution supply chain to more efficiently manage discarded food. Dhir et al. [14] comprehensively reviewed related previous studies on the problem of food waste in the hospitality industry. Their review revealed that the main keywords for the food waste problem were "hotspots", "leftover handling", "stage of generation", and "nudges".

Hartmann et al. [17] emphasized the importance of consuming ugly agricultural products to solve the food waste problem and analyzed measures to increase consumers' ugly food choices. Xu et al. [8] emphasized that promotional activities for ugly food are urgently needed to reduce food waste. Qi et al. [18] also argued that more diverse promotional activities are urgently needed to change the negative perception of ugly food to a more positive view and studied marketing strategies to increase ugly food sales.

In addition, studies on the food waste problem have been conducted widely in various countries and have yielded diverse results owing to different theories and analysis methods.

In particular, there are more studies analyzing the many causes of food waste than there are discussing solutions to the food waste problem [2,11,23,24].

In this study, the ugly food purchase intention was analyzed as a solution to reduce food waste. Measures to minimize food waste and contribute to the environment will require a wide range of complex approaches. However, this study aims to conduct an analysis focusing on individuals' purchase intention for ugly food to provide valid basic data in related research fields.

2.2. Protection Motivation Theory

The PMT, first presented by Rogers [20] to help explain the influence of fear, states that some stimuli affect individuals' threat appraisal and coping appraisal, which eventually stimulate protection motivation, leading to behaviors [20]. PMT predicts changes in human behavior based on two perspectives of environmental fear appeal and personality: environmental fear is represented by threat appraisal, and personality is represented by coping appraisal [25]. Threat appraisal consists of the two sub-concepts severity and vulnerability. More specifically, threat appraisal is an individual's estimation of the level of threat [26]. Coping appraisal is a concept that explains recommended behavior to reduce threats, and also consists of two sub-concepts: response efficacy and self-efficacy [26]. This theory was evaluated as a model that can accurately predict human decision-making processes and behaviors [27].

PMT has been applied in various fields; in particular, studies have been widely conducted on social issues, such as disasters and health. Al-Rasheed [28] studied protection motivation behavior against the COVID-19 pandemic in Kuwait. Trust in the government and perceived severity, vulnerability, response efficacy, and self-efficacy have been shown to increase protection motivation behaviors among Kuwaitis. Kim and Crimmins [29] studied the different behaviors of younger and older people regarding the COVID-19 pandemic in the United States and revealed differences by age. Additionally, Okuhara et al. [30] studied the psychological factors related to the COVID-19 pandemic by applying the PMT. Japanese individuals' perceived severity and self-efficacy were shown to enhance individuals' experiences of staying at home. However, perceived vulnerability and response efficacy did not have a significant effect on Japanese behavior.

In addition, this theory has been applied to environmental issues, such as various waste problems, which have been considered another social issue in recent years. Janmaimool [31] studied sustainable waste management and analyzed respondents' reuse and recycling, waste avoidance, waste disposal, and green purchasing behaviors, focusing on Bangkok, Thailand. Tchetchik et al. [32] studied the consumption and recycling reduction behavior due to COVID-19 in Israel by applying PMT. Yusoff and Asmuni [33] studied waste management behavior, focusing on Malaysia.

2.3. Relationships among the Constructs

2.3.1. Relationship between Awareness of Food Waste Problem and Threat Appraisal

Cho et al. [34] studied restaurant customers' water quality concerns caused by water pollution, and indicated that water quality significantly affects threat appraisal composed of severity and vulnerability. Chang and Lee [35] studied the risk of COVID-19 and health consciousness and confirmed that the risk of COVID-19 positively influences threat appraisal composed of severity and vulnerability. In terms of recycling reduction behavior due to COVID-19, Tchetchik et al. [32] revealed that the COVID-19 lockdown positively affected threat appraisal composed of collective and individual threat appraisal.

As such, both environmental and health-related problems and concerns increase threat appraisal. Based on these findings, Hypotheses 1 and 2 were established:

Hypothesis 1. *"Awareness of food waste problem" positively affects severity.*

Hypothesis 2. *"Awareness of food waste problem" positively affects vulnerability.*

2.3.2. Relationship between Awareness of Food Waste Problem and Coping Appraisal

According to Cho et al. [34], water quality positively affects consumers' coping appraisal comprising self-efficacy and response efficacy. Chang and Lee's [35] study showed that people's health consciousness positively influences coping appraisal composed of self-efficacy and response efficacy. Regarding consumption reduction behavior due to COVID-19, Tchetchik et al. [32] indicated that the COVID-19 lockdown positively affected coping appraisal composed of adaptive and maladaptive appraisal.

Environmental and health-related problems enhance coping appraisals. Based on these findings, Hypotheses 3 and 4 were established:

Hypothesis 3. *"Awareness of food waste problem" positively affects response efficacy.*

Hypothesis 4. *"Awareness of food waste problem" positively affects self-efficacy.*

2.3.3. Relationship between Threat Appraisal and Ugly Food Purchase Intentions

Janmaimool [31] studied food waste disposal behavior and found that threat appraisal composed of perceived severity and probability positively affected respondents' waste disposal behaviors. According to Chen et al.'s [36] electronic waste protection study, perceived threat as a threat appraisal positively affected information security protection intention. In terms of waste management behavior, according to Yusoff and Asmuni [33], threat appraisal positively affects waste disposal and reuse behaviors.

Threat appraisal positively affects individuals' behavior. Based on these findings, Hypotheses 5 and 6 were established:

Hypothesis 5. *"Severity" will positively affect ugly food purchase intention.*

Hypothesis 6. *"Vulnerability" will positively affect ugly food purchase intention.*

2.3.4. Relationship between Coping Appraisal and Ugly Food Purchase Intentions

In the context of tourism, Horng et al. [37] studied energy-saving behavior and indicated that travelers' response efficacy and self-efficacy as coping appraisal positively affect their energy-saving behaviors. In terms of a sustainable waste management study, Janmaimool [31] revealed that coping appraisal that consists of response efficacy and self-efficacy affected waste disposal behaviors partially. Only self-efficacy enhanced respondents' waste disposal behavior, and response efficacy did not significantly affect waste disposal behavior. Shafiei and Maleksaeidi [38] studied university students' pro-environmental behaviors and found that students' self-efficacy positively affects pro-environmental behavior. Chen et al. [36], in the context of an electronic waste study, reported that self-efficacy as a coping appraisal positively affected information security protection intention. Yusoff and Asmuni [33] indicated that coping appraisal positively affects waste disposal behavior.

Coping appraisal was found to enhance individuals' behavior. Based on these findings, Hypotheses 7 and 8 were established:

Hypothesis 7. *"Response efficacy" positively affects ugly food purchase intention.*

Hypothesis 8. *"Self-efficacy" positively affects ugly food purchase intention.*

2.3.5. Moderating Role of Age

According to Mayer et al. [39], human behavior is deeply connected with age; humans mature with age, and their ability to control their emotions improves. Humans tend to show a higher level of problem-solving ability as they get older based on the diverse

knowledge they have gathered in their lives, and their empathy for others also tends to become stronger [40].

Kim and Crimmins [29] studied the COVID-19 situation in the United States, and the PMT was applied to analyze differences by age. The results indicated that younger people's coping appraisal had a positive effect on protection motivation behaviors; however, in the case of older people, threat appraisal had a positive effect on protection motivation behavior. In other words, the results differed according to age. Shao et al. [16] confirmed the moderating effect of age in a study on ugly food promotion. In the younger group, women's purchase intention was much higher, whereas in the relatively older group, both men and women showed a high purchase intention for ugly food. Wilson et al. [41] attempted to analyze the moderating effects of age in a study on the possibility and fear of COVID-19 and found that the fear of COVID-19 felt by younger age groups was higher than that of older people, revealing differences by age.

As such, previous studies in several fields have revealed significant differences in consumer behavior according to age. Furthermore, age is a basic demographic variable that influences consumer behavior, and the results derived from age-specific moderating effect analysis will be meaningful in establishing more effective and practical marketing strategies in our daily lives [16]. Based on these findings, Hypothesis 9 was established (see Figure 2):

Hypothesis 9. *Age (younger vs. older) has a moderating role between awareness of food waste problems, threat appraisal (severity and vulnerability), coping appraisal (response efficacy and self-efficacy), and ugly food purchase intentions.*

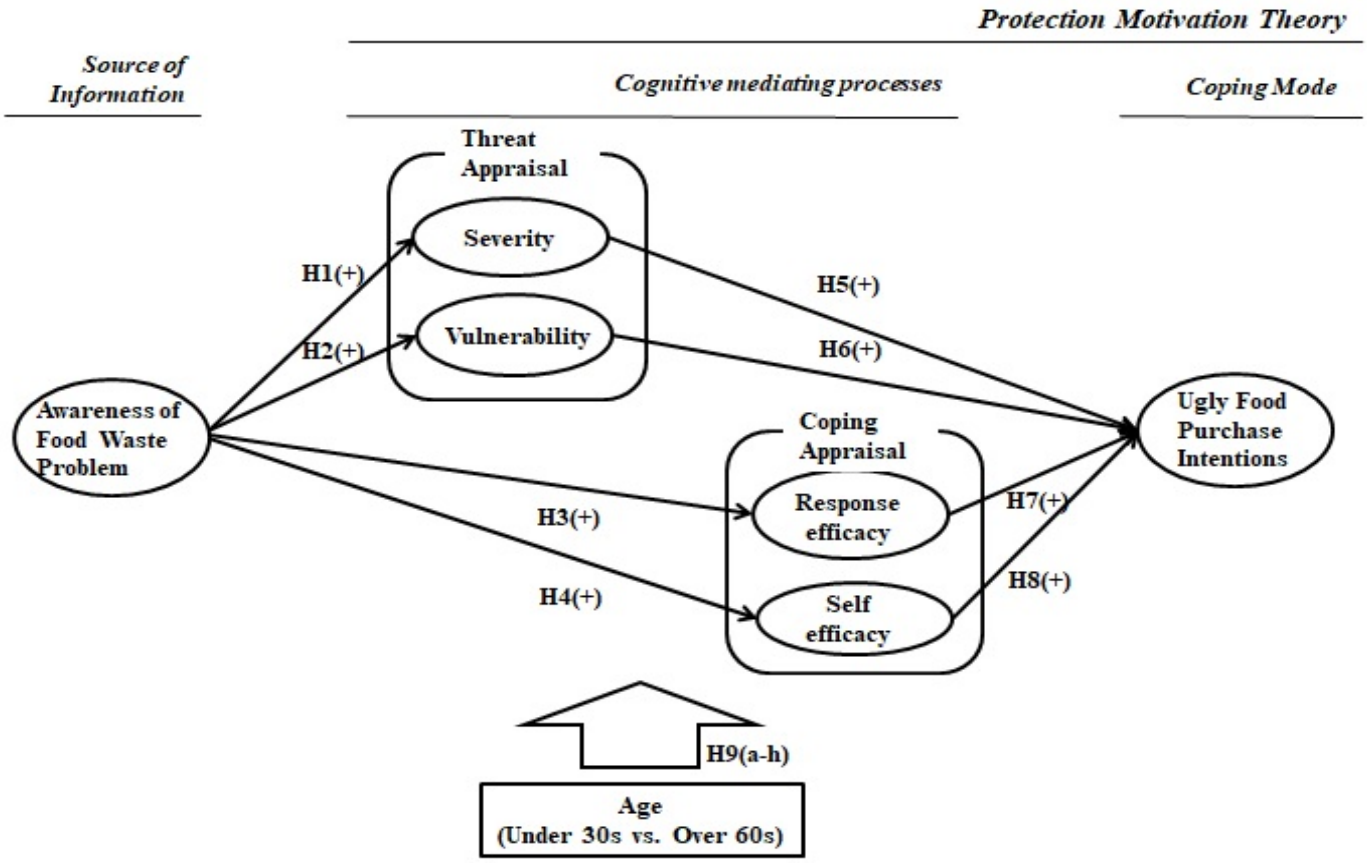

Figure 2. Research framework.

3. Materials and Methods

3.1. Data Collection and Participants

Due to the COVID-19 pandemic, the survey was conducted online. Data were collected for one week during the first week of August 2021, through an online research company with the largest number of panels in Korea. Before starting the survey, we explained its purpose to the respondents. Only those who provided informed consent were included in the survey. All the respondents were given coupons by the research company. Furthermore, we calculated the number of samples using the G-power program and conducted a final analysis based on data that exceeded the minimum number of samples required, considering multi-group analysis. Out of 367 responses collected, 361 were used in the final analysis. Using graph analysis of the SPSS program, we removed outliers—those who responded with "1" for all questions.

3.2. Survey Instrument and Measures

Regarding the "food waste problem", four questions were adopted from Cho et al. [34]. Four questions assessing "Severity" and three questions assessing "Vulnerability" were also adopted from Cho et al. [34]. Three questions related to "response efficacy" were adopted from Pechmann et al. [42] and Lee and Larsen [43]. Three questions about "self-efficacy" were adopted from Lent et al. [44] and Lee and Larsen [43], and four questions regarding "purchase intention" were adopted from Cho et al. [34]. All questionnaire items were used, and only some words, such as "food waste problems" and "ugly food", were modified and supplemented to suit the subject of this study (see Appendix A Tables A1 and A2). In addition, these questions have already been validated in previous studies. After modifying certain words, the validity of each construct was additionally and finally confirmed based on AVE (0.5 or higher) and CCR (0.7 or higher) derived through confirmatory factor analysis [45,46]. All questions were rated on a five-point Likert scale (1 = highly disagree, 2 = disagree, 3 = normal, 4 = agree, and 5 = highly agree).

The questionnaire was divided into three stages. In the first step, the researchers obtained informed consent, and assessed respondents' awareness of ugly food and the environmental pollution problem caused by food waste. In the second step, each variable presented above was evaluated, and in the last step, the demographic data were collected. All questions were translated into Korean by two professors fluent in Korean and English.

Frequency analysis, descriptive statistical analysis, and reliability analysis were performed using SPSS 23. Additionally, confirmatory factor analysis, structural equation modeling, and multi-group analysis were performed using AMOS 23.

4. Results

4.1. Sample Characteristics

Respondents' characteristics are listed in Table 1. More than half (54.5%) of the respondents were aged 50 years or older, while only 10.8% were under 30 years old. The proportion of women respondents (52.4%) was slightly higher than men (47.6%), and the ratio of unmarried (28.3%), married (68.7%), and others (3%) is given. The order of educational level was university (54.6%), high school (17.7%), two-year college (16.1%), and graduate school (11.6%). The monthly income was USD 2000 (25.8%), more than USD 5000 (22.7%), USD 3000 (18%), USD 4000 (14.4%), less than USD 1000 (11.9%), and USD 1000 (7.5%). Finally, the order of occupations was: office job (45.2%), homemaker (19.4%), others (13.6%), professional jobs (12.5%), self-employed (7.2%), and student (2.2%).

As a result of Levene's test, all p-values were higher than 0.05, and all demographic variables achieved equality of variance. In order to confirm the difference in ugly food purchase intention according to demographic variables, a t-test was performed on gender and one-way ANOVA was performed on other variables. A significant difference was observed only for gender ($t = -2.822$, $p < 0.01$). Women's ugly food purchase intention was higher than that of men. There was no statistically significant difference in purchase intention according to other demographic variables.

Table 1. Sample characteristics (n = 361).

Characteristics	n (%)	f-Value	Characteristics	n (%)	f-Value
Age (years)		1.488	Monthly income		1.836
20–29	39 (10.8%)		<USD 1000	43 (11.9%)	
30–39	55 (15.2%)		USD 1001–USD 2000	26 (7.2%)	
40–49	70 (19.4%)		USD 2001–USD 3000	93 (25.8%)	
50–59	99 (27.4%)		USD 3001–USD 4000	65 (18%)	
Over 60	98 (27.1%)		USD 4001–USD 5000	52 (14.4%)	
Sex		−2.822 **	USD 5001≤	82 (22.7%)	
Men	172 (47.6%)	(t-value)	Occupation		1.955
Women	189 (52.4%)		Student	8 (2.2%)	
Marital status		0.737	Office job	163 (45.2%)	
Unmarried	102 (28.3%)		Self-employed	26 (7.2%)	
Married	248 (68.7%)		Professional job	45 (12.5%)	
Other	11 (3%)		Homemaker	70 (19.4%)	
Educational level		0.742	Other	49 (13.6%)	
High school	64 (17.7%)				
Two-year college	58 (16.1%)				
University	197 (54.6%)				
Graduate school	42 (11.6%)				

Notes: Monthly income was calculated based on the exchange rate in December 2021, and USD 1 USD was KRW 1182; ** $p < 0.01$.

4.2. Validity and Reliability of Measurements

In this study, measurement variables were derived based on previous studies. The measurement questions were also modified and used according to the subject of this study by applying those developed in previous studies. Therefore, to determine if the questionnaire was properly constructed, the validity and reliability of each construct were confirmed using confirmatory factor analysis before hypothesis verification. Convergent validity analysis is performed to determine whether a construct is properly constructed by measurement questions [45,46]. Convergent validity is judged to be suitable for each construct when the factor loading value is at least 0.5 or higher ($p < 0.05$), average variance extracted (AVE) is at least 0.5 or higher, and composite construct reliability (CCR) is at least 0.7 or higher [45,46]. In addition, each construct is considered to be reliable if the Cronbach's alpha value representing internal consistency is 0.7 or higher [45,46]. Therefore, a confirmatory factor analysis was performed to verify the convergent validity of each construct. All composite construct reliability values were higher than 0.7 (a distribution of 0.776 to 0.834), and all average variance extracted values were higher than 0.5 (a distribution of 0.537 to 0.569). In addition, Cronbach's alpha values for all constructs were between 0.732 and 0.830. Hence, the convergent validity of all the constructs met the criteria [45,46].

Moreover, in terms of model fit, χ^2/df was 1.789 ($p < 0.001$), root mean square residual (RMR) was 0.019, goodness of fit index (GFI) was 0.927, adjusted GFI (AGFI) was 0.903, Tucker–Lewis index (TLI) was 0.951, comparative fit index (CFI) was 0.960, incremental fit index (IFI) was 0.960, and root mean square error of approximation (RMSEA) was 0.046. Therefore, the model fit also met these criteria (see Table 2).

Table 3 shows the results of the discriminant validity of all constructs. All constructs' squares of correlations were lower than AVEs, except for the relationship between the food waste problem and vulnerability and the relationship between response efficacy and self-efficacy. To verify the discriminant validity of the two paths, a secondary analysis (correlation coefficient ± 2 × standard error) was performed [45]. As a result, the confidence interval between food waste problems and vulnerability was in the range of 0.703–0.819, and the relationship between response efficacy and self-efficacy ranged from 0.686 to 0.802. That is, since 1 was not included in the confidence interval, discriminant validity between the two paths was also confirmed [45].

Table 2. Confirmatory factor analysis test results.

Construct	Standardized Loadings	*t*-Value	CCR	AVE	Cronbach's Alpha
Awareness of Food Waste Problem			0.834	0.557	0.825
I am aware that the food waste problem is serious, directly connected to our daily lives	0.803				
I am well aware of the food waste problem these days	0.724	14.076 ***			
I am usually interested in the food waste issue	0.720	13.991 ***			
I am aware that the food waste disposal issue is crucial	0.736	14.342 ***			
Severity			0.834	0.558	0.826
The environmental pollution problem caused by food waste is serious	0.810				
When disposing of food waste, various harmful substances are generated	0.714	13.675 ***			
Korea is suffering from environmental pollution due to food waste problems	0.640	12.108 ***			
Our surroundings are becoming increasingly polluted by food waste	0.811	15.507 ***			
Vulnerability			0.786	0.551	0.761
Food waste will eventually have a harmful effect on people	0.767				
When disposing of food waste, various environmental hazards are generated, which is harmful to health	0.715	12.589 ***			
The food waste problem will eventually threaten our lives	0.744	13.044 ***			
Response Efficacy			0.776	0.537	0.732
Efforts to reduce food waste will help prevent environmental pollution	0.693				
Efforts to reduce food waste are effective solutions to prevent environmental pollution	0.762	12.502 ***			
If we try to reduce food waste, we can minimize environmental pollution	0.741	12.233 ***			
Self-Efficacy			0.798	0.569	0.791
I can do enough to reduce food waste	0.829				
I am confident that I will join in reducing food waste	0.712	13.247 ***			
I will try to reduce food waste	0.716	13.321 ***			
Ugly Food Purchase Intentions			0.830	0.550	0.830
I am willing to purchase ugly food to reduce food waste	0.784				
I have a plan to purchase ugly food, thinking about the future environment	0.719	13.414 ***			
I am going to purchase ugly food, thinking about environmental issues	0.776	14.493 ***			
I am going to keep purchasing ugly food	0.682	12.689 ***			

Notes: $\chi 2/df = 1.789$, $p < 0.001$; root mean square residual (RMR) = 0.019; goodness of fit index (GFI) = 0.927; adjusted GFI (AGFI) = 0.903; Tucker–Lewis index (TLI) = 0.951; comparative fit index (CFI) = 0.960; incremental fit index (IFI) = 0.960; root mean square error of approximation (RMSEA) = 0.046; CCR: composite construct reliability; AVE: average variance extracted; *** $p < 0.001$.

4.3. Results of Hypothesises 1 to 8

Structural equation modeling (SEM) was conducted using the AMOS program to confirm the hypotheses. Awareness of the food waste problem positively affected severity ($\beta = 0.338$, $p < 0.001$); therefore, H1 was supported. This result also supports the findings of Chang and Lee's [35] study. Awareness of the food waste problem positively affected vulnerability ($\beta = 0.790$, $p < 0.001$); therefore, H2 was supported. This result also supports the findings of Tchetchik et al. [32]. Awareness of the food waste problem positively affected response efficacy ($\beta = 0.786$, $p < 0.001$); therefore, H3 was supported. This result also supports the findings of Cho et al. [34]. Awareness of the food waste problem positively affected self-efficacy ($\beta = 0.579$, $p < 0.001$); therefore, H4 was supported. This result also supports the findings of Cho et al. [34]. Severity positively affected food purchase intentions

(β = 0.395, $p < 0.001$); therefore, H5 was supported. This result is consistent with that of Janmaimool's study [31]. Response efficacy positively affected food purchase intentions (β = 0.285, $p < 0.001$); therefore, H7 was supported. This result supports the findings of Yusoff and Asmuni [33]. Self-efficacy positively affected ugly food purchase intentions (β = 0.251, $p < 0.001$); therefore, H8 was supported. This result supports Shafiei and Maleksaeidi's [38] study. However, vulnerability had no positive effect on ugly food purchase intention (β = 0.030, $p > 0.05$); therefore, H6 was not supported.

Table 3. Discriminant validity and correlations.

Construct	1	2	3	4	5	6	Mean	*SD*
1. Food Waste Problem	0.557 [a]	0.248 [b]	0.761 [b]	0.711 [b]	0.493 [b]	0.493 [b]	4.223	0.527
2. Severity	0.061 [c]	0.558 [a]	0.340 [b]	0.383 [b]	0.410 [b]	0.571 [b]	3.574	0.675
3. Vulnerability	0.579 [c]	0.115 [c]	0.551 [a]	0.672 [b]	0.395 [b]	0.424 [b]	3.976	0.622
4. Response Efficacy	0.505 [c]	0.146 [c]	0.451 [c]	0.537 [a]	0.744 [b]	0.587 [b]	4.265	0.503
5. Self-Efficacy	0.243 [c]	0.168 [c]	0.156 [c]	0.553 [c]	0.569 [a]	0.566 [b]	4.189	0.531
6. Purchase Intentions	0.243 [c]	0.326 [c]	0.179 [c]	0.344 [c]	0.320 [c]	0.550 [a]	4.166	0.535

Notes: "a" diagonal elements are the AVE; "b" top diagonal elements are the correlations; "c" bottom diagonal elements are the square of correlations.

In terms of model fit, $\chi 2/df = 2.333$ ($p < 0.001$), root mean square residual (RMR) was 0.031, goodness of fit index (GFI) was 0.903, Tucker–Lewis index (TLI) was 0.918, comparative fit index (CFI) was 0.929, incremental fit index (IFI) was 0.930, and root mean square error of approximation (RMSEA) was 0.060. Hence, the model fit also met the criteria (see Table 4).

Table 4. Results of Hypotheses 1 to 8.

	Relationships	β	B	S.E.	*t*-Value	*p*-Value	Results
H1	Food Waste Problem → Severity	0.338	0.414	0.075	5.515	0.000 ***	Supported
H2	Food Waste Problem → Vulnerability	0.790	0.875	0.075	11.667	0.000 ***	Supported
H3	Food Waste Problem → Response Efficacy	0.786	0.699	0.065	10.784	0.000 ***	Supported
H4	Food Waste Problem → Self-Efficacy	0.579	0.573	0.062	9.206	0.000 ***	Supported
H5	Severity → Purchase Intentions	0.395	0.310	0.045	6.832	0.000 ***	Supported
H6	Vulnerability → Purchase Intentions	0.030	0.026	0.068	0.383	0.702	Not Supported
H7	Response Efficacy → Purchase Intentions	0.285	0.308	0.087	3.527	0.000 ***	Supported
H8	Self-Efficacy → Purchase Intentions	0.251	0.244	0.063	3.879	0.000 ***	Supported

Notes: $\chi 2/df = 2.333$, $p < 0.001$; root mean square residual (RMR) = 0.031; goodness of fit index (GFI) = 0.903; Tucker–Lewis index (TLI) = 0.918; comparative fit index (CFI) = 0.929; incremental fit index (IFI) = 0.930; root mean square error of approximation (RMSEA) = 0.060; *** $p < 0.001$.

4.4. Results of Hypothesis 9

A multi-group analysis (MGA) was performed to confirm the moderating effect of age (under 30s vs. over 60s). Groups were divided into quartiles according to age, and the upper 25% and lower 25% were used for analysis to determine a clear difference. We classified the model into a free model, including a constrained model, and confirmed a path in which the amount of change in the chi-square value for the degree of freedom 1 was 3.84 or more [46]. First, the moderating effect confirmed the relationship between response efficacy and ugly food purchase intention. The response efficacy did not significantly affect ugly food purchase intentions among respondents in their 30s and younger (β = 0.108, $p > 0.05$); however, it positively affected ugly food purchase intentions among respondents in their 60s and older (β = 0.708, $p < 0.01$). Second, the relationship between self-efficacy and ugly food purchase intentions confirmed the moderating effect. In the younger group, self-efficacy positively affected ugly food purchase intentions (β = 0.387, $p < 0.01$); however, in the older group, self-efficacy did not significantly affect ugly food purchase intentions (β = −0.133, $p > 0.05$). Therefore, H9 was partially supported (see Table 5).

Table 5. Results of Hypothesis 9.

Structural Relationship		Under 30s (n = 94)		Over 60s (n = 98)		Free	Constrained	$\Delta\chi^2$	Results
		I^2	t-Value	I^2	t-Value	χ^2 (df = 360)	χ^2 (df = 361)		
H9a	Food Waste Problem → Severity	0.542	4.305 ***	0.359	2.994 **	542.339	543.340	1.001	Not Supported
H9b	Food Waste Problem → Vulnerability	0.804	6.028 ***	0.901	6.370 ***	542.339	543.168	0.829	Not Supported
H9c	Food Waste Problem → Response Efficacy	0.780	5.858 ***	0.876	5.844 ***	542.339	542.483	0.144	Not Supported
H9d	Food Waste Problem → Self-Efficacy	0.636	5.223 ***	0.781	5.473 ***	542.339	543.266	0.927	Not Supported
H9e	Severity → Purchase Intentions	0.250	1.908	0.294	2.947 **	542.339	542.565	0.226	Not Supported
H9f	Vulnerability → Purchase Intentions	0.025	0.151	0.105	0.485	542.339	542.441	0.102	Not Supported
H9g	Response Efficacy → Purchase Intentions	0.108	0.661	0.708	2.811 **	542.339	546.652	4.313	Supported
H9h	Self-Efficacy → Purchase Intentions	0.387	2.664 **	−0.133	−0.739	542.339	546.302	3.963	Supported

Notes: *** $p < 0.001$, ** $p < 0.01$.

5. Discussion

5.1. Theoretical Implications

This study analyzed ugly food purchase intention as one of the solutions to the food waste problem, which is becoming an increasingly significant global issue. In particular, food waste discharges various environmentally harmful substances during the disposal process, which further exacerbates environmental pollution. The academic implications of this study are as follows. First, this study attempted to analyze the food waste problem by applying PMT to an individual's awareness of the food waste problem, classifying its sub-factors of threat appraisal into severity and vulnerability and coping appraisal into response efficacy and self-efficacy. In conclusion, this study is meaningful in understanding individuals' protective motivation behavior for food waste problems using the PMT model.

Second, this research is meaningful because it is the first study, to the best of our knowledge, to connect ugly food purchase intentions as a solution to food waste problems and an individual's protective motivation behavior. Ugly food refers to agricultural products discarded because of their ugly appearance; these food ingredients have been attracting attention for several years [16]. Moreover, due to their lack of marketability, the purchase and use of ugly food is evaluated as a solution to reducing the food waste problem [15]. Through this study, consumers' ugly food purchase intention was found to be a significant protection motivation behavior for food waste problems.

Third, this study attempted a multi-group analysis between individuals below the age of 30 and those 60 years or older, and analyzed the differences in their food waste problem perspectives according to age. Differences in perspectives on specific social phenomena have been revealed in various studies [16,29]. This study also showed the difference in behavior according to age; for the older group, response efficacy increased ugly food purchase intention, whereas in the younger group, self-efficacy enhanced ugly food purchase intention. The interpretation of this result is intended to have practical implications. These academic implications are also meaningful in that we provide new basic data related to research fields, which will be helpful for future research. Furthermore, it is expected to help develop various strategies to reduce food waste in Korea and worldwide.

5.2. Managerial Implications

This study demonstrated the process by which an individual's awareness of food waste problems leads to their protective motivation behavior through the PMT constructs of

severity, vulnerability, response efficacy, and self-efficacy. Various practical implications can be presented as follows. First, this study proved the relationship between an individual's awareness of food waste problems and the severity and vulnerability corresponding to their threat appraisal. It has been confirmed that an individual's awareness of food waste problems increases their severity and vulnerability. This could mean that most Koreans consider the food waste issue a critical problem. Cho et al. [34] stated that concerns about tap water quality increased the severity and vulnerability of restaurant customers in China. It was said that positive messages about tap water quality should be introduced more effectively to customers, and that a plan is needed to suggest protective behavior to minimize consumer concerns. In this context, this study suggests various solutions and strategies to reduce this problem at the social and national levels because many Koreans are already aware of the seriousness of food waste problems and their vulnerability to this issue. Furthermore, Baig et al. [47] mentioned that the food waste problem in the Kingdom of Saudi Arabia is also serious. The authors pointed out that, compared to cafes and restaurants, the amount of food waste discarded at home is the highest, and it begins with people's unplanned and inappropriate shopping excursions. They stressed the need for a campaign, such as "stop food waste", to alert people to this serious issue.

Second, this study found that individuals' awareness of food waste problems increased response efficacy and self-efficacy. Response efficacy represents the feeling of minimizing rejection of a particular issue and accepting it as much as possible [48], and self-efficacy refers to the confidence that one can do well [49], meaning that the majority of individuals have a positive will to work on the social problem of food waste. Therefore, it is necessary to more actively present various waste reduction strategies that people can easily engage with. Efforts should be made to reduce the amount of food waste that individuals throw away in their daily lives. In addition to providing theoretical and scientific information on how to solve the food waste problem, it is necessary to provide more practical and specific information that consumers can practice. For example, consumers should be continuously informed through various messages that if they choose ugly food, they can reduce the agricultural waste discarded from farms and, thus, help save the environment. According to James [50], ugly food can be healthier and more flavorful because it has higher antioxidant and sugar content than standard agricultural products. It is necessary to appeal more actively to consumers, and from a long-term perspective, regarding the specific information about ugly food, which is offered at a more reasonable price.

Third, between the severity and vulnerability of food waste, only severity had a significant positive effect on ugly food purchase intention, which corresponds to protective motivational behavior. In other words, Koreans are seriously judging the food waste problem, and it is confirmed that they are very willing to purchase ugly food as a solution to this problem; therefore, the expansion of this food market will be more urgent in the future. In Korea, many consumers are still unaware of what ugly food is, and there are not many ways to purchase it because most agricultural product distributors sell products with good marketability. As one of the many solutions to the food waste problem, first and foremost, more active promotion of ugly food and expansion of various retailers are urgently needed. Currently, ugly food is sold at a relatively low price compared to standard agricultural products; however, other than price discounts, it is necessary to inform consumers that ugly food purchases are also a way to save the environment. According to a study by Qi et al. [18], in addition to discounted prices on agricultural products, other messages can affect consumers positively. In addition, considering that many consumers still avoid ugly food, selling it in combination with standard agricultural products, not just ugly food, will be an easier way to access these consumers.

Fourth, both response efficacy and self-efficacy on awareness of food waste problems had a significant positive effect on ugly food purchase intention, which corresponds to protective motivational behavior. From these results, it can be seen that individuals are active in solving some of these social problems. According to Horng et al. [37], most people receive news reports about phenomena, which are scientific to an extent and often

feel far from our daily lives; therefore, the ability to reach consumers is limited. In other words, more detailed and practical message delivery is essential to approach consumers. Active sales of ugly food require the simultaneous efforts of everyone involved in their supply chain, including farmers, distributors, and sellers, as well as more sustainable waste management that can help reduce food waste while co-existing with it.

Finally, as a result of the multi-group analysis according to age, it was found that response efficacy to food waste had a significant positive effect on ugly food purchase intention in the older group. Furthermore, it was found that among young people in their 30s and below, self-efficacy in food waste had a significant positive effect on ugly food purchase intentions. Therefore, the moderating effect of age was confirmed, and the patterns were different. Kim and Crimmins [29] emphasized that different approaches and solutions should be presented according to age groups to overcome various crises. In this study, the older group expressed their ugly food purchase intention from the standpoint of accepting this waste problem without any change, and the younger group from the perspective of being confident that they could solve the situation well. Thus, there were differences in the motivation for ugly food purchase depending on age group. However, it is necessary to expand the range of retailers to ensure the efficient purchase of these foods in the future. The direct sales method between farmers and consumers must be increased to shorten the complex distribution process and increase ugly food sales channels. These efforts will contribute to farm profits, help consumers, and reduce food waste to create a better future environment.

6. Conclusions

This study attempted to understand the food waste problem, which is a growing social concern. The study was conducted by applying PMT and ugly food purchase intention to find a solution. In addition, a moderating effect analysis was conducted according to age. The results showed that Koreans' awareness of food waste problems increased their severity, vulnerability, response efficacy, and self-efficacy, among which individual's severity, response efficacy, and self-efficacy enhanced ugly food purchase intention. Furthermore, the multi-group analysis conducted according to age confirmed the moderating effect between groups in their 30s or younger and 60s or older. For those in their 30s and younger, self-efficacy had a positive effect on ugly food purchase intention, and for those in their 60s and older, response efficacy positively affected ugly food purchase intention. The results of this study are meaningful in dealing with food waste problems directly related to the global environment, as they confirmed both threat appraisal and coping appraisal of food waste problems perceived by individuals, and identified individuals' ugly food purchase intention to reduce the food waste problem. Furthermore, we could see a difference in behavior according to age; the younger group showed higher confidence in solving this problem, thus, giving us hope for the future. Efforts should be made from various perspectives to create a brighter and cleaner global environment, including the further expansion of ugly food promotion and distribution channels. A more rational supply process and sustainable management of ugly food will soon improve the global environment and make valuable changes in the future.

7. Limitations and Future Research

Although this study has various implications, it is not without limitations. First, this study was conducted during the COVID-19 pandemic as an online survey, and it is presumed that the pandemic also affected the research results. Conducting related research after the pandemic has ended will lead to further meaningful results. Second, as it only targeted a sample of Koreans, there is limited generalizability of the results. There will be differences in the seriousness and level of food waste problems in each country. In the future, it will be useful to conduct country-specific research and analyze these differences. Third, in this study, PMT was applied to the food waste problem; however, in the future, it will be necessary to apply other models to derive divergent and comprehensive results.

Fourth, there will be many other related variables that can be suggested as possible solutions in addition to the ugly food purchasing behavior for food waste problems. Therefore, it is necessary to analyze the relationship between food waste problems and other wider variables. Finally, in this study, the moderating effect of age was confirmed, but there will be various demographic variables that actually affect consumer behavior in relation to the food waste problem. Therefore, in the future, there is a need to derive meaningful results by conducting multi-group analysis using other demographic variables such as gender.

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Appendix A. Survey Questionnaires

Table A1. Construct Questionnaires.

Questionnaire	Highly Disagree	Disagree	Normal	Agree	Highly Agree
Awareness of Food Waste Problem					
I am aware that the food waste problem is serious, directly connected to our daily lives	①	②	③	④	⑤
I am well aware of the food waste problem these days	①	②	③	④	⑤
I am usually interested in the food waste issue	①	②	③	④	⑤
I am aware that the food waste disposal issue is crucial	①	②	③	④	⑤
Severity					
The environmental pollution problem caused by food waste is serious	①	②	③	④	⑤
When disposing of food waste, various harmful substances are generated	①	②	③	④	⑤
Korea is suffering from environmental pollution due to food waste problems	①	②	③	④	⑤
Our surroundings are becoming increasingly polluted by food waste	①	②	③	④	⑤
Vulnerability					
Food waste will eventually have a harmful effect on people	①	②	③	④	⑤
When disposing of food waste, various environmental hazards are generated, which is harmful to health	①	②	③	④	⑤
The food waste problem will eventually threaten our lives	①	②	③	④	⑤
Response Efficacy					
Efforts to reduce food waste will help prevent environmental pollution	①	②	③	④	⑤
Efforts to reduce food waste are effective solutions to prevent environmental pollution	①	②	③	④	⑤
If we try to reduce food waste, we can minimize environmental pollution	①	②	③	④	⑤
Self-Efficacy					
I can do enough to reduce food waste	①	②	③	④	⑤
I am confident that I will join in reducing food waste	①	②	③	④	⑤
I will try to reduce food waste	①	②	③	④	⑤
Ugly Food Purchase Intentions					
I am willing to purchase ugly food to reduce food waste	①	②	③	④	⑤
I have a plan to purchase ugly food, thinking about the future environment	①	②	③	④	⑤
I am going to purchase ugly food, thinking about environmental issues	①	②	③	④	⑤
I am going to keep purchasing ugly food	①	②	③	④	⑤

Table A2. Demographic Questionnaires.

Demographics Questionnaire	Please Check the Option that Applies to You
To which age group do you belong?	
Below 20 years old	①
20–29 years old	②
30–39 years old	③
40–49 years old	④
50–59 years old	⑤
60 years old and above	⑥
What is your sex?	
Male	①
Female	②
What is your marital status?	
Unmarried	①
Married	②
Other	③
What is your educational level?	
High school	①
Two years college	②
University	③
Graduate school	④
What is your monthly income?	
Less than 1 million won (KRW)	①
1 million but less than 2 million won (KRW)	②
2 million but less than 3 million won (KRW)	③
3 million but less than 4 million won (KRW)	④
4 million but less than 5 million won (KRW)	⑤
5 million won (KRW) or more	⑥
What is your occupation?	
Student	①
Office job	②
Self-employed	③
Professional job	④
Homemaker	⑤
Other	⑥

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