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Environmental Protection and Consciousness Influence Sustainable Consumption: Mediated by Perceived Control and Moderated by Responsibility

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This study explores the relationships among environmental protection, environmental consciousness, perceived behavioral control (PBC), and sustainable consumption behavior within production departments. It examines the mediating role of PBC and the moderating role of social responsibility, aiming to provide a comprehensive understanding of the drivers of sustainable practices in industrial contexts. A quantitative research design was adopted, targeting 233 supervisors and managers from production departments across various industries. Data were collected through structured surveys using standardized scales adapted from prior research. Partial Least Squares Structural Equation Modeling (PLS-SEM) was conducted using ADANCO to assess reliability, validity, and structural relationships among the constructs. The results confirmed that environmental protection and consciousness significantly influence sustainable consumption behavior. PBC mediates these relationships, highlighting its central role in translating attitudes into actionable behavior. Additionally, social responsibility moderates the effect of PBC on sustainable consumption, amplifying its impact. The findings underscore the importance of individual and contextual factors in shaping sustainable practices. This study extends the Theory of Planned Behavior by integrating social responsibility as a moderator and emphasizing PBC as a mediator. It provides practical insights for managers and policymakers to design interventions promoting sustainability in production, contributing to the broader discourse on environmental responsibility.

Keywords: Environmental Consciousness, Behavioral Control, Environmental Protection, Sustainability, CSR

Introduction

Sustainable consumption has recently become a matter of much interest because of increasing environmental concerns and the urgent need to mitigate ecological degradation. As the world becomes increasingly aware of the adverse effects of unsustainable consumption patterns, the emphasis has shifted toward behaviors that are balanced between economic development and environmental sustainability (H. Ali et al., 2023). Sustainable consumption is consumption of goods and services that allow people to enjoy basic needs, reducing the level of negative environmental impact, by preserving resources for future generations, (M. Ali et al., 2023). This has close relations to the United Nations' Sustainable Development Goals, focusing on responsible patterns of consumption and production, that is, achieving Goal 12, (Aslan, 2023).

Environmental protection and awareness have been thrust forward as leaders of consumption sustainability (Dolnicar, 2022). Environmental protection refers to the protection of natural ecosystems from damages made by humans, whereas environmental consciousness deals with the awareness of a person to ecological matters (Gansser & Reich, 2023). Several approaches have been employed to push for sustainable behavior in governing bodies, businesses, and the general public: recycling schemes, eco-labeling, and raising public awareness (Kapoor et al., 2022). Despite these efforts, translation of environmental awareness into behavior remains inconsistent, and there is a need for deeper exploration into factors such as perceived behavioral control and social responsibility, which were identified by (Woo et al., 2024). It is essential to understand these dynamics in order to develop effective interventions to encourage sustainable consumption across diverse contexts.

A huge body of literature has investigated the antecedents and consequences of sustainable consumption behavior (Khan, 2023; Zeng et al., 2023). The current studies consistently underscore the use of environmental attitudes and values in shaping consumption choices (Gansser & Reich, 2023). For example, it is suggested that pro-environmental values are more likely to influence the adoption of eco-friendly practices, such as non-waste and green product consumption, among individuals with strong pro-environmental values (Kapoor et al., 2022). Besides, empirical evidence stresses the role of environmental awareness and its positive association with sustainable consumption intentions (Lange & Nakamura, 2023). Across cultures and socio-economic contexts, it has been established that environmental awareness cuts across geographic boundaries with consistent findings in linking it to behavioral changes (Lavuri et al., 2023).

Another critical determinant of sustainable consumption is perceived behavioural control (PBC), as an indicator that individuals are actually confident about being able to make a specific action (Leong et al., 2022). Studies revealed that the larger PBC, the higher intentions and indeed sustainable behaviors, energy saving, or recycling (Li et al., 2023; Lim & Weissmann, 2021). This paper also

reveals how social responsibility had become a large moderator in that domain. Scholars argue that those with a sense of social responsibility are more likely to align consumption with the greater ecological and societal good (Martos-Pedrero et al., 2022). Even with these insights, though, the challenges remain in understanding the interplay between the factors and their effect on sustainable consumption, leading to comprehensive models that integrate individual, social, and structural dimensions.

Although previous studies have significantly added to the knowledge of sustainable consumption behavior (Rozenkowska, 2023; Trautwein et al., 2021), many gaps still exist in research (Zeng et al., 2023). To begin with, most existing studies concentrate on direct relationships between environmental attitudes and sustainable consumption while omitting the mediating and moderating roles of factors such as PBC and social responsibility (Alzghoul et al., 2023). For instance, extant literatures are still not very common concerning the understanding of how PBC fills the gap between environmental protection or consciousness and the actual act in real life (Ghaffar & Islam, 2023). The other aspect which has not been well explored concerning these relationships is social responsibility as a moderating variable, especially against the backdrop of different cultural and economic contexts (Jebarajakirthy et al., 2024).

Second, much of the existing literature applies cross-sectional designs, which are unable to reflect the dynamic and constantly changing nature of sustainable consumption behavior (Khan, 2023; Woo et al., 2024). Longitudinal studies are sparse, in that there is little work that analyzes how attitudes, perceptions, and behaviors evolve with time (Siddique et al., 2024). As such, knowledge about the influence of interventions and policies on sustainable consumption over a long period remains underdeveloped (Lim & Weissmann, 2021). Most studies are constrained to specific issues of sustainable consumption, such as recycling or green purchasing (M. Ali et al., 2023), failing to analyze more general behavioral patterns that cover over one dimension (Kapoor et al., 2022). Filling these gaps would be important in providing comprehensive frameworks which account for the complexities of sustainable consumption behavior.

Based on the Theory of Planned Behavior (TPB) and the Value-Belief-Norm Theory (VBN), this study will further be able to provide a sound research framework for the factors deciding sustainable consumer behavior. According to Ajzen (1991), the theory claims that determinants of behavior are attitudes, subjective norms, and perceived behavioral control as held by the focal actor. The theory of planned behavior is applied to understand how attitudes are constructed by environmental consciousness or protection within the domain of sustainable consumption and how PBC acts as a mediator of those factors toward behavior (Lange & Nakamura, 2023). VBN theory completes this framework as it points out that values and beliefs promote pro-environmental norms and actions (Gansser & Reich, 2023). Together, these theories give a holistic view in looking at the individual, social, and structural interactions that determine sustainable consumption behavior.

The main focus of this research is to look into the associations between environmental protection, environmental consciousness, perceived behavioral control, social responsibility, and sustainable consumption behavior. Specifically, it tries to see the mediating role of PBC in the linkage between environmental protection and consciousness with sustainable behavior and how the moderating influence of social responsibility plays a part in these relations. This research aims to move forward the current understanding of sustainable consumption behavior by addressing gaps in existing research and integrating theoretical insights. Recommendations will be actionable for policymakers, businesses, and individuals based on this research .

Literature Review

Research about sustainable consumption gained a considerable stride as an emergent field with regards to pressing global issues nowadays-the concerns surrounding ecological degradation, dwindling resource capabilities (H. Ali et al., 2023). According to available literature, this paper reiterates and sustains what people know for now that 'pro-environmental behaviors may primarily be initiated because of environmentally concerned behavior in numerous cultures' end (M. Ali et al., 2023). Studies have shown that individuals with higher environmental awareness are likely to engage in practices such as waste reduction, energy conservation, and the adoption of eco-friendly products (Aslan, 2023; Dolnicar, 2022). These are often reflected in behavioral intentions, which mediate between knowledge of the environment and actual consumption behavior. Social norms, education, and effective marketing campaigns are commonly cited mechanisms to increase environmental consciousness, leading to greater-scale sustainable consumption (Gansser & Reich, 2023).

Simultaneously, the link between environmental protection and consumption patterns is becoming more prominent as researchers examine how individual motivations, societal influences, and systemic barriers interact (Kapoor et al., 2022). Psychological theories such as Theory of Planned Behavior and Value-Belief-Norm Theory give insight into why attitudes toward the environment translate into sustainability behavior (Leong et al., 2022). In empirical work, it has shown that the ability of an action to make a difference and a belief in efforts by institutions determines choices for sustainable consumption (Lange & Nakamura, 2023). Structural factors such as affordability, accessibility, and sustainable alternatives determine the consumption patterns (Lavuri et al., 2023). Personal values and ethical considerations might be at the heart of lifestyle choices (Li et al., 2023). However, usually, it is the outside forces that regulate how sustainability can enter these choices: through economic incentives and regulatory measures (Lim & Weissmann, 2021). Overall, advancement in sustainable consumption practices internationally will be pivotal with promoting an

environment that aligns individual consciousness with supportive policies and infrastructure

The aspect of environmental protection has been widely recognized to affect sustainable consumption behavior (Martos-Pedrero et al., 2022). Studies show that individuals who perceive environmental protection is essential usually behave in alignment with the dimensions of sustainable consumption, such as the reduction of waste, resource utilization, and environmentally friendly good purchases (Patwary, 2022; Pütz et al., 2022). For example, research exists that connects the level of perceived urgency of environmental problems and consumer's adoption of sustainability practices in their everyday life (Ribeiro et al., 2023). Cross-national studies have found empirical evidence that regions with a higher level of environmental protection awareness report a more significant adoption of sustainable consumption habits, which are influenced by governmental policies and societal norms (Rozenkowska, 2023). In addition, longitudinal analyses have established a strong correlation between environmental attitudes and sustainable consumption, emphasizing the fact that as environmental concerns escalate, individuals are more likely to align their behaviors with ecological preservation goals (Savari et al., 2023).

This directly impacts sustainability through consumption through the fact that environmental protection triggers deliberate behavior modification by building on pro-environmental attitude development (Silva et al., 2022). According to previous research studies, once a consumer determines that his actions do impact the environment, that individual is sure to engage in a more eco-friendly form of activity (Tian et al., 2023; Trautwein et al., 2021). This is further supplemented by empirical evidence that the presence of environmental information and educational campaigns makes the relationship between attitudes toward environmental protection and sustainable behaviors stronger (Ur Rahman et al., 2021). Studies on policy interventions also reveal that regulatory frameworks based on environmental protection can significantly enhance sustainable consumption patterns by making individual and collective goals congruent (Zeng et al., 2023). Therefore, the hypothesis that environmental protection significantly influences the behavior regarding sustainable consumption well-supported by empirical findings placed much emphasis on the interplay of awareness, policies, and individual choices.

H1: *Environmental protection significantly influences the sustainable consumption behavior.*

Environmental consciousness, defined as the state of awareness and concern for the ecological well-being, has been widely studied as a predictor of sustainable consumption behavior (Alzghoul et al., 2023). It has been found that ecologically conscious persons are more likely to take the environment into consideration when making consuming decisions, often preferring those products that have smaller ecological footprints (Batool et al., 2023). Empirical studies around other demographics indicate that environmental consciousness remains an enabler for the adoption behavior, such as recycling, conserving energy, and sustainable brands (Fauzi et al., 2022; Ghaffar & Islam, 2023). Surveys on both developed and developing countries showed a clear sign of positive linkage between the level of environmental consciousness with the decision making for sustainable buying (Jebarajakirthy et al., 2024). Furthermore, experimental studies have shown that the environment-conscious individual reacts favorably to eco-labeling and green marketing, further reinforcing its position in sustainable consumption (Khan, 2023).

The hypothesis is that environmental consciousness plays a major role in sustainable consumption behavior based on the premise that awareness and attitudes determine behavioral intentions (Laheri et al., 2024). This idea has empirical evidence since it has been observed that people who internalize environmental values are likely to make informed consumption choices (Siddique et al., 2024). Additionally, interventions related to environmental awareness, including grassroots activities and learning activities, were also found to positively influence behavior for sustainability (Woo et al., 2024). Other researchers still consider that in order for these factors to promote behavioral change for sustainability (Kapoor et al., 2022), it must be concomitant with environmental consciousness since people with the power to act on their environmental values tend to adopt sustainable behaviors. All these findings put together support the hypothesis and suggest that environmental consciousness is the key factor that fosters sustainable consumption.

H2: *Environmental consciousness significantly influences the sustainable consumption behavior.*

Social responsibility has been defined as that moral obligation toward contributing to societal and environmental well-being (Silva et al., 2022). It has been considered a critical moderator in a number of behavioral frameworks (Jebarajakirthy et al., 2024; Siddique et al., 2024). According to empirical studies, socially responsible personalities are associated with increased sensitivity related to the contribution they make in affecting the environmental system, impacting their consumption practices (Aslan, 2023; Ur Rahman et al., 2021). For instance, research conducted in organizational and consumer contexts reveals that a strong sense of social responsibility enhances the likelihood of pro-environmental behaviors, particularly when individuals feel that their actions have an impact (Fauzi et al., 2022; Lange & Nakamura, 2023). Moreover, studies on ethical consumption reveal that social responsibility reinforces the relationship between behavioral intentions and sustainable behavior, and thus, might play a moderating role in more general models of behavior (Martos-Pedrero et al., 2022; Ribeiro et al., 2023).

Empirical studies further support the moderating role of social responsibility in the relationship between perceived behavioral control and sustainable consumption behavior as they underscore the influence of this construct on decision-making processes (Patwary, 2022). Indeed, it has been established that those who have social responsibility will turn their perceived control over environmental outcomes into actions if they feel that they can do something to alter environmental outcomes (Zeng et al., 2023). This hypothesis is further supported by evidence

that socially responsible individuals are more amenable to intervention as they are likely to adopt behaviors that promote personal control and authority in the community sphere (Tian et al., 2023). Incorporation of social responsibility in behavioral theories has been successful enough to enhance alignment of perceived control and sustainable consumption as shown below with its moderation potential.

H3: *Social responsibility significantly moderates the relationship of perceived behavioral control and sustainable consumption behavior.*

PBC has been heavily studied as an important predictor of sustainable consumption behavior (Ur Rahman et al., 2021). PBC is a perception of the respondent's ability to perform a particular behavior, conditioned by available resources, opportunities, and self-efficacy (Dolnicar, 2022). Based on empirical findings, it seems that the stronger the PBC, the stronger the translation of environmental attitudes to sustainable behaviors (Kapoor et al., 2022; Li et al., 2023). For example, green product consumption research findings suggest that PBC acts as a mediator variable in the environment concerns and buying behavior relationship as a situation of more perceived efficacy promotes buying (Lange & Nakamura, 2023). Finally, it has been observed that institutional support and green alternative availability also mediate a higher impact of environmental protection attitude on behavior where PBC is high (Gansser & Reich, 2023). It further shows the pivotal role PBC plays in bringing together environmental awareness and behavioral action (Aslan, 2023).

There is evidence empirically indicating the mediating role of PBC between environmental protection and sustainable consumption behavior (H. Ali et al., 2023). Thus, perceived capability would drive the behavior (Martos-Pedrero et al., 2022). However, if it were that the environment mattered but the ability or means or barriers prevented structural or psychological ones from arising, the behavior does not relate to attitude (Ribeiro et al., 2023). However, evidence reveals that the impact of initiatives such as skill-building workshops, resource availability, and information campaigns on strengthening PBC greatly strengthens the relationship between environmental protection and sustainable consumption (Trautwein et al., 2021). In addition, behavioral models research reveals that PBC serves as a translator that converts pro-environmental intentions into action through reduced perceived barriers (Zeng et al., 2023). These findings validate the hypothesis that PBC plays a significant mediating role between environmental protection and sustainable consumption behavior, thereby reiterating its central position in behavioral frameworks.

H4: *Perceived behavioral control significantly mediates the relationship of environmental protection and sustainable consumption behavior.*

Environmental awareness has been pinpointed as the much-needed precursor for sustainable consumption behavior, and PBC is the key to making this awareness translate into action (Martos-Pedrero et al., 2022). Individuals who are environment-friendly but lack perceived control show a disconnection between their intended behaviors and actual behaviors (Trautwein et al., 2021). For instance, recycling and energy conservation studies reported that although awareness of the environment predicts behavioral intention, PBC accounts for the realization of such intentions in action (Jebarajakirthy et al., 2024; Zeng et al., 2023). Even empirical evidence indicates that interventions that target the PBC enhance the impact of environmental consciousness on behavior by increasing access to recycling facilities or by providing detailed instructions in carrying out eco-friendly actions (Laheri et al., 2024). This positions PBC as a core intermediary between awareness of the environment and practice sustainability.

Several researches have discussed the interactive effects among these constructs with the view to ascertaining that PBC indeed mediates the relationship between environmental consciousness and sustainable consumption behavior (Laheri et al., 2024; Woo et al., 2024). The results are such that, when controlled, individuals highly conscious of the environment will still consume more sustainably (Ghaffar & Islam, 2023). For example, researches on the adoption of green products have realized that the consumer who is very sensitive and has a high level of PBC is likely to engage in an environmentally responsible purchase (Patwary, 2022; Rozenkowska, 2023). Furthermore, the results of the experiments show that with targeted interventions, increasing PBC strongly relates consciousness with a sustainable action (Ribeiro et al., 2023). These findings justify the hypothesis based on the assumption of the mediator PBC's function in leading people to pro-environmental consumption based on awareness.

Perceived behavioral control significantly mediates the relationship of environmental consciousness and sustainable consumption behavior.

Theory to Explain Research Relationships and Model

The proposed research framework aligns closely with the Value-Belief-Norm (VBN) Theory and the Theory of Planned Behavior (TPB). The VBN Theory describes how values and beliefs, like environmental consciousness and protection, are used to generate pro-environmental norms and behaviors (Jebarajakirthy et al., 2024). The TPB attempts to describe how these constructs influence intentions and actions by combining attitudes, subjective norms, and PBC (Tian et al., 2023). In this study, it is assumed that environmental protection and consciousness influence attitudes, while PBC mediates the pathway toward sustainable consumption. Social responsibility further regulates these relationships by strengthening the link between perceived control and behavior. The model (Figure 1) would, therefore, integrate these two concepts toward a holistic interrogation of dynamic interactions between individual values, perceived capabilities, and sustainable consumption behaviors.

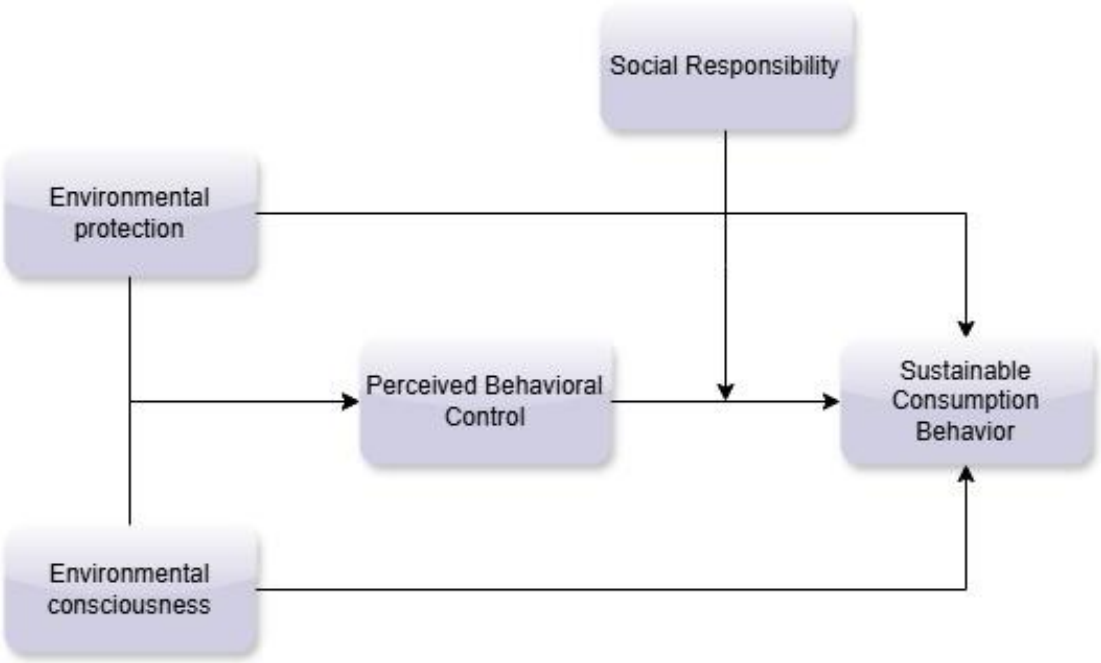

Figure 1: Conceptual Model

Methodology

Research Design

This study was conducted through the use of a quantitative research approach to understand how relationships between environmental protection, consciousness, perceived behavior control, social responsibility, and sustainable consumption behaviors are developed. The study had to utilize data from a cross-sectional survey focused on production departments' supervisors and managers since they are those persons directly involved in the making of decisions influencing organizations' sustainability practice. By adopting this methodology, the collected data would therefore relate to actual know-how concerning consumption sustainability within industries.

Population and Sample

The study sample consisted of the target population supervisor and managers from departments of production for different industries-whose activities, to a high extent, reflect the impact that departments have on environmental sustainability and consumption patterns at the organizational level. A sample size of 233 supervisors and managers constituted the sample pool for the given study. The sample is based on purposive sampling, where the respondents have relevant experience and knowledge of sustainability practices in production processes. Such targeted sampling ensures that there are greater chances of getting accurate, meaningful data reflective of the research objectives.

Measurement Instruments

This study employed standardized scales (Table 1) adopted from previous research to measure its constructs. The adopted scales were chosen by virtue of their reliability and validity established in earlier works.

Table 1: Details of instruments

Variables of research	Items	Reference
Environmental protection	6	(He et al., 2017)
Environmental consciousness	3	(Maichum et al., 2017)
Perceived behavioral control	3	(Verma & Chandra, 2018)
Social responsibility	3	(Lee et al., 2015)
Sustainable consumption behavior	13	(Junior, 2017)

Items were scaled using a five-point Likert scale with anchors that read from "1 = Strongly Disagree" to "5 = Strongly Agree." Such scaling ensured a degree of granularity and thus permitted powerful statistical analysis.

Data Collection Procedure

A structured questionnaire was distributed via online and paper forms to gather data. Questionnaires were dispatched to the respective supervisors and managers via emails, clearly specifying the objective of the study with step-by-step guidelines on filling up the form. The entire questionnaire was created in a manner such that the answer could be found easily, minimizing the chance for errors. Collection took three months as per participants' convenience to yield a usable sample size of 233 questionnaires.

Data Analysis

The data were analyzed using ADANCO, a specialized software for Partial Least Squares Structural Equation Modeling (PLS-SEM). The reason for choosing ADANCO was its ability to deal with complex models, assess reflective and formative constructs, and provide comprehensively outlined reliability and validity measures. The procedure of analysis involved the following steps:

1. Descriptive Statistics: The first stage was an introductory exploration of the data to understand the

demographic characteristics of the sample and the distribution of responses.
2. Test the measurement model with indicators for reliability and validity: Dijkstra-Henseler's rho (ρA), Jöreskog's rho (ρc), Cronbach's alpha, Average Variance Extracted AVE.
3. Discriminant Validity: Assessed through the Heterotrait-Monotrait Ratio of Correlations, to ensure that constructs were distinct.
4. Structural Model Evaluation: Through the path coefficient, t-value, and p-value, a test of hypotheses regarding the structure is conducted. Furthermore, determination coefficient (R^2), predictability (Q^2predict), and model fitting indices like Root Mean Square Errors and Mean Absolute Errors were obtained to assess whether the model in general fits as a reasonable predictor.

With this approach in the analysis process, the finding is reliable and valid, showing robust empirical justification for the posited relationships.

Results

Table 2 depicts the reliability and validity statistics of study constructs, ensuring they are appropriate for structural equation modeling. Reliability is measured using Dijkstra-Henseler's rho (ρA), Jöreskog's rho (ρc), and Cronbach's alpha (α). All the constructs display excellent reliability as the values for ρA, ρc, and α are above the threshold value set at 0.7, thus asserting item consistency. Environmental protection proves ρA = 0.890, ρc = 0.888, and α = 0.889, which validates the soundness of the measurement scale. In the same way, environmental consciousness, perceived behavioral control, social responsibility, and also sustainable consumption behavior have reliability coefficients way above the norm, which enables the justification of the validity of their corresponding constructs.

Table 2: Variables reliability and validity

	Dijkstra-Henseler's rho (ρA)	Jöreskog's rho (ρc)	Cronbach's alpha(α)	Average variance extracted (AVE)
Environmental protection	**0.890**	**0.888**	**0.889**	**0.543**
Environmental consciousness	**0.812**	**0.874**	**0.901**	**0.563**
Perceived behavioral control	**0.899**	**0.897**	**0.896**	**0.514**
Social responsibility	**0.883**	**0.880**	**0.884**	**0.566**
Sustainable consumption behavior	**0.848**	**0.846**	**0.847**	**0.509**

All the AVE values were above 0.5 minimum threshold for convergence validity. Consciousness environmental value was at 0.563, followed by environmental protection value at 0.543, and perceived control value at 0.514. The value of AVE for social responsibility was at 0.566, while the value of AVE for sustainable consumption behavior is at 0.509. This, therefore, proves that the latent variables explain the indicator adequately. Collectively, the results validate the reliability and the validity of the measurement model (Figure 2) that ensures its usability for further analyses.

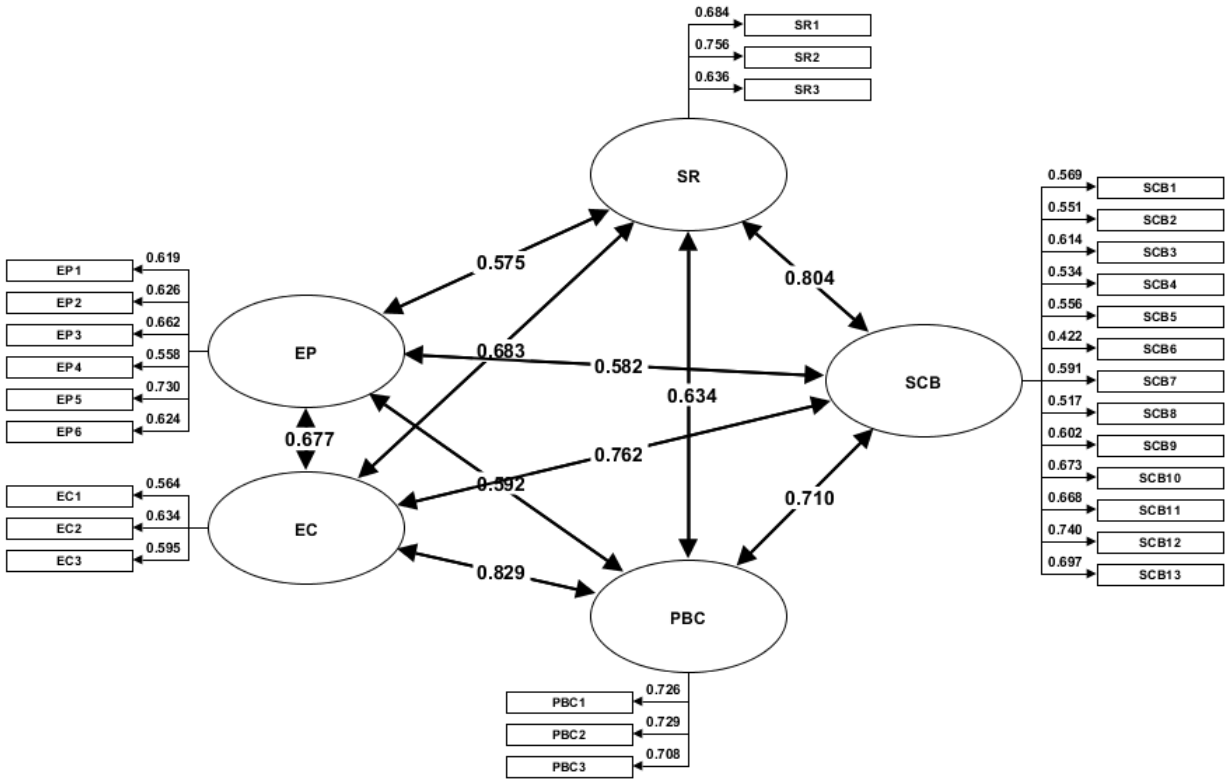

Figure 2: Estimated Model

Table 3 provides the fitness statistics of measurement items for each construct. The standardized factor loadings indicate how well each item represents its corresponding latent variable. For environmental protection, item loadings range from 0.558 (EP4) to 0.730 (EP5), demonstrating moderate to strong contributions. Environmental consciousness exhibits loadings between 0.564 (EC1) and 0.634 (EC2), confirming the adequacy of these indicators. Perceived behavioral control shows strong item loadings, with PBC1 at 0.726 and PBC3 at 0.708, reflecting the coherence of its scale. Similarly, social responsibility items have loadings ranging from 0.636 (SR3) to 0.756 (SR2), highlighting their significance. Sustainable consumption behavior encompasses a wide range of items, with factor loadings between 0.422 (SCB6) and 0.740 (SCB12). Although SCB6 has the lowest loading, it remains above the minimum acceptable level of 0.4, suggesting its retention within the model. These statistics confirm the overall fitness of measurement items and their contribution to their respective constructs.

Table 3: Measurement Items Fitness Statistics

Indicator	Environmental protection	Environmental consciousness	Perceived behavioral control	Social responsibility	Sustainable consumption behavior
EP1	0.619				
EP2	0.626				
EP3	0.662				
EP4	0.558				
EP5	0.730				
EP6	0.624				
EC1		0.564			
EC2		0.634			
EC3		0.595			
PBC1			0.726		
PBC2			0.729		
PBC3			0.708		
SR1				0.684	
SR2				0.756	
SR3				0.636	
SCB1					0.569
SCB2					0.551
SCB3					0.614
SCB4					0.534
SCB5					0.556
SCB6					0.422
SCB7					0.591
SCB8					0.517
SCB9					0.602
SCB10					0.673
SCB11					0.668
SCB12					0.740
SCB13					0.697

Table 4 assesses discriminant validity using the Heterotrait-Monotrait Ratio (HTMT). All HTMT values fall below the threshold of 0.85, confirming that the constructs are distinct from one another. The HTMT value between environmental protection and environmental consciousness is 0.688, indicating sufficient discriminant validity between these closely related constructs. Perceived behavioral control exhibits HTMT values of 0.635 with environmental protection and 0.808 with environmental consciousness, demonstrating that these constructs are conceptually unique. Social responsibility shows lower correlations with other constructs, such as 0.470 with environmental protection and 0.486 with environmental consciousness, supporting its distinct role in the model. Sustainable consumption behavior has the lowest HTMT values, with a maximum correlation of 0.663 with social responsibility, further emphasizing the independence of the constructs. These results validate the discriminant validity of the measurement model, ensuring the constructs' appropriateness for structural analysis.

Table 4: Discriminant Validity: Heterotrait-Monotrait Ratio of Correlations (HTMT)

Construct	1	2	3	4	5
Environmental protection					
Environmental consciousness	0.688				
Perceived behavioral control	0.635	0.808			
Social responsibility	0.470	0.486	0.539		
Sustainable consumption behavior	0.324	0.421	0.506	0.663	

Table 5 evaluates the model's goodness of fit, focusing on coefficients of determination (R^2), adjusted R^2, Q^2predict, RMSE, and MAE. The R^2 for perceived behavioral control is 0.623, indicating that 62.3% of its variance is explained by the predictors. For sustainable consumption behavior, the R^2 is higher at 0.754, reflecting a strong explanatory power of the model. The adjusted R^2 values confirm the robustness of these relationships, with minimal reductions compared to the R^2 values. Predictive relevance (Q^2predict) for perceived behavioral control is 0.202,

surpassing the threshold of zero and confirming the model's predictive validity. The root mean square error (RMSE) and mean absolute error (MAE) values for perceived behavioral control are 0.073 and 0.078, respectively, indicating a good fit. Collectively, these statistics validate the model's ability to accurately predict the dependent variables and reflect its overall goodness of fit.

Table 5: Model Goodness of Fit Statistics

Construct	Coefficient of determination (R2)	Adjusted R2	Q²predict	RMSE	MAE
Perceived behavioral control	0.623	0.667	0.202	0.073	0.078
Sustainable consumption behavior	0.754	0.755			

Table 6 presents the path coefficients, standard errors, t-values, and p-values for the hypothesized relationships. All hypotheses are supported with significant p-values (<0.001). Environmental protection significantly influences sustainable consumption behavior, with a path coefficient of 0.282 and a t-value of 5.074. Environmental consciousness has a stronger influence on sustainable consumption behavior, with a coefficient of 0.430 and a t-value of 6.277.

Table 6: Path Analysis

Hypothesis	Coefficients	Standard Errors	t-values	p-values
Environmental protection significantly influences the sustainable consumption behavior.	0.282	0.051	5.074	<0.001
Environmental consciousness significantly influences the sustainable consumption behavior.	0.430	0.062	6.277	<0.001
Social responsibility significantly moderates the relationship of perceived behavioral control and sustainable consumption behavior.	0.515	0.078	5.298	<0.001
Perceived behavioral control significantly mediates the relationship of environmental protection and sustainable consumption behavior.	0.491	0.069	6.505	<0.001
Perceived behavioral control significantly mediates the relationship of environmental consciousness and sustainable consumption behavior.	0.352	0.058	5.530	<0.001

The moderation effect of social responsibility in the relationship between perceived behavioral control and sustainable consumption behavior is substantial, with a coefficient of 0.515 and a t-value of 5.298, indicating a robust moderating role. The mediating role of perceived behavioral control in the relationships between environmental protection and sustainable consumption behavior (coefficient = 0.491, t = 6.505) and between environmental consciousness and sustainable consumption behavior (coefficient = 0.352, t = 5.530) is also confirmed. These findings underscore the strength and significance of the proposed relationships, validating the theoretical framework and research model (Figure 3).

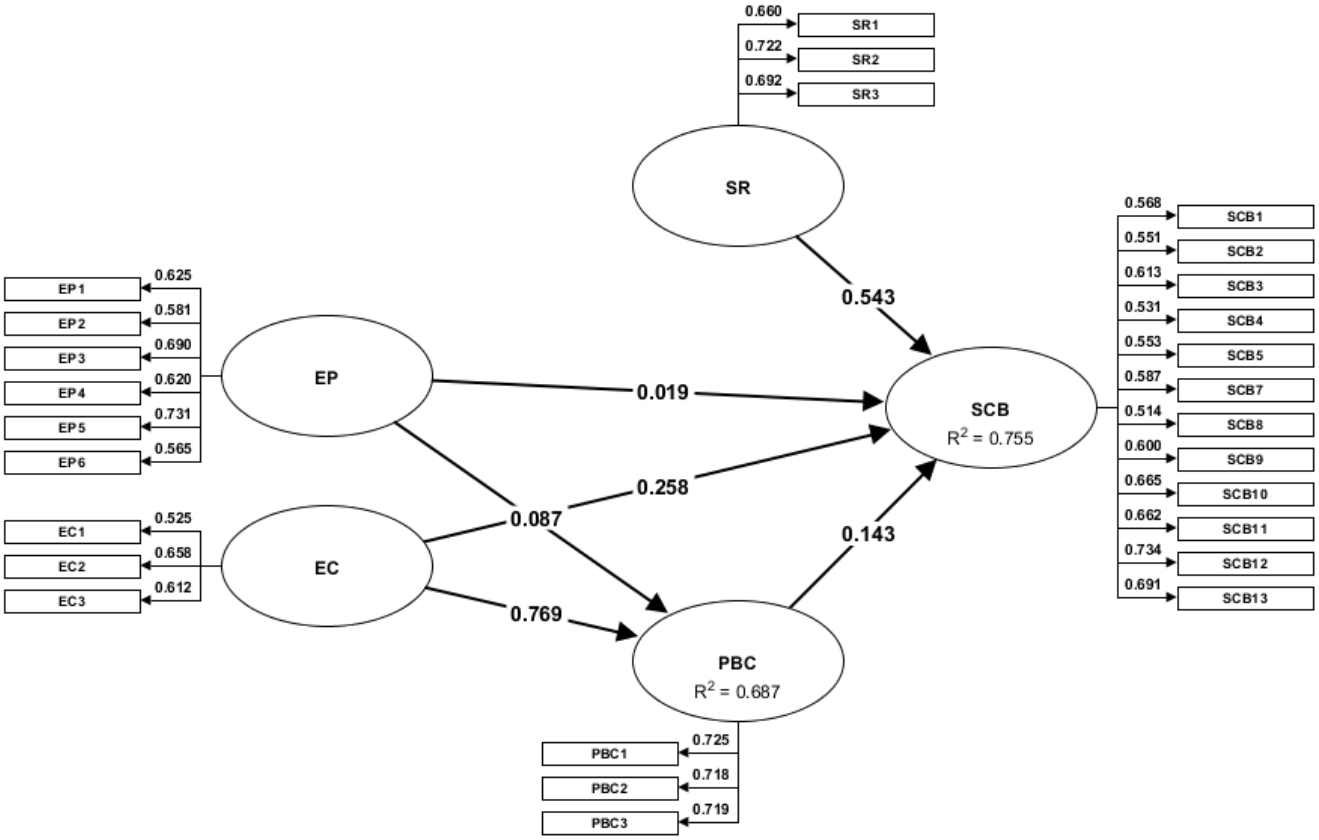

Figure 3: Structural Model for Path Analysis

Discussion

Findings from this study thus provide critical insight into the very complex relationships of environmental protection and awareness of environmental consciousness, PBC, social responsibility, and consumption behavior for sustainable consumption. Therefore, this paper contributes to greater understanding of what drives and shapes sustainable consumption with increasing global ecological degradation and scarcity of resources. All of these hypotheses yielded acceptance, implying that personal attitudes, perceptions, and other contextual factors are generally influential in promoting responsible environments through appropriate behaviors. This study is comprehensive in nature by looking at direct and mediated relationships and the moderating effect of social responsibility, thus integrating psychological, social, and environmental dimensions of sustainable consumption behavior.

The results support that environmental protection strongly impacts sustainable consumption behavior (H1). This is in agreement with previous research, which has highlighted the importance of environmental attitudes in determining pro-environmental actions (Dolnicar, 2022). The results show that individuals who are concerned about the environment are more likely to participate in sustainable practices, such as waste reduction, eco-friendly purchases, and energy saving. These behaviors reflect an ecological responsibility spurred by the awareness of environmental issues and belief in the urgency of preserving the environment (Leong et al., 2022). Moreover, the acceptance of this theory allows for the added role of environmental education and policy actions to exert stronger commitments on individuals toward sustainability. By integrating environmental protection into consumption behavior, it is clear how attitudes regarding ecological well-being act as a trigger for powerful behavior change.

The acceptance of H2 which posits that environmental consciousness highly Influences sustainable consumption behavior. Therefore, this indicates that awareness is leading to sustainable behaviors. Environmental consciousness-be it that the person knows and cares about the environment-is very strong for sustainable consumption behaviors. The study supports the assumption that a person will be prompted to act in line with his values once they have become aware of environmental impacts (Martos-Pedrero et al., 2022). The results further shed light upon cultural and social impacts that determine the environmental consciousness in the way that people mainly internalize the pro-environmental norms due to education, socialization, and media exposure. These results seem to indicate that by elevating the level of environmental consciousness through running such targeted campaigns as well as carrying out community engagement activities, a rise in the sustainable consumption practice can be seen.

Thus, an additional dimension has been added through the moderation effect of social responsibility in the perceived behavioral control relationship with sustainable consumption behavior: "The expression of actual control over sustainable actions tends to be stronger among those people who experience increased social responsibility levels, thereby also strengthening the connection between intention and behavior" (H3). This outcome is consistent with earlier studies that social responsibility positively affects ethical decision-making and pro-environmental behaviors (Lange & Nakamura, 2023). The moderator's effect by social responsibility emphasizes the importance of developing collective responsibility towards ecological conservation. More policies and interventions based on community involvement and ethical accountability may further enhance the PBC effect to sustainable consumption.

The results point to PBC largely mediating the relationship between environmental protection and sustainable consumption behavior, H4. This result also validates the perceived control concept in facilitating the translation of environmental attitudes into actual action. Also, pro-environmental types are likely to bring about sustainable consumption only when they feel they can modify a situation. PBC operates within the boundaries of structural as well as psychological obstacles to pro-environmental behavior, (Ajzen, 1991). For example, having access to environment-friendly alternatives along with incentives and accessible information, it is probably going to raise people's belief in their own capability to be environmentally friendly. Research studies have revealed the fact that intervention efforts targeting PBC development may serve as a bridge to link environmental attitudes with behavior (Batool et al., 2023).

Acceptance of H5 establishes PBC as a mediator in the relationship between environmental consciousness and sustainable consumption behavior via the interaction between awareness, capability, and action. Ecological considerations force an individual to calculate the environmental consequence of their choice, but what actually determines if such intentions translate into actions is a perception of control. This conclusion is in agreement with previous studies, which demonstrate that PBC plays a crucial role in enhancing the enabling factors of pro-environmental behaviors among conscious individuals (Siddique et al., 2024). Results for this study demonstrated how increasing PBC through education, resources available, and supportive infrastructure would increase the effect of environmental consciousness on the behavior. This outcome emphasizes that multi-dimensional approaches, in terms of building awareness and capacity building, should be utilized.

The mediating position of PBC in both relationships determines the centrality of this construct in the theoretical framework of the given work. Results from the study reveal that, although environmental protection and consciousness are motivational underpinnings for sustainable behavior, it is PBC as the mechanism for unfolding action. Adding depth to models of sustainable consumption integrating psychological constructs, such as PBC, to understand behavior at a comprehensive level, these results develop models further (Ghaffar & Islam, 2023). It has been able to touch the attitudinal as well as

the structural aspects in this study, flowing actionable knowledge toward policy- and practice-leaders striving for scale toward a sustainable end.

The discussion of the findings shows how environmental attitudes, perceived control, and social responsibility interplay with each other to shape sustainable consumption behavior. The acceptance of all five hypotheses highlights the importance of integrating psychological and contextual factors in strategies to promote sustainability. This research not only validates the constructs developed into specific theoretical frameworks, such as Theory of Planned Behavior but also extends them by pointing out the mediator role of PBC and the moderating influence of social responsibility. In this respect, the study addresses some critical gaps in the literature, thereby enhancing the understanding of the dynamics of sustainable consumption and providing practical implications to the enhancement of responsible environmental behaviors. These results open the door for further research into other factors and contexts that will drive the global transition toward sustainability.

Conclusion

Insights gained from this research emphasize the driving forces and mechanisms underpinning sustainable consumption behavior and underscore the criticalness of the environmental protection role, the environmental consciousness role, the role of perceived behavioral control, and the social responsibility role. Validating all five hypotheses, the study highlights the balance of individual attitudes, perceptions, and societal influence needed in policies geared toward sustainability. The findings extend the applicability of established theoretical frameworks, such as the Theory of Planned Behavior, and highlight the need for multi-dimensional approaches that address psychological, structural, and contextual factors. The practical and theoretical implications of this research pave the way for actionable interventions and future investigations. Policymakers, organizations, and practitioners can leverage these insights to design effective programs and policies that encourage sustainable behavior at both individual and collective levels. While the study's limitations highlight areas for further exploration, its contributions provide a strong foundation for advancing the understanding of sustainable consumption dynamics. By fostering a deeper commitment to environmental protection and consciousness, and by addressing barriers to sustainable behavior, this research contributes to the broader goal of achieving a more sustainable future.

Implications of the study

This study makes significant contributions to the theoretical understanding of sustainable consumption behavior by incorporating constructs such as environmental protection, environmental consciousness, perceived behavioral control (PBC), and social responsibility into a coherent framework. The results for and beyond validation of TPB are maintained by indicating that the PBC mediates the relationship between environmental attitude and sustainable consumption. Unlike most traditional models that focus mainly on attitudes and intentions, the importance of PBC as a mechanism that translates environmental attitudes into actual action behaviors is the thrust of this study. Social responsibility further develops the theoretical model, showing the moderation effect; thus, in this case, the external factors of ethical responsibility could enhance PBC's prediction power. By expanding the framework of TPB in a multidimensional way, this approach unfolds new insights in understanding how both psychological and contextual aspects can interact and form sustainable behavior. This research contributes to growing literature on the topic of sustainability by providing the empirical evidence related to the separated yet interconnected tasks of environmental protection and environmental consciousness. Both have been discussed with each other's interchangeability yet the findings portray their unique contribution to sustainable consumption. This sharpens the conceptual understanding of the pro-environmental behavior thereby encouraging future study to take consideration of the differentiated nature of those constructs. It is also pertinent that the present study underlines the interplay between individual level factors, like consciousness and protection, and macro influences, for instance, social responsibility, bringing in micro-and macro-level theories within sustainability research. The proposed model addresses several theoretical gaps as a foundation to explore further about the dynamics of sustainable consumption.

From a practical point of view, the study provides actionable information for policymakers, organizations, and practitioners who would like to advance sustainable consumption. The fact that environmental protection and consciousness have a major impact on sustainable consumption means that awareness campaigns and education programs may be the best tools. The government and NGOs can develop special programs that promote the importance of environmental preservation and increase the level of consciousness among individuals. For example, the inclusion of environmental education within school curriculums, as well as using media programs to promote sustainable living, helps develop pro-environmental attitudes, which promote sustainable consumption in the long term. Organizations also align their marketing strategies with these values by highlighting environmental benefits of the products they provide, appealing to environmentally conscious consumers.

The results of the study concerning the mediating role of PBC and the moderating role of social responsibility emphasize the need for structural support and community engagement in the pursuit of sustainable behavior. Policymakers can target removing barriers to sustainable consumption through making eco-friendly alternatives available and affordable. Offering incentives, such as tax benefits or subsidies for green products, will further enhance individuals' perception of control and influence their choice toward sustainability. Fostering social responsibility in the community can be further achieved through CSR initiatives, corporate public campaigns, and community-based initiatives, which would augment the effects of individual actions. Companies can exploit this

by enhancing their CSR campaigns and establishing mediums through which consumers can contribute to environmental causes and, thus, enhance their collective sense of responsibility.

Limitations and Future Research Directions

Despite its strengths, this research has several weaknesses that need consideration. First, the study employs cross-sectional data, which are not ideal to establish causality among the constructs. Future work may consider the longitudinal design with the aim of tapping into the time-dependent nature of sustainable consumption behavior. Second, the study's geographical scope may be limited, that is, relying on data only from a single region or a specific population group. This limits the generalizability of findings across diverse cultural and socioeconomic contexts. Expanding the research by including participants from across different regions and cultures will give deeper insights into the global applicability of the model.

Another limitation lies in the use of self-reported measures, which are susceptible to social desirability and response biases. Future studies may add objective measures like tracking of behaviors or experimental methods to test the generalizability of the results. Further, the present study confines to a certain set of constructs; other variables, including social norms, personality, and technological progress, could influence sustainable consumption as well. An analysis of these factors in future research may further extend the theoretical base and provide an even more all-encompassing understanding of sustainable behavior determinants. In addition, the extent to which AI and blockchain play a role in enhancing sustainability should be explored.

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Appendix 1

Environmental protection

1. How much time would you like to spend on working to protect the environment?
2. How much of your personal income would you like to contribute to environmental protection?
3. What's the possibility of you choosing environmental protection as your future career?
4. To what extent would you live a low-carbon lifestyle?
5. To what extent would you apply environmental protection awareness to real work?
6. To what extent will you choose low-carbon transportation?

Environmental consciousness

1. I am very conscious of the environmental issues that I am facing in my life.
2. It is very important to raise environmental consciousness among Thai people.
3. I have consciousness that purchasing green products will contribute to the sustainable future.

Perceived behavioral control

1. Whether or not I stay at a green hotel when traveling is completely up to me
2. I am confident that if I want, I can stay at a green hotel when traveling
3. I have resources, time, and opportunities to stay at a green hotel when traveling

Social responsibility

1. The mobile telecommunication service provider I currently use makes a notable effort to raise social fund.
2. The mobile telecommunication service provider I currently use encourages its employees to take part in volunteering activities in local communities.
3. The mobile telecommunication service provider I currently use supports sporting and cultural events.

Sustainable consumption behavior

1. I separate metal objects (aluminum cans, oil, tomato extra ct, etc.) for recycling.
2. Separate glass (beer gags, soda, perfume bottles, etc.) for recycling.
3. I separate papers (newspapers, magazines, books, notebooks, etc.) for recycling.
4. Separate plastic packaging (bags, PET bottles, disposable cups, etc.) for recycling.
5. In elections for public office, I prefer to vote for candidates who have strong positions in defense of the environment.
6. I stop buying from a company that shows disrespect for the environment.
7. Change the brand choise to buy from companies that show greater care the environment.
8. I'm looking for ways to reuse objects.
9. I try to fix things instead of throwing them away.
10. I buy used cars and nearly new equipment.
11. I leave devices like television and computer connected even when I'm not using them.
12. I lock faucets from the sink or shower when I am using soap.
13. I leave lights on unnecessarily.