Decoding the Role of Environmental Knowledge on Green Purchase Behavior: Investigating the Mediating Role of Green Brand Attachment and the Moderating Role of Green Trust

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Abstract. The main aim of this study is to assess the impact of environmental knowledge (EK) on green purchase behavior (GPB). Furthermore, it examines the moderation effect of green trust (GT) and the mediation role of green brand attachment (GBA). The theoretical framework presented in this study is based on the Stimulus-Organism-Response theory. The data was collected from the perspective of the manufacturing sector of Pakistan as it is considered the prominent area contributing to environmental damage. The sample size was 341 consumers purchasing manufactured goods from different industries in the manufacturing sector, for instance, textiles, automobiles, furniture, plastic, or food. The empirical results support the hypotheses formulated for the study well. Research findings reveal that environmental knowledge positively affects green purchase behavior. In addition, significant results are found in the case of moderation and mediation. Moreover, theoretical and practical implications are highlighted, along with future research directions.

Keywords: Environmental Knowledge, Green Purchase Behavior, Green Brand Attachment, Green Trust

1 Introduction

Humans bear the most responsibility for the environmental issues plaguing the planet [52]. As a component of its 2030 Global Agenda, the United Nations (UN) established a collection of seventeen Sustainable Development Goals (SDGs). As stated by the UN (2015), the purpose of these objectives was to encourage governments across the globe to tackle various issues, including environmental protection. Concerning responsible consumption and climate action, SDG 12 and SDG 13 are the focal points of the current study. Observable and anticipated climatic changes for the twenty-first century and global warming have brought about substantial transformations on an international

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scale over the past five and six decades [1]. The planet we reside on is confronted with a substantial challenge posed by the persistent global trend of climate change. Global warming, predominantly driven by human-induced greenhouse gas emissions, along with significant alterations in weather patterns, is the cause of this trend. The global ramifications of climate change are extensive and unparalleled in magnitude, as stated on the official website of the UN. Although significant progress has been made in improving human welfare, there are still considerable societal issues that the international community must address, such as climate change [42].

Based on air pollution assessment, Pakistan comes third most polluted nation on the World Air Quality Index 2023. The score suggests that Pakistan has a restricted ability and financial means to tackle environmental concerns adequately. Researchers have highlighted human consumption patterns as the key factor contributing to environmental degradation. The observation above signifies the growing acknowledgment of ethical consumerism and ecological preservation in contemporary times [55]. Researchers and practitioners have noted the importance of sustainability and commitment to green brands in the past few decades. The contemporary state of the natural environment is characterized by sustainability and environmental challenges, requiring individuals to adapt their consuming behaviors to attain sustainable results [1].

Green purchasing has recently garnered considerable interest due to its profound economic, societal, and environmental impacts [2;32;39]. As stated by Bogueva et al. (2017), there is clear evidence indicating a rise in the excessive usage and inadequate management of natural resources, leading to a substantial depletion of the Earth's vital resources at a worrisome pace. Therefore, it is evident that it is necessary to consider a change in attitude from conventional consumption patterns to environmentally friendly purchasing behavior (Farzana et al., 2019). Prior research has primarily focused on the macroeconomic aspects of green purchasing rather than considering the consumer's perspective [46; 57]. Consumer behavior is pivotal in preserving natural resources and achieving sustainable development at the national level (41; 46).

In countries like Malaysia, consumers exhibit pro-environmental conduct by actively acquiring environmentally friendly items. On the other hand, there exists a dearth of consciousness of environmentalism in countries like Pakistan, necessitating attention and resolution [24].

According to Trudel (2019), to achieve a sustainable future and promote significant changes in behavior, it is crucial to possess a thorough comprehension of the psychological factors that impact environmental or sustainable behaviors. Despite its apparent importance and the considerable impact of research in this domain, the comprehension of sustainable behavior and decision-making remains constrained. It noticeably lags behind other subjects within the realm of consumer psychology. This study aims to ascertain the factors influencing green purchasing behavior in Pakistan. EK may be seen as one of the factors influencing GPB.

Furthermore, prior studies have solely focused on investigating environmental knowledge (EK) on green products and recycling, leading to a restricted range of investigations. To thoroughly comprehend the environment, it is recommended to analyze EK concerning its underlying causes and subsequent impacts on the environment, alongside the solutions employed to preserve the environment.

This study aims to make significant additions to the current body of research concerning GPB and expand the current body of work on GPB by examining it through the lens of consumers. Additionally, there is a research requirement to assess the relationship between EK and GPB in the specific context of Pakistan, which necessitates further investigation. Furthermore, the objective of this study is to increase the understanding and awareness of GPB demonstrated by customers in Pakistan. The results also offer environmental strategists an excellent understanding of the essential functions that GT, GBA, and EK have in impacting GPB.

2 Literature Review

2.1 EK and GPB

The knowledge and awareness about the environmental state, climatic and ecological effects of consumption and production, and solutions to environmental problems are referred to as EK [43]. The decision-making and intents of individuals are influenced by their knowledge. People with limited knowledge about the situation tend to avoid such a situation [48].

According to Chan et al. (2014), consumers with knowledge about environmental problems and their effects showed a higher tendency to use organic food, invest in environmentally friendly items, engage in sustainable activities, and practice waste recycling. According to Zsóka et al. (2013), an individual's knowledge of the complications resulting from environmental problems and the solutions raises concerns and a sense of responsibility. It motivates an individual to play one's part in protecting the environment. EK is considered a significant indicator of environmental behavior, and engaging in GPB is one of the ways to preserve the environment [20]. GPB deals with purchasing environmentally friendly products and avoiding products that are harmful to the environment [30]. In a study about the consumption behaviors of college students by Vicente-Molina et al. (2013), the researchers found that EK promotes environmental behavior intentions. According to Eze and Ndubisi (2013), knowledge about environmental problems positively impacts the purchasing behavior of consumers. Other contemporary researchers have reported similar findings [4;13;35;47] SOR theory (Jacoby, 2002) suggests that the stimulus can trigger the responses; based on the implications of this theory, this research suggests that EK can act as a stimulus that can lead to a response in the form of GPB. Therefore, this study hypothesizes the following

H1 EK will positively impact GPB

2.2 EK and GBA

Attachment refers to the extent to which an individual feels connected to a particular object [36] Brand attachment can result from a long-term relationship between the consumer and the brand (Esch et al., 2006). Consumers can get attached and commit to a brand when the brand is considered part of oneself [10;49]. According to previous research [18;37] individuals with a greater understanding of environmental matters are inclined to have a more favorable disposition towards the environment. The possession of EK plays a significant role in fostering environmental apprehension. Individuals may

exhibit a heightened interest in delving deeper into environmental matters after demonstrating an early inclination toward environmental awareness [47]. Consequently, the customer may start regularly buying environmentally friendly products, which may lead to intense emotional connections in the form of attachment to the brand because it is concerned for the environment [31]. According to the SOR theory [29], the stimulus can trigger the organism, which are the emotions and perceptions of the target. This research suggests that environmental knowledge can act as a stimulus that can spark an emotional attachment to the brand because of its environmental concerns, i.e., GBA. This research formulates the following hypotheses based on the presented arguments.

H2 EK will positively impact GBA

2.3 GBA and GPB

Customers establish a lasting emotional connection with particular brands due to their strong brand attachment to those specific brands [17]. Thus, customers who are attached to a certain brand purchase more of that particular brand as compared to ones who do not possess such an attachment [24]. The reason behind this behavior is that the customers who are attached to that particular brand feel satisfaction by buying that specific brand. According to Wang and Tsai (2014), the relationship between the brand and customers can be as strong as the bond we make with other people. Three-quarters of purchasing behavior is influenced by emotions and cognitions. Brand attachment has emerged as a fundamental gizmo in customer satisfaction. Companies have started developing strategies to enhance the brand attachment of their customers because such emotional attachment leads to higher loyalty and commitment to that particular brand [51]. An individual with a higher brand attachment will have a positive attitude and image of that specific brand and, therefore, will buy more of that brand [24]. People who are attached to a brand because of their environmental concerns will buy more products from brands with similar regard for the environment. SOR theory [29] also suggests that the behavior of individuals is based on their perceptions and cognitions. Based on these arguments and SOR theory, this research suggests that customers with greater brand attachment will buy more of that specific brand than those who do not possess such attachment. Therefore, we hypothesize the following,

H3 GBA will have a positive impact on GPB

2.4 Mediation Effect of GBA

This study suggests that EK is positively associated with GBA, positively impacting green buying behavior in H 2 and H 4. Besides, this research also predicts that environmental knowledge is positively linked to GPB in H 1. Therefore, environmental knowledge can directly and indirectly impact GPB through GBA. According to the SOR theory [29], green knowledge management is a stimulus that may lead to the organism in the form of GBA, which can drive response, for this research, GPA. Based on the above arguments and in line with SOR theory, this research hypothesizes the following,

H4 GBA mediates the relationship between EK and GPB

2.5 Moderation Effect of GT

Trust is a mental state in which an individual recognizes their vulnerability as a result of a positive experience [56]. Trust is essential for interpersonal and business connections [4]. Chen (2010) defined GT as "a willingness to depend on a product, service, or brand based on the belief or expectation resulting from its credibility, benevolence, and ability about its environmental performance" (p. 312). According to Li et al. (2021), green purchase intentions are influenced by varying degrees of customer GT. Researchers have found that GT can trigger customers' purchase intentions for green products [19;44]. According to Lee (2024), trust reduces customers' perceived risk and increases the probability of executing the transaction. When customers possess greater trust in green products, the customers who are concerned about the environment may contact the suppliers or manufacturers to gain information about the system and processes to acquire appropriate environmental awareness, which may promote green product purchases [34]. Hence, buyers who are loyal to environmentally conscious brands and have confidence in eco-friendly items are inclined to purchase ecologically friendly products. This study anticipates that the level of trust in environmentally friendly practices can enhance the already good correlation between green brand attitude (GBA) and green purchase behavior (GPB). Additionally, we hypothesize,

H5 GT acts as a moderator between GBA and GPB such that the relationship is more robust when GT is high.

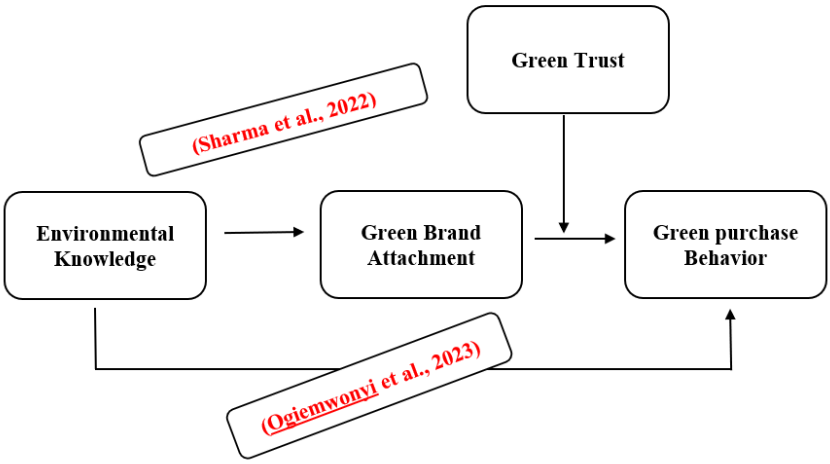

Fig 1. Conceptual framework

3 Methods

The sample size of the current study was 341 consumers across cities in Pakistan famous for manufacturing. Pakistan has a widespread manufacturing sector, with specific regions of the country being the primary hubs for varied industrial activities. Karachi specializes in textiles and automotive, while Faisalabad focuses on textiles, furniture, and starch. Sialkot is commonly associated with recreational goods and textiles, while Lahore is known for cars, motorbikes, electronics, chemicals, and textiles. The Gujranwala region produces iron, steel, plastics, food, textiles, and leather. Gujrat is renowned for its furniture, jewelry, handicrafts, shoes, and food. Sheikhupura is known for its chemicals, automotive, ceramics, and medicines.

The measurements employed in the present investigation are based on prior studies conducted under comparable conditions. The questionnaire utilized a 5-point Likert scale to assess the participants' responses, with 1 indicating "strongly disagree" and 5 indicating "strongly agree". The measurement scale was divided into two distinct portions. The preliminary section gathered demographic information, encompassing age, gender, educational attainment, and income levels, among other metrics. The subsequent section comprised the items of variables. To maintain ethical integrity, all participants were duly notified that their data would be treated with confidentiality should they agree to partake in the research. Those who indicated their willingness to participate were subsequently included.

3.1 Measures

EK. A five-item scale developed by Ellen (1994) and Minton and Rose (1997) was adopted to measure EK. The scale items are retrieved from a paper written by Kautish and Sharma (2019). The sample item includes “I have knowledge about global warming phenomena.” Items were measured on a five-point Likert scale.

GBA. To assess GBA four-item scale by Park et al. (2010) was adopted. The sample item includes “The brand’s extraordinary environmental features make you willing to pay for it.” A five-point Likert scale was used to measure GBA.

GT. GT was measured using a scale developed by Chen (2010). A four-item scale was assessed on a five-point Likert scale. Sample items include “You feel that this brand’s environmental commitments are generally reliable.”

GPB. To measure GPB, a four-item scale by Lee (2008) was adopted, and items were assessed on a five-point Likert scale. The sample item includes “I prefer green products over non-green products when their product qualities are similar.”

4 Results

Descriptive statistics were conducted on 341 valid responses. Out of them, 164 (48%) were from female respondents, and 177 (52%) were from male respondents. A total of 201 respondents, accounting for 59%, fell within the age range of 21-30. The age group of 31-40 accounted for 106 individuals, or 31% of the total. The age group of 41-50 comprised 34 individuals, making up 10% of the total.
The evaluation of models in PLS-SEM involves a two-step procedure, encompassing the measurement and structural models.

4.1 Evaluation of Measurement Model

The indicator's reliability is assessed using the measuring model, taking into account both convergent validity and internal consistency. The lowest acceptable thresholds for each category have been established by the researchers. According to Hair et al. (2021), the factor loading needs to be at least 0.7, the composite reliability needs to be at least 0.7 and the average variance extracted (AVE) needs to be at least 0.5 [5].

The factor loading is shown in Figure 2, where most of the constructs have loadings of 0.7 or above, except GBA 4, which has a loading of 0.660. Hair et al. (2021) state that if removing a variable increases the Average Variance Extracted (AVE), then it should be done so. Thus, all the items are retained for further analysis.

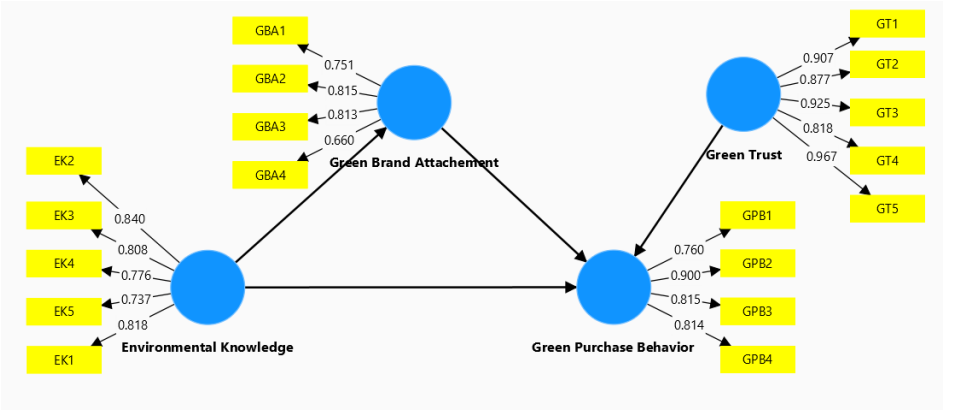

Fig 2. Measurement Model

Table 1. Demonstrates the composite reliability values for several factors. EK has a reliability of 0.895, GBA has a reliability of 0.866, GPB has a reliability of 0.956, and GT has a reliability of 0.947. All of these composite dependability levels exceed 0.7. All constructs possess AVE values ≥ 0.5. However, the other calculated metrics, Cronbach alpha, and composite reliability, exceed the threshold required to establish convergent validity.

Table 1. Validity and Reliability

Variables	Cronbach's alpha (α)	Composite reliability (rho_c)	Average variance extracted (AVE)
EK	0.856	0.897	0.635
GBA	0.758	0.846	0.581
GPB	0.841	0.894	0.679
GT	0.941	0.955	0.81

A ≥ 0.7 CR ≥ 0.7 AVE ≥ 0.5

Validity and reliability were assessed using Cronbach's alpha (α). Composite reliability, denoted as rho_c, refers to the reliability or consistency of a composite score or construct and the Average Variance Extracted (AVE). The Cronbach alpha values are Ek 0.856, GBA 0.758, GPB 0.841, and GT 0.941. – The composite reliability, the values are EK 0.897, GBA 0.846, GPB 0.894 and GT 0.955. – The values of AVE are EK 0.635, GBA 0.581, GPB 0.679 and GT 0.810.

The values of Cronbach Alpha are all ≥ 0.7, the value of CR is ≥ 0.7, and the value of AVE is ≥ 0.5. Thus, fulfilling all the threshold criteria confirms the validity and reliability of the variables under study.

To confirm the discriminant validity among components, the HTMT Ratio was used, which should be less than 0.90 as suggested by [26]. Thus, Table 2 shows that all the constructs have HTMT values less than 0.90. Therefore, the legitimacy of discrimination is confirmed.

Table 2 illustrates the Assessment of Discriminant Validity. The Heterotrait Monotrait Ratio (HTMT) is used to assess discriminant validity. All the HTMT values are less than 0.90, thus ensuring the discriminant validity of variables.

Table 2. HTMT Ratio

Variables	EK	GBA	GPB
EK			
GBA	0.767		
GPB	0.609	0.632	
GT	0.111	0.107	0.21

HTMT less than 0.90

4.2 Evaluation of Structural Model

The second phase entailed assessing the structural model. Foremost is, the variance inflation factor (VIF) that was examined to eliminate the potential presence of multi-collinearity. Hair et al. (2019) report that the VIF should be less than 5. All the variables in Table 3 have a VIF less than 5. This ensures the absence of multicollinearity.

Table 3. VIF

Variables	VIF
EK -> GBA	1.000
EK -> GPB	1.630
GBA -> GPB	1.680
GT -> GPB	1.012

VIF less than 5

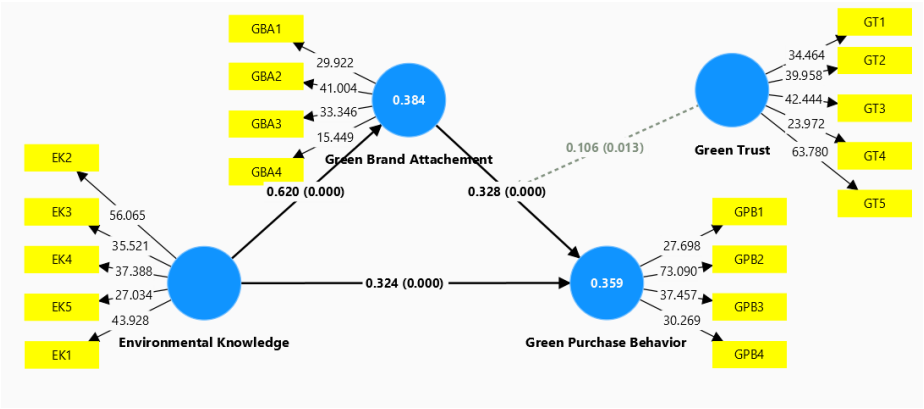

Fig. 3. Structural Model.

Hypothesis Testing. To examine the hypotheses, the researchers used a bootstrapping approach with 10,000 sub-samples, as advocated by scholars. The process of hypothesis testing involves initially analyzing the direct and moderation paths, followed by the evaluation of the mediation path. The current investigation presented three direct hypotheses. The first hypothesis was that EK positively impacts GPB, with a beta coefficient (β) of 0.324, p-value of 0.000, and t-value of 6.204. Thus, the statistical analysis showed evidence in favor of hypothesis 1. The second hypothesis is that the variable EK positively affects GBA, with a beta coefficient of 0.620, a p-value of 0.000, and a t-value of 13.771. The results supported hypothesis 2. The third hypothesis suggests that GBA positively impacts GPB, with a beta coefficient (β) of 0.328, p-value of 0.000, and t-value of 5.865. The study's findings verified this notion. The fifth hypothesis suggests that GT moderates the relationship between GBA and GPB so that GT strengthens the relationship, ($\beta = 0.106$, $p = 0.013$, $t = 2.49$). Therefore, the statistical findings also support the moderation hypothesis.

Concerning Table 4, the outcomes of both straight and moderation effects.

Table 4. Direct and Moderation Paths

Variables	β	STDEV	T statistics	P values
EK -> GBA	0.620	0.045	13.771	0.000
EK -> GPB	0.324	0.052	6.204	0.000
GBA -> GPB	0.328	0.056	5.865	0.000
GT -> GPB	0.137	0.046	2.972	0.003
GT x GBA -> GPB	0.106	0.043	2.49	0.013

P < 0.05 t > 1.96 CI = 95%

The current study reveals that GBA mediates the relationship between EK and GPB (β = 0.203, p = 0.000, t = 5.005). As a result, the statistical analysis supports the hypothesis of a mediation effect. However, the results showed only partial mediation.

Table 5. Mediation Effects

Direct Path	β	P	Indirect Path	β	STDEV	T stats	p
EK -> GPB	0.203	0.000	EK-> GBA -> GPB	0.203	0.041	5.005	0.000

Table 6 shows the model's capacity to explain, as demonstrated by the values of R^2 and Q^2. According to researchers, R^2 ranges from 0 to 1. However, for primary data, it is advised that $R^2 \geq 0.2$ [23] According to Table 6, the value of R^2 exceeds 0.2, indicating that it meets the condition. Shmueli et al. (2016) proposed utilizing the coefficient of determination (R^2) and the Q^2 measure to assess the predictive ability of latent variables. They suggest that Q^2 should be bigger than 0. Table 6 indicates that the value of Q^2 is greater than zero.

Table 6. Explanatory and Predictive Power

Variables	R^2	Q^2
GBA	0.384	0.221
GPB	0.359	0.237

$Q^2 > 0$

The Research Scholar provides guidelines for determining effect size (f2), with values ranging from 0.02 (showing a small effect) to 0.15 (indicating a medium effect) and 0.35 (representing a large effect). Cohen (1988) considers any result less than 0.02 to imply no influence.

Table 7 shows that the EK and GPB have a moderate impact. Similarly, GBA and GPB have a moderate impact. Whereas EK and GBA have a large effect size. In contrast, GT and GPB have a small effect size.

Table 7. Effect Size

Variables	GBA	GPB
EK	0.624	0.100
GBA		0.100
GT		0.029

5 Discussion

This research empirically tested the relationships between EK, GBA, GPB, and GT. First, the direct link between the variables is discussed and second, this research postulated the mediation role of GBA between EK and GPB. Third, the moderating role of GT between GBA and GPB was also examined. This study hypothesized a positive association between EK and GPB. The findings revealed a direct relationship between EK and GPB. These findings are consistent with previous research on EK and GPB [4;47;53]. According to Mostafa (2009), EK is one of the critical behaviors that impact consumers' green purchase behavior. The second hypothesis of this study was about the positive association between EK and GBA. Empirical support was found for this hypothesis. Some recently published studies have shown that individuals with EK show a positive attitude toward environmental concerns [16;35]. According to Polonsky et al. (2012), EK is one of the main determinants of positive environmental attitudes, and GBA is a positive attitude in terms of showing concern for the environment to buy environment-friendly products. The third hypothesis of this research was about the positive association between GBA and GPB. Empirical findings supported this hypothesis. These findings are in line with previous studies about GPB. According to Hung and Lu (2018), consumers' emotional attachment is an effective predictor of purchasing behavior t. Another research by Alghamdi and Agag (2024) has also suggested that consumers' environmentally concerned cognitive and emotional state leads to GPB. The fourth hypothesis of this study was about the mediating role of GBA between EK and GPB. According to Bian and Yan (2022), the consumer-brand relationship mediates the link between brand attributes and the purchasing behavior of the consumers. The findings are supported by SOR theory; in this study, EK acts as a stimulus, which can cause GBA (organism) and further lead to the consumers' GPB (response). The fifth hypothesis was about the moderating role of GT between GBA and GPB. Empirical findings supported the hypothesis, which aligns with previous research on the moderating role of GT [11;34].

6 Theoretical Implications

The phenomenon of GPB is transforming and has garnered increasing attention from academic and corporate communities. To promote the acceptance of environmentally friendly products, it is crucial to identify the characteristics that can facilitate the consumption of such items.

This study's empirical findings fill the void in the existing literature regarding the fundamental mechanism that promotes environmentally friendly purchasing behavior. This study employed the Stimulus-Organism-Response model to explain the mechanism of determinants of GPB. Most of the studies in the literature relied on a theory of planned behavior. The conceptual framework devised in this study is explained by the S-O-R theory, which states that there is a stimulus that triggers an organism and leads to a response. The stimulus in the present study is EK which triggers GBA to an organism, and the response is GPB.

7 Practical Implications

Several causes can be attributed to the absence of environmentally conscious purchasing behavior in Pakistan's manufacturing sector. Despite the increasing global focus on sustainable and environmentally friendly practices, Pakistan's industrial sector has difficulties effectively incorporating green procurement into its operational framework. The challenges include (i) The presence of economic constraints, (ii) insufficient awareness and knowledge, (iii) difficulties related to regulations and policies, (iv) limitations in the Supply Chain, etc. This study highlights the significance of EK in increasing GPB, and empirical evidence also supports the notion. Thus, environmental strategists can devise strategies, policies, and regulations to enhance green purchases based on the results of the present study.

8 Limitations and Future Research Directions

Some limitations have been noted for the current investigation. Firstly, the research is restricted to the manufacturing industry. Secondly, the research is cross-sectional. Thus, future research can use time lag to better understand consumers' actual purchasing behavior.

This study used the Stimulus-Organism-Response model to clarify the conceptual framework. Future studies can employ theories such as eco-conscious models, norm activation models, and value-belief-norm theories to investigate pro-environment-related conduct. Subsequent investigations could integrate psychological variables such as morality and empathy.

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