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Are Consumers Ready to Consider Insect-Based Foods as a Sustainable Food Choice? An Application of the Extended Protection Motivation Theory to Italian Consumers

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Abstract: Adopting sustainable food choices is crucial to mitigating the environmental impacts of food production. Insect-based foods offer a promising alternative with low resource requirements and reduced greenhouse gas emissions. This study examines the psychological factors influencing consumers' intentions to purchase insect-based foods using an extended protection motivation theory (PMT) model that includes disgust as a critical factor. Data from 233 Italian participants were analyzed through partial least squares structural equation modeling (PLS-SEM). Results indicate that perceived response efficacy—the belief in the environmental benefits of insect consumption—and self-efficacy—confidence in one's ability to incorporate insect-based foods—positively influence purchase intentions. However, strong aversions rooted in disgust and low intrinsic motivation present major barriers, highlighting cultural resistance to entomophagy in Western contexts. Extrinsic motivators such as social recognition, perceived costs, and perceived severity or vulnerability to environmental issues had no significant effect. The findings suggest that effective strategies should focus on reducing disgust and strengthening consumer confidence, emphasizing the environmental benefits to shift attitudes toward sustainable dietary choices.

Keywords: sustainable food systems; insect-based foods; protection motivation theory; disgust concerns; consumers' behavior; acceptance barriers

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1. Introduction

Considering climate change's acknowledged negative effects on a global scale [1], the increase in the global demand for food [2,3], as well as the food paradox, whereby a significant proportion of the raw material produced and food processed is wasted while malnutrition rates rise [4], a rethinking of food systems' objectives is imperative.

The issue of global climate change is inducing a change in dietary habits, with an increasing focus on the utilization of more sustainable sources of protein in daily diets. In the event of a transition in global food production to plant-based diets, a net reduction in greenhouse gas emissions of between 332 and 547 $GtCO_2$ is projected to be observed by 2050. This figure represents a reduction in CO_2 emissions of between 99% and 163%, which is in line with the objective of limiting global warming to 1.5 °C [5]. What strategies might be employed to reverse the global warming trend? Furthermore, how might the agenda of the Sustainable Development Goals (SDGs) be met, with a particular focus on the second goal (SDG2), which focuses on eradicating world hunger by 2030? The European Union (EU) put forth a policy structure entitled Food 2030 [2,6] that is consistent with the Green Deal (GD) and Farm to Fork (F2F) objectives. In other words, the development of sustainable food systems must consider the impact of climate change, ensure the preservation of natural resources, and reduce the emission of greenhouse gases (GHGs).

To address the aforementioned issues, a radical transformation is required in the global food system, encompassing all food production, processing, distribution, preparation, and consumption activities. Considering this, it is also essential to review current food policies and consider ways to alter food production and consumption patterns to achieve nutritionally sound and environmentally sustainable diets and food systems [7].

As defined by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO), sustainable healthy diets are dietary patterns that promote all dimensions of individuals' health and well-being, have low environmental pressure and impact, are accessible, affordable, safe and equitable, and are culturally acceptable [8]. It is insufficient to consider dietary patterns as mere reflections of nutrient intake and consumption of specific food groups; instead, a more comprehensive approach is necessary, incorporating social, cultural, environmental, and biodiversity considerations within the context of economic fairness [9].

The EAT-Lancet Commission defined a healthy diet as predominantly plant-based, with minimal fish and white meat consumption, and no or low intake of red meat and processed foods [10]. To achieve nutritional goals in a sustainable manner, a significant shift in dietary habits has recently been observed, with a reduction in red meat consumption in favor of alternative protein sources. In this context, research on alternative protein sources such as algae, single cell protein, and insects is increasing [11].

In designing food policy interventions to promote sustainable diets, it is essential to acquire a more advanced comprehension of the elements that shape individuals' dietary preferences. This analysis focuses on identifying the factors related to the potential introduction of insect protein sources.

Entomophagy is the practice of consuming insects as food. Worldwide, more than 2000 species of insects are eaten, although the most consumed insects are beetles. More than two billion people worldwide include insects in their traditional diets, primarily in sub-Saharan Africa, Central and South America, Southeast Asia, and the Pacific. The global market value of edible insects is USD 2.8 billion, and the largest market for edible insects is the Asia-Pacific region [12].

What are the reasons for considering insects as an alternative source of protein? Insects provide an economically, nutritionally, and environmentally advantageous food source. In fact, their high feed conversion efficiency due to their poikilothermic nature makes it possible to convert feed into protein in an environmentally friendly and cost-effective process [13]. In general, insects are a valuable source of micronutrients, including iron, zinc, and calcium, which are essential for maintaining human health [14,15]. In addition, insect husbandry has a lower carbon footprint and produces less ammonia than conventional animal husbandry [13]. Edible insects have the potential to offer economic and environmental advantages, and they appear to be a more sustainable and environmentally friendly source of nutrients than other animal-based products [16]. In Western countries, consumer acceptance represents a significant obstacle to the adoption of diets based on edible insects. What factors contribute to the negative attitudes held by Western consumers toward entomophagy? This phenomenon has been the subject of extensive investigation in recent years, and disgust and neophobia emerged as the main factors that contribute significantly to it [17–19]. Although disgust is a valid reason for rejecting novel foods of animal origin (e.g., insect-based food), it should be distinguished from neophobia, which refers to an aversion to unfamiliar or novel foods. Indeed, food neophobia represents a general phenomenon shaped by subjective beliefs, whereas disgust is elicited by a specific stimulus [17]. Indeed, it is unsurprising that even a food with which consumers are familiar can evoke feelings of disgust. Furthermore, the stimuli that elicit disgust may be culturally specific and/or associated with the presence of pathogens that represent a health threat. Consequently, new food technologies may also be included in the domain of disgust, particularly in contexts where information is asymmetrically distributed [19].

Of course, it is also important to consider the role of prevailing food culture in Western societies [20]. However, various studies show that concern about environmental issues, climate change, and sustainability related to food production and consumption patterns could positively influence the acceptance of insect-based food in Western dietary habits [21,22].

Based on the last consideration, mainly related to consumers' concerns due to climate change, the objective of our analysis is to ascertain the potential motivating factors and significant impediments that may influence the willingness of Western consumers to incorporate edible insects into their regular diets.

The predominant models for defining and examining the relationships among cognitive constructs associated with dietary behaviors are socio-psychological theories [7], such as the theory of planned behavior (TPB) [23] and the protection motivation theory (PMT) [24,25]. However, the PMT offers a more detailed and nuanced understanding of human behavior in relation to the TPB [26]. The theory is based on the premise that there are specific psychological and cognitive processes that drive protective behavior in response to fear appeals regarding individual health [25]. A recent meta-analysis demonstrated the theory's efficacy in explaining the behavior of individuals facing threats [27], and PMT has been widely applied across a range of research fields, including tourism and marketing, extending beyond its initial focus on health [28]. In recent years, PMT has been widely used to explain consumers' pro-environmental behavior in response to global environmental threats, such as climate change, biodiversity loss, and deforestation [29]. The PMT was applied in the context of food consumption by Pang et al. [30] to study consumers' purchase intention towards organic food. The study conducted by Chen [31] demonstrated that the capacity to elucidate and anticipate the intention to reduce meat consumption is equally efficacious when utilizing the PMT, TPB, or a combination of PMT and the theory of reasoned action (TRA). In this context, the PMT model is an effective tool for examining consumer acceptance of insect-based foods due to its ability to address two primary concerns: health and climate change. By addressing these fears, it may encourage individuals to adopt more environmentally conscious behaviors related to food choices.

Based on the above, our study introduces a novel approach to examining the protective behaviors associated with the hypothetical consumption of insect-based food through the theoretical framework of protection motivation theory. Furthermore, the disgust domain construct was incorporated into the conventional PMT constructs to enhance the interpretation of the behavioral pattern. The research gap that our work seeks to address is corroborated by the findings of a recent systematic literature review conducted by Kröger et al. [13]. This review examined the acceptance of insect-based foods in Western societies and revealed that, of the 119 studies analyzed, 21 pertained specifically to Italy. It is noteworthy that none of the referenced works employed the PMT theory as a reference framework in the context of food. The proposed model was applied to analyze the response of a sample of Italian consumers toward their willingness to consume insect-based foods. This paper is structured as follows: the theoretical background supporting the research hypotheses is presented in Section 2, while the methodology is described in Section 3; Section 4 presents the results, and Sections 5 and 6 provide discussion and conclusions, respectively.

2. Theoretical Background and Research Hypotheses

2.1. The Protection Motivation Theory

The protective motivation theory (PMT) was developed by Rogers [24] as a means of investigating the potential influence of fear on attitudes and behaviors in medical settings regarding the selection of personal protective measures for health purposes. PMT is a psychological practice that is concerned with the motivation behind human behavior. The foregoing model is frequently employed in the investigation of general health issues. Nevertheless, it has also been applied to the prediction of pro-environmental behaviors [29,30,32]. The underlying premise is that individuals engage in pro-environmental actions when confronted with environmental risks. This is influenced by two key factors: perceived vulnerability and severity on the one hand, and the perceived efficacy of potential responses and self-efficacy on the other.

A distinctive feature of PMT is that the model postulates that individuals evaluate pro-environment alternatives in terms of both current behavior and their expectations of new behavior, considering the respective costs and benefits of each in accordance with their subjective valuation. The core argument of the PMT is that when individuals make oriented choices, they evaluate both the immediate and future consequences of their actions in terms of the costs and benefits associated with them. Thus, PMT provides a framework for identifying both barriers to and enabling factors for the adoption of protective behaviors.

Rogers [25] put forth the idea that a range of environmental and interpersonal factors, including personality, can give rise to two distinct behavioral processes to ensure their own protection: threat appraisal and coping appraisal. The threat appraisal is the cognitive process through which individuals evaluate the potential consequences of a maladaptive response, which encompasses both intrinsic and extrinsic rewards, in relation to their perception of the situation's severity and vulnerability. The coping appraisal is a measure of the discrepancy between an individual's coping response efficacy and self-efficacy, along with an assessment of the associated costs (Figure 1).

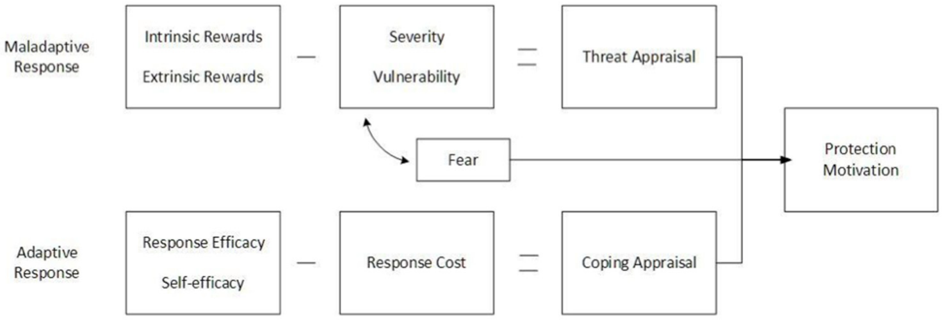

Figure 1. Cognitive mediating process of protection motivation theory (source: [27]).

A threat can be defined as an individual's subjective appraisal of the potential severity of an adverse outcome, which may or may not be objectively justified [33]. The findings of Baker et al. [34] and Palmieri et al. [35] indicate that the recognition of adverse environmental consequences may serve as a compelling incentive for consumers to consider entomophagy as an alternative to conventional animal-based protein sources. Sogari et al. [21] and Hénault-Ethier et al. [22] demonstrated that the acceptance of insect-based foods is directly correlated with concerns about environmental issues, climate change, and sustainability.

Perceived vulnerability is the degree to which an individual perceives themselves to be susceptible to threat [25]. Research findings reveal that individuals who possess greater insight into their vulnerability in relation to specific occurrences are more likely to adhere to the prescribed behavioral norms. In this study, perceived vulnerability is conceptualized as an individual's assessment of the likelihood of experiencing adverse consequences because of climate change.

As proposed by Floyd et al. [28], an increase in perceived severity and perceived vulnerability is accompanied by a corresponding increase in the likelihood of engaging in protective behaviors, thus the following hypothesis was put forth:

H1: *Perceived severity (H1a) and perceived vulnerability (H1b) have a direct and positive effect on the intention to purchase insect-based food.*

The motivation to perform recommended behaviors is influenced by both intrinsic and extrinsic rewards; however, when individuals believe that they could gain more by avoiding a certain behavior, the motivation to engage in that behavior is diminished. The concept of consumer wellness, which is regarded as an intrinsic and multidimensional factor encompassing both mental and physical well-being, appears to exert a negative influence on the intention to purchase insect-based foods. The greater the appreciation of a conventional food among consumers, the more pronounced their disapproval will be of its preparation when insects are introduced as an ingredient [36]. A review of the literature on the introduction of insects as food products allows for the distinction between individual health-related benefits and collective environmental benefits. Notwithstanding the environmental advantages associated with insect-based foods, sustainability represents a tenuous rationale for consumers' purchasing decisions [37]. In examining extrinsic factors, it appears that the opinions of others, as well as the perceived benefits of saving time and money, can exert a significant influence on the intention to engage in a given behavior. Furthermore, Sidali et al. [38] observed that individuals' positive or negative perceptions regarding the safety and palatability of insects as food items influenced their intention to purchase insect-based foods. In accordance with the PMT, the prospect of high intrinsic and extrinsic rewards from the purchase of conventional products is likely to result in a reduced intention to purchase insect-based foods. Considering the evidence, the following hypotheses are proposed:

H2: *The intrinsic (H2a) and extrinsic (H2b) rewards exert a direct and negative influence on the intention to purchase insect-based food.*

In the assessment of coping, response efficacy, self-efficacy, and response cost are proposed as antecedents of the intention to engage in protective behavior. The response efficacy is used to describe the conviction that a specific protective conduct will effectively circumvent a given danger. In our analysis, we define it as consumers' belief that the consumption of insect-based foods can be an effective method of reducing the environmental impact of climate change. So, the following hypothesis is proposed:

H3: *The response efficacy directly and positively influences the purchase intention of insect-based food.*

Self-efficacy, in turn, signifies one's estimation of their capacity to execute the requisite protective behavior. Consumers tend to purchase a product when they believe that a certain action is possible and easy for them. For our purpose, self-efficacy can be assessed in terms of an individual's belief that he or she will be able to reduce the threat to the environment if he or she successfully adopts the consumption of insect food. Cox et al. [39] and Verkoeyen et al. [40] found that self-efficacy is one of the strongest predictors of intention to purchase. Hence, the hypothesis proposed is:

H4: *Self-efficacy directly and positively influences insect-based food purchase intention.*

In the context of protective behavior, response costs pertain to the perceived costs associated with the implementation of the protective measure in question. In this study, response costs are not only related to the price of insect foods. They are also related to safety and willingness to change eating habits according to the benefits of eating insect foods. Several studies have shown a low level of acceptance of insect-based foods in terms of consumers' willingness to change their eating habits for environmental benefits. Verneau et al. [41], Verbeke et al. [42], and Hartman et al. [43] agree that only a small proportion of consumers are willing to change their eating habits for environmental reasons. The limited availability and opportunity to eat these products in familiar places such as restaurants and supermarkets increases consumers' lack of trust and uncertainty. The latter is also exacerbated by the fact that the only option for purchase of these foods is through online stores that have a limited supply. Hence, the hypothesis proposed is:

H5: *The cost of response directly and negatively influences the purchase intention of insect-based food.*

2.2. Disgusting Factors

The theoretical model of the present study is concerned with the role of disgust as a factor related to entomophagy in Western countries, for several reasons. Firstly, the role of disgust has been extensively investigated by various researchers [21,38,44]. Second, recent studies have shown that disgust is a dominant factor in scales measuring individuals' attitudes towards eating insects [43,45,46]. Finally, it represents the first attempt to assess Western consumers' acceptance of insect-based foods based on PMT in relation to disgust elicitors. How does disgust affect attitude towards insect-based food? As previously noted, neophobia and disgust are two factors that play a pivotal role in the decision-making processes of Western consumers regarding food products derived from insects [17,42,47]. Specifically, neophobia is associated with the acceptance of novel foods, defined as those with which there is no prior purchasing history. In contrast, disgust is related to perceptions of poor hygiene and the origins of the food's raw ingredients [19] and represents the main factor negatively affecting insect-based food consumption.

Based on that, we posit that:

H6: *The disgust constructs have a negative effect on the purchase intention of insect-based foods.*

2.3. Research Framework

The framework of this research integrates the PMT constructs with those related to disgust in the food domain, which, in previous literature, have been proven to have explanatory power on pro-environmental behaviors. Figure 2 illustrates the extended model and the related research hypotheses.

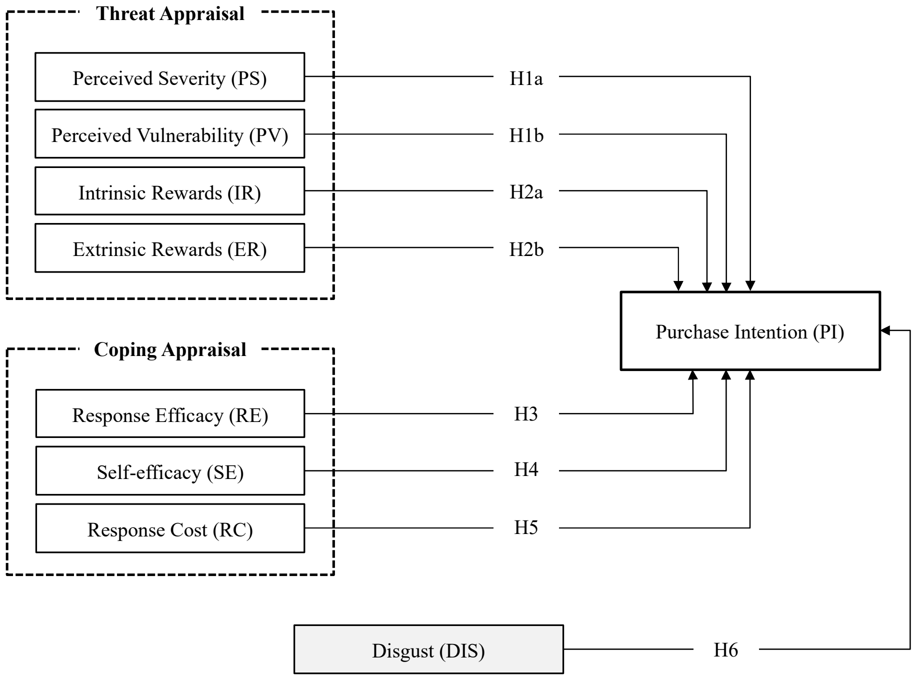

Figure 2. Theoretical model framework and research hypotheses (H1–H6) of consumers intention to purchase insect-based food products.

3. Materials and Methods

Following our theoretical model (Figure 2), we designed a questionnaire to explore the factors influencing consumers' intention to purchase insect-based food products under the lens of the protection motivation theory [24,25] extended with disgusting factors. The questionnaire was defined after a thorough literature review of consumer behavior in the PMT framework [26,29,30,39,40] and of models focusing on attitudes toward insect-based foods [17,21,22,35,36,38,43–45,47]. Each construct of our model was described by items adapted from previous research, and answers were collected using a seven-point Likert scale (from strongly disagree (1) to strongly agree (7)) (Table A1).

The items describing the construct of the PMT model were chosen from those proposed by Pang et al. [30]. The authors applied the PMT model, extended with TPB, to analyze the antecedents of consumers' purchase intentions towards organic food. The authors' basic assumption is that consumers purchase organic food as a pro-environmental behavior to minimize the harmful impact of food production on the natural environment. Regarding the items for the disgust construct, they were chosen after a careful literature review of studies investigating the effect of disgust on consumer behavior. Disgust theory was first proposed by Rozin and Fallon [48] and posits that disgust functions as a defense mechanism against the recognition of human animality. In 1994, Haidt et al. [49] defined seven domains of disgust, ranging from aversion to toxin avoidance, disease avoidance, and finally the social and moral domain [50,51]. Investigations in the food domain did not expand significantly until the nutritional and environmental validity of introducing alternative proteins to those derived from meat in eating habits became a prominent topic of investigation. Food disgusting scales (FDS) have been proposed to address the avoidance of a disease with physiological and cultural characteristics and to contribute to the understanding of consumer acceptance of new foods [19]. Based on the crucial role of disgust, the new interest of consumer segments in Western countries in eating insects, and the validity of the use of insect-derived proteins in sustainable diets, La Barbera et al. [45] developed the entomophagy attitude questionaries (EAQ), a methodology to predict intentions to consume insects. In detail, the EAQ is based on three main concepts that emerge from the literature: disgust, interest in novel foods, and the use of insect-derived proteins in animal feed. From this theoretical core, several items (23) were selected, tested, and validated. For the purpose of our study, only disgust-related constructs (5) were selected and included in the PMT model (see Table A1).

The questionnaire, written in Italian, was implemented using "Google Forms", an easy-to-use online platform for designing and developing web-based survey questionnaires. To ensure clarity and relevance, the questionnaire was checked by scholars and academic experts and pre-tested with 15 randomly chosen university students. Data were collected in winter 2024 (between January and March) through convenience sampling. The questionnaire was disseminated online among a diverse sample of university students and via major social media platforms, including Facebook, to a population with an interest in the topic [52]. The total sample comprised 234 participants distributed across the Italian macro-regions. However, one respondent was excluded due to the lack of consent, leaving a final sample size of 233. Further details of the sample characteristics are provided in Table 1.

Table 1. Socio-demographic characteristics of the sample.

Dimension	Frequency	Percent
Gender		
Female	165	71
Male	68	29
Age		
18–25	58	25
26–35	69	30
36–50	41	17
>50	65	28

Table 1. *Cont.*

Dimension	Frequency	Percent
Education		
Middle and high school	91	39
Bachelor level	55	24
Graduate	84	36
PhD	3	1
Macro-region		
North	18	8
Centre	15	7
South and Island	200	85
Living area		
Rural	25	11
Urban	208	89

Our extended PMT model was empirically tested using partial least squares structural equation modeling (PLS-SEM) [53,54]. The model was constructed and analyzed using R software version 4.2.2 [55], utilizing the SEMinR package [53], a recent tool designed for PLS-SEM. PLS-SEM was chosen due to its effectiveness with small sample sizes and its ability to handle complex models with multiple structural relationships [53,54]. As noted by Hair et al. [53], PLS-SEM is particularly suited for research aimed at exploring and expanding theoretical frameworks, aligning well with our study's objectives. A PLS path model consists of two primary components: (i) the measurement model (or outer model), which defines the associations between latent constructs and their indicators (manifest variables), and (ii) the structural model (or inner model), which examines the relationships among latent constructs. Once these models were specified, we proceeded with estimating the PLS model and assessing the quality of both the measurement and structural model outcomes.

4. Results

4.1. Extended PMT Model Evaluation

The quality of the measurement model was evaluated by assessing both indicator reliability and internal consistency, as well as convergent and discriminant validity [53,54]. Indicator reliability was determined by examining the outer loadings: indicators with loadings above 0.708 were retained, those below 0.40 were excluded, and indicators with loadings between 0.40 and 0.708 were removed only if their exclusion improved internal consistency or convergent validity beyond the acceptable threshold [53,54]. Reliability and convergent validity were evaluated using the reliability coefficient rho_A and the average variance extracted (AVE), respectively. The rho_A values were below the critical limit ($rho_A < 0.95$) and the AVE values above the minimum threshold ($AVE \geq 0.50$) for all constructs. Finally, discriminant validity was assessed using the heterotrait–monotrait ratio (HTMT), showing values below the suggested conservative threshold (0.85) [56]. The results of the measurement model assessment are detailed in Tables 2 and 3.

After confirming the quality of the measurement model, we evaluated the structural model results [53,54]. Collinearity was assessed by examining the variance inflation factor ($VIF < 3$), while the significance and relevance of the structural model relationships (path coefficients) were tested using a bootstrapping procedure with 10,000 random subsamples and a 95% confidence interval. The model's explanatory power was evaluated using the coefficient of determination (R^2). Ranging from 0 to 1, R^2 values of 0.25, 0.50, and 0.75 indicate weak, moderate, and substantial explanatory power, respectively. In some cases, however, values as low as 0.10 may also be considered satisfactory [53,54]. With an R^2 of 0.413, our model demonstrates moderate explanatory power. We also assessed our model's predictive power (or out-of-sample predictive power), namely the model's ability to predict new or future observations [53]. To this, we used PLSpredict [57], which estimates the model on a training sample and evaluates its predictive performance on a holdout sample [58]. Our model shows high power in predicting the purchasing intention of insect-based food products, as all indicators have lower RMSE values compared to the LM ones. The results of the structural model assessment are detailed in Table 4.

Table 2. Reliability and convergent validity indicators of the model.

Constructs	Items	Loadings	rho_A	AVE
Perceived severity (PS)	PS_1	0.936	0.882	0.720
	PS_2	0.929		
	PS_3	0.512		
	PS_4	0.945		
Perceived vulnerability (PV)	PV_1	0.835	0.742	0.539
	PV_2	0.689		
	PV_3	0.678		
	PV_4	0.733		
Intrinsic rewards (IR)	IR_1	0.671	0.837	0.670
	IR_2	0.875		
	IR_3	0.833		
	IR_4	0.878		
Extrinsic rewards (ER)	ER_1	D	0.887	0.664
	ER_2	0.762		
	ER_3	0.755		
	ER_4	D		
	ER_5	D		
	ER_6	0.657		
	ER_7	0.794		
	ER_8	0.808		
Response efficacy (RE)	RE_1	D	0.885	0.897
	RE_2	0.881		
	RE_3	0.887		
Self-efficacy (SE)	SE_1	0.907	0.791	0.825
	SE_2	0.886		
	SE_3	D		
Response cost (RC)	RC_1	0.835	0.804	0.564
	RC_2	0.507		
	RC_3	0.799		
	RC_4	0.815		
Purchase intention (PI)	PI_1	0.919	0.932	0.823
	PI_2	D		
	PI_3	0.853		
	PI_4	0.926		
	PI_5	0.911		
Disgust (DIS)	DIS_1	0.900	0.918	0.794
	DIS_2	0.888		
	DIS_3	0.925		
	DIS_4	D		
	DIS_5	0.827		

Table 3. Discriminant validity of the model: heterotrait–monotrait ratio (HTMT).

	PS	PV	IR	ER	RE	SE	RC	DIS
PV	0.609							
IR	0.441	0.241						
ER	0.425	0.240	0.678					
RE	0.715	0.418	0.277	0.330				
SE	0.146	0.086	0.136	0.098	0.205			
RC	0.284	0.169	0.321	0.116	0.326	0.261		
DIS	0.262	0.170	0.203	0.067	0.401	0.298	0.849	
PI	0.177	0.153	0.237	0.048	0.404	0.493	0.482	0.525

Table 4. RMSE and LM values.

	PI_1	PI_3	PI_4	PI_5
RMSE	1.78	1.61	1.72	1.61
LM	1.94	1.65	1.80	1.67

4.2. Extended PMT Model Results

The findings of our structural model testing provide partial support for the hypotheses proposed in our behavioral model (Figure 3 and Table 5). Hypotheses H1a and H1b, which predicted that perceived severity and perceived vulnerability would have a direct, positive effect on the intention to purchase insect-based food, were not supported by the data. The path coefficients for both constructs were not statistically significant, suggesting that neither consumers' perceptions of climate change severity nor their sense of personal vulnerability to environmental issues are significant motivators for insect-based food purchases. This result contrasts with previous studies that have shown that perceived vulnerability to environmental threats can positively influence sustainable behaviors [28,29], though this influence may vary with product type and cultural context [16,21,22,36].

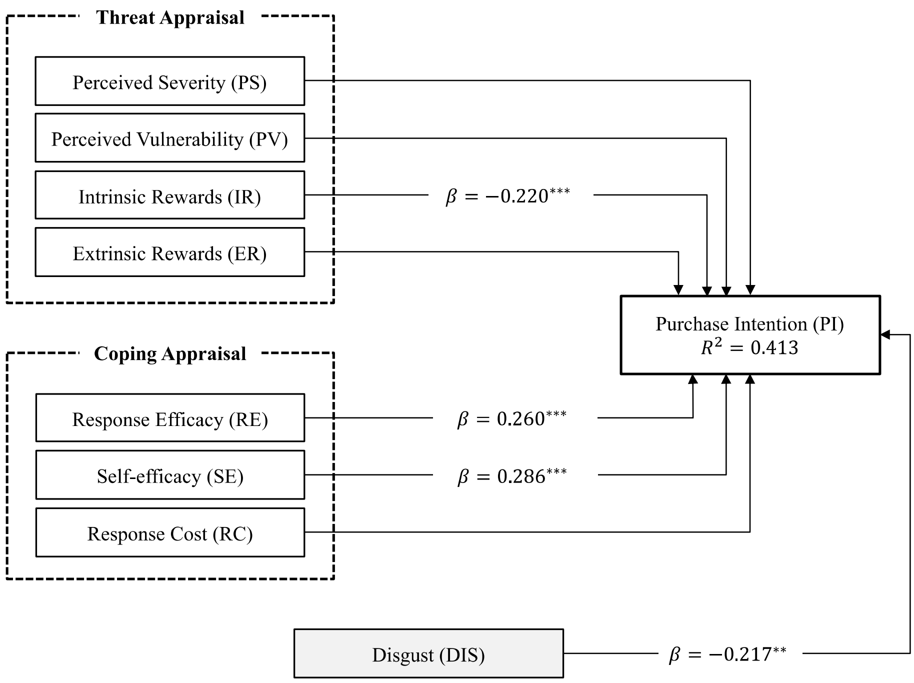

Figure 3. Path (β) and explanatory power (R^2) coefficients of our extended PMT model. ** Sig. 0.01; *** Sig. 0.001.

Table 5. Results of hypotheses testing.

Hypotheses	Relationship	Path Coefficient	Results
H1: *Perceived severity (H1a) and perceived vulnerability (H1b) have a direct and positive effect on the intention to purchase insect-based food.*	PS → PI		Not supported
	PV → PI		Not supported
H2: *The intrinsic (H2a) and extrinsic (H2b) rewards exert a direct and negative influence on the intention to purchase insect-based food.*	IR → PI	−0.220 ***	Supported
	ER → PI		Not supported
H3: *The response efficacy directly and positively influences the purchase intention of insect-based food.*	RE → PI	0.260 ***	Supported
H4: *Self-efficacy directly and positively influences insect-based food purchase intention.*	SE → PI	0.286 ***	Supported
H5: *The cost of response directly and negatively influences the purchase intention of insect-based food.*	RC → PI		Not supported
H6: *The disgust constructs have a negative effect on the purchase intention of insect-based foods.*	DIS → PI	−0.217 **	Supported

** Sig. 0.01; *** Sig. 0.001.

In contrast, the results support H2a, which hypothesized that intrinsic rewards would have a direct, negative effect on the intention to purchase insect-based foods. The path coefficient for intrinsic rewards was −0.220 and statistically significant at $p < 0.001$. This suggests that the internal satisfaction or self-gratification associated with consuming insect-based products may actually diminish purchase intention, a finding that aligns with the notion that Western consumers often experience an "ick factor" or psychological aversion to consuming insects [46].

Hypothesis H2b, which posited a similar negative influence of extrinsic rewards, was not supported. The lack of statistical significance for this path indicates that external motivations, such as social recognition or monetary incentives, do not significantly impact consumers' intentions to purchase insect-based foods. This finding aligns with recent research suggesting that extrinsic motivators might be less effective in promoting environmentally oriented purchases for unconventional foods, as social acceptance of insect consumption remains limited [38].

The data did support H3, which predicted a positive effect of response efficacy on purchase intention. The path coefficient for response efficacy was 0.260, with a significance level of $p < 0.001$. This finding implies that consumers who believe that consuming insect-based foods can effectively contribute to addressing environmental problems are more likely to intend to purchase these products. This is consistent with findings by [21], who observed that consumers' sense of environmental responsibility and their belief in the efficacy of sustainable actions positively influence their attitudes toward novel foods, including insect-based products.

Hypothesis H4, regarding the influence of self-efficacy, was also supported, with a path coefficient of 0.286 ($p < 0.001$). This indicates that consumers' confidence in their own ability to incorporate insect-based foods into their diet significantly enhances their purchase intentions. High self-efficacy could reflect familiarity with dietary changes, confidence in handling unfamiliar foods, or a greater openness to novel experiences, all of which have been associated with a willingness to try insect-based foods [39,40].

Conversely, hypothesis H5, which proposed a negative effect of response cost on purchase intention, was not supported, as the path coefficient was not statistically significant. This suggests that the perceived cost, whether financial, social, or effort-related, does not significantly deter consumers from considering insect-based food products. This finding challenges the conventional understanding that cost barriers heavily influence consumer decisions for sustainable products. It may be that other psychological barriers, such as disgust, are more salient in this context, minimizing the relative importance of cost concerns.

Finally, hypothesis H6, which posited a negative effect of disgust on purchase intention, was strongly supported. The path coefficient for disgust was −0.217, significant at $p < 0.01$, indicating that feelings of disgust exert a substantial negative impact on the intention to purchase insect-based foods. This aligns with previous studies on the role of disgust in food-related behaviors, where aversion rooted in cultural and sensory factors can create strong resistance to novel food types, including insects [19,21,38]. In Western cultures, insects are often perceived as contaminants, and overcoming this aversion requires substantial exposure or reframing, as noted by [17,44].

5. Discussion

The findings from this study provide valuable insights into the psychological factors influencing consumer intentions to purchase insect-based foods. These results not only validate certain elements of the protection motivation theory (PMT) in the context of sustainable food choices, but also align with existing literature on consumer behavior regarding novel and unconventional foods.

The lack of support for H1a and H1b (perceived severity and vulnerability) suggests that while consumers might recognize environmental issues related to food production, this awareness alone may not be sufficient to drive their purchase intentions for insect-based products. This finding is consistent with prior research that indicates environmental awareness does not always translate into behavior change, particularly for behaviors perceived as unfamiliar or culturally challenging, such as insect consumption [59]. This could imply that mere awareness of the severity and potential personal vulnerability to environmental issues is not enough to overcome psychological barriers or cultural aversions to entomophagy. Another potential explanation could be the lack of a clear and tangible link between climate change awareness and the consumption of insect-based foods in the minds of consumers. If consumers are not well-informed about the environmental benefits of these products (e.g., reduced greenhouse gas emissions), their perceptions of severity or vulnerability to climate change might not naturally lead to intentions to purchase. This aligns with research showing that awareness alone does not always result in sustainable behavior unless coupled with a clear sense of efficacy and personal relevance. To overcome this barrier, familiarity, attitudes towards entomophagy, and knowledge about entomophagy positively influence the acceptability of insect consumption [13,21], and these factors can be increased by providing information [60,61].

The partial support for H2 highlights a nuanced role of rewards in shaping consumer behavior towards insect-based food. The significant negative effect of intrinsic rewards (H2a) suggests that individuals may not view insect consumption as personally gratifying or inherently valuable. This outcome aligns with studies indicating that Western consumers often struggle to find intrinsic appeal for culturally unusual food such as insects [36]. Sensory expectations and evaluations positively influence consumer acceptance [21,35]. The association of the taste of an insect-based food with a familiar conventional food increases the willingness to try the novel food [62], while texture in everyday food choices decreases acceptance of insect-based foods [63]. However, the lack of significance for extrinsic rewards (H2b) could indicate that incentives such as social recognition or status associated with sustainable choices do not meaningfully influence consumers' intentions here, possibly because the societal acceptance of insect consumption is still relatively low. To improve this, the consumption of these new foods could be associated with a hedonistic experience rather than the satisfaction of a utilitarian need.

Support for H3 and H4 (response efficacy and self-efficacy) suggests that consumers' confidence in both the effectiveness of insect-based food to mitigate environmental issues and their personal ability to consume these foods are crucial drivers of purchase intention. This aligns with prior studies on sustainable food adoption, which suggest that consumers are more likely to consider a product when they perceive it as a solution to pressing issues and feel capable of integrating it into their diet [37,64,65]. In this context, response efficacy reflects the perceived environmental impact of the product, while self-efficacy indicates a readiness to adapt individual behavior. Together, these findings highlight the importance of emphasizing both the environmental benefits of insect-based foods and providing consumers with the resources or support to facilitate this dietary shift.

H5 was not supported, indicating that the cost of response, such as the perceived financial or time investment needed to adopt insect-based foods, does not significantly deter purchase intentions. This finding contrasts with prior research on barriers to sustainable food choices [66] and may suggest that the psychological hurdles related to unfamiliarity and disgust may overshadow cost concerns in this context. According to the analysis of the eleven food choice motives (FCMs) [13], the FCM price has no influence as a motivation for the daily acceptance of insect-based foods, except for as a low-price daily food choice. Thus, it appears that addressing psychological barriers may be more impactful than focusing on perceived costs for insect-based food adoption.

Finally, the strong support for H6 underscores the influential role of disgust in deterring insect-based food purchase intentions. The significant negative path coefficient reflects the deeply rooted aversion many Western consumers have towards entomophagy, grounded in the cultural perception of insects as unclean or unsafe [17,46,67]. This effect is strengthened when considering the influence of residence and traditional eating habits, which affect consumer acceptance of insects or insect-based products [65,68]. In fact, most of the subjects in our sample are Italians who live in the regions of Southern Italy, where the culinary tradition is strongly rooted in the Mediterranean diet and in the local culture. This finding is consistent with extensive literature indicating that disgust is a powerful deterrent, often preventing individuals from trying unfamiliar foods associated with contamination risks [67]. Therefore, to promote insect-based foods as a viable dietary option in Western markets, it may be essential to reduce disgust, perhaps through educational initiatives in schools, through strategic education, through positive exposure (e.g., packaging that avoids explicit images, pictures, or evocative names that refer to insects), or through familiarization initiatives (e.g., different meal offerings such as sushi preparations based on insect ingredients).

From a marketing point of view, there is a need for significant efforts to increase the availability of food products that are in line with the consumption attitudes and intentions of Generation Z consumers, who are sensitive to health and environmental concerns and represent a significant portion of the future global purchasing power. This consumer segment is opposed to the presence of insects per se in products [69], but is in favor of processed products, such as those using insect flours, for more common foods in this generation's diet, such as snacks, chocolate bars, or burgers [13,70]. Increasing familiarity, and consequently, education about the concept of consuming insect-based products and information about entomophagy are interventions to gain public acceptance [71].

In summary, these results suggest that response efficacy and self-efficacy play crucial roles in promoting the intention to purchase insect-based foods, as consumers who feel capable of contributing to environmental solutions and confident in their dietary adaptability are more likely to consider these products. However, intrinsic rewards and disgust present significant barriers, highlighting the complex interplay of motivational and psychological factors in shaping consumer behavior toward insect-based foods. These insights align with the broader literature on consumer resistance to entomophagy, suggesting that successful promotion strategies will need to address the psychological and cultural dimensions of consumer attitudes to shift behavior effectively. Future interventions aimed at promoting insect-based foods may benefit from focusing on reducing disgust and increasing self-efficacy, while also addressing environmental benefits to enhance perceived response efficacy.

6. Conclusions

This study sheds light on the psychological factors influencing consumer intentions to purchase insect-based foods, with a focus on environmental benefits and cultural acceptance barriers. While insect-based foods are a promising solution to global environmental issues, such as reducing greenhouse gas emissions, resource usage, and promoting sustainable protein sources, our findings suggest that consumer adoption is complex and influenced by multiple psychological factors.

The extended protection motivation theory (PMT) model indicates that consumer beliefs about the environmental efficacy of insect-based foods (response efficacy) and their confidence in incorporating these foods into their diet (self-efficacy) positively affect purchase intentions. This implies that consumers are more open to trying insect-based foods when they believe they can make a meaningful contribution to environmental sustainability and feel capable of making dietary changes.

However, intrinsic rewards and feelings of disgust strongly deter purchase intentions, highlighting the "yuck factor" as a significant psychological barrier. Disgust associated with insect consumption, rooted in cultural norms and particularly evident in Western societies, plays a critical role in shaping consumer attitudes, while intrinsic rewards, or personal satisfaction, remain low due to unfamiliarity and aversion. Interestingly, extrinsic rewards and perceived response costs were not significant, suggesting that social approval or financial incentives are less effective than overcoming internalized cultural aversions in driving behavior change.

These findings suggest that effective promotion strategies for insect-based foods must address both psychological and cultural barriers. Reducing disgust, possibly through education, exposure, or sensory-based marketing strategies, could help reshape consumer perceptions. Emphasizing the environmental benefits through environmental campaigns and bolstering consumers' confidence in trying novel foods may also increase acceptance. Future interventions should consider these insights, focusing on building familiarity with insect-based foods to shift public attitudes, ultimately aiding the transition toward more sustainable dietary practices.

Overall, our research contributes to the literature on sustainable food choices, particularly around entomophagy, and highlights the importance of addressing deep-seated psychological factors to promote environmentally beneficial foods in the Italian market.

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Appendix A

Table A1. Protection motivation theory constructs and items, and its extension.

Constructs	Items
Perceived Severity (PS)	PS_1 Climate change is a serious issue. PS_2 Climate change will have negative consequences on this planet. PS_3 The negative impact of climate change is not severe (R) *. PS_4 The thought of climate change scares me.
Perceived Vulnerability (PV)	PV_1 Climate change can negatively affect me. PV_2 I will experience the negative effects of climate change in my lifetime. PV_3 I am vulnerable to the negative effects of climate change. PV_4 My chances of being affected negatively by climate change are high.

Table A1. *Cont.*

Constructs	Items
Intrinsic Rewards (IR)	IR_1 I feel comfortable purchasing conventional food. IR_2 If I purchase conventional food, I will be healthier. IR_3 If I purchase conventional food, I will be more confident. IR_4 If I purchase conventional food, I will be happier.
Extrinsic Rewards (ER)	ER_1 Conventional food is not easily available (R). ER_2 If I purchase conventional food, I will save time. ER_3 If I purchase conventional food, I will save money. ER_4 If I purchase conventional food, I will save effort. ER_5 If I purchase conventional food, I will obtain more acceptances from my peers. ER_6 If I purchase conventional food, I will obtain more approval from my peers. ER_7 If I purchase conventional food, I will be popular among my peers. ER_8 If I purchase conventional food, I will meet my peers' expectations.
Response Efficacy (RE)	RE_1 I am sure that purchasing insect-based food is ineffective in preventing negative environment effects (R). RE_2 I am sure that purchasing insect-based food will help to prevent depletion of the scarce resources. RE_3 I am sure that purchasing insect-based food will help to prevent threat to my well-being and the well-being of society.
Self-efficacy (SE)	SE_1 It is easy for me to be involved in purchases of insect-based food. SE_2 If I wanted to, I could easily be involved in purchases of in-sect-based food. SE_3 It is mostly up to me whether I would like to be involved in purchases of insect-based food.
Response Cost (RC)	RC_1 Although insect-based food is better for my health or the health of my kids or the environment, I am not willing to pay more for insect-based food. RC_2 Insect-based food is relatively expensive to purchase. RC_3 Purchases of insect-based food would require too much of an adjustment in my food consumption. RC_4 There is not enough certainty about the safety of insect-based food.
Purchase Intention (PI)	PI_1 I will consider buying insect-based food because they are less polluting in coming times. PI_2 I will consider switching to insect-based food for ecological reasons. PI_3 I plan to spend more on insect-based food rather than conventional food. PI_4 I expect to purchase insect-based food in the future because of its positive environmental contribution. PI_5 I definitely want to purchase insect-based food in the near future.
Disgust (DIS)	DIS_1 I would be disgusted to eat any dish with insects. DIS_2 Thinking about the flavour that a bug might have sickens me. Dis_3 If I ate a dish and then came to know that there were insects among the ingredients, I would be disgusted. DIS_4 I would avoid eating a dish with insects among the ingredients, even if it was cooked by a famous chef. DIS_5 I would be bothered by finding dishes cooked with insects on a restaurant menu.

* (R) R-item was reversed for analyses.

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